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Michel Callon

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"L'homo œconomicus n'est pas derrière nous, il est devant nous ; comme l'homme de la morale et du devoir ; comme l'homme de la science et de la raison. L'homme a été très longtemps autre chose ; et il n'y a pas bien longtemps qu'il est une machine, compliquée d'une machine à calculer"¹
(Mauss 1960, p.272)

"Economists have long recognized the importance of technological innovation for economic growth; however, economists have generally studied only such contributions of the physical sciences, overlooking the fact that economics itself has been the source of a surprising number of inventions."
(Faulhaber and Baumol 1988, p. 577)

¹ "Homo œconomicus is not behind us, he is ahead of us: like the moral and dutiful person; like the person of science and of reason. The person has long been something else, and only recently has the person been a machine, complicated by a calculator" (my translation).

Faulhaber and Baumol's Quandary

In 1988 economists Gerald Faulhaber and William Baumol raised a question similar to the one that I raised in *The Laws of the Markets* (Callon 1998).² In their piece entitled "Economists as Innovators: Practical Products of Theoretical Research", they indicated their intention to "determine how much economists have in fact contributed to the flow of innovation used in business and government and to judge what this evidence implies about the degree of validity of the standard optimization premise." (Faulhaber and Baumol 1998, p. 580).

To this end, Faulhaber and Baumol selected nine noteworthy innovations (marginal analysis; the use of net present value for capital budgeting; peak load pricing; econometric forecasting; the portfolio selection model and the associated beta coefficient and duration analysis; the Black-Scholes option pricing model; Ramsey pricing; and the stand alone cost test) and studied their history from origins to (non) adoption and diffusion, treating these innovations produced by economics, like any other scientific or technological innovation.

Their results were "mixed." While economics did play a part in the conception of innovations, it was less important than they had anticipated. Economics seldom acts alone and is rarely a driver of invention. The classification they provide of their results shows these findings clearly:

- a) cases in which economists provided the actual invention and may have contributed to the innovation process (e.g., econometric techniques, duration, *beta*, stand-alone costs)

² This paper has been prepared during my stay as an invited member at the International Center for Advanced Studies (NYU). I benefited greatly from Tim Mitchell's insights and support. I thank all the participants in the 2004-2005 ICAS seminar, and in particular Koray Caliskan, Julie Graham, Vincent Lépinay, Fred Myers and Steven Lukes for their comments and criticism. I am also grateful to Donald MacKenzie, Fabian Muniesa and Bruno Latour for their suggestions and to Martha Poon for her cautious reading.

- b) cases in which economists helped in the innovation process, though the idea was initially contributed by others (e.g., discounted present value, Ramsey pricing)
- c) cases in which economists provided an optimality formula for a concept previously introduced by others in an imperfect and intuitive version (e.g., peak-load pricing)
- d) cases in which economists acted primarily as disseminators of the ideas of others (marginal analysis) (Faulhaber and Baumol 1988 p.580).

This mixed conclusion clearly put Faulhaber and Baumol in a quandary. On the one hand, like many of their colleagues, they were convinced that economics does not have to make any contribution whatsoever to the economy in order to justify its existence. On the other, they were concerned about economic agents' lack of interest in economists' work.

If Faulhaber and Baumol were uneasy about their results, it is first because they had shown that economics (in its most theoretical form) plays a secondary or even tertiary role in innovation. Even the best economists are often content to relay or to rediscover inventions produced by others and they sometimes completely fail to impose their most original views, as they did in the case of marginal analysis, one of the cornerstones of neo-classical theory. Economics may be useful but it acts simply as an additional force! In this view, skeptics might see economists as mere parasites, common ideologists or vile mercenaries in the pay of wicked capitalists.

If Faulhaber and Baumol's quandary was due only to what they consider as an unexpectedly weak contribution of economics, it would be easy enough to reassure them. Having dared to treat economics like any other science and to question its contribution to economic life, they have fallen victims of the theory of innovation that they chose to use. According to that theory, innovation is seen as a linear process (research → invention → development → innovation → diffusion), in which basic research can play only one part: a necessarily episodic role in which it is the source of major innovations.

