Alessandro Delfanti:

Hacking genomes. The ethics of open and rebel biology

Abstract:

A new open science culture is emerging within the current system of the life sciences. This culture mixes an ethic of sharing with features such as anti-bureaucracy rebellion, hedonism, search for profit. It is a recombination of an old culture, the Mertonian ethos of modern open science, and a new one: the hacker ethic. This new culture has an important role in the evolving relationship between science and society. And it maintains a political ambivalence. Biohackers are rebel scientists and open access advocates who challenge today's Big Bio's concentration of power. But at the same time they live in a new territory of accumulation that never excludes entrepreneurship and profit.

Agenda:

The tragedy 53
Merton revisited 54
The remix 54
Biohackers 55
The ambivalence of sharing 55
Hacking the rules of biology 56

Author:

Alessandro Delfanti:

- University of Milan, via Passione 13, Milan, Italy
- ✉ delfanti@sissa.it, 💻 http://people.sissa.it/delfanti
- Relevant publications:
  - Special issue on Peer-to-peer and user-led science, JCOM 9 (1), March 2010 (Ed.).
  - "What Dr. Venter Did on his Holidays". Exploration, hacking, entrepreneurship in the narratives of the Sorcerer II expedition, New Genetics and Society, 28 (4), 2009.

ISSN 1614-1687

Crack the (genetic) code, share your data, have fun, save the world, be independent, become famous and make a lot of money. There is a link between the public image of contemporary scientists devoted to open biology and the ethics and myths of the hero of the computer revolution and of informational capitalism: the hacker. In this article, I want to outline a remix between the Mertonian ethic, the famous account of the scientist's norms of behaviour proposed in the 1930s by the science sociologist Robert Merton (1973) and the hacker ethic, a set of moral norms that emerged in the 1960s within the first hacker communities in the United States, and was formalised for the first time by Stephen Levy in his 'bible' of hacker history (Levy 1984). I point out an emerging open science culture that mixes rebellion and openness, anti-establishment critique and insistence on informational metaphors and operates in a context of crisis where the relationship between researchers, scientific institutions and intellectual property is redefined. Indeed, discursive strategies and socioeconomic practices of contemporary biologists who use open science tools such as open access databases, sharing platforms, open participation to biological research and the likes have an important role in the changing relationship between science and society. These biologists, to whome I refer to as *biohackers*, can be a rich model for current transformations in both the life sciences and in informational capitalism. In particular, they are the public face of a transformation that involves the proprietary structure of scientific information - who owns and controls biological data and knowledge? This phenomenon is also related to the ambivalence between openness, which is a prerequisite for peer production as well as a neoliberal claim linked to free market. Christopher Kelty, who referred to a broader world, not limited to scientific research but related to free software (2008, p. 302), has argued that the new wave of open and peer production projects related to the emergence and spreading of free software culture are «a new response to a widely felt reorientation of knowledge and power». But this reorientation can be as paradoxical as the relationship between open source and free software is, where the former is perceived as business model while the latter is often seen as a tool for resistance. And this is nothing new if, as Armand Mattelart (2003) points out, during every new technological cycle the redeemer discourse of the information society emerges again, while the long history of the free flow of information is strictly related to deregulation and neoliberalism.

Finally, this is a peculiar field: biotechnology genesis partially overlaps computer and hacking history and their cultural background (Vettel 2008). For example, they share common birth places (MIT, San Francisco Bay Area), while genomics is heavily dependent on hardware and software to analyse and extract relevant information from genetic sequences. Furthermore, the rise of gene patenting and the increasing relevance of private corporations have made the life sciences an important battlefield where the scientists' ethics of sharing have been at the center of a wave of legal and political clashes around intellectual property rights and biopiracy. Lastly, biological innovation now takes place in increasingly complex and mixed configurations, in which open data policies and open access coexist with different, and more strict, sets of intellectual property rights (Hope, 2008). Hence the transformations I am pointing to challenge the institutional environment in which biological research takes place: "Big Bio", or the ensemble of big corporations, global universities and international and government agencies that compose the socioeconomic system of the current life sciences.

The tragedy

The most common, and naïve narrative about open science tells us that once upon a time, ethics in science was a good thing: sharing, equality, disinterest and the common good drove the everyday work of scientists. Then evil corporations entered science and changed the rules of the game, patenting life, enclosing the commons, and eventually destroying the willingness to share data, information and knowledge. The expression «tragedy of the anticommons» comes from a famous paper published by *Science* in 1998 (Heller and Eisenberg). According to this formula, the proliferation of restrictions to access, patents and industrial secrets represents an obstacle to innovation. While Michael Heller and Rebecca Eisenberg reverse the classic perspective on the "tragedy of the commons," Garrett Hardin's widely cited 1968 paper has been used as an example of the necessity of centralized management, or privatization, of common goods. Finally, the rise of the anticommons has been interpreted as a cause of corruption of the norms of good science, expressed by the adherence to corporate values and goals by the producers of scientific knowledge. Patenting, secrecy and the quest for profit radically conflict with the norms of modern open science, i.e. with the «commitment to the ethos of cooperative inquiry and to free sharing of knowledge» (David 2003, p. 3). And free and open dissemination of knowledge remains an important ideal associated with scientific progress. According

to many authors and open access advocates, we need to couple the rise of new technological tools with a restoration of the modern open science culture. Today, so the story goes, we have new tools that together with the old open science spirit and can be used to rebel against evil, defeat it and allow scientific knowledge to flow freely again. These tools are the Internet, open source licenses and open access science, and they can be used to tear down the barriers to the access to scientific knowledge.

Merton revisited

But the old tradition of open science ethos is not enough to understand the transformations we are facing. The new open science culture that is emerging in the life sciences evolves from the 20th century Mertonian ethic but also contains several new cultural elements. In times of crisis and change the need for a reconfiguration of different aspects belonging to one or more pre-existing cultures becomes more insistent in order to answer the urgent need for new strategies of action (Swidler 1986). Thus scientists can mobilize cultural characteristics and operate a remix between an old culture, already accepted and embodied in a recognized set of practices and norms, and ready to be used; and a different set of cultural features that belongs to other social groups. In his 1942 accounts of scientists' behaviour, *The normative structure of science*, Robert Merton famously proposed what is now a classic list of norms of behaviour which govern academic scientist's work and science's functioning. The norms that guide research practices, later summarized by the acronym CUDOS, are communalism, universalism, disinterestedness and organized skepticism. These imperatives are linked to rewards given to members of the scientific community who follow them, and sanctions applied to those who violate them. *Communalism* means that scientific data are a common good and need to be shared freely. Individual creativity must be recognized in the form of authorship, not ownership. *Universalism* means that science can not use criteria such as race, religion or personal qualities to evaluate scientific claims. *Disinterestedness* is a norm against fraud and against the intrusion of personal interests in scientific activity. *Organized Skepticism* states that the whole scientific community must be able to check facts and ideas until they are well-established and recognized. Yet as historians and sociologists have pointed out, the Mertonian ethic is neither an accurate description of scientists' work nor a set of moral norms scientists should follow. CUDOS norms are rather to be considered a means for scientists to position themselves within a precise historical social contract between science and society. Merton's normative visions is substituted by a significantly more complex scenario, in which autonomy and disinterestedness are not seen as values internalized by the scientific community but ways of positioning within a system of incentives that rewards them. Together with Popperian positivism, these norms serve as an «organizational myth of science» (Fuchs 1993).

And, this goes without saying, the social contract between science and society is now being updated. The ethic of sharing expressed by some contemporary biologists can be very different from the one required in modern, Mertonian open science. Hackers though provide a multifaceted example of a culture attuned to the economic dynamics of the software world made of start-ups, people escaping from academia, corporate networks, garages and computer science departments, hi-tech gift economy (Barbrook 1998), and horizontal labor organisation. Even though several different accounts of it give several different viewpoints and definitions, for the sake of this paper I consider hacker ethic as composed of a quasi-formalised set of moral norms. For example, Levy (2010) lists elements such as: access to computers should be unlimited and complete, all information should be free, mistrust authority, hackers should be judged by their hacking, not bogus criteria such as degrees, age, race, or position, you can create art and beauty on a computer, computers can change your life for the better. To hack means to promote and follow an active access to information and knowledge, and to technology. This ethic is historically related to the academic scientists' ethos and is also an important component of the cultural side of contemporary informational capitalism (Himanen 2001, Coleman and Golub 2008).

The remix

So the remix between the Mertonian ethic of 20th century scientists and the ethic of hackers is a new form of open science culture that not only embodies elements related to openness and sharing, but is rather a more complex recombination in which alongside these, other characteristics emerge: antibureaucratic rebellion, extreme informational metaphors, institutional critique, autonomy, independence, a radical refusal of external interferences and also of scientific institutions themselves, hedonism, the importance of being an underdog, and finally an intense relationship with the media. This culture expresses the re-emergence of an ancient

and recurrent element in the history of science, namely the fight between openness and closure. But the complex and diverse cultural repertoire of biohackers is pretty different from the classical ethic of modern scientists who work in academia, are disinterested, respectful of bureaucracy and peers, not compromised by the market. At the same time, it is also different from a corporate ethos of secrecy, hierarchy, closure. In any case, it does not represent a break in the norms regulating the production of scientific knowledge. It is rather the expression of the transformations affecting the relationship between biosciences, society, public communication, and the market.

Biohackers

In fact, hacking genomes means several different things. The open approach to information is not enough to understand the different possibilities enabled by open science practices. Features such as rebellion, anti-bureaucracy and participation have a crucial role in making DNA something people can hack. Biohackers criticize the scholarly publication and peer review system. They struggle against Big Bio bureaucracies and incumbents. They rebel against authority and refuse to obey to the established (both corporate and academic) hierarchies of the life sciences systems. They adopt radical approaches to the sharing of genomic data or standards. They try to find new business models that stand against Big Bio and follow open access models of data management. They build open source PCR machines or genomic sequencers. In 2003 the 'bad boy of science', Craig Venter, started using open access approaches and circulating genomes in a heterogeneous network of firms, universities, foundations and mass media. He often announces that his greatest success is that he managed to get hated by both worlds: academic and corporate. Yet his hack is directed towards profit and entrepreneurship, as Venter tries to exploit openness in order to participate in a different form of biocapitalism in which data circulation is as important as data gathering and management (Delfanti 2009). In 2006, the Italian veterinary virologist Ilaria Capua made the DNA of viruses hackable by removing it from the secret world of Big Bio, a world where an old-style priesthood decides who can access databases: she forced the World Health Organization to change its policies on restricting access to avian flu data. She refused the secrecy of the WHO bureaucracy and pushed a giant-sized institution towards change. The explicit hacker references and practices of amateur biology projects such as DIYbio (diybio.org) talk about opening up biology to public participation but also to new forms of grassroots entrepreneurship. Their hacks are not merely a political criticism directed against Big Bio, but rather an attempt at finding new and better ways of accessing cells and DNA. The «open source junkie» George Church from Harvard, also nicknamed «information exhibitionist» given his attitude for total data disclosure, is the director of the open source Personal Genome Project and is involved in many startups in the field of genomics. Another example is Drew Endy of the MIT Biobricks Project, with his ideas for «DNA hacking» that he has also presented in public meetings such as the Chaos Communication Congress of Berlin, one of the best known hacker gatherings on the planet. Church and Endy are two of the most famous supporters of open genomics and citizen biology. 23andMe, the Google genomic startup, urges users explicitly: "Unlock the secrets of your DNA. Today." But besides cracking the code of your genome, 23andMe asks us to share our genetic, phenotypical and medical data on its social media website. The overlapping of openness, anti-bureaucracy, hedonism and sometimes even explicit references to hacking are becoming common in today's biology.

The ambivalence of sharing

Thus the hacking of genomes is a powerful story precisely because it narrates one, or perhaps several possible futures of change, openness and horizontality in a field as difficult, criticized and soaked with Big Bio practices as biotechnology is. Biohackers represent very different worlds, such as academic and public funded science, freelance research able to raise money from corporations, governments and venture capitalists, and amateur research who has ambivalent relationships with universities and firms. Yet putting them together under the umbrella of hacking, I point out the emergence of a new open science culture: a new ethic of sharing that scientists can use to build new strategies of action and better interact with the peculiar socio-economic configuration of contemporary biological sciences. The old Mertonian ethic of the 20th century academy is still at scientists' disposal, but in order to use it as a powerful tool it needs to be remixed with components coming from cultures directly related to computers and information technologies. The spreading of legal and technological tools that enact new forms of data and knowledge sharing needs a cultural adaptation that Merton can not provide. Open science needs new social, communicative and political practices and a new incentive system. Old media such as peer-reviewed scientific journals are

not always an adequate answer to new societal and economic needs. In hi-tech gift economies, data sharing and participation are part of corporate economic models as well as ways to enrich the commons and challenge monopoly power and its informational land revenues.

I think this emergent class of biohackers is related to a new possible type of interaction between scientists' practices and biology's social contract. A new open science social contract would restore some sharing practices that characterized 20th century academic research. But they would be transformed, broadened and improved by web technologies and the widespread diffusion of open and peer production. At the same time, it would include practices of closure such as patents and copyright. Different forms of intellectual property rights would coexist in an environment inhabited by creatures as diverse as companies, universities, public agencies, start-ups and new institutions such as citizen science projects.

The new open science culture linked to this social contract maintains a political ambivalence. Through their mobilisation of ethics, scientists better position themselves within the current socioeconomical configuration of biological sciences. Both academic and industrial research (provided that it is still possible to clearly separate them) have increasingly been using diverse and mixed approaches to intellectual property, and in some cases - such as database management - strictly proprietary models are seen as no longer sustainable. Thanks to open and free input of voluntary contributors, participatory processes of governance, and universal availability of the output, open and peer production might prove to be more productive than centralized alternatives.

Hacking the rules of biology

But these biologists are also hacking the rules of biology. Their active approach to information allows them to participate in the transformation and shaping of the current structure of science. Their struggles against Big Bio priesthoods are a challenge against the current distribution of power among science's institutions. In this sense, their stories could be a model for transformations that are also taking place within other innovation regimes such as software, hardware, technology, and so on. In many fields of information and knowledge production, actors are actively transforming and building their own infrastructures - whether they are technological or legal (licenses). Pierre Bourdieu (2004, p. 63), while referring to epistemic (and not institutional) revolutions, emphasized that the revolutionary scientist does not only head towards a victory. Scientists can be willing to change the rules of the game: «revolutionaries, rather than simply playing within the limits of the game as it is, with its objective principles of price formation, transform the game and the principles of price formation».

The direction this reorientation will take and the role of scientists' culture in this process is still to be deciphered. But this ethic of sharing and rebellion shows how open science represents two opposite tendencies within the evolving relations between research, society and the market. One towards an individualistic culture of openness both in information circulation and in capitalist competition, a new open frontier for science entrepreneurship in a new territory of accumulation. The other towards a collective, peer produced biology where open sharing is coupled with open participation and a discourse of democracy. Both these tendencies are somehow part of a countersymbolic order, since they challenge today's forms of Big Bio's concentration of power. But neither of these tendencies excludes a crucial role for entrepreneurship and profit. Genes, even when freely shared online, can always be objects of private interest. The ambivalent claims we have heard all along the history of information society – all information must be free! – echo again in labs and in the media arena.

References

Bourdieu, P., 2004. Science of science and reflexivity. Cambridge: Polity Press

Coleman, G. and Golub, A., 2008. Hacker practice. Moral genres and the cultural articulation of liberalism, Anthropological Theory, 8 (3), pp. 255–277

David, P., 2003. The Economic Logic of "Open Science" and the Balance between Private Property Rights and the Public Domain in Scientific Data and Information: A Primer, Stanford Institute for Economic Policy Research, discussion paper

Delfanti, A., et al., 2009. What Dr. Venter did on his holidays. Exploration, hacking, entrepreneurship in the narratives of the Sorcerer II expedition, New Genetics and Society, 28 (4), pp. 415-430

Fuchs, S. (1993) Positivism is the organizational myth of science, Perspectives on science, 1, pp. 1-23

Hardin, G., 1968. The tragedy of the commons, Science, 162 (3859), pp. 1243-1248

Heller, M., and Eisenberg, R., 1998. Can patents deter innovation? The Anticommons in Biomedical Research, Science, 280 (5364), pp. 698-701.

Himanen, P., Torvalds, L., 2001. The Hacker Ethic, and the Spirit of the Information Age. New York: Random House

Hope, J., 2008. Biobazaar. The open source revolution and biotechnology. Cambridge: Harvard University Press

Kelty, C., 2008. Two Bits. The cultural significance of free software. Durham: Duke University Press

Levy, S., 1984. Hackers: heroes of the computer revolution. New York: Doubleday

Mattelart, A. (2003) The Information Society: An Introduction (London: Sage Publications)

Merton, R., 1973. The Normative Structure of Science (1942), in: Merton, R., The Sociology of Science: Theoretical and Empirical Investigations. Chicago: University of Chicago Press, pp. 221-278

Swidler, A. (1986) Culture in Action: Symbols and Strategies, American Sociological Review, 51 (2), pp. 273-286

Vettel, E. (2008) Biotech: The Countercultural Origins of an Industry (Philadelphia: University of Pennsylvania Press)