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A WEBERIAN APPROACH TO THE ETHOS OF SCIENCE

Abstract: Robert Merton judged his ethos of science as “a limited introduction to a larger problem” in his seminal article. Despite this caution, the ethos has been interpreted, used and criticized as a self-consistent normative structure. As such, critics consider the ethos of science too rudimentary, obsolete or ideological. To overcome these critics, some supporters of the concept propose to revisit or to reconstruct it. This essay is an attempt to satisfy critics and supporters while respecting Merton’s legacy. For that purpose, we consider a Weberian paradigm to expand this “limited introduction”.

Keywords: ethos of science; Robert King Merton; Max Weber; values; norms; rules; order

Weberovský přístup k étosu vědy

Abstrakt: Ve svém zásadním článku označil Robert Merton své pojetí étosu vědy za „omezený úvod do širšího problému“. Tomuto varování navzdory byl však Mertonem reflektovaný étos vědy interpretován, používán a kritizován jako sama o sobě konzistentní normativní struktura, přičemž byl v této podobě odsuzován jako příliš rudimentární, zastaralý či ideologický. Aby tyto kritiky překonali, uchylují se naopak zastánci Mertonova pojetí k jeho přepracování nebo rekonstrukci. Autor předkládaného eseje si klade za cíl uspokojit kritiky i zastánce, aniž by se proto zpronevěřil Mertonově odkazu. K rozšíření Mertonova „omezeného úvodu“ využívá weberovské paradigma.

Klíčová slova: étos vědy; Robert King Merton; Max Weber; hodnoty; normy; pravidla; řád

BRUNO BOURLIAGUET

Laval University
2325 Rue de l’Université, Ville de Québec, QC G1V 0A6, Canada
email / bruno.bourliaguet.1@ulaval.ca

Introduction

Merton conceptualized the ethos of modern science as “four sets of institutional imperatives” called communism (thereafter called communalism), universalism, disinterestedness and organized scepticism (CUDOS). He mobilized these imperatives to explain why science was able to extend certified knowledge more effectively in a democratic order. More generally, Merton described this ethos as:

[...] that affectively toned complex of values and norms which is held to be binding on the man of science. The norms are expressed in the form of prescriptions, proscriptions, preferences, and permissions. They are legitimized in terms of institutional values. These imperatives, transmitted by precept and example and reinforced by sanctions are in varying degrees internalized by the scientist, thus fashioning his scientific conscience or, if one prefers the latter-day phrase, his super-ego. Although the ethos of science has not been codified, it can be inferred from the moral consensus of scientists as expressed in use and wont, in countless writings on the scientific spirit and in moral indignation directed toward contravention of the ethos.¹

Thereafter, this original definition drifted toward a normative structure and these “imperatives” have been transformed into “norms”. For example, the controversy with Ian Mitroff around the ethos as well as the concept of ambivalence was developed on the grounds of norms and counter-norms.² Merton’s heiress like Norman Storer also considered the “imperatives” like norms. He wrote:

We lack a clear-cut means for distinguishing between norms and values, but as a rule of thumb we can say that values concern primarily end-states or the characteristics of desirable goals, whereas norms pertain more to standards of behavior without direct regard for the purposes of that behavior. It is when behavior is judged with reference to its presumed goal, or when “proper behavior” itself is seen as an end rather than as a means, that the distinction between norms and values becomes blurred. Considering only the main distinction between them, we should speak of the norms of science rather than, as some

¹ Robert K. MERTON, “The Normative Structure of Science.” In: Robert K. MERTON, *The Sociology of Science: Theoretical and Empirical Investigations*. Edited and with an Introduction by Norman W. Storer. Chicago: University of Chicago Press 1973, p. 268–269 (267–278).

