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## Original Article

# This is not an article: Model organism newsletters and the question of 'open science'

**Christopher M. Kelty**

Institute for Society and Genetics, Department of Information Studies and Department of Anthropology, UCLA, Rolfe Hall 1315, Box 957221, Los Angeles, CA 90095, USA.

**Abstract** Scientific newsletters, especially in biology, flourished in the twentieth century. They are virtually unstudied, but can tell us a great deal about the simultaneous development of scientific communities or collectives and the concepts, techniques, collections, materials and maps they produce. This article introduces scientific newsletters as a 'model organism' on which to study the moral economy of science. As an exemplary case, the article explores issues of property and propriety in the *Drosophila Information Service* and explains how newsletters constitute a closed community at the same time that they demand the unrestricted sharing of organisms, techniques, results and other information within the community. The last third of the article compares aspects of newsletters with the contemporary claims about 'open science' in the case of synthetic biology, and speculates about the relationship of the current political economy of intellectual property to the moral economies present in newsletters.

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## Introduction

There is a saying in biology that goes 'for many problems there is an animal on which it can be most conveniently studied'.<sup>1</sup> Some organisms are ideal for studying digestion, whereas others are better for behavior or morphology and so on. What then, might be the right 'organism' for studying science itself? If science is to be conceived of as a lively and continuously changing process – if not quite an organism – then is there a right organism for understanding everything from 'paradigms' and their 'anomalies' (Kuhn, 1962) to 'epistemic objects' and their 'surprises' (Rheinberger, 1997)?

1 The so-called August Krogh Principle (Krebs, 1975), originally formulated (Krogh, 1929, p. 247) as: 'For such a large number of problems there will be some animal of choice or a few such animals on which it can be most conveniently studied'.

Several candidates have suggested themselves: humans obviously, but also theories and concepts, scientific instruments like the microscope, a detector of some sort, or even the model organism itself. Philosophers choose to follow propositions (Popper's 'systems of statements', for instance); historians choose the laboratory notebook or the unpublished correspondence. Anthropologists often choose the lived interactions and relations of scientists and their compatriots. Sociologists and information scientists have in the past overwhelmingly opted for the published journal article and even more precisely, the citations therein, as their model organism.<sup>2</sup> Some of these tend toward the micro-scale – as in the studies of historians and anthropologists who work with masses of detail in given cases – some tend toward a macro-scale – as in the case of sociologists and scientometricians who discover vast networks of relation.

There is however one humble and avowedly overlooked organism that has had a central role in the middle distance: the *newsletter*. Starting in about the 1920s and continuing into the present in altered forms, newsletters are tools of coordination and collaboration that emerge whenever a scientific or technical problem overruns the bounds of a single laboratory or office. They exist in every domain of science, but they have been particularly central in biology, and especially in the pursuit of genetics.

Newsletters, I argue herein, are good model organisms for three reasons. First, in the best cases, they can allow a detailed glimpse into the collective formation of scientific concepts – the constitution of a community simultaneous with the creation of concepts, collections, maps, theories and techniques. Second, they allow access to that meso-scale aspect of scientific practice in which much of the collective action of science takes place – they are not the lab notebook or the private correspondence of individual scientists. But neither are they the purified formal publication of the scholarly literature. They represent science in action; they offer a glimpse into creation of *collective* concepts, not individual ones; they mediate between the individual researchers and the disembodied 'literature' of science, and they become machines for generating experimental systems and shared concepts as much as allegiances and friendships. Third, and perhaps most important, newsletters of the early to mid-twentieth century are an ideal place to test claims about 'open' and 'closed' science that are frequently made in the twenty-first century. From the limited perspective of those in the present, newsletters undoubtedly seem like quaint objects of a bygone era when time moved slowly and mimeograph ink was still purple. However, this article argues that they are both the origin of and continuous with contemporary obsessions concerning databases, the 'data deluge', open access, wikis, blogs and social media, standardization, intellectual property, peer production, open source software, and the general political and ethical morass

2 The metaphor of the model organism may seem playful, but at least one recent work has taken the notion of model organisms as metaphors more or less seriously, comparing models, cases and exemplary narratives across the sciences and humanities (Creager *et al*, 2007). One clear point demonstrated by the increasingly voluminous literature on model organisms is that the choice of organism is a very momentous one. It determines not only the problem one can explore, but also the amount of funding available, who will become peers and collaborators, and much else besides. An argument might be made that the choice to focus on citations instead of propositions or archives is not just a methodological or disciplinary one, but also a choice of model – with the many implications that it carries for the formation of traditions, communities, paradigms or epistemic objects. There is also a large general literature on models and model organisms in science (Levins, 1966; Griesemer and Wade, 1988; Griesemer, 1990, 2006; Morgan and Morrison, 1999; de Chadarevian and Hopwood, 2004).

of the publishing, biotechnology and information technology industries. All of these concerns have occupied scientific newsletters, many of which set the terms of debate in cosmopolitan scientific cultures. Newsletters allow us to track the creation and development of ‘moral economies’ in science as the political economy of science changes in the twentieth century.<sup>3</sup>

In this article, I introduce scientific newsletters as a virtually unstudied aspect of science and technology, especially in the domain of biology where model organisms have been central.<sup>4</sup> I then explore in detail the ‘moral economy’ represented by newsletters and the collective formation of concepts and hypotheses by looking in detail at one case: the issue of property and propriety in the *Drosophila Information Service (DIS)*, arguably the most well-known newsletter. In that section, I explain how newsletters constitute a closed community at the same time that they facilitate and even demand the unrestricted sharing of flies, techniques, results and other information within the community. By doing so, the newsletter became the *de facto locus* for the construction of a recognizable and stable research collective – a community, a paradigm, a tradition and so on with stable concepts and epistemic objects contributed by and collectively owned by *Drosophila* labs around the world. At the end of the article, I explore what an understanding of newsletters and their functions might tell us about a particular contemporary case: that of synthetic biology. Many of the questions being put to synthetic biology are framed in epochal terms: Is it radically new? Does it change the definition of life? Will it destroy the planet if not controlled? Many of these questions explicitly or implicitly invoke a Manichean image of science with openness arrayed on the side of true science and closure arrayed on the side of biotechnology and commercial science. Instead, I argue here that synthetic biology is interesting because it allows a glimpse into the creation of scientific communities *caught in between* the need for collective collaborative property in science and the pressures of contemporary intellectual property-saturated biotechnology. What results will almost certainly not look like the science of the past – but it will equally certainly look a little bit like a newsletter.

3 Kohler (1994, pp. 11–13) employed the concept of ‘moral economy’ to great effect in his analysis of the *Drosophila* research community, both before and after the constitution of the *DIS* newsletter. The concept signifies not simply a community of norms or practices, but a community concerned with exchange, and in particular with the moral rules and expectations governing exchange. As he explains, he borrowed the notion from E.P. Thompson’s (1971) article exploring the moral economy of eighteenth century British peasants, see also Scott (1976). Both Lorraine Daston (1995) and Steven Shapin (1996), and more recently Bruno Strasser (2011) have also made use of the concept for similar reasons. Thompson’s analysis has resonance here because it concerned the displacement of a moral economy (that of the peasants) by a formalized *political* economy in which new forms of production, new legal arrangements and a massive leap in the scale of production confronted these peasants from all sides. Without wanting to figure twentieth century biologists as peasants, it is possible to see a similar conflict between a cherished moral economy of science and a new political economy occurring along similar lines.

4 Newsletters are invariably mentioned in works that address particular model organisms as in Ankeny (1997, 2000, 2001, 2007); de Chadarevian (1998, 2006); Rader (1998, 2004); Kass and Bonneuil (2004); Leonelli (2007, 2008a, 2008b); Strange (2007); Murray *et al* (2008); Murray (2010); Ankeny and Leonelli (2011). Occasionally, sociologists interested in scientific communities have stumbled on them (Mullins, 1968, 1972; Star and Ruhleder, 1994). But with the exception of Kohler (1994) they are rarely addressed directly. Hogan (2009) is the only other work I’ve encountered that explores them in detail. Newsletters might also be seen as continuous with the growth of ‘Big Science’ in America (Galison and Hevly, 1992), except that very few of them represent large-scale, bureaucratic, institutionalized enterprises, even though they mimic some of the same functions and features of a scaled-up research enterprise.



## Model Organism Newsletters in the Twentieth Century

It is a curious feature of twentieth-century biological research on model organisms that nearly all of them have an associated newsletter: *DIS* (1934–Present), *Neurospora Newsletter* (1962–1985), *Mouse Newsletter* (1947–Present), *Yeast Newsletter* (1950–Present), *Worm Breeder's Gazette* (1975–Present), *Maize Genetics Cooperation Newsletter* (1932–Present), *Xine: The Xenopus Newsletter* (2001–2007), *Cellular Slime Mold News* (1975–1993) and so on (See Table 1 for a representative list in biology).<sup>5</sup> The need for such newsletters is no more surprising than the need for model organisms themselves: multiple researchers around the world, but working on the same problems needed a way to communicate and monitor progress in the field.