The linear view of technological change has recently been superseded by a non-linear conceptual model featuring feedback loops emanating from each stage (Kline and Rosenberg 1986). In this alternative model, basic science can fit into the process of innovation at any stage. Moreover, the very idea of a source or an origin point of technology is misleading because innovation is an emergent, interactive activity. It involves many actors who cooperate or oppose one another (Akrich, Callon and Latour 2002). Science and scientists – and especially economics and economists – are no exception. Considered from the point of view of the interactive and iterative model, the four trajectories identified by Faulhaber and Baumol no longer demonstrate the weakness of economics' contributions. To the contrary, what they confirm is the variety of possible contributions economics can make to the economy, as well as its constant presence in technological change. If we take the interactive and iterative model of innovation and apply it to economics, economics' contribution to the economy becomes significant and diverse because, as Faulhaber and Baumol's case studies show, there have been few innovations in which it has not been involved at some stage in one way or another.

We could stop there and be content with developing a sociology of economic innovations based on the interactive model, one that gives a more accurate and more balanced view of the contribution of economics to the economy. But that would only partially solve Faulhaber's and Baumol's quandary since they are tormented, not only by the (supposed) weakness of economics' contribution to the economy, but also by a real epistemological concern. Is it reasonable to consider that a scientific theory can alter the nature of the object that it describes? Can economics act on the behavior of real economic agents, which it claims to analyze objectively and from a distance? Wouldn't this be tantamount to claiming that physics and physicists are able to influence the laws governing the course of planets?

These sorts of objections clearly worry the authors. They have them in mind when they clarify the criteria by which they selected the innovations in their study: "We explicitly focus on innovations whose value to those who adopt them is the promise of improvement in their own economic performance in coping with market forces" (Faulhaber and Baumol 1988, p. 577). Faulhaber and Baumol chose innovations that were compatible with the model of rational agents capable of

deciding what would provide them with a competitive advantage; in short, innovations that markets and agents should have invented and would eventually have invented on their own. For Faulhaber and Baumol economic theory can play a role in accelerating the processes that it sets out to describe but it cannot change their course.

When, addressing the issue of the epistemological status of economic knowledge, Faulhaber and Baumol present two different conceptions of relationships between economics and its object (the economy). In the first economists are *inventors* who naturally fit into the innovation process and are immersed in the economy; in the second they are *describers* (or analysts) who produce concepts, theories and tools and who stand back from the economy.

Faulhaber and Baumol know that the majority of orthodox economists are fervent supporters of the second position and believe that the market, provided it is well organized, prompts agents to conceive of and adopt efficient behavior. The discovery of formulae such as that of Ramsey or of Black-Sholes does not change behavior; it describes and clarifies it, just as Newton's laws have not changed the behavior of falling apples: "Yet strong believers in the market will be skeptical, claiming that competition will force firms and agents to do what is optimal. Consequently, the discovery of a formula for discounting or peak-load pricing will not change behavior but merely describe it" (Faulhaber and Baumol 1988, p. 578). Economic agents don't need economists to conceive of tools and to choose the right behavior. When they use economics, it is because economists correctly describe what will necessarily happen – just as Newton's laws anticipate any trajectory of any bodies in any field of gravitational forces: Basically, for an efficient market, economics is a futile luxury.

The opposition between scientists as describers and scientists as innovators is not peculiar to markets or institutions. It runs through all the disciplines and the philosophy of science, with those who think that theories simply mirror reality on the one hand and those who believe that they can represent reality only by intervening on and transforming it on the other (Hacking 1983).

The reader can sense that Faulhaber and Baumol believe more in the thesis of inventors-innovators than in that of describers. If they fail to state their preferences explicitly, it is because they are aware of the weakness of their positions. Describers dominate economics. Moreover, no proof, no crucial experience allows the two positions to be separated in the short term. In several cases Faulhaber and Baumol – as if they were inspired by a sociology of science à la Feyerabend– concede that it is impossible for them to prove that the use of a formula or a new calculating tool (for instance the use of a discounting technique that allows calculation of the payment necessary to reimburse a debt earlier than planned) affords a competitive advantage for the agents who adopt it, because: "ceteris are never paribus (*sic*)" (Faulhaber and Baumol 1988, p. 578). At another point, even though they are sure of having shown that Black-Scholes' formula really did contribute to changes of behaviors and markets – and in a way that markets, left to themselves, would have been incapable of imagining – they observe that some of their colleagues will object. These colleagues will argue that the well-known thesis of beauty contests or self-fulfilling prophecies is enough to explain the effects of the adoption of this tool. The equation *per se* has no impact; it simply acts as a convention, a common belief that guarantees the coordination of actors in a situation of uncertainty.