² Robert K. MERTON, *Sociological Ambivalence and Other Essays*. New York: The Free Press 1976, p. 32–33.

have, the “values of science”, for, as will become clear, norms, concern mainly the sorts of behavior in which scientists should engage, rather than the goals they should seek.³

In this way, the concept of the ethos of science gained a hazardous independence. Critics and supporters have generally employed the CUDOS as a fourfold of norms to justify the behavior of scientists regardless of the situation. Claiming Merton’s fatherhood, this interpretation became a cornerstone for a normative theory of science despite striking examples that invalidated a scientific institution regulated by this normative structure.⁴ The most obvious examples were the exclusion of women and minorities from academic positions despite *universalism* and the individualistic behavior of scientists that refuted *communalism* and *disinterestedness*.⁵

Regarding ethos weakness, the New Sociology of science has easily trapped the concept in limbo for years. However, one would be presumptuous to neglect the behaviors respected by a large part of the scientific community whether it be the integration of minorities occurring on behalf of certain beliefs and values or the condemnation of unethical acts that violate ethics, such as plagiarism or fraud. Ragnvald Kalleberg notes: “Merton identified a real phenomenon. His work was not only historically important, but is also essential today.”⁶ Nico Stehr states that the ethos is: “[...] one of the most significant theoretical foundations for a sociology of science.”⁷

But the original bedrock of the ethos of science seems too weak. As his editor, Storer remarked the strange fate of Merton’s essay introducing this concept: “The third paper, perhaps the least ‘complete’ (in the traditional Aristotelian sense of being a well-rounded essay) of all Merton’s papers in

³ Norman W. STORER, *The Social System of Science*. New York: Holt 1966, p. 76–77.

⁴ David J. HESS, *Science Studies: An Advanced Introduction*. New York: New York University Press 1997, p. 56.

⁵ Daniel J. KEVLES, *The Physicists: The History of a Scientific Community in Modern America*. 1st ed. New York: Knopf – Random House 1978, p. 370–371; Barbara F. RESKIN, “Sex Differences in Status Attainment in Science: The Case of the Postdoctoral Fellowship.” *American Sociological Review*, vol. 41, 1976, no. 4, p. 597–612; Ian I. MITROFF, *The Subjective Side of Science: A Philosophical Inquiry into the Psychology of the Apollo Moon Scientists*. Amsterdam – New York: Elsevier 1974; Ian I. MITROFF, “Norms and Counter-Norms in a Select Group of the Apollo Moon Scientists: A Case Study of the Ambivalence of Scientists.” *American Sociological Review*, vol. 39, 1974, no. 4, p. 579–595.

⁶ Ragnvald KALLEBERG, “A Reconstruction of the Ethos of Science.” *Journal of Classical Sociology*, vol. 7, 2007, no. 2, p. 138 (137–160).

⁷ Nico STEHR, “The Ethos of Science Revisited: Social and Cognitive Norms.” *Sociological Inquiry*, vol. 48, 1978, no. 3/4, p. 173 (172–196).

this volume, is yet one of the most significant in the history of the sociology of science.”⁸ Merton himself considered the ethos as a “limited introduction to a larger problem: the comparative study of the institutional structure of science.”⁹ This “limited introduction” must be reconsidered in order to use the ethos as a versatile tool. But instead of using new approaches and theories discussing the nature and the goal of these norms, we use the richness of the theoretical sources that influenced Merton, more precisely Weber’s concept of *order*. Furthermore, we specify the nature of *values* and *norms* that we complete with *rules*. The articulation of these three regulations in the normative structure is discussed. Finally, we put the ethos in a utilitarian context to restore the momentum of an ever-changing scientific institution. In order to avoid any ambiguity concerning the scope of the ethos, we continuously remember its limits especially the functional ones.

Criticism concerning the ethos

The ethos of science is a controversial concept. Its existence, nature and completeness have been challenged. This criticism has produced a body of literature much too wide to review in detail here. We only allude to three central complaints: that Merton’s ethos is obsolete, not exhaustive and more of an ideology than a normative structure (e.g. Dubois, 1999; Saint-Martin, 2013; Anderson et al., 2010; Stehr, 1978).

Obsolescence

How does the ethos represent the current scientific institution? The advocates of Mode 2,¹⁰ those of the Triple Helix,¹¹ the supporters of the post-

⁸ Storer in MERTON, *The Sociology of Science*, p. 226.

⁹ MERTON, “The Normative Structure of Science,” p. 269.

¹⁰ Michael GIBBONS – Camille LIMOGES – Elga NOWOTNY – Simon SCHWARTZMAN – Peter SCOTT – Martin TROW, *The New Production of Knowledge: The Dynamics of Science and Research in Contemporary Societies*. London – Thousand Oaks, Sage 1994; Helga NOWOTNY – Peter SCOTT – Michael GIBBONS, *Repenser la Science: Savoir et Société à l’Ère de l’Incertitude*. Paris: Belin 2003.

¹¹ Henry ETZKOWITZ – Loet LEYDESDORFF, “The Dynamics of Innovation: from National Systems and ‘Mode 2’ to a Triple Helix of University–Industry–Government Relations.” *Research Policy*, vol. 29, 2000, no. 2, p. 109–123.

normal science,¹² or those of the post-academic one,¹³ all theorize deep changes. These transformations of the scientific institution in the second half of the twentieth century would obsolete a steady ethos. The fourfold norms poorly characterize what has become a much more heterogeneous community. Robert Rothman made the assumption that the ethos of science radically changed when the middle class increasingly accessed the profession of researchers.¹⁴ A simple discourse analysis – for example by measuring the occurrences of the name of the norms since 1945 with a scientific search engine – demonstrates that the scientific community have rarely mobilized these norms.¹⁵ Whether scientists identify themselves with the ethos, they seldom express this feeling. However, that ethos would be a historical artefact rather than a social reality must be qualified.

At the time Merton conducted his analysis, empirical observations regarding the norms of the ethos already refuted his normative theory. The scientific community was, and possibly still is, the product of an elitist system that discriminated against women, racial minorities and lower classes.¹⁶ *Universalism* was contradicted rather than supported by the weak percentages of scientists to those who were not from the American upper classes or a recent European immigration. Merton described the community of pure sciences teaching at Ivy League colleges. *Universalism* could be considered as a kind of *universalism among the peers*, not a *universal universalism*. As a consequence, the norms would be those of a privileged class instead of those of science. In this way, *disinterestedness* would represent a form of *distinction*, as demonstrated by Pierre Bourdieu. Aaron Panofsky qualifies the ethos as an ideal type or “an image of science that may be gone and may never have existed.”¹⁷ His own success supposedly lured Merton; that of a modest

¹² Silvio O. FUNTOWICZ – Jerome R. RAVETZ, “Science for the Post-Normal Age.” *Futures*, vol. 25, 1993, no. 7, p. 739–755.

¹³ John M. ZIMAN, *Real Science: What It Is, and What It Means*. Cambridge: Cambridge University Press 2000.

¹⁴ Robert A. ROTHMAN, “A Dissenting View on the Scientific Ethos.” *The British Journal of Sociology*, vol. 23, 1972, no. 1, p. 102–108.

¹⁵ The enquiry was run on “Science” webpage, [online], 2016. Available at: <<http://www.sciencemag.org/search>> [cit. 10. 7. 2016].

¹⁶ See KEVLES, *The Physicists*.

¹⁷ Aaron PANOFSKY, “A Critical Reconsideration of the Ethos and Autonomy of Science.” In: CALHOUN, C. J. (ed.), *Robert K. Merton: Sociology of Science and Sociology as Science*. New York: Columbia University Press 2010, p. 159 (140–163).

Jewish immigrant (his real name was Meyer Robert Schkolnickoff)¹⁸ becoming a successful academic perfectly integrated into the establishment.

However, discrimination against minorities was not a social behavior specific to science. Although the dominant groups try to regulate the competition for positions to ensure a better access for their members, the upward trend of minority enrolment continues at a slow but steady rate. Positive discrimination policies, or affirmative action, demonstrate that the transgression of *universalism* has been looked upon as an anomaly, an abnormality that needs to be rectified through incentive or coercive policies.

The differentiation between various disciplines and the middle class access are not recent phenomena. The growth of the scientific community has occurred at least since the late nineteenth century and each generation of researchers is much more differentiated. This differentiation never prevents the share of common values. Many scientists subscribe to the ethos, as demonstrated for example by Melissa Anderson's survey.¹⁹ Obviously, we can question whether there is an ideology at work or whether this survey is affected by an analysis bias. Interviewing process specifically on these norms could indeed induce a conformity bias. Although this study seems inconclusive with regards to the institutionalization of the ethos, it demonstrates that scientists recognize themselves implicitly or explicitly in these norms. As Anderson notes, although we couldn't assert that this ethos sufficiently represents the normative structure of the scientific institution, the norms of the ethos always constitute valuable indicators for the analysis of ethical issues.

Incompleteness

Because his empirical research on scientists working on the Apollo missions showed a different picture, Ian Mitroff, a psychologist, judged the ethos of science insufficient to explain the behavior of scientists.²⁰ His interviews with Apollo's scientists revealed competitive and confrontational relationships. Mitroff blamed Merton of failing to fully characterize the normative structure. He adopted a second set of counter-norms such as *secret*, *interest-*

¹⁸ Arnaud SAINT-MARTIN, *La Sociologie de Robert K. Merton*. Paris: La Découverte 2013, p. 11.

¹⁹ Melissa S. ANDERSON – Emily A. RONNING – Raymond DE VRIES – Brian C. MARTINSON, "Extending the Mertonian Norms: Scientists' Subscription to Norms of Research." *Journal of Higher Education*, vol. 81, 2010, no. 3, p. 366–393.

²⁰ See MITROFF, *The Subjective Side of Science*.

edness or *emotional engagement* because he considered the researchers torn between norms and counter-norms as between two poles, one rational and the other not.

Merton has never had the ambition of such completeness. Let us say it once again, the concept of the ethos did not represent the complete institutional structure of science. To reduce the ethos to four norms creates a questionable limit if one does not specify the function of the ethos: to explain the cohesion of the community and its relationship within the environment. That other norms exist, which appear specific or not to the scientific institution, do not invalidate Merton's analysis. Several authors, including Merton himself, did not hesitate to subsequently add new norms such as *emotional neutrality*, *rationality* or *objectivity*.²¹ Merton himself specifically answered Mitroff's criticism by the notion of sociological ambivalence. He wrote:

Like other institutions, science has its corpus of shared and transmitted ideas, values and standards designed to govern the behavior of those connected with the institution. The standards define the technically and morally allowable patterns of behavior, indicating what is prescribed, preferred, permitted or proscribed. The culture of science refers, then, to more than habitual behavior; its norms codify the values judged appropriate for the people engaged in doing science. A major characteristic of social institutions is that they tend to be patterned in terms of potentially conflicting pairs of norms. This sets a task for those governed by the institution to blend these imposed inconsistencies into reasonably consistent action. This is what I mean by saying that sociological ambivalence is embedded in social institutions generally and, in its distinctive fashion, in the institution of science as well.²²

Where Mitroff applied a psychologic individualistic approach, Merton used a structural and normative one. If the norms and counter-norms are analyzed in a utilitarian way, Merton's norms of the ethos represent collective interests and Mitroff's counter-norms represent individual interests. A potential conflict between these individual and collective interests would be nothing specific to the scientific institution. Any analysis using the concept of the ethos of science that would go beyond the original analytical framework of Merton must take into account this ambivalence of norms, which implies a tension between individual and collective interests.

²¹ Bernard BARBER, *Science and the Social Order*. Glencoe, Ill.: Free Press 1952.

²² MERTON, *Sociological Ambivalence and Other Essays*, p. 32–33.

Scientists own a set of norms, more or less defined, more or less collectivist, more or less individualistic, more or less stable. Among these norms, the four of the ethos assume a specific function. Merton didn't mobilize the ethos to explain the day-to-day behavior of scientists than to reveal the affinity between science and democracy. He originally retains only four norms because they were satisfactory for his argument and never assume the completeness of this ethos. Furthermore, as noted by Michel Dubois: "what for Merton differentiates science from other institutions is never a given norm, considered alone, but their combination into a single singular whole."²³

Regarding Merton's articles, we identify three functions that a scientific institution respecting the ethos fulfils: accordance with a democratic system, normalization of scientists' relationships and expansion of certified knowledge. As indicated by the original title of his article *Science and technology in a Democratic order*, the first function justified the seminal work of Merton²⁴. The purpose was to explain why Science seems more productive into a democracy. *The second function became more apparent* when the title of the article subsequently changed for *Science and Democratic Social Structure in Social Structure and Social Theory*, and finally for *The Normative Structure of Science* in Merton's Opus Magnum *the Sociology of Science*.²⁵ The third function is explicitly described as the main function of the scientific institution in the article when Merton wrote: "the institutional goal of science is the extension of certified knowledge"²⁶. As Norbert Wiener noted:

The duties of a scientist are considered from the narrow point of view of what is called "professional ethics", in the sense of the code of conduct adopted by a profession for the minimization of internal friction, and the aggrandizement of its vested interests as far as they determine its attitude to the rest of the world, together with a certain modicum of pious respectability.²⁷

We reformulate these three functions as related to three regulations: an external regulation between the scientific institution and its environment, an internal regulation between members and a regulation of the produc-

²³ Michel DUBOIS, *Introduction à la Sociologie des Sciences et des Connaissances Scientifiques*. Paris: Presses universitaires de France 1999, p. 90.

²⁴ Robert K. MERTON, "Science and Technology in a Democratic Order." *Journal of Legal and Political Sociology*, vol. 1, 1942, no. 1-2, p. 115-126.

²⁵ MERTON, *The Normative Structure of Science*, p. 267, footnote.

²⁶ *Ibid.*, p. 270.

²⁷ Norbert WIENER, "The Armed Services Are Not Fit Almoners for Research." *Bulletin of the Atomic Scientists*, vol. 3, 1947, no. 8, p. 228.

tion. Some critics consider separately these functions, some other new ones, pointing to the weaknesses or usefulness of certain norms. Significant confusion stems from this misuse.

Idealism

Several sociologists assimilate the concept of ethos into an ideology serving the interests of the scientific institution. Michael Mulkey characterized the norms of the ethos as:

Better conceived as vocabularies of justification, which are used to evaluate, justify and describe the professional actions of scientists, but which are not institutionalized within the scientific community in such a way that general conformity is maintained.²⁸

Pierre Bourdieu typified Merton's thesis as a hagiography, a self-justification of the American scientific elite behaviors. Bourdieu described this scientific community as: "[...] a social field like any others, with its power relations and its monopolies, its struggles and strategies, interests and profits, but where all these invariants have particular forms."²⁹

Bourdieu's criticism was similar to Mitroff's: scientists accept individual interests. In an endless struggle, all strive for obtaining peer recognition. These behaviors are valued because they allow securing *scientific capital*. The norms serve as a tool in the hands of dominants to maintain a comfortable *status quo*. Building on the work of Warren Hagstrom,³⁰ Bourdieu affirmed that the specificity of the scientific institution resides not in its ethos, but in the fact that scientists are at the same time science producers, consumers and evaluators. Thereafter Bourdieu changed his mind a little. In a subsequent tribute to Merton, Bourdieu wrote:

He [Merton] omits to raise the question of the relation between, on the one hand, the ideal values proclaimed by the "scientific community" (another indigenous mythology), such as objectivity, originality and utility, and the norms which it professes, universalism, intellectual communism, disinterestedness and scepticism, and, on the other hand, the social structure of the science

²⁸ Michael J. MULKEY, "Norms and Ideology in Science." *Social Science Information*, vol. 15, 1976, no. 4-5, p. 653-654 (637-656).

²⁹ Pierre BOURDIEU, "Le Champ Scientifique." *Actes de la recherche en sciences sociales*, vol. 2, 1976, no. 2, p. 89 (88-104).

³⁰ Warren O. HAGSTROM, *The Scientific Community*. New York: Basic Books 1965.

universe, the mechanisms which tend to ensure “control” and communication, evaluation and rewards, recruitment and training. Yet it is this very relation that the foundation of the specificity of the scientific field resides.³¹

Whether the Merton analysis has been accused of idealism, Bourdieu’s view was extremely realistic. Besides the cognitive interest of scientific work, we can question the predominance of conflicts between actors. Robert Oppenheimer stated: “In the first instance the work of science is cooperative; a scientist takes his colleagues as judges, concurrent and collaborators”.³² Instead of ideology, other arguments can be used to explain the idealistic tone. Merton’s work was a macro-sociological analysis about science and democracy written during the war. It is not surprising that this article mobilize collective norms as well as values.

Reconsidering the ethos of science

These three arguments against the concept of the ethos – obsolescence, completeness, and idealism – did not totally convince us. Ignoring the original framework of the concept, supporters as well as critics have misrepresented the ethos of science as a set of idealistic values or a set of incomplete norms. However, we must respect these criticisms because they emphasize Merton’s ambiguities. *These studies emphasized the inaccuracies on the nature of the ethos. Stehr questioned the ethos as a regulation and as a guarantee of certified knowledge. Kalleberg referred to Habermas and Boudon to campaign for a teleological approach instead of a causal one. Stehr, Kalleberg or Barry Barnes and Alex Dolby³³ discussed the nature of norms selected by Merton. Are they statistical norms or professed ones, technical or moral, cognitive or social? Regardless their conclusions, these analyses demonstrated that the concept of norms deserves more attention. They also pointed out several “misconceptions and missing elements.”³⁴ Stehr proposed to “revisit the ethos”, Kalleberg “a reconstruction”, Thomas Gieryn wanted to turn it into*

³¹ Pierre BOURDIEU, “Animadversiones in Mertonem.” In: CLARK, J. – MODGIL, C. – MODGIL, S. (eds.), *Robert K. Merton: Consensus and Controversy*. London – New York: Falmer Press 1990, p. 298 (298–301).

³² J. Robert OPPENHEIMER, “Physics in the Contemporary World.” *Bulletin of the Atomic Scientists*, vol. 4, 1948, no. 3, p. 65–86.

³³ Barry BARNES – R. G. A. DOLBY, “The Scientific Ethos : A Deviant Viewpoint.” *European Journal of Sociology / Archives Européennes de Sociologie*, vol. 11, 1970, no. 1, p. 3–25.

³⁴ KALLEBERG, “A Reconstruction of the Ethos of Science,” p. 138.

a *kuhnian paradigm*.³⁵ Although we agree with these diagnostics, we rather suggest putting back the ethos into its Weberian legacy instead of mobilizing new theories. In this way, we will address questions about the ethos normative, teleological and functional scopes.

Values and norms

The debate over the concept of ethos has focused on Merton's essay published in 1942. This relatively short article leaves several ambiguities unresolved, especially regarding a clear differentiation between *values* and *norms*. Merton employed different words to describe very similar concepts: *ethos*, *values*, *norms*, *mores*, *moral consensus*, *institutional imperatives*. Assuming originally the ethos as a set of *values* and *norms*, he created an ambiguity on the exact definition of the concept similar to the conceptual confusion between *ethic* and *ethos*. As an example, Bourdieu distinguished *ethics* and *ethos*—cognitive values and practical norms—and incorporates the ethos into the *habitus*.³⁶ Several other sociologists, from Max Scheler to Raymond Boudon, offer definitions to overcome the ambiguity between *norms* and *values*. The *Critical Dictionary of Sociology* states:

From a more analytical point of view, the sociologist distinguishes among the diversity of “stages” or “Dimensions” of the experiment, the norms, which are ways of doing, being or thinking, socially defined and sanctioned, and the values which guide the individual activity diffusely by providing a set of ideal references, and in the same time a variety of identification symbols that help to situate themselves and others in relation to this ideal.³⁷

According to this definition, one can think that the four “imperatives” are closer to a set of values than to a set of norms—explaining the critics about the idealistic tone of the ethos—, values described with normative consequences in Merton's essay. Embedded into an “institutional structure”, these two concepts must be further distinguished and articulated. To do that, we specify the normative structure with Weberian concept of *order*.

³⁵ Thomas F. GIERYN, “Paradigm for the Sociology of Science.” In: CALHOUN, C. J. (ed.), *Robert K. Merton: Sociology of Science and Sociology as Science*. New York: Columbia University Press 2010, p. 113–139.

³⁶ Pierre BOURDIEU, *Questions de Sociologie*. Paris: Éditions de Minuit 2002, p. 133–136.

³⁷ Raymond BOUDON – François BOURRICAUD, *Dictionnaire Critique de la Sociologie*. Paris: Presses universitaires de France 1986, p. 417.

Normative structure

The kinship between Merton and Weber's works seems obvious. Merton's PhD thesis emphasized the correlation between science and Puritanism as Weber the relations between capitalism and Protestant ethic. Merton expanded this correlation to include the democratic system. Following a Weberian legacy, we suggest mobilizing the concept of *order* to better characterize Merton's normative structure. In *Economy and Society*, Max Weber linked the *guarantee of the legitimacy of an order* with multiple mechanisms:

The legitimacy of an order may be guaranteed in two principal ways: (1) The guarantee may be purely subjective, being either (a) affectual: resulting from emotional surrender; or (b) value-rational: determined by the belief in the absolute validity of the order as the expression of ultimate values of an ethical, esthetic or of any other type; or (c) religious: determined by the belief that salvation depends upon obedience to the order. (2) The legitimacy of an order may, however, be guarantee also (or merely) by the expectation of specific external effects, that is, by interest situations.

An order will be called (a) convention so far as its validity is externally guaranteed by the probability that deviation from it within a given social group will result in a relatively general and practically significant reaction of disapproval; (b) law if it is externally guaranteed by the probability that physical or psychological coercion will be applied by a staff of people in order to bring about compliance or avenge violation.³⁸

Following this definition, Merton's normative structure is similar to a *value-rational legitimated convention*. Regarding the ethos of science and how it could be used today, the paradigmatic model suggested by Weber questions the reduction made by Merton. Although the *law* introduce an important objective reference³⁹ because scientists respect rules as well as people from other institutions, Merton neglected it. In other words, the question became whether the scientific institution is autonomous⁴⁰ or is only ruled by internal authority.⁴¹ How far modern science internalizes rules, for example

³⁸ Max WEBER, *Economy and Society*. Berkeley: University of California Press 1968 [1922], p. 33–34

³⁹ In *La division du travail social* Émile Durkheim highlights the importance of the law and discussed the relation with mores. Émile DURKHEIM, *De la Division du Travail Social*. Paris: Presses universitaires de France 1960 [1893], p. 29–30

⁴⁰ PANOFSKY, "A Critical Reconsideration of the Ethos and Autonomy of Science."

⁴¹ Following Hannah Arendt's definition.

through the university ethics committees? How far governments or societies impose these rules? David Guston theorized a new social contract for science since the 70s to assure the integrity of science and its productivity.⁴² This contract materializes in new rules, maybe new coercion.⁴³ According to the Weberian model, Merton's concept of the ethos as a *convention* would be mitigated with *law* and a third level of regulation considered (*rules* added to *values* and *norms*).

Unfortunately, although this order embeds the ethos in a less idealistic system thanks to objective entities, it does not completely solve the annoying confusion between the concepts of *value* and *norm*. Barber's excerpt cited in introduction represents an attempt. To overcome this issue, we could use another simple semiotic "rule of thumb". It is possible to sum up a value with a conceptual single word (*honesty, universalism, autonomy, etc.*) that represents ideal references, which require no explanation. In other words, values are the simplest and idealistic form of the imperatives. According to Merton and Weber, these values legitimate the normative structure. At the opposite, if the regulation is expressed in a written form involving a sanction for violations from a coercive dedicated staff, we will talk about *rules*. Whether these rules have to be purely internal at the institution or could be external remains an open question.

If the regulation does not fit into any of these two categories, we will talk about *norms*. Considering this negative definition, norms include more or less complex entities that could be differentiated between technical norms, moral norms, individual or group norms as suggested by the authors previously cited. For example, a norm addresses how a list of authors is sorted (alphabetic order for economics, involvement for physics, etc.), another the normal behavior during a thesis defence for the candidate or the jury, etc.

Merton's ethos of science is a convention only if we can prove that the scientific institution is autonomous and "authoritative". Otherwise, this normative structure has to be mitigated or replaced by law. Ultimately, the triptych *rule-norm-value* must be regarded as a system where these three levels of regulation are interwoven and influence each other.

Because Weber's paradigm is not peculiar to science, a warlike analogy can illustrate this system. All armies around the world value courage and honor as well as all troops are regulated by military codes. These

⁴² David H. GUSTON, *Between Politics and Science: Assuring the Integrity and Productivity of Research*. Cambridge – New York: Cambridge University Press 2000.

⁴³ For example, the scientists jailed after the Aquila earthquake.

regulations ensure that soldiers assume their duties during a military service using predictable and cohesive behaviors. The United States Medal of Honor recognizes outstanding acts of heroism. Four medals have been awarded posthumously during the Iraq War, three for falling on a grenade to save comrades. The normal behavior in this situation, to go away from the threat, doesn't violate US standards of honor and courage. The military code imposes gallantry, but an altruistic sacrifice of his life remains idealistic. Norms associated with gallantry take into account our individualistic culture. For a Japanese soldier during the Second World War, the bushido code praised the sacrifice for the group. Whether to surrender after fighting did not dishonor a Westerner, a Japanese soldier preferred death to all other solutions because the alternative price was his family's dishonor. In both cases, the values equate but the rules and norms differ. Several systems are possible to fulfill the same functions for the group cohesion, the place of the group into the society and its objectives.

Wertrational and zweckrational

Concerning this last element, a lack of dynamic may also have prejudiced Merton's ethos. Merton considered these four imperatives as a historical legacy embedded within scientific communities. This view crystallizes the concept into a conservative stance. A dynamic ethos requires a teleological approach that Weber's model ensures with a second mechanism of legitimation: the concept of *expectation*. Ethics and interests are not mutually exclusive as well as value rational (*wertrational*) and means-end rational actions (*zweckrational*). The respect of inherited values and norms explain the normative structure, but these regulations are updated to reflect the negotiated interests of the different stakeholders. As a social construction, the ethos copes the transformations, differentiation and hybridization that certain parts of the scientific community or the environment undergo. This adaptation goes far beyond the ambivalence of norms. If this concept of ambivalence accepts the coexistence of conflicting norms, a tension remains. To ensure stability, these tensions must be released. For example, each scientist weighs his interests with those of his colleagues and employers. The community tolerates this flexibility to not alienate either the pure or the ambitious, and to ensure the coexistence of these different characters. If the community must consider these internal tensions, it must also manage external pressures. All stakeholders have to reconcile their interests, at the risk of transforming the norms, the rules or the values. How could the

ethos adapt to these disturbances, weak or strong, and remain functional? Regarding our system with fluctuating norms, culturally rooted in values and legally anchored in rules overcomes this problem. The norms vary into a moral framework of values, and a legal framework of rules. The first provides a flexible interpretation of good and evil, the second is a strict frame of permission and prohibition. *Values* and *rules* assume the overall coherence of the system while norms ensure local consistency. This local adaptation of norms would be based on stabler values and rules. The rules change through a long and formal process; the values change through a slow cultural one. Of course, the stability of *rules* and *values* rests relative. But to change values and rules claim a global effort. To change norms is a local one. Moreover, this system owns an intrinsic self-regulation mechanism. As it is impossible to refer constantly to formal norms and rules, anchoring norms at values serves to self-regulation and self-production. Thus defined, the concept of the ethos adapts itself to new functions or interests.

Conclusion

A history of the ethos of science deserves to be written to understand how this concept escaped its author to become a kind of self-consistent stand-alone entity, mythologized and betrayed. However, to disqualify this concept deprives the analysis of the scientific community of a great tool, but a tool that cannot be used isolated. One can legitimately question its relevance today, as the concept of *innovation* gradually corrodes those of *science* and *technology*. The aim of science would no longer to extend certified knowledge but to generate profit. Such a development impact deeply on the functions of science, the science *disinterestedness*, and the autonomy of the scientific institution. But at the same time, some rules strengthen the normative structure of science, accentuating certain values such as *universalism* through positive discrimination. Ultimately, if the profound changes perceived by many sociologists of science needed to question Merton's ethos of science, its values, its norms and its functions, we affirm that it offers a framework, once well understood, responsive and useful to study the reminiscence of these values. But the ethos of science do not represent a "sacred cow". Making this concept a versatile sociological tool requires a more accurate definition. At this price, it might be used to characterize the scientific institution and its transformations. Pierre Bourdieu wrote about the *open concepts*: "Concepts have no definition other than systemic ones, and are designed to be *put to work empirically in systematic fashion*. Such notions

as habitus, field and capital can be defined, but only within the theoretical system they constitute, not in isolation”.⁴⁴ The ethos of science suffers the same fate.

In my opinion, the ethos of science described by Merton is a conventional order comprising a set of norms legitimated by values. Following Aaron Panofsky, this ethos can be considered and discussed as an *ideal type* of this *convention*. As such, it represents an idealistic autonomous and “authoritative” institution, maybe representative of the American mid-twentieth century science institution. However, today the normative structure of science differs. The institution is losing autonomy and authority. In a Weberian legacy, we have embedded the ethos within a *law* order comprising a set of rules and legitimated this ethos with expectations. It is important to re-introduce this last form of regulation in the analysis because this is the most objective and the most coercive. It is also important to introduce expectations because stakeholder interests seem to increase, in a collaborative or a competitive dynamic, which require systemic adjustments. With a set of norms more contingent than the *values* or the *rules*, these adjustments are locally possible. In our opinion, this Weberian theoretical system represents a better option to characterize more broadly and more accurately the current normative system of science and should be used for empirical studies. This statement doesn’t invalidate the Merton ethos of science, but force us to always consider the ethos of science in this “systematic fashion”.

⁴⁴ Pierre BOURDIEU – Loïc J. D. WACQUANT, *An Invitation to Reflexive Sociology*. Chicago: University of Chicago Press 1992, p. 96.