Newsletters concerning model organisms in the mid-twentieth century are especially common because of the complexity of understanding heredity and mapping chromosomes. In fact, the first newsletters during this period are allied with the communities studying maize and fruit flies – two of the first organisms through which mechanisms of heredity were explored. But newsletters are not confined to these problems either in biology or at large. It is clear that there are other kinds of newsletters in biology and in other disciplines – a notable case being the *Chorionic Villus Sampling (CVS)* newsletter in the 1980s (Hogan, 2009). There are also many ‘in-house’ and industry-specific newsletters in the corporate world that could also be compared, though I do not attempt that here.

Newsletters are more than just paper: they are indistinguishable from the collectives they create, and they constitute an object of attention and interpellation for those who receive them and contribute to them. Newsletters aid standardization of nomenclature and language; they promote sharing of materials and methods; they connect a cosmopolitan scientific community in a tangible, periodically visible manner. What was once called an ‘invisible college’ has actually long had a ‘facebook’ (although a sober one) that made it eminently visible to each of its members – a newsletter.<sup>6</sup> Indeed, newsletters emerge along

5 A brief note on method: model organism newsletters are both easy and hard to study. Easy because any given scientist (of a certain age) is likely to have copies of them lying around; and hard because few libraries catalog them systematically or keep complete runs of them. Some have been digitized and moved to the Web for instrumental purposes. However, these are often not direct scans of the original documents – sometimes lacking any contextual or meta-data. Some newsletters are well attested by a simple Google search, other well-known ones (like *Mouse Newsletter*) seem to be entirely unknown to Google. In short, the certainty with which it is possible to know of their existence or location is not high. I have looked at several in detail: the *DIS*, the *Yeast Newsletter*, the *Maize Genetics Cooperation News Letter*, the *Cellular Slime Mold Newsletter*, the *Worm Runner's Gazette* and the *Neurospora Newsletter*. For the purposes of this article, my analysis has focused on the social and communication aspects of these newsletters rather than particular conceptual problems.

6 Considerable efforts have been made to keep the idea of an ‘invisible college’ on life support throughout the years. But invisible colleges aren't invisible: they exist in newsletters and other minor, grey, quotidian features of everyday activity in science. As ephemera, they might disappear, but they are not invisible. Derek John de Solla Price (1963) and Diana Crane's (1972) initial formulations of the concept sought to capture the growth of science as a phenomenon using published papers as a proxy, but newsletters are not published papers; for critiques see Lievrouw, 1989. Beginning at least with Collins (1974) work, the ‘invisibility’ of scientific networks has been made visible, among other ways, by looking at objects rather than objectivity (Daston, 2000; Daston and Galison, 2007), experimental systems rather than hypotheses (Rheinberger, 1997), ‘metrology’ rather than measurements (Latour, 1986; Schaffer, 1992; Wise, 1995) and infrastructure rather than its logical structure (Star and Ruhleder, 1994; Bowker and Star, 2000; Keating and Cambrosio, 2003). Newsletters also make science visible, periodically and centrally visible, to those who participate (and literally: most newsletters are centrally concerned with keeping up to date lists of active researchers and their addresses). Related work on the nature and significance of authorship in science is contained in Biagioli (2003).

**Table 1:** Representative scientific newsletters: A partial list

<i>Name</i>	<i>Organism/Topic</i>	<i>Type</i>	<i>Date of publication</i>
Annual Wheat Newsletter	Wheat	Newsletter (annual)	1954–Present
Barley Newsletter	Barley	Newsletter	1957–2009
Carnivore Genetics Newsletter	Carnivorous lab animals, mostly dogs and cats	Newsletter	1966–Present
Daphnia Genomics Consortium Collaboration Wiki	Daphnia Water Flea	Wiki of the Daphnia Genomics consortium	DGC started 2002
DictyBase (Cellular Slime Mold Newsletter)	Slime Mold ( <i>D. discoideum</i> )	Newsletter, genome database, general information source	CSM News 1975–1993. CSM Electronic Newsletter 1993–Present
Drosophila Bionet Archives	Drosophila	Online Communication Forum	April 1993–Present
Drosophila Information Newsletter	Drosophila	Newsletter (electronic)	January 1991–October 1995
Drosophila Information Service	Drosophila	Newsletter/Journal	1934–Present (Volume 94 is currently in pre-publication)
Laboratory Primate Newsletter	Non-human primates	Newsletter, digitized and paper	January 1962–Present
Maize Genetics Cooperation Newsletter	Maize	Newsletter	1932–Present (85 Issues)
Mendel Newsletter	Archival Sources for History of Genetics	Online Newsletter	1991–Present
Mendelian Inheritance in Man	Humans	Book series	1960s
Microbial Genetics Bulletin	Phage lambda	Newsletter	1950–Present
Mouse Newsletter	Mouse	Newsletter	1950–Present
Neurospora Newsletter/Fungal Genetics Newsletter	Neurospora	Newsletter	Neurospora Newsletter 1962–1985; Fungal Genetics Newsletter, 1985–Present
Plant Breeding and Genetics Newsletter	Multiple plants	Newsletter	May 1998–Present
Rice Genetics Newsletter	Rice	Newsletter	1984–2010 (annual)
Silkworm Information Service	Silkworm ( <i>Bombyx mori</i> )	Newsletter	1947–Present
Soybean Genetics Newsletter	Soybean	Newsletter	1973–2010 (Volume 37)
The Arabidopsis Newsletter (later, the Arabidopsis Information Resource, TAIR)	Arabidopsis	Newsletter and electronic resources	1964–Present
The Worm Breeder's Gazette	<i>C. Elegans</i>	Newsletter	December 1975–Present
The Yeast Newsletter/ Yeast	Yeast (various types)	Newsletter	1950–Present
The Zebrafish Network	Zebrafish	Genome Archive, informational resource	~ 1997–Present
Xine – a Xenopus Newsletter	Xenopus	Newsletter	October 2001–2007 (last updated)

with the model organism itself, and are inextricably intertwined with that organism and the findings it yields, especially those involving the complicated mapping of chromosomes. They are mechanisms for stabilizing the organism and its conceptual limits at the same time as they constitute an organized collective.

Newsletters are a feature of the twentieth century, spurred on by advances in mimeographing, photocopying, air travel and the general post-war growth in scientific investment, and they track the evolution of media closely.<sup>7</sup> By the 1980s and 1990s, most printed, copied or mimeographed newsletters were rapidly giving way to (or being supplemented by) Internet ‘mailing lists’ – the term signals the continuation of the community (the list of recipients) without the mediating object (the newsletter itself). Newsletters are also the most recent common ancestors of many of the most widely used shared databases in biological research. FlyBase (the database of the *Drosophila* genome) grew directly out of the *DIS* – numbers 73 and 74 (1994) are printed versions of the contents of the database. The Gramene database incorporates decades of work from various grasses (barley, rice, maize, oat, wheat, each of which had its own newsletter); Online Mendelian Inheritance in Man was a project of the series of books edited by Victor McKusik, DictyBase now supplements the *Cellular Slime Mold Newsletter* and so on.

Most biological newsletters have served two overlapping communities: scientists interested in a particular model organism, and the technicians who managed or handled those organisms. Some newsletters show this difference more acutely, as in the case of the *Carnivore Genetics Newsletter* run by amateur fancier and lab technician Roy Robinson, or the *Laboratory Primate Newsletter*, which contains extensive information on the care and feeding of primates for research.<sup>8</sup> Newsletters therefore represent both continuity and discontinuity, and as such are valuable model organisms. They allow contrast across a long span of time as well as mapping out genealogies of current research; and they track both the scientific and the artisanal culture of a specialty.

Perhaps one of the most significant reasons why newsletters are illuminating is the way they reveal issues of property, propriety and moral economy – issues that are often implied or entailed by talk of ‘openness’, ‘open access’ or ‘open source science’. Because newsletters represent a line of continuity within science, it is possible to use them diagnostically: to look at these issues before and after events such as the Bayh-Dole Act of 1980, the *Diamond v. Chakrabarty* and *Moore v. the Regents of the University of California* cases of the 1980s, and the 1976, 1980 and 1998 extensions to US copyright law. It is not the case that issues of ownership, property and propriety only came into being with the expansion of intellectual

7 Though I do not do so here, one might track the pre-cursors of newsletters in other prior communicative media of the eighteenth and nineteenth century: newspapers, pamphlets, broadsheets and other forms of inexpensive and widely distributed media, as well as the growth of catalogs, mailing lists and other techniques of managing communities via the postal system or telegraphy. On labor in producing such communication networks see, for example, (Downey, 2002; Blok and Downey, 2004). In recent work, Bruno Strasser makes the case that the collections of DNA sequences that are the *sine qua non* of contemporary biology represent a continuation of the tradition of natural history collections (Strasser, 2011); Daston and Galison’s (2007) analysis of scientific atlases is also a sort of precursor insofar as atlases represent a similar kind of collective stabilization of complex reality as that at work in the newsletters in genetics. In a very different idiom, Murray and O’Mahony (2007) have approached the scientific accumulation visible in informal networks in an organizational studies approach.