Aware that the balance of power is not in their favor, Faulhaber and Baumol downplay the importance of their observations. Yet this does not prevent them from developing killing arguments against an extreme version of the expectation that the market will always get it right. Since the market, simply by its force, is seen as capable of causing actors to innovate, Faulhaber and Baumol rightly say that it ought to have driven firms, on their own, to find the electric, chemical or biological techniques that guarantee them a competitive advantage. Whereas the history of science and technology shows the opposite: "First, if the market is always able to force surviving firms to anticipate correctly (if implicitly) the behavior called for by as yet unborn economists, why does it not work in the case of engineers and physicists also unborn?" (Faulhaber and Baumol 1988, p. 579). Without assistance, economic agents are not able to produce of all the innovations that will guarantee them a competitive advantage. They need chemists, physicists or biologists working in universities. So why treat economists, who profess to be scientists in their own right, any differently from others of their kind?

If Faulhaber and Baumol refuse to answer this question clearly it is because they feel that it might introduce a difficulty that is peculiar to economics. To an open-minded economist it poses no problem that chemistry, physics or biology participate in the construction of markets and their functioning because these disciplines say nothing and have nothing to say about economic markets. As such, they can take part in the economy because their object is unrelated to it. Economics is not so fortunate. By participating in the economy, it would place itself within the object that it is supposed to be studying from the outside, and it would thus run the risk of corrupting or distorting that object. To maintain the parallel with the natural sciences, we need to ask what would happen to chemistry, physics or biology if they were to participate in the constitution of the "natural" objects that they are purported to describe.

My thesis is that both the natural and life sciences, along with the social sciences, contribute towards enacting the realities that they describe (Law and Urry 2004). The concept of performativity affords a way out of the apparent paradox of this statement. Without performativity we would be destined to sharing Faulhaber and Baumol's quandary. We would have no alternative but to acknowledge economist-describers' point of view. We would have to settle for a comfortable but rather boring life offered by academic ivory towers.

Performativity: Truth as Success

How can a discourse be outside of the reality that it describes and simultaneously participate in the construction of that reality as an object by acting on it? To this paradoxical question the concept of performativity provides a convincing and general answer.

My intention here is not to enter into the details of the debates surrounding this concept. Yet I cannot continue to settle for a metaphoric use and for the accurate but elliptical definition I gave in *The Laws of the Markets*. A discourse is indeed performative, as I suggested there, if it contributes to the construction of the reality that it describes, but we need to go further than that and at least briefly turn towards discourse analysis to understand the meaning of the verb "to contribute." The idea is

to assess the extent to which the concept of performativity, which implies that any discourse acts on its object, applies to science in general and to economics in particular.

The Pragmatic Turn

Since the Ancient Greeks, reflection on language has been organized around the dissociation between logic and rhetoric. While logic questions the conditions of the verisimilitude of statements through an analysis of propositions and their sequence; rhetoric - the prerogative of sophists and rhetoricians- disregards the question of truth and apprehends discourse as a producer of effects, a power of intervention in the real. Logic implies the existence of an outside world, populated by entities that are distinct and cut off from the propositions referring to them. The ontology of the world of logic is set and independent of the discourses describing it. Rhetoric, on the other hand, implies relationships of entanglement between propositions and their referents; it acts on the ontology of the entities to which it refers. Science obviously seems to be on the side of logic and exteriority (an electron is an electron, irrespective of what one says about it), while politics is on the side of rhetoric (the identity and missions of the USA depend on what is said about them).

It has always been difficult to establish an impervious division between these different modalities of the functioning of discourse. The two ways constantly interfere with each other, as in the so-called Port-Royal logic in which considerations of a strictly rhetorical order are introduced alongside purely logical developments.

"If we say to someone that they have lied, and we consider only the main meaning of the phrase, it is as if we told them that they knew the opposite of what they had said. But apart from the main meaning, these words convey an (accessory) idea of contempt, which makes them insulting."
(Arnauld and Nicole 1970 {1662}).

In this extract the notion of an accessory idea denotes that which, along with the propositional content of a discourse, constitutes what was later called its illocutionary force – in this case its value as an insult. The mere fact of saying: "You

have lied" is at once a statement, a description of the state of the world (which may be true or false) and an act through which the enunciator acts on the enunciatee (the receiver) of the statement (by insulting him or her).³

Despite these theories and observations, which show the difficulty of separating logic from rhetoric, the interlocutory dimension of language has always been considered as located at the periphery of logic. It was only with the rise of pragmatics that the gap was reduced. There is pragmatics as soon as one gives up the separation between the grammatical structure of the discourse and its use. The use of language is not added to a theoretically self-sufficient statement from the outside. C. Morris has noted, for example, that any language has a syntax (relations between signs), semantics (relationships between the signs and what they denote), and pragmatics⁴ (relation between signs and their use context), which cannot be entirely dissociated from one another (Morris 1938). There is no discourse without a speaker and an audience, and no communication without well-formulated sentences and well-articulated concepts. On the basis of these distinctions, several positions seem possible. From a minimalist point of view we can consider that pragmatics is one component of linguistics among others (along with syntax and semantics), or else adopt a maximalist point of view and argue that nothing in linguistic phenomena can escape pragmatics.

Austin's decisive contribution is to have shown, or at least to have suggested, that the very idea of a separation between these dimensions is impossible and that only the maximalist position is defensible. Austin's work is interesting precisely because he starts with a distinction between those statements that describe the worlds to which they refer, and those that act on those worlds and help to make them exist. This is his famous distinction between constative utterances (the cat is on the mat; the

³ The opposite is also true. The best specialists of rhetoric (Perelman 1982) have pointed out its close relations with logic. The notion of demonstration, useful to both the rhetor and the scientist, serves to understand the articulation of these two dimensions of discourse (Barry 2001; Rosental 2002). Moreover Cassin (1995) shows how the epideixis (through which the speaker tries to convince his or her audience) is always articulated to the apodeixis (by which the speaker indicates and qualifies the objects to which he or she is referring).

⁴ Pragmatics derives from pragma: action; a deed or intentional act.

structure of DNA is a double helix; in the prisoner's dilemma rational agents choose suboptimal configurations) and performative utterances ("I promise," "I baptize you," "I sentence you to ten years' imprisonment," "I marry you"). In the former the object is the outside world; the latter cause the reality that they describe to exist (e.g. being married is the consequence of an act of language). By proposing this distinction and showing the diversity and large number of purely performative statements, Austin wanted to criticize the idea that the function of language is essentially representative. But, in attempting to make this distinction more precise and profound, he seriously considered concluding that all utterances are performative (or illocutionary) and that it is impossible to maintain the hypothesis of the existence of pure constative utterances.⁵

The Semiotic Turn

According to Austin, because it is uttered (what is called enunciation), there is no statement that does not constitute the context in which it functions.: there is no language; there are only acts of language. Phrased in Greimassian terminology: to have meaning a statement implies its context of enunciation (at least an enunciator and an enunciatee) (Greimas and Courtès 1982). Although Austin was not explicitly referring to scientific discourse, there is no reason to exclude science from the general rule as we will see. Scientific theories, models and statements are not constative; they are performative, that is, actively engaged in the constitution of the reality that it describes.

To explain the scope and reasons for this assertion, that all science is performative, which some would consider scandalous, we can conveniently begin with the distinction between universal and singular statements. For its clarity and precision I prefer to adopt Popper's terminology here, and will refer to singular existential statements (SES) and universal statements (US).⁶

⁵ In his twelfth lecture, Austin says that "Stating, describing, are just two names among a very great many others for illocutionary acts" (Austin 1962, pp. 147-48).

⁶ The obvious limit of Austin's work is that his analysis does not depart from discourse per se, as his work on the different categories of verbs and performativities shows. Consequently, he can explain neither the force of statements nor their meaning. These limits have led certain authors to complete the

SESs can be found in all of the scientific disciplines. An SES is characterized by its indexicality: it explicitly refers to particular circumstances, singular entities located in time and space.⁷ For instance, "At *such-and-such* a place, at *such-and-such* a time, *such-and-such* a thread can be observed, that breaks when we apply *such-and-such* a force over x kilograms." This statement describes the existence of an *event* (the thread breaks) whose spatio-temporal coordinates are provided (the event is observable at a particular time and place) and whose operating mode is indicated. One of the characteristics of SESs is that they contain what semioticians call "shifters", words in the statement which refer (or shift) to situations, contexts or operations that can be described and observed. In the example given, the statement includes phrases such as: *at such-and-such a place, at such-and-such a time*. The statement also indicates precise devices, operators and operating modes which are not directly described but have to be describable (for instance through the addition of other statements that complete the SES and clarify what it implies). In other words, the statement contains its own context.⁸

The epistemological question concerning the conditions under which the observation is considered as valid and the mechanisms through which witnesses are convinced, as well as the equally epistemological question concerning relationships between the SES and other US (for example of the type: "threads subjected to a force

Austinian analysis, either by highlighting the importance of the interlocutors' subjectivity (as Grice and Searle for philosophy or Butler for sociology do) or by noting the need to take social and cultural context into account (Bourdieu). But these critiques simply continued Austin's error by accepting an insurmountable boundary between discourse and that which lies beyond it (either in the form of the psychology of subjects or of society). To extend Austin, we have to go in another direction and question the actualization of the contexts and subjectivities that are implied by the utterance. In the case of science, this implies the study of the relationships between SES and socio-technical arrangements (agencements). The critique of Austin should not exclude the notion of performativity but rather should enrich and complete it, first by insisting more on the fact that the context of enunciation is included in the enunciation (semiotic turn) and, second, by taking into account the materialities composing that context (ANT turn).

⁷ An SES perfectly illustrates the thesis of Cassin in terms of which any discourse articulates epideixis and apodeixis (see note 3).

⁸ Shifters are traces or marks of the enunciation. They point to the world presupposed by the utterance.

exceeding their breaking strength will break") are of no interest, even if they have fuelled fierce controversies.⁹ The only thing that matters here is that in a scientific theory or model there is necessarily a place for SESs. There is no science without the possibility of formulating statements that describe singular events localized in time and space, and no science without describable socio-technical devices that produce events described by singular statements.

This implies that the verisimilitude of the statement (i.e. does the event occur or not?) cannot be dissociated from the context denoted by and built into the statement. The SES is not a statement outside the world or worlds to which it refers; it requires that very world. Conversely, the world to which it refers is meaningless without the statement that puts it into action. A thread on which a weight is hung and which breaks is not an intelligible and interpretable event; under no circumstances can it be associated with a scientific fact if it is not, at least, accompanied and framed by the singular existential statement announcing that its breaking stress has been exceeded.¹⁰ The SES is entangled with the device that produced what it describes; the device and the series of actions undertaken are shaped by the statement, and vice-versa.

Last Turn: The ANT Turn

To understand the strange relations of exteriority and interiority, that are implied by the semiotic turn consider as an example, a set of operating instructions and the device to which they refer (Akrich 1992). Without the material device the operating instructions are meaningless: the gaze needs to constantly *shift* from one to the other. Likewise, the machine without the instructions is likely to be opaque, unusable and passive. At the heart of science lies this two-way relationship between description and action. When I say: "this thread breaks", I am referring to all the actions that cause the break in the thread and that cause my statement to be true, to actually happen (or not). It is because the statement describes a singular course of action still to happen – and not a preexisting word out there – that it is performative.

⁹ See Callon (1994).

¹⁰ This is what epistemology highlights when it asserts that facts are always theory-laden.

A scientific statement can be compared to the instructions for use (that is, for action) with which we grapple when we try to get a VCR to function.

This helps to explain why I prefer to refer to the relationships between statements and their worlds as socio-technical *agencements*.¹¹ The term *agencement* is a French word that has no exact English counterpart. In French its meaning is very close to "arrangement" (or "assemblage"). It conveys the idea of a combination of heterogeneous elements that have been carefully adjusted one another. But arrangements (as well as assemblages) could imply a sort of divide between human agents (those who arrange or assemble) and things that have been arranged. This is why Deleuze and Guattari (1998) proposed the notion of *agencement*. *Agencement* has the same root as agency: *agencements* are arrangements endowed with the capacity of acting in different ways depending on their configuration. This means that there is nothing left outside *agencements*: there is no need for further explanation, because the construction of its meaning is part of an *agencement*. A socio-technical *agencement* includes the statement[s] pointing to it, and it is because the former includes the latter that the *agencement* acts in line with the statement, just as the operating instructions are part of the device and participate in making it work. Contexts cannot be reduced, as in semiotics, to a pure world of words and interlocutors: they are better conceived as textual and material assemblages (Latour 2005).

We can now see why the concept of performativity has led to the replacement of the concept of truth (or non-truth) by that of success or failure. Donald MacKenzie (forthcoming) shows, for instance, that Black and Scholes' famous formula, so basically simple, has meaning and effect only in its own world. MacKenzie rightly talks of "an equation and its worlds" (MacKenzie 2003). One world implied by the equation - without which the equation would not function and which would not function without the equation - is a world in which prices can be observed [to] follow a random walk. It is a world in which "skewnesses" (a new variable for taking into account non-Gaussian distributions) will later be calculated and re-injected into pricing formulae, a world in which software (Autoquote) will allow the production of

¹¹ See Deleuze and Guattari (1998).

continuous quotation even for options with low liquidity. It is a world which has its vocabulary, its evaluation criteria, a world in which the notion of implied volatility, a simple mathematical variable, becomes observable and calculable. What MacKenzie describes with surgical precision is the gradual actualization of the world of the formula: a formula that progressively discovers its world and a world that is put into motion by the formula describing it. A formula that previously functioned in a paper world, which was perfectly real (for what could be more real than paper or equations?), subsequently functions, after many investments, in a world of computers and silicon, algorithms, professional skills, and cleverly adjusted institutions. We could say that the formula has become true, but it is preferable to say that the world it supposes has become actual.¹² The supposed world has gained in precision, weight, robustness and extension through the intense work of articulating, experimenting and observing that has been required to produce the gradual, mutual adjustment of socio-technical *agencements* and formulae. The actualization process is a long sequence of trial and error, reconfigurations and reformulations. But what makes this process possible is the performative dimension of the statements and the trials that they allow. For if the statement could be dissociated from the world in which it functions, if it could be denied as an utterance pointing or shifting to supposed worlds, no trial, learning or adjustment would be conceivable. The conditions of felicity of a (performative) statement, that is, its success, depend on this adjustment, an adjustment that is never a given in advance and always requires specific investments.

As MacKenzie shows in his chapter (forthcoming), at a certain point in time, in certain places, the world of the formula is actualized, in such a way that it can be said that the formula describes and represents its world correctly. We are no longer in the register of truth as a reference but – to stick to the same word – in that of truth as success or failure, in truth as fulfilled conditions of felicity. The formula that is born performative, and remains so, seems to be constative when the world (finally) acts

¹² Deleuze has proposed distinguishing between two sets of relations he calls virtual/actual and potential/real. The latter refers to processes in which events could be reduced to the causal consequence of pre-existing configurations; the former to events that could be said to be dependant on but not causally determined by preexisting configurations. In one case, framing (and repetitions) prevail, whereas in the second case overflowing (and differences) impose their destabilizing logic (Deleuze 1968).

according to it. Yet failure can occur when events take place that are incompatible with the formula and its world. Financial crisis is a crisis for the formula. New adjustments are made; the formula is given a new twist (volatility skew) that translates into an alteration of the socio-technical *agencements* (dedicated professionals and observation tools are required to carry out the calculation of this parameter daily). And the game is never over, for new framings are always possible, always involving a *bricolage* of both the *agencements* and the statements. This at least, is what the notion of performativity, enriched by the semiotic and the ANT turn, makes visible.

From Self-Fulfilling Prophecies to Performance

One of the main benefits of the notion of performativity is that it rids us of what Pickering calls the representational idiom (Pickering 1995) in terms of which the purpose of science is to create representations of reality. But we have to go further. We would be wrong to sum up the debate as the opposition between performativity and constativity. Many concepts are proposed, especially in this book, to describe the strange relations between the social sciences and their objects. I am now going to discuss some of them. This will enable me to further clarify the meaning of the notion of performativity.

Self-Fulfilling Prophecies

One way of describing the effects of economic theories on agents is through the notion of self-fulfilling prophecies proposed by Robert K. Merton, the father of the option theorist whose work is discussed MacKenzie (forthcoming). If everyone is persuaded that Bank X is on the verge of bankruptcy, then to avoid being ruined, all of its clients will rush to withdraw their money before everyone else does and bankruptcy will inevitably ensue. Likewise, if we are convinced that women do not have the capacities required to practice certain occupations, those occupations will effectively be closed to women and the assertion will be verified. The concept of a self-fulfilling prophecy seems to apply to economics. Economics – and this is where it derives its strength – is a constructed, logical discourse based on a number of irrefutable hypotheses. As discourse it can change into a system of beliefs that infiltrate agents' minds and colonize them. For example, neo-classical theory is based

on the idea that agents are self-interested. If I believe this statement and if this belief is shared by the other agents, and I believe that they believe it, then what was simply an assumption turns into a reality. Everyone ends up aligning themselves to the model and everyone's expectations are fulfilled by everyone else's behaviors. To predict economic agents' behaviors and therefore economic theory does not have to be true; it simply needs to be believed by everyone. Since the model acts as a convention it can be perfectly arbitrary. Even if the belief has no relationship with the world, the world ends up corresponding to it. We can thus consider that the famous Black and Scholes formula has no truth value, that it says nothing of real markets, and that it is simply a coordination tool that allows mutual expectations. It constitutes a false but effective representation, and can be seen as pure convention. This is what Faulhauber and Baumol suggest in their article.

Those who support the thesis of the self-fulfilling prophecy or that of prescription explain that if an economic model or formula can act as a convention (by nature arbitrary), it is because their object is human beings whose actions and behaviors depend entirely on their beliefs and the meanings that they attribute to the social world surrounding them. Could one say that the universal law of gravity is a self-fulfilling prophecy? Of course not. We justifiably believe that it is not enough for human agents to behave as if they believed in the law, for it to govern the course of planets. A law in $1/d^3$ would not become true if everyone believed in it, simply because celestial bodies follow their nature, irrespective of what the humans who observe and interact with them think and say. In contrast, the Black-Scholes-Merton model can be self-fulfilling because it is all about the behaviors of human beings, and human beings depend on beliefs and expectations that planets do not have. In the final analysis it is the humanity of human beings that allows self-fulfilling prophecies and, more generally, the effectiveness of conventions. Society has thus opposed nature since Aristotle.

This 2500-year old conception is not convincing. The case of Black and Scholes equation is a typical example of the limits of the theory of self-fulfilling prophecies applied to the social sciences and especially economics. Imagine, as MacKenzie proposes, a different formula, for instance one with a calculation error or a statistical incoherence. Would it have had the same impact? It is obviously difficult

to answer this question directly since no one has ever tried the experiment. Fortunately there is another, indirect, way of answering the question. MacKenzie shows that the use of the Black and Scholes formula led to a situation of crisis that can be explained in a plausible way by the technical shortcomings of the formula. These shortcomings amplified the crisis since the formula induced behaviors that challenged the distribution of the very course of action on which the formula itself was based. To be sure, the Black and Scholes formula does successfully organize agents' coordination, at least for a certain time. But, as the 1987 episode shows, it cannot for all of that be considered an (arbitrary) convention. The content of the formula matters.¹³ The Black and Scholes formula implies a world without which it cannot function and the realization of that world is at stake. Clearly, as seen above, it is not the formula itself that can cause that world, a socio-technical *agencement*, to exist. Other forces are involved, other interests. It so happened that the adjustment took place – Donald MacKenzie explains how – for a few years, but it was unable to withstand the 1987 events. This was due not to a lack of belief in the formula but to the incapacity of the formula to forecast the events and the behaviors they triggered. Whereas the notion of a self-fulfilling prophecy explains success or failure in terms of beliefs only, that of performativity goes beyond human minds and deploys all the materialities comprising the socio-technical *agencements* that constitute the world in which these agents are plunged: performativity leaves open the possibility of events that might refute, or even happen independently of, what humans believe or think.

MacKenzie proposes the notion of counter-performativity to denote these failures, because in this case the formula produces behaviors that eventually undermine it. This analysis applies equally to the natural sciences and to the human and social sciences. What Popper called refutation is another name for counter-performativity or what I have called overflowing. The fact of imposing devices designed to realize a statement causes other worlds to proliferate in reaction to that

¹³ From this point of view, a major issue is arbitrage conceived in a socio-technical sense: see Beunza, Hardie, and MacKenzie (2006). Some formulae are more vulnerable than others to the counter program of the arbitrageur. E.g. an option formula that has as its result half the Black-Scholes price, or twice the Black-Scholes price, would have succumbed in this way, just as, in fact, the practitioners' rules-of-thumb prior to Black-Scholes succumbed to Black-Scholes-based arbitrage (MacKenzie, personal communication).

performance. Any act, even of language, produces effects that might strike back. The history of science is nothing but the long and interminable series of untimely overflowings, of socio-technical *agencements* that have been caught out, unable to discipline and frame the entities that they assemble. Just as, through their very actions, a badly calculated boat, an ill-adjusted missile or a wrongly formulated theorem reveal unsuspected worlds, the Black and Scholes formula sets in motion events that without it would not have happened and that, once taken into account, lead to new socio-technical *agencements*. What is at stake is the success or failure of the performance, what is at stake is the realization of the socio-technical *agencement* inscribed in the statement.

The notions of representation, convention or belief and, with them, that of self-fulfilling prophecy, do not enable us to study failures because they give no principle of reality. The Black and Scholes formula has a world to impose, socio-technical *agencements* outside of which it cannot survive. A formula that would index share prices on sunspots (Guesnerie 1986) that is, that would be pure convention, would last no more than a second, simply because there is not a single element that can be mobilized to rapidly produce a socio-technical *agencement* linking sunspots to share prices in an observable and stable manner.

Prescription

The notion of "prescription" is not very far removed from that of "self-fulfilling prophecy." It is also frequently mobilized to describe the mechanisms through which a conformity between economic theory and economic reality is achieved. Whereas self-fulfilling prophecies imply (similarly) formatted human minds ready to believe in the truth of certain categories or assumptions proposed by economic theories, prescription implies a medium, an intermediate device between theory and behavior, between economics and the economy. Generally this medium is taken to be institutions and the norms that they impose (Ferraro, Pfeffer and Sutton 2005). Consider, for example, the role of economic theories and their hypotheses in institutional design. We can say that the creation of a European central bank, directly inspired by the monetarist theses of Milton Friedman, helps to make real monetary markets correspond to the descriptions and analyses proposed by theories or models

qualified as abstract. Likewise, enforcing incentives, inspired by economic theories and their assumptions about human or organizational behaviors, causes these behaviors to fit the theory's predictions. When workers are paid on the basis of performance, they end up complying with the anthropological models that fit the incentives imposed on them. If we consider that a firm is a nexus of contracts, and we set up procedures to make these contracts explicit and to ensure their enforcement, the firm does become a nexus of contracts. One of the contributions of the prescription thesis is that it highlights the importance of what I have called *socio-technical agencements* in comprehending relations between economics and the economy. To understand how statements become true and describe the world as we see it, one has to take into account institutions and the constraints and incentives that they impose. The difference between self-fulfilling prophecies and prescriptions is slim: from the point of view of prescription (as in that of self-fulfilling prophecy), economic theory says nothing about the real economy. Economics does not have to describe reality; its mission is to say what the economy is supposed to be and to propose solutions and devices to make it that way.

Since it is often said that economics is prescriptive rather than descriptive, it is worth devoting a few lines to the difference between prescription and performance. I am going to show that the notion of prescription denotes a particular case of performance.

A convenient way of proceeding is via Sahlins who introduces the opposition between performative and prescriptive structures, in order to describe the attitude of Hawaiians who are reported to have offered Captain Cook and his crew the opportunity of having sexual relations with them (Sahlins 1985). How can this type of behavior with strangers be explained? Sahlins notes that the case shows, above all, Hawaiian society's faculty for invention when faced with the unexpected. He argues that Hawaiian women showed their strong ability to adapt and to react when Cook and his crew landed, adding that these faculties of adaptation and change were nevertheless framed by references to well-established beliefs and norms that were not questioned. If Cook was considered to be a God and Hawaiian culture encouraged women to have children with gods then Hawaiians can be said to have adjusted to a new situation without disregarding the norms of their culture.

Based on this observation, Sahlins develops a more general reflection. To account for this framed inventiveness, he proposes that some societies have performative structures,¹⁴ while others have prescriptive structures. In the former, identities are performed by the actions undertaken by individuals (when they are in situations of uncertainty); in the latter, the actions are prescribed by cultural codes that imply well-established identities and roles: these are the cold, repetitive societies described by Radcliffe Brown.

All in all, Sahlins considers that there is a dialectical relation between prescription and performance. An unexpected event – in this case the arrival of those strange Englishmen – is interpreted in terms of existing categories (Cook is considered as a God) which prescribe behaviors and practices (the norm is that, since he is a god, the women should want to be pregnant by him) that perform Cook as a veritable god. But the performance can be successful only if Cook – and especially his sailors! – fulfill the role ascribed to them, which is not the case. Neither Cook nor the sailors behave as gods ought to. In reaction to this inappropriate behavior, the Hawaiians then set about devising new categories and practices. Hawaