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Exorcising Merton's Ghost from the Study of Scientific Collaboration: Learning the Lessons of DARPA

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Abstract. This article seeks to demystify the influence that Robert Merton continues to have over the sociology of science, including *The Geography of Scientific Collaboration*. It draws attention to a subtle shift in Merton's own thinking from a 'communist' to a more stratified approach to scientific collaboration, the latter exemplified by what he called the 'Matthew effect', which he seemed to endorse. This has led the science system to move in two seemingly opposing directions at once: on the one hand, a more freelancing approach by individual scientists ('Ricardian') and, on the other, a more teamwork approach by the scientific community ('Saint-Simonian'). It results in a 'dependency culture', especially in academia, as reflected in the H-index of scientific citations. From the standpoint of the dynamics of capitalism, such a result is not surprising. Against this backdrop, DARPA offers an alternative model of scientific collaboration. This US Cold War-inspired agency makes open calls for researchers to participate in projects whose futuristic orientation reduces the prior relative advantage of the applicants. In that respect, it points to a more egalitarian approach to collaboration that might also serve to deconstruct the academic disciplines that currently sustain the hierarchical approach.
Keywords: scientific collaboration; Robert Merton; DARPA; Matthew effect; H-index

Robert Merton's original discussion of scientific collaboration appeared in his 1942 account of the norm he called "communism": "The substantive findings of science are a product of social collaboration and are assigned to the community" (Merton 1973, p. 273). His account is likely to strike today's reader as peculiar, since its spirit is diametrically opposed to that articulated in what he later called the "Matthew effect", Merton's idea that Olechnicka et al. (2019) focus on. Scientific collaboration in the "communist" mode meant openly sharing and collectively owning the fruits of scientific labour: without trade secrets and intellectual property rights. Neither is collaboration only international, but also inter-generational. It is here that Merton first invokes Newton's axiom about 'standing on the shoulders of giants', to which he would return periodically throughout the rest of his career, albeit more as a historical curiosity than a regulative scientific principle.

Yet even in his original discussion of scientific communism, Merton already conceded that there is the desire, perhaps even the need, for the esteem of col-

leagues, which is ultimately about 'priority' of discovery. This nudges us closer to his later thinking, as it would seem to imply that hierarchy rather than equality is the true governing principle of science as a collective enterprise. Olechnicka et al. invoke "co-opetition" in this context, but it would be worthwhile delving more deeply into the transient nature of such a temporal sense of hierarchy. After all, if you were the first to discover something of truly universal significance, then under scientific communism others would soon master your discovery and perhaps even extend its application further than you ever could. Indeed, Merton went so far as to propose that the most successful strategy for having one's own ideas promoted is to donate them to those whose cumulative professional advantage will endow the ideas with greater purchase. At this point, we approach the "Matthew effect" as a kind of scientific self-organizational principle. "Collaboration" in this context largely means "supporting role" of the sort that tends to go unrecognized by Nobel Prize committees, which restrict the number of winners for any single prize to three.

The background assumption that makes sense of Merton's somewhat contradictory view of scientific collaboration, both egalitarian and stratified, co-operative and competitive, is that science as a whole is a robustly autonomous enterprise. Everett Mendelsohn (1989) observed that Merton's original sense of this autonomy, which may have influenced his decision to call it "communism", later to become "communalism" was John Desmond Bernal's vision of scientists as constituting an international Marx-style vanguard class that is both "in" and "for" itself, to use the old Hegelian terminology. This vision may be contrasted with two other familiar visions of scientific collaboration that are prevalent in capitalist societies. One is that of collaborators as project-oriented freelancers. These would be people whose value was determined by the specific skills they brought to the project, regardless of the project's content. Such people's careers may pass through many different fields, working with many different people in many different contexts. The other vision of scientific collaboration positions collaborators as regular members of more permanent entities, "teams", constructed more like firms than markets. Such people may also bring a set of specific skills to many different projects, but there is a stability in terms of partners and perhaps style of investigation by virtue of membership of the teams.

Bernal believed that both capitalist visions of scientific collaboration ultimately undermined the autonomy of science. The freelancers' easy association with other collaborators would enable them to move through academic, industrial and government working environments with relative ease, and a concomitant lack of commitment, to any specific dedication to "science as a vocation", apart from ensuring that their skills are up to date for the requirements of the current market. In contrast, Lily Kay (1993, p. 7) observed with regard to the Rockefeller Foundation's strategy to establish "molecular biology" in the middle third of the twentieth century, met-

aphorically "in house" teams were developed to work on interrelated projects that over time would combine to lay the foundations for the new field. This strategy both eliminated the usual uncertainties of the labour market in finding the "right" people for a given project and enabled Rockefeller to create privileged channels of communication among its projects that amounted to an intellectual property zone in everything but name.

While the two modes of scientific collaboration take their inspiration from different features of capitalist political economy, freelancing from the idea of the market and teamwork from the idea of the firm, both have clearly infiltrated modern academic science, which is the purported object of *The Geography of Scientific Collaboration*. The tendency to freelance has been promoted by the morphing of science's training process through excessive credentialing. Postgraduate academic education, once seen as a kind of apprenticeship, is today an extended exercise in skill acquisition, marked by a series of postdoctoral assignments that are presented as opportunities for acquiring still more skills and, equally important, recognition for having acquired them. On the other hand, teamwork has turned many university laboratories and research institutes into virtual R&D departments that may be intensely focussed on research orientation or agenda, but relatively detached from the relevant departments in their home institutions. This is expressed in the team's largely extramural funding sources and the ever present threat that it might move camp to another university.

Underpinning the difference between freelancing and teamwork are contrasting visions of exactly wherein lies the 'intelligence' that renders collaboration "scientific". We may dub them *Ricardian* and *Saint-Simonian*, respectively, after the two early nineteenth century theorists of labour under capitalism (Fuller 2020a). Freelancers are 'Ricardian' insofar as they understand their labour in terms of comparative advantage, with each scientific project treated as a miniature labour market, in which they try to achieve the maximum advantage they can leverage as they move into the next market. This means that no skill or expertise is sacrosanct, let alone the basis of an entire career. Indeed, there is bound to be a great deal of improvisation at play, as freelancers adapt to a variety of work settings, as may be observed in the composition of one's *curriculum vitae*, which is routinely prepared in multiple versions that taken together portray less a principled inquirer than a resourceful redeployer, what I have subsequently dubbed a 'player' (Fuller 2020c). In this respect, the whole of any given collaboration is *less* than the sum of its parts, insofar as the collaborators are, at least in principle, always open to acquiring and displaying new skills, as market conditions demand. In contrast, the team worker is "Saint-Simonian" because much of the autonomy of the individual scientist is delegated to the "knowledge manager" (i.e. "lab director" or "principal investigator") whose special "organizational" skills transform a group of scientists into a purposeful "research unit", thereby rendering the whole *more* than the sum of its

parts. The members of such a group are certainly more than simply interchangeable pieces of a puzzle; but, whatever 'ideas' they might have for disposing goal of their collective enterprise. The military inspiration of Saint-Simon's vision is unmistakable (cf. Fuller 2018a, chap. 4).

That the Ricardian vision of scientific collaboration might morph into the Saint-Simonian vision begins to explain the way the young Merton of Bernalian Communism could have turned into the old Merton of the Matthew Effect. Basically, by whatever means, and here the 'free market' serves as little more than a euphemism for causal ignorance, certain collaborators become 'strong attractors' with whom others wish to work. Olechnicka et al. observe that Mark Granovetter's "strength of weak ties" thesis offers an insight into the matter, especially when supplemented by Ronald Burt's conception of "structural holes" (Olechnicka et al. 2019, p. 129). The people best placed to be 'principal investigators' are those with the greatest proven capacity to multiply the impact of collective effort, which typically requires a track record in bringing to fruition projects involving a very wide range of people. Exactly who is well-placed to occupy this role depends on the shifting frontiers of inquiry, but such a person need not be among the most intellectually distinguished contributors. The person will, however, likely be highly cited. Burt himself possesses well over 100,000 citations. More to the point, he probably scores highly on the H-index, which concerns really nothing more than the likelihood that one's work will be highly cited (Fuller 2018b).

That the professional standing of scientists is increasingly based on measures such as the H-index reflects the extent to which academia fosters a "dependency culture", a tendency that I pointed out nearly a quarter-century ago, when "journal impact factors" were first becoming noticed as "meta-level" products of Eugene Garfield's Science Citation Index, the Merton-inspired Cold War precursor of today's "Web of Science" (Fuller 1997, chap. 4). This self-organizing version of Saint-Simon, which creates the need for "centres of collaboration" would probably set the visionary proto-positivist spinning in his grave. I say "probably" because while Saint-Simon's doubts about the ultimate efficacy of "invisible hand" thinking took him down the path that led to his coining "socialism" to name his brand of organized capitalism, he might well be impressed, as would Pareto, with the resulting hierarchy, whereby in the region of 80% of citations accrue to 20% of publications, in which an even smaller number of authors figure prominently.

Much closer in spirit to Saint-Simon's "managerial" approach to scientific collaboration, however, is the *modus operandi* of DARPA, the 'next generation' research agency historically tied to the US Department of Defence. While partly inspired by the Rockefeller Foundation, DARPA put teams together in rather differently. Rockefeller had depended on connoisseurs of scientific talent such as Warren Weaver, who routinely visited university campuses and industrial laboratories to see who was doing interesting work, with an eye to some high-level "match-

making" on behalf of the Foundation (Kohler 1991, chap. 10). DARPA, by contrast, proceeds by issuing vision statements scoping out a research horizon to which people with various sorts of technical expertise and work experience might apply to contribute. This "Request for Information" (RFI) approach to scientific collaboration might be seen as a precursor of today's "crowdsourcing", but DARPA issues such requests before it decides the exact nature of the problem that needs to be addressed. The RFI is therefore what psychologists would call a 'projective' exercise, similar to a Gestalt-style ambiguous figure into which one might read various possible realizations. In short, DARPA decides on the problem after it judges which sets of collaborators have a decent chance of making something concrete out of the original vision statement.

Saint-Simon would have been intrigued by a deeper difference in the *modus operandi* of the Rockefeller Foundation and DARPA, notwithstanding their shared "top-down" organisation of scientific collaborations. Rockefeller stuck with Saint-Simon's default intuition that academic and industrial knowledge were two mutually exclusive parts of the same whole, which when brought together would bring abundant benefits for humanity. Saint-Simon suggested that this mutual exclusivity derived from humanity's biblically fallen state, which explains the reason he called his movement the "New Christianity". Rockefeller himself might well have agreed with this analysis and, as a Baptist, even have embraced the name. DARPA, however, presumed that the "sin" in the knowledge system goes much deeper. The very distinction between academic and industrial science in particular is called into question. This means the US National Science Foundation (NSF), with its largely discipline-based, peer-review approach to research funding resembles the original Protestant vision of the Roman Catholic Church, whose power was based on supporting traditional dynastic lineages that promised to keep the peace in their lands and allowed the Church to operate freely. Such an arrangement simply invited mutual corruption, both to the material power of the state and the spiritual power of the Church.

From DARPA's standpoint, the Charter of the Royal Society of London was an attempt to secure the same "Catholic" arrangements for the inchoate scientific community in one sovereign Protestant nation – and the NSF was designed to be the US state-supported version of the Royal Society on steroids. After all, by the time of the NSF's establishment in 1950, this realm of protected free inquiry that the Royal Society canonically ensured had become just as hierarchical and materialistic as the Roman Catholic Church. In short, it adopted the trappings of its secular environment. Against this backdrop, DARPA made its entrance as the great Protestant reformer to eliminate all the differences between academic and industrial, and internal and external (to science). This was done in the name of the *future*, a place of absolute uncertainty that transcended default political and scientific trajectories. Put theologically, the question became one of *salvation* rather than mere

survival. After all, if "survival" had been the name of the game in the Cold War, it would have ended much earlier without the various baroque science-based races between the US and the USSR which put the entire planet under enormous collective stress for nearly a half-century.

Here it is worth recalling that DARPA emerged as a direct response to the launch of the first Sputnik space satellite, a venture "to boldly go where no man had gone before" (Belfiore 2009). DARPA's RFIs amount to an invitation to take risks. The vision statement behind DARPA's 2016 RFI, for example, aspired to produce a "Social Science Supercollider", which suggested a technology capable of more than simply storing and processing the gargantuan dimensions of "big data". It might also be generative of still more useful meta-data that could assist both social scientists and policymakers. The person who delivered this statement (Duncan Watts) has, DARPA-style, divided his career between Microsoft research posts and Ivy League academic appointments (Watts 2013). The ultimate success of such DARPA-style vision statements should be judged less on their own terms than by the collaborative products they spawn that end up having unanticipated benefits. The easiest way for such benefits to accrue is through new multi-purpose technologies, the workings of which then serve to reconfigure academic disciplinary agendas. The paradigm case from DARPA's own stable is that of the internet, but we should not forget virtual reality and drones.

Peter Galison (1997) has spoken of such technologies, with specific reference to the Monte Carlo random number simulator used by interdisciplinary teams of Cold War scientists, as "trading zones", though he focussed more on the way these technologies shaped specific collaborations than their long-term anchoring effects on science's overall research agenda. The latter goal, however, has always been in DARPA's sights as part of its grand strategy to unleash scientific potential from its institutional silos. In this respect DARPA is the *Anti-NSF*, insofar as it should have been enacted by the US government at the very start of the Cold War (DARPA was launched a dozen years later) in order to inhibit the emerging calcification of academic science through increasing specialisation. Had DARPA been enacted in 1950 *instead of* the NSF, so that the NSF never came into existence, then much of the irrelevance of academic research today, not only to the wider academic community but also to the public at large, would have been avoided. An inchoate version of this insight now propelled Boris Johnson, notwithstanding economically difficult times, to call for a UK version of DARPA, which has now been enacted by Parliament as the "Advanced Research and Invention Agency", or ARIA (Fuller 2020b).

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