8 A profile of Roy Robinson appears in ‘A very professional amateur’, *New Scientist*, 16 June 1977, p. 642.

property law, as contemporary legal scholars and activists sometimes suggest, but rather that these changes to law have had ramifications on the moral economies already in place. Newsletters and their communities have handled issues of property and community ownership in ways that often did not make reference to the law at all – but were nonetheless concerned with moral evaluations of exchange and production. While a first glance at model organism newsletters might seem to be good evidence that ‘science has always been open’, a further look reveals that the distinction open/closed is not a helpful one. Rather, there is a longstanding relationship between the constitution of a collective and the moral economy governing exchange within that community. This relationship necessarily raises questions about the difference between individual ownership of things and ideas (a veritable article of faith in our contemporary political economy) and collective property in the form of concepts, data, maps, collections and the theories built out of them. It is too simple to assert that ‘science has always been open’ – but there is nonetheless something to learn from the past and its ‘moral economies’ if one wants a critical angle on the contemporary expansion of intellectual property in biology.

## Property and Propriety in the *DIS*

In genetics, perhaps the most widely recognized and most successful model organism is *Drosophila melanogaster*. *Drosophila* was made famous by the research community constituted around Thomas Hunt Morgan’s project – in what Kohler (1994, pp. 30–33) classed as ‘experimental evolution’ – and the race to map the mutant characters to particular places on the charismatic insect’s chromosomes. The project was elaborate and involved a huge number of mutant flies. As the community grew, and began to include more and more researchers from outside Morgan’s group, there emerged a now equally famous, if slightly less charismatic, newsletter: the *DIS* number 1 appeared in 1934 under the direction of Milislav Demerec and Calvin Bridges at Cold Spring Harbor. The *DIS* was not the first such newsletter. It was based on the earlier *Maize Genetics Cooperation News Letter* started by Rollins Emerson at Cornell University in 1932, which began life as a mimeographed stock list of available seeds circulated among the early maize geneticists. In print form, newsletters run the gamut from mimeographed sheets to professionally printed and bound booklets, with esthetics that vary from the aggressively utilitarian (nothing but lists and names), to the playful and illustrated. Reading such publications can either produce a sense of the almost inscrutable (and boring) detail of ongoing research or a glimpse of the lifeworld of problem-solving, scientific creativity, drudgery, success and failure. The *DIS* is perhaps the most engaging and occasionally entertaining of the newsletters, with the possible exception of the *Worm Runner’s Digest* devoted to research on *C. elegans* in the mid- to late-twentieth century.

In this section, I look at the detailed mechanics of propriety in the constitution of the community of users of the *DIS*. Kohler (1994), following Thompson (1971), used the notion of a ‘moral economy’ to explain the wide range of rules and expectations that govern the practical ethics of engaging in research – and especially the moral evaluation of exchange in those settings. By emphasizing the issues of propriety here, I am drawing attention in particular to debates about the nature of property and its relationship to exchange. How are concepts and collections (in this case, the map of mutant characters on the chromosomes of

*Drosophila melanogaster*) ‘owned’ in a non-legal sense – both individually and collectively? How is that ownership tracked and signaled in a newsletter?

As will become clear, the tensions around rules of propriety emerge precisely because of a concern over what counts as individual property (the research and intellectual activities of an individual or lab) and what will count as *collective* property (the concepts and techniques that are necessary to coordinate research in order to produce a complex object such as a map of the chromosomes). What should be clear (in order to understand how things have changed) is that in the case I describe here, the law provides neither an explicit incentive nor a restriction on what was accomplished through the medium of the newsletter.

Model organism newsletters were not open to just anyone: they were circulated only to working scientists’ labs, they were often not ordered or archived by libraries, they were conducted in an idiom and a style that assumed a very advanced level of specialized knowledge and they were intended for very specific purposes. And yet they facilitated a kind of sharing that was the very antithesis of hoarding and secrecy. The *DIS*, for instance, was available to anyone who contributed a stock-list of mutant fruit flies available in their labs (and thereby was willing to share these mutants by mail or in person). Andrew Hogan (2009) notes a similar dynamic at work in the *CVS* newsletter in the 1980s; newsletters require recipients to respond (that is, contribute data, stock lists and so on) in order to be considered an ‘active member’. In this way, it was possible to produce maximum openness by allowing anyone to read or contribute, but also to constitute a certain form of recognizable closure: everyone can see who the ‘active contributors’ are, those who are the most committed of the participants. All others are either doing something else or are not ‘actively engaged’. Therefore, by way of this structure, it was possible to constitute a center of sorts, nominally organized around an organism (*Drosophila*, *Dictyostelium* and so on), but implicitly organized around a set of concepts for which that organism either is or will become central (for example, experimental evolution, and eventually chromosome mapping in the case of *Drosophila*). If one wanted to work on those concepts, one would eventually have to become an ‘actively engaged’ member of this community.

In the *DIS*, everyone who contributed had access to everyone else’s flies and data, and thereby, it was argued that progress was made faster and more effectively than if any one participant kept these resources to themselves. This production of a core of ‘active contributors’ and an open communication media is strikingly similar – to take an example from a much different domain – to the structure of many Free and Open Source Software (FOSS) projects, at least those conducted in freely available forums and mailing lists. A similar claim (although about a different kind of bug) is made about the efficiency of FOSS practices: ‘Given enough eyeballs, all bugs are shallow’ (Raymond, 1999).

The newsletters were also a safe place to publish results that communicated what a lab was working on before a result sufficient for ‘official’ publication could be achieved. This meant that researchers could signal each other about the problems they ‘owned’ without fear of getting scooped, without publishing too quickly and in the absence of any explicit intellectual property rights (that is, before 1976 in the United States, when copyright law changed to an automatic assignment of legal rights). In many ways these newsletters created expanding scientific communities, but in other ways they isolated them. Not just anyone who worked in genetics could work in this community – only those invested in *Drosophila* as a tool for understanding evolution and heredity experimentally. This kind of closure



created a community rich with tools, techniques and knowledge for exploring genetics in one kind of organism.

Newsletters are never *sui generis*. As the foreword to *DIS* makes clear:

An appreciable share of the credit for the fine accomplishments in *Drosophila* Genetics is due to the broadmindedness of the original *Drosophila* workers who established the policy of a free exchange of material and information among all actively interested in *Drosophila* research ... in over 20 years of its use, no conspicuous abuse has been experienced.<sup>9</sup>

The community of *Drosophila* geneticists was a peculiar case within academic zoology, keen to make contributions to a general understanding of heredity and evolution in the wake of the re-discovery of Mendel's genetics.<sup>10</sup> A very large number of *Drosophila* geneticists trained with Thomas Hunt Morgan at Columbia University, who actively cultivated an elite, largely male, community of scientists (called 'flyboys' informally and 'Drosophila workers' in the quasi-collectivist language of the *DIS*, a designation used in many other newsletters: 'Yeast workers' 'Maize workers' and so on).

The Columbia community was a tightly knit and playful group, 'highly skilled in the rituals of group renewal, which taught greenhorns the basic tricks of the trade while contributing to the group's communal output' (Kohler, 1994, p. 102). A similar claim could be made for many – though certainly not all – research projects organized around particular model organisms. The Phage group at Cold Spring Harbor was a direct descendant of the *Drosophila* community, led initially by Demerec and Max Delbrück, who served as its charismatic leader. Phage had its own newsletter as well: *The Microbial Genetics Bulletin*, which mirrored and extended the function and style of *DIS*. More recent examples include the research group around *Dictyostelium*, the social amoeba, which has been in existence since the mid-1970s with its own newsletter the *Cellular Slime Mold Newsletter*, later the foundation for the Dictybase database (dictybase.org). A counter example might be the water flea *Daphnia*, which has only recently (since the early 2000s) acquired a coherent community of collaborators at the *Daphnia* Genomics Consortium Collaboration Wiki (wiki.cgb.indiana.edu/display/DGC/Home), despite over 300 years of research on the organism (Korovchinsky, 1997).

Outside of biology, a productive comparison could be drawn with similar close-knit communities such as the MIT AI lab in the 1970s, which inculcated a moral economy (the so-called 'hacker ethic') in participants similar to the one in Morgan's lab among the flyboys; or the culture of Bell Labs which while serving a corporate mission, nonetheless cultivated a playful spirit, and an ethic of open sharing within the lab and among employees from the 1930s onward (Levy, 1984; Kelty, 2008).

The appearance of a newsletter in any community is thus a sign of success, not the beginning of something. They are a solution to the problems of coordination revealed as a model organism becomes more widely used, and the results more generally available. In

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<sup>9</sup> *DIS*, number 1, 1934, p. 2.

<sup>10</sup> Kohler's book contains two chapters that detail the system of exchange developed by the early *Drosophila* geneticists in the period 1910–1930, along with a description of the role that the *DIS* played (Kohler, 1994, Chapters 4 and 5).

this it resembles Kuhn's claims about the formation of paradigms – they represent a mature 'normal' science – except that the negotiations necessary to accomplish this are not primarily epistemological, but infrastructural. In the case of the *DIS*, the number of laboratories and their distribution around the world was growing as Morgan's labs and others reproduced geneticists committed to mapping *Drosophila*. By the second issue, stock lists were being received from the United States and Europe, Japan and the Soviet Union.<sup>11</sup> The complexity of mapping the genes and variants of genes in *Drosophila* was obvious, and the need for a system of keeping track of ongoing work clear. The first issue of the *DIS* declared that it would contain new mutant characters (phenotypes) and associated data 'including those not of sufficient interest to warrant a special paper'; summaries of linkage data; chromosome maps; stock lists and names of labs; notes and news, including techniques and requests or offers of material; a directory of *Drosophila* geneticists; a bibliography; and other suggestions or corrections. From this list, it is clear that many different functions that are today disaggregated were combined in this newsletter: stock centers and the management of the circulation of stocks; a nascent international scholarly society with members; and a kind of data repository linking scientific papers with people and information about *Drosophila*.

The *DIS* thus seems to have served many of the functions of an official scientific journal, which makes especially surprising the notice printed front and center on the newsletter's cover: 'This is not a publication ~ Unpublished material presented in this circular must not be used in publications without the specific permission of the author' (see Figure 1). This Magritte-like injunction captures several aspects of the *constitutive closure* of *Drosophila* genetics research.<sup>12</sup>

The statement was important enough that the editors devoted the 'Foreward' [sic] to *DIS* number 2 to an extensive explanation of what it meant (see Figure 2). The *DIS* was meant as a tool to 'disseminate privately information important to those actively engaged in *Drosophila* research', and not to a general scientific public via the mechanism of citation or mention in the published scientific literature. Contributions of information to *DIS* were not entirely restricted, but meant to be treated in the same manner as 'when information is obtained thru correspondence, tho circular number and page may be cited'.

Even more complicated was the understanding of how the information in *DIS* should be understood with respect to credit and informal ownership: 'It is assumed by the editors that the material printed in the circular is such that any single item in itself does not contain information which would not willingly be supplied thru correspondence to any other *Drosophila* worker'. In other words, the newsletter represents a many-to-many letter writing system, as opposed to a series of one-to-one correspondences, and should be conceived of in this fashion. Anything a worker would not share by mail with another *Drosophila* worker should not be published in *DIS*. Such an approach more or less denounces the power implicit in letter-writing to create distinctions between members of the community, and values

11 A table in *DIS*, number 11, p. 7 lists a total of 319 recipients from 16 countries, primarily United States, Russia, Japan, Germany and Britain, but extending to the Philippines, China and Australia.

12 'Constitutive closure' here refers to the fact that an open community of scientists comes into being at the same time that it produces a kind of closure. Such an insight owes much to the work of Shapin and Schaffer in *Leviathan and the Air Pump*, where they note that 'solutions to the problem of knowledge are solutions to the problem of social order' (Shapin and Schaffer, 1985, p. 332).

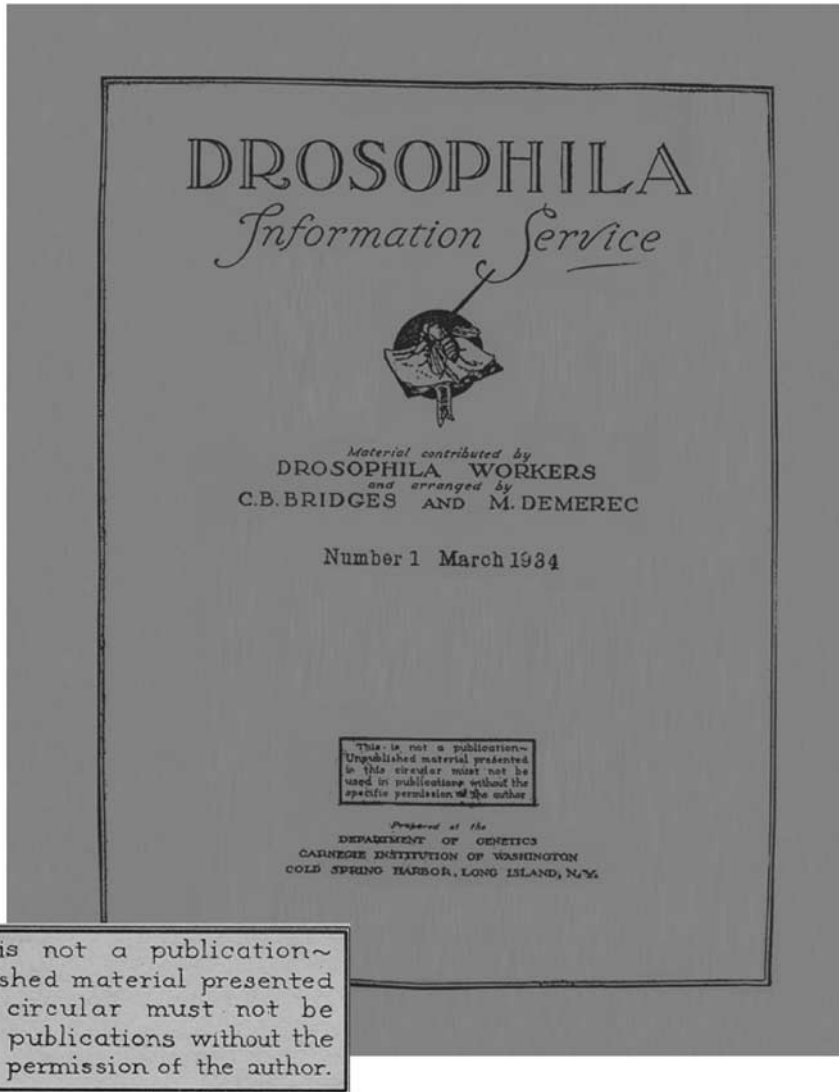


Figure 1: ‘This is not a publication’. The front cover of the first *DIS* #1, March 1934. *Reproduced with permission.*

instead a more abstract category of people who are all on the same plane: actively engaged *Drosophila* workers.

The explanation makes clear that material distributed in the *DIS* enters a quasi-collective domain: ‘for the use of such information, therefore, either in working out a problem or in publishing that work, it would not be expected that permission of the author is necessary, tho due acknowledgment of the source should be made’. Facilitating the use of the information was valued over control, though not at the expense of proper attribution and distribution of credit. As Kohler notes, there were necessarily breakdowns in the system that



DIS no. 2 1934

## FOREWARD

This second issue of the DIS circular brings together melanogaster stock lists of practically all the research laboratories and this makes the available research material known to anyone who may have a use for it. This issue also contains complete statements concerning the mutants and stock lists of *D. virilis*. An almost complete directory of *Drosophila* research workers is given.

The first two issues succeeded in bringing together extensive material in two important sections, viz. in the symbol or mutant list and in the stock lists. In subsequent issues it is intended to keep these sections up to date by noting changes and by issuing new complete lists at intervals. The third issue, which is planned for February, 1935, will contain a revised list of symbols and mutants of *D. melanogaster*. Please keep the list of your own mutants continually revised and up to date, with the inclusion of name of finder and the date of discovery of each mutant. Please also check over the old lists for errors and for filling in the above two items, both of which aid greatly in the identification and characterization of a mutant or stock.

To avoid misunderstandings it is deemed advisable to amplify the statement in the box on the cover page. The "this is not a publication" sentence was intended to make clear that DIS is a means to disseminate privately information important for those actively engaged in *Drosophila* research. The main purpose of this sentence was to prevent the reference to DIS in the literature lists of published papers since the material of the circular is not put in a conventional form to be easily handled in literature lists and also since the circular is not generally available but has a limited and selected circulation. If any reference to this circular is made it should be put in the text in a form similar to that used when information is obtained thru correspondence, the circular number and page may be cited.

The second sentence "unpublished material presented in this circular must not be used in publications without the specific permission of the author" was intended for the protection of contributors rather than the establishment of barriers for a free use of the material by investigators. It is assumed by the editors that the material printed in the circular is such that any single item in itself does not contain information which would not be willingly supplied thru correspondence to any other *Drosophila* worker. For the use of such information, therefore, either in working out a problem or in publishing that work, it would not be expected that the specific permission of the author is necessary tho due acknowledgement of the source should be made. This question assumes a different aspect, however, when any large section of the circular is considered. If, for example, a whole section on symbols and mutants of melanogaster or the chromosome map of *virilis* or mutants of *funnebris* etc. should be abstracted from the circular and republished in a copyrighted textbook or some other copyrighted publication, that procedure might cause unpleasant embarrassment to those contributing to or arranging such a section. To avoid such an occurrence the second sentence in the box on the cover has been inserted.

Figure 2: The foreword (sic) to DIS #2, August 1934. *Reproduced with permission.*

required adjudication – cases where the line between a resource for use by all, and a result owned by one or a few seemed blurry. For instance, was a partial map of a chromosome a result or a resource? To what level of quotidian detail should techniques listed in *DIS* be acknowledged in published work?

The extensive reflection on this small phrase that the editors thought necessary to take up in the foreword to *DIS* number 2 was in fact prompted by H.J. Müller, one of Morgan's more famous and prickly students whose role in the *DIS* was central. Müller's exploration of the issue was even more in-depth, and was printed in the 'Miscellaneous Notes' section as two long notes: 'Concerning Acknowledgement' (p. 66) and 'Concerning material to be published' (p. 67). Müller objected that the statement seemed the very opposite of the ethic invoked by the publication, as it was clear from every other angle that the newsletter facilitated the open and unrestricted sharing of information, of mutants, or tips and techniques, of addresses and current research projects. He suggested that if it was necessary to get permission to cite something from *DIS* in a publication, it 'must surely be even more obligatory for the user not to secretly take the information given and use it *without acknowledgements*, in the obtaining of further data or conclusions which he then presents in a publication ...' (*DIS*, number 2, p. 66). Müller's objection captures the peculiar nature of the 'constitutive closure' and the difficulty of specifying the extent of the 'free exchange' that forms the basis of the *Drosophila* community. At the heart of this anxiety is the distinction between individual concepts and collective ones: when does something become a concept readily available to 'actively engaged *Drosophila* researchers' and therefore available for standardization, transformation and extension, and when is a concept something crafted by an individual lab or individual scientist?

As suggested in the foreword (and oft repeated in other issues of *DIS*) part of the confusion was handled by the repeated use of the phrase 'only those *actively engaged* in *Drosophila* research'. This excluded not only a general public, but also geneticists working on other organisms. Furthermore, it restricted the concern only to those scientists who both received and *contributed* to the newsletter. The note on the front cover, and the repeated assertion of 'active engagement' sent a clear message that though the ethic of openness and sharing was extremely strong inside the community, any extension beyond that was subject to the discretion of the scientists who owned the flies, the data, the maps, the problems or the results. As Müller put it:

This matter, in other words, must be up on the same footing as in the case of material (data, conclusions or suggestions) passed on by word of mouth or by letter where of course it is the most obvious and elementary principle of ethics that acknowledgement of the source must be made if the scientific material is put to published use'. (*DIS*, number 2, p. 66)

The 'most obvious and elementary principle of ethics' derived from the experience of letter-writing also implies the existence of a kind of friendship and familiarity that needs be preserved in the case of *DIS*. The *personality* of those involved was valued over the *impersonality* of the formal scholarly publication. Müller's note details the various ways in which acknowledgement must be handled in the *DIS*, in order to facilitate and extend the standards of conduct concerning free and open exchange, suggesting at the end of his note:

'Experience has shown that it is unfortunately only too true that such overt understandings must be reached beforehand, even in the case of scientists, in order that real cooperation may be possible' (*DIS*, number 2, p. 67).

For the first 20 years of *DIS*, the phrase 'this is not a publication' could make some sense; given that the newsletter had an avowed informality and a clear mission that was both social and technical in the constitution of a research community around the newsletter and its functions. But by 1955, after 20 years of relative stability in the functions of *DIS*, the issue of publication and acknowledgement was raised again in number 29 by the editor, Milislav Demerec (see Figure 3). Over these 20 years, however, the frequency and length of these notes steadily increased and the tendency to refer to them did as well. Demerec raised the question of removing the note, as it seemed somehow (as Müller suggested 20 years earlier) to indicate the opposite of free and open exchange. Some groups (including Müller's lab, then at the University of Indiana), included general blanket statements allowing citation of the material they contributed, but the question emerged as to how to determine who wished

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## FOREWORD

When *DIS* was started, nearly twenty-two years ago, it was intended as a private bulletin for *Drosophila* workers, through which they could circulate information about stocks, new mutants, and new laboratory methods, such as is not usually contained in published papers. The Directory and Notes sections were included to keep the group informed about personnel and current happenings at different laboratories. *DIS* was not meant to be used as a medium for the publication of results; and as a protection to contributors the statement beginning, "This is not a publication..." has always appeared on the cover of each issue. The fact is, however, that the members of our group have found it increasingly convenient to send preliminary notes about their work to *DIS*, and to refer to them in publications. Other geneticists also make published references to notes appearing in *DIS*. There is no reason why this should not be done, or why, if the members wish, *DIS* should not be used as a medium for "publishing" brief notes. In this case, however, the statement on the cover is superfluous and acts as a barrier to the free use of material; for it obliges other workers to obtain permission from authors before referring to *DIS* notes in published papers. This question has been brought to the Editor's attention by several contributors. Müller's group solved the problem in their own case by inserting the following statement in the last issue of *DIS*: "*Drosophila* workers at Indiana University extend permission to cite any of the material which they have had or will have in any issue of *DIS* except where, in specific instances, a contrary statement is made." This year we have included a note to the same effect sent by the Rochester group. It seems, however, that the time has come for a more general solution. This might be accomplished either (1) by an agreement, suggested by Kenneth Cooper, that every note be marked with an asterisk by the author if he consents to its citation, or (2) by the more radical measure of omitting the restrictive statement from the cover in future issues. The Editor would prefer the more radical solution, but before acting wishes to have the approval of the *Drosophila* group. He will assume that all those who do not express disapproval by writing about it are in favor of the change.

Figure 3: The foreword to *DIS* #29, November 1955. *Reproduced with permission.*

their contributions to be ‘quotable’ and who did not. Demerec proposed either a system of denoting quotable articles with an asterisk or eliminating the statement on the cover entirely.

In number 30, *DIS* adopted bits of both solutions in response to community concerns. A modified statement on the front cover drops the phrase ‘this is not a publication’ opening *DIS* up to a recognition that it has achieved something of this status – a medium for *publicization*, to be sure, but not a *publication* that is widely available in libraries and properly edited and reviewed, nor with the status of an ‘official’ scholarly journal (see Figure 4). In addition, a system was devised of using an asterisk to designate which notes can be cited, though it appears that the system was either not followed or almost no one wanted to

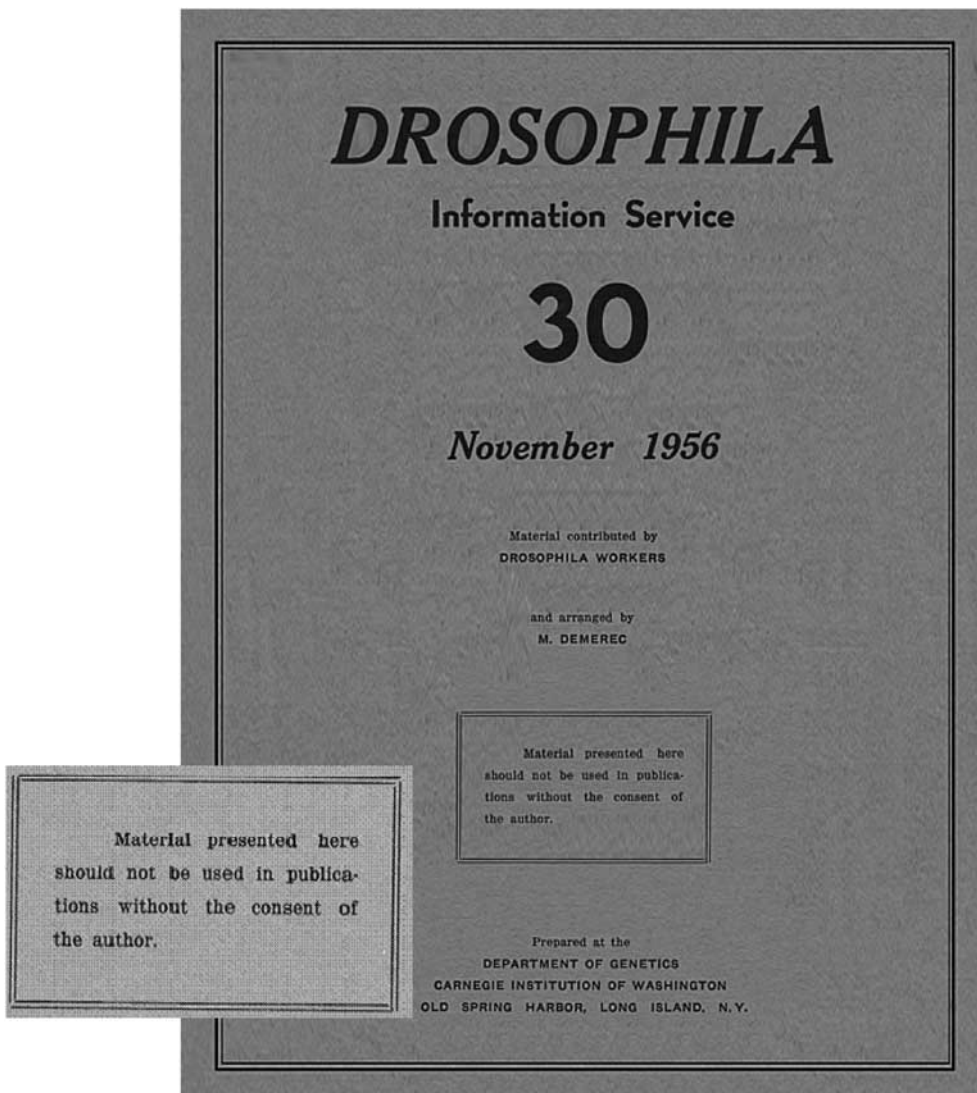


Figure 4: Is it now a publication? The front cover of *DIS* #30, November 1956. *Reproduced with permission.*

allow citation of the material they contributed. By number 37, the new editor, Edward Novitski, wrote a section called ‘quotability of notes’, which reflected on the editorial process involved, the informality and even ‘inaccuracy’ of many of the notes, and the impossibility of providing proofs to authors so that they might double check their contributions. Even the blanket statement ‘all of my notes are quotable’ was deemed insufficient, as it implies all the notes have been proofread. Novitski’s response was to create a list of those notes that have been specifically marked with an asterisk by issue number and page number.

The issue never quite goes away. Although the phrase ‘this is not a publication’ was dropped in 1956, no copyright notice was added, and there would be no explicit assertion of copyright even into the twenty-first century. This absence is an implicit affirmation of the informal rules of acknowledgment and ethical re-use instead of the legal protections of copyright. It is important to understand that there might be very different understandings of what role copyright law plays among the different contributors and over time as copyright law has changed. The fact that *DIS* was a photocopied publication, and contributions were collected without any formal transfer of rights was possible only because of an implicit ‘opting out’ of the copyrighted publications system. The 1976 amendments to the US copyright statute were explicitly formulated in response to the spread of mimeographs, photocopiers and audio cassettes, and in many ways would render the ability to do what *DIS* did legally impossible after 1980. Seen from this perspective, *DIS* is a specific, century-long engagement with exactly the same issues that plague contemporary debates about open access publication and publication on the Internet: issues of quality control, persistence, availability, and citability, all of which can be seen in microscopic form in *DIS*, but were never addressed as problems of law or legal right.

There was thus a remarkable level of reflexive understanding of the dynamics of cooperation present in the *DIS*. That the conventions concerning circulation, use, credit and attribution should all be made explicit in this context shows both an awareness of the value they have for scientific process and the need to make such norms explicit in the context of a new technology – in this case the newsletter. The norms made explicit here – the moral economy – are not a result of the newsletter form; they entirely precede it, in fact. However, the novelty of the form requires that members be reminded of the norms and guided as to how to apply them to this new context; it also ensures new readers are informed of the same thing, and that the norms are stabilized in an ‘infrastructural’ if not quite an institutional sense.

By way of comparison, this activity of the working out of a moral economy also occurred in many different places during the advent of the Internet. Two cases, in particular, concern the development of the EMACS (the ‘Editing MACroS’ text editor beloved by computer programmers) and the development of both the Linux operating system and the Apache Web server in the 1990s (Kelty, 2008, Chapters 6 and 7). In the case of EMACS, the community of users engaged in the development and use of the software experienced a very similar transition from a small-scale environment of explicitly normed sharing and free exchange of software, ideas and tools (the MIT AI Lab in the late 1960s and early 1970s), to a larger, more distributed network of user-developers on USEnet, ARPAnet and eventually the Internet. In that case, however, many issues were strikingly different: the application of copyright law to software was uncertain and the context of the commercialization of



software much more developed and threatening. For instance, the context of intellectual property law differs markedly between the 1930s and the 1980s, when it had expanded and encroached far enough into the activities of working scientists that it was no longer possible to ‘opt out’ in the ways the members of *DIS* had, without falling afoul of US copyright law.<sup>13</sup> The result in the case of EMACS was not an informal community that opted out of formal law, but the development of the first Free Software license by Richard Stallman – the GNU (Gnu’s Not Unix) General Public License. This license was a means of strengthening what had been up to that point a set of norms and expectations about free exchange and acknowledgement, but which were insufficient to guide people with respect to the new technologies of circulation and ‘publication’ involved in writing software and distributing it on the Internet. It was also a way of producing something like a *collective* object – a commons out of which to build subsequent software – rather than an individual product (owned by an individual or corporation, and circumscribed as a product rather than an innovation, a platform or a tool).

In the case of *DIS*, the norms and expectations concerning free exchange and acknowledgments are constantly repeated. In many issues, the foreword from the first issue and the rules about use and attribution from the second are reprinted or re-iterated. In addition, both Bridges and Demerec took it upon themselves to urge people to share their stocklists, check and re-check their existing ones, and contribute any notes or information about ongoing work. In this context, they frequently repeat the origin story of the newsletter and the norms, such as in number 11:

The primary purpose of this service was to establish a means of contact between various *Drosophila* workers scattered throughout the numerous research laboratories the world over ... by acting as a clearinghouse for new information, it quickly straightened out many discrepancies, helped to keep a unified system in *Drosophila* nomenclature and contributed towards its improvement.

Further on: ‘the original *Drosophila* workers established the policy of a free exchange of material among all actively interested in *Drosophila* research. This became an unwritten law which is contributing more than any other single factor toward the usefulness of *Drosophila* as research material’ (*DIS*, number 11, p. 5).

The *DIS* thus served not only a technical function, but also a clearly self-reflexive social one: it guided ethical action with the goal of facilitating cooperation. It was cooperation, however, of a particular kind. This was not a newsletter that explicitly organized workers by task into a hierarchical or ordered system of goals. It does not facilitate command-and-control bureaucracy. Rather, it was presumed that all those ‘actively engaged in *Drosophila* research’ were competing with each other at some level, but that this competition could

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13 For instance, the 1976 amendment removed the requirement to register works in order to have copyright status. In 1934, therefore, the contributions to *DIS* would have been uncopyrighted; by 1980 they would be automatically copyrighted. The difference is that in the former case, objection to the copying of a contribution to *DIS* (either the initial ‘publication’ or a subsequent reproduction) would have little legal basis and instead would be governed by the norms of the community, and presumably adjudicated there as well. In 1980, individual contributors would have far more legal basis for objecting to the reproduction of a contribution. Studies of such ‘privately ordered’ regimes – though not in science – are in Bernstein (1992, 1996 and 2001).

only be productive, only be progressive, in a ‘cooperative’ context where workers could see what others had done, and be allowed to make use of it. The cooperation it facilitated was the ability to avoid re-inventing the wheel, to avoid duplicating tedious or difficult labor in the service of producing a larger system of knowledge. To do this, the community must be constitutively closed – consisting only of those ‘actively engaged’. This closure was not structural, however; anyone could become ‘actively engaged’ in the same fashion that any two people could become friends, through a serendipitous connection, a mutual acquaintance or a strong recognition of shared interests, for example. It was this friendly incorporation, this partial porousness that was essential because it allowed for the community to reproduce the norms and renew the group as such. The porousness also represented an informal control over the boundaries of the research group – it was not open to ‘just anyone’ but neither was it a legally, nor bureaucratically closed entity.

Group renewal also required repeated, gentle injunctions to participate in cooperation, as in *DIS*, number 3, where the foreword ends with the following:

To avoid possible misunderstanding, we wish again to express our strong belief that *DIS* can continue to succeed only as a cooperative project. Therefore it is made a primary condition that those who continue to receive the benefits of this project shall also contribute to its upkeep. The only contribution asked is that *Drosophila* workers regularly *answer* requests for material. In order to receive copies of an issue a *Drosophila* laboratory or worker must answer the call for material even if the answer to most items is ‘no change to report’. (*DIS*, number 3, p.4)

And again, in *DIS* number 4: ‘The editors wish to point out again that contribution to past *DIS* issues does not automatically entitle the contributor to receive future issues. In order to receive a particular issue the laboratory or individual must answer the call for material specified for that issue’ (*DIS*, number 4, p. 3). As the first note makes clear, this isn’t necessarily a requirement that one have new contributions, but merely that one keep current the stock lists and information about the lab. Coupled with the assertion that *DIS* is only for ‘actively engaged’ researchers, however, it clearly demonstrates how the norms of contribution will create expectations for continued updating and active ‘publicization’ within the group, of ongoing work and results. To fail to do this, it is clear, removes one from this particular community; and being removed from the community means no longer having access to the richest and most up to date collection of *Drosophila* mutants, techniques and results in the world.

As this introduction to the issues of property and propriety in *DIS* should make clear, the simple distinction between an open and a closed science is of little use, as *DIS* facilitated both closure and openness at the same time. Rather, the concerns of those involved ran instead toward issues of what it means to be actively engaged, what counts as publication and how both issues relate to the creation of collectively owned concepts, materials, maps and techniques.

Not only did *DIS* facilitate closure and openness at the same time, but it also made competition and collaboration compatible. By collaboratively creating an immense resource of collectively owned concepts, maps, materials and techniques – along with rich and constantly negotiated rules about use and reuse of this material – the *DIS* facilitated

competition among researchers, between labs and individuals to map the chromosomes of *Drosophila melanogaster*. The race to contribute to a robust theory of heredity was a sometimes intense and vicious one – but it was a race that would have been impossible without the agreed upon creation of collective property. Clearly the science of genetics did not happen only within the pages of *DIS*; but by the same token, without such a coordinating mechanism, it is not clear if it could have happened at all, with the relative speed that it did.<sup>14</sup>

The *DIS* is a useful example for exploring these issues precisely because it does so in the absence of any reference to law – to refer to the issues raised here as issues of ‘intellectual property’ would be a misnomer, if not exactly anachronistic. Scientists were no doubt well aware of the rules of propriety and the law of copyright when it came to published research – journals and books. This was in fact precisely why the front cover declared so plainly: ‘This is not a publication’, despite having every appearance of being one. Property and propriety were worked out in the service of establishing the possibility of a science of genetics.

The *DIS* is also diagnostic in that it persists throughout the twentieth century and into the twenty-first. The *Drosophila* community expanded *DIS* to include yearly conferences, organized by key members.<sup>15</sup> By the 1980s, the complete map of the fly genome was well underway (and would take shape as Flybase, under the direction of Dan Lindsley at the University of California at San Diego) and as the conferences grew in size, more recognizably bureaucratic structures such as the ‘*Drosophila* Board’ came into being. Today the community depends on the Genetics Society of America for help with organizational aspects of the conferences and managing the money associated with them. *DIS* itself eventually became so well known – and so frequently cited – that it has essentially been converted into a journal; but just as this happened, a supplementary newsletter – the *Drosophila Information News* (DIN) appeared to fill the void. *DIN* lasted 5 years (1991–1995) when it was replaced by the ‘bionet.drosophila’ mailing list, and the FlyBase Web site. Even though such things no longer carry the name or the particular tangibility of ‘newsletter’, they serve the same purposes, I would argue, of facilitating the creation of collaborative competition in collectives.

In the following section, I explore some of the issues that are often raised about twenty-first century science and technology and how they might be re-interpreted through the lens of model organism newsletters and their functions. The first of these is simply to historicize some of the claims made in the present – to point out that, despite the frequently expressed sense of novelty and accelerated change wrought by the Internet and the expansion of intellectual property, there are precedents for the problems of openness and closure faced today.

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14 In other work I have discussed the notion of a ‘recursive public’ as a way to articulate how hackers and geeks working on Internet infrastructure and free software conceived of their community as inescapably enabled by the technology, legal rules and communal norms they created in order to create free software and the Internet. This case shows a similar phenomenon at work in the newsletter, but instead of a ‘public’, it aims instead at the creation of concepts, materials, maps and techniques that enable the theory of genetics (Kelty, 2008).

15 Two issues of *DIS* recount the history of these conferences: *DIS*, number 56, March 1981 and *DIS*, number 75, July 1994.

The second is to raise the question of how to understand the relationship between collective property and the conceptual developmental nature of science in a context where intellectual property law and commercial interests are manifestly more present than they were in the case of many domains of biological science in the twentieth century.

## The Meaning of Openness in Contemporary Technoscience

In the last decade, appeals for more ‘openness’ in nearly every area of life have become more frequent and more concerted.<sup>16</sup> But what does it mean to appeal to openness today in the domains of science and technology? Among the possible meanings are: public engagement or public participation; open access to journal publications; the use of FOSS; some notion of transparency, whether internal to science, or between science and its stakeholders; the removal of ‘gatekeepers’ and mediators who possess the power to restrict who may or may not participate; unrestricted sharing of publications, results, data, organisms or technologies; resistance to excessive restriction by patent, copyright or trademark; and most generally, an appeal to science as a mode of knowing that is always subject to scrutiny and never rests on authoritative or revealed sources.

Over the last decade, ‘openness in science’ has been both a point of reference for, and driven by, debates about openness in information technology and the Internet. Scholars such as Yochai Benkler, Clay Shirky, Larry Lessig and James Boyle have made strong claims for the emergence of radically new forms of cooperation, participation and production based on the Internet and its new affordances for social interaction (Benkler, 2006; Boyle, 2008; Lessig, 2008; Shirky, 2008). Benkler and Lessig, for instance, both claim that there is (now, after the Internet) more than one kind of productive economy operative today: a regular (monetary) economy of goods and services and a ‘sharing’ economy or ‘peer production’ economy in which new things are made through the contributions of large numbers of people. Shirky has argued recently that these ‘sharing’ economies are sustained by a ‘cognitive surplus’ seeking outlet (Shirky, 2010). Very often these claims have pointed to scientific practice as a model or even origin for this new economy, implying that what has worked for science will also work for culture and the economy. And perhaps perversely, it is now common to hear the promotion of new tools – blogs, wikis, Creative Commons Licenses and open access publication – by scientists themselves, in a struggle to make science *more open* and more like the Internet.<sup>17</sup> If the classic Mertonian norms of science (communalism, universalism, disinterestedness and organized skepticism) do not exist, then it seems today’s scientists intend to invent them.

16 One of the earliest academics to explicitly diagnose the problem of ‘open science’ and intellectual property right protections was Paul David (David, 1998, 2004). These concerns have been very well developed within the legal literature at least since the mid-1990s (see, Rai, 1999, for a review). A National Research Council conference in 2003 was an early call for a more open science (Uhlir and Esanu, 2003, 2004). A handful of books and articles have also made the call for open science, such as Hope (2008); Waldrop (2008); Varmus (2009); Cribb and Sari (2010); Nielson (2012). As of 2012, there have been several conferences devoted to open science, such as the ‘Open Science Summits’ organized by Joseph Jackson ([opensciencesummit.com](http://opensciencesummit.com)).

17 Scholars such as Boyle, Lessig and Benkler are well aware of this double appeal to science as both origin of openness and in need of more. The Science Commons project, an offshoot of creative commons is one key example ([sciencecommons.org](http://sciencecommons.org)).

Perhaps the most visible poster child for ‘open source science’ has been synthetic biology, at least in the form popularized by Drew Endy and Tom Knight, roughly during the years 2003–2008 at MIT. In part, the concern with ‘open source science’ is due to a direct filiation with FOSS production. Drew Endy and Rob Carlson forged their ideas of what synthetic biology could be (along with Roger Brent) in the context of Sidney Brenner’s Molecular Sciences Institute at Berkeley, an institute expressly designed to explore the possibilities for ‘open source biology’. And Tom Knight emerged directly out of the milieu of computer science and information technology at MIT and (along with Randy Rettberg) has transplanted the assemblage of practices, orientations and methods learned there into the domain of biological engineering. Both Knight and Endy have worked cheek-by-jowl with some of the more important luminaries of the FOSS world (Hal Abelson, Gerald Sussman, and Richard Stallman, among others) and within the storied halls of the MIT AI lab (though recently transplanted to a plywood-bedecked Frank Gehry building of uncertain narrative).<sup>18</sup>

Synthetic biology promoters have traded heavily in the rhetoric of open source and its success, arguing that the limiting factors in the success of the science are organizational and legal. To this end, the ‘BioBricks Foundation’ and the ‘Registry of Standardized Parts’ have been pitched as the equivalents respectively of the Free Software Foundation and software foundries like SourceForge that make free software easily accessible for reuse, modular assembly or contribution. The reason, they say, is to draw on the dynamics of collective production pioneered in FOSS, in order to transform biology into a true engineering discipline. Such reasoning trades in the ‘agnostic’ or a-political version of open source in which it is conceived of as outside of any particular political (or moral) economy of value (Coleman, 2004).

However, given the history of newsletters that I have detailed above, it is possible to see the project of synthetic biology not in terms of open source, but as something like the creation of a newsletter for synthetic biology. All of the features of newsletters that I emphasize here – the moral economy, the creation of collective property and the instantiation of a competitive approach based on collaboration – are present in parts of what Endy and Knight have tried to create. The Registry of Standardized Parts, for example, can be seen as a kind of stock list. While most often described as a standardized catalog of parts from which any kind of biological object might be constructed, it represents – as the stock list of mutants in a newsletter did – the health of a community of researchers for whom ‘parts’ are the tools by which something more general is investigated. The vibrancy of the community (and all the anxieties about its success) is tied not simply to a database, but to the frequency and quality of *contributions* made by *actively engaged* members of the synthetic biology community.

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18 Significant work on synthetic biology has already been pursued by a number of scholars. Among other relevant work Calvert (2008, 2010) deals directly with intellectual property; Campos (2009) recounts the history; O’Malley *et al* (2008), Fox Keller (2009), Morange (2009) and Pottage (2006) have debated both the intellectual and legal legacies. Rabinow and Bennett (2012) contains a complete analysis of the SynBERC engineering center of which Endy and Knight were a part. In addition, there are many students actively researching related topics: Sara Aguiton (Sciences Po), Caitlin Cockerton (LSE), Susanna Finlay (LSE), Alex Hamilton (LSE), Sara Tochetti (LSE), Talia Dan Cohen, Sophia Roosth, Anthony Stavrianakis (UC Berkeley), Christina Agapakis (UCLA) and Alessandro Delfanti, among others.

Synthetic biologists, including Endy himself, oscillate across the distinction between engaging in biological research and engineering new devices and systems. They have promised a great deal: the ultimate toolbox for solving any problem (curing malaria, growing a house, purifying water and so on). And they have created an extremely clear procedure for investigating biology in a new way, a kind of thoroughgoing pragmatist biology, in which the creation of a ‘part’ is the testing of certain conceptual claims about how biology works, and the parts that ‘work’ become the very instantiation of that conceptual scheme (Bennett, 2010). The registry represents a bid similar to that of the newsletter: to create *collectively owned* concepts and propositions within a constitutively closed community of researchers – and not only a repository of freely available parts for anyone to use.

From the perspective of engineering, anecdotal evidence suggests that people are frustrated because ‘the parts don’t work’ – that they are not yet fully standardized or robust in an engineering sense. But from the perspective of biologists, the parts are mysterious not because they don’t work, but because it isn’t yet clear how and what they might tell us about biology. In Kuhnian terms, the Registry has not become a paradigm, and so cannot yet generate the ‘anomalies’ that might question the given arrangement of theories and concepts in biology. Given sufficient enthusiasm, funding and persistence, perhaps it might yet generate something like a new paradigm for biological research.

Another striking similarity between Synthetic Biology, specifically at MIT, and that of model organism newsletters is the International Genetically Engineered Machine (iGEM) Jamboree. iGEM has turned out to be a very clever way to increase the number of parts in the Registry. To compete in the iGEM, one has to contribute one’s parts to the Registry, just as in order to receive a copy of the *DIS*, one had to contribute a stock list and be willing to share mutants. As such, like the *DIS*, iGEM serves other purposes as well: it grows the network of people who see themselves as part of a particular style of biological engineering, it communicates the norms and goals of that network to new members, it inculcates a moral economy of sharing and the promotion of camaraderie. But perhaps more importantly, it also functions to create that *constitutive closure* that is so important by requiring the use and contribution of a particular form of standardized parts. Other people working on synthetic biology in other idioms or with a different ‘standardization’ cannot participate.

The most obvious case of closure-as-exclusion has been the case of ‘DIY Bio’ groups being excluded from iGEM. The decision to exclude ‘DIY Bio’ groups from participating in iGEM stemmed in part from the lack of an institutional identity – a proxy for safety – and in part from an unwillingness to open the competition to ‘just anyone’. The constitutive closure necessary to maintain the collective production of cumulative knowledge runs up against the quasi-democratic aesthetic of opening up science to anyone, anywhere. And whereas the *DIS* succeeded in constituting a single community, a nomenclature, a set of techniques, an experimental practice and ultimately a theory of genetics, there are many different synthetic biologies today, many different communities working on something similar, but not identical to synthetic biology as practiced by Drew Endy and Tom Knight. Whether they are successful largely depends on who chooses to ‘subscribe to their newsletter’ as it were – and more than that, to contribute to it regularly. There are other pretenders to the throne: Craig Venter as usual, but also the various communities of researchers in molecular engineering or nanotechnology, the synthetic and organic chemical engineers, and many others. Each of

these communities is already engaged in constructing their own versions of a newsletter – an infrastructure for collaborative competition and collectively owned concepts, propositions, hypotheses, results.

However, the fact that synthetic biology sits at the intersection of the biotechnology industry and the academic pursuit of genetics constitutes a momentous difference. To do the work they dream of doing, synthetic biologists must depend on the biotechnology industry both for tools (like DNA synthesis) and the money (in the form of venture capital-funded start-up companies who then become something like internal competitors to the creation of a robust, standardized synthetic biology). Endy, Knight, Jay Keasling and Craig Venter – are all well and truly ensconced in the commercial side of biotechnology even as they struggle to define what the technoscience of synthetic biology will become. The moral order of FOSS does not dovetail with the political economy of market-based competitive production.

The appeal to openness or open source in this context has faced other challenges. The most obvious one, much commented upon, is that biotechnology and pharmaceuticals are dominated by patents, as opposed to copyright, and the structure of investment and return has both a different temporality and a significantly higher return on investment than in the domain of information technology (Rai and Boyle, 2007). In this respect, the science of biotechnology – and those research domains where the science of biology is most closely tied to it, such as plant genetics and agricultural genetics – has become a considerably more ‘closed’ as a result of intellectual property expansion and the vagaries of commercially driven science.

The nature of this closure, however, is slightly different than I have highlighted in the case of newsletters. Whereas the closure of newsletters was intended to facilitate the creation of collectively owned concepts in the service of a cumulative science, the intellectual property system recognizes no such thing: all concepts, techniques, objects, practices, must be *individually* owned – subject to the intellectual property regime’s definition of an individual and his/her/its rights. Even though the intent of the intellectual property system may once have been to balance individual gain with public benefit (Boyle, 2008; Hyde, 2010), the reality of the system as implemented is that everything, down to the very mutant fly and its sequenced gene, must be individually owned in order to serve the growth of a competitive market. It is simply impossible to rely on a ‘moral economy’ within a project of the scale of global biotechnology. There is no going back to the ‘flyboys’ of Morgan’s day – even if we call it a ‘jamboree’.

What newsletters like *DIS* highlight is that this contemporary form of political economy sacrifices the collaborative construction of cumulative knowledge. Rather than producing collectively owned concepts and techniques that result in a mix of collaboration and competition, a strong intellectual property system demands that all concepts, techniques, propositions or results be individually owned; that they be made available only through a market that will decide who collaborates with whom. The predictable issues of lock-in, non-standardization, patent thickets, barriers to entry (even pathological objects like terminator seeds) are clearly problems that the creation of a newsletter – on a smaller scale – was intended to forestall. Rather than 20 labs all pursuing *Drosophila* genetics in their own manner, with their own nomenclature, and a distinctive set of conceptual claims, *DIS* produced one community of *Drosophila* biologists producing one standardized and

organized practice of experimental evolution; and as a result, *one* theory of genetics. Biotechnology, by contrast, operates in a field of competing concepts and theories, a riot of non-standardized tools and techniques, and a legal minefield that even the most enthusiastic participants will agree creates massive expense and sows confusion everywhere.

## Conclusion

I have suggested that model organism newsletters are generally a good, if under-studied, way of accessing the meso-scale constitution and development of sciences. They offer a window on the formation of concepts, collections, theories and techniques at the collective level – in between that of the individual scientist or laboratory and that of the published literature and public face of science. I have also suggested that by looking at the way model organism newsletters developed in the twentieth century, one can critically examine certain claims about the twenty-first century political economy of science – and especially the increasingly ideological insistence on a difference between ‘open’ and ‘closed’ science. Model organism newsletters demonstrate that this distinction makes no sense in science; a case such as the creation of genetics in the field of *Drosophila* research shows that scientific collectives must be both open and closed at the same time. More salient is the moral evaluation of exchange – the moral economy – and how it distributes and controls collectively owned concepts, collections, maps or techniques. Such a moral economy creates collective property on which competition and comparison become a meaningful – even ‘normal’ – scientific activity. On this analysis, a contemporary science like synthetic biology can be seen as creating the norms and moral evaluations of exchange necessary to the constitution of a competitive and collective endeavor. It is not ‘openness’ or ‘closure’ that is at stake; rather it is a struggle to create a recognizable moral economy of collaborative competition using collectively owned concepts and materials.

At the same time, the transformed and scaled-up political economy of biotechnology is unavoidably dominant today – intellectual property laws have changed, the costs of research are larger, and arguably the vocation of science itself has also been transformed (Rabinow, 1997). One might conclude that the creation of a science of genetics along the lines of that created in the *Drosophila* community in the 1930s–1950s has in fact become impossible today. Instead, we have a political economy in which collaboration has become an extraordinarily complex affair, and in which there is virtually no ‘collectively’ owned property any longer. Even that statutory carve-out in patent law protecting products and laws of nature has come under constant and irrepressible threat in the courts.

A final way of understanding newsletters might be to focus on the ‘new’ in news: the fact that newsletters are mechanisms for tracking novelty. Novelty here can be understood both as a very internal concern with the known and the unknown and as a more external concern with signaling, adjudicating and legitimizing claims on novelty.<sup>19</sup>

There are a lot of new things created in such settings: new mutant flies, new hypothesis, new concepts, new collections, new maps, new techniques and new theories. All become the collective property of a group of ‘actively engaged’ researchers. Newsletters have been the

19 Bernadette Bensaude-Vincent (2009a, 2009b) has recently taken up the problematic of invention in chemistry and nanotechnology as has Andrew Barry (2005) with respect to pharmaceutical chemistry.



vibrant heart of an ongoing research enterprise to create concepts that make sense of empirical complexity; even if they do not narrate or illustrate each success in the way the published literature seeks to. But they are also the core of a moral economy (which overflows their pages naturally) that organizes the production of novelty into individual and collective projects, gives rules for contribution, standardizes nomenclature, encourages ‘active engagement’ and ultimately disappears as the formal scholarly literature becomes the ossified relic of the process of innovation and discovery in the fields of science and engineering. Synthetic biology is frequently heralded for its capacity to create new things: new forms and definitions of life, new kinds of engineering, new tools and techniques and so forth. But I would suggest that the novelty of synthetic biology lies not in its claims and object, but in the fact that it sits at the intersection of two different – and conflicting – systems of managing that creation of novelty. On one hand, there is the world of newsletters, where collective concepts and collaborative competition create new things; and on the other hand, in the world of biotechnology, where individuated ownership and competition in rule-governed markets govern what’s new and who owns it. Between the two remain questions about the nature of a collectively shared, and yes, open science – but also the possibility of a new one.

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## About the Author

Christopher M. Kelty is an Associate Professor at the University of California, Los Angeles. He has a joint appointment in the Institute for Society and Genetics, the Department of Information Studies and the Department of Anthropology. He is the author of *Two Bits: The Cultural Significance of Free Software* (Duke University Press, 2008).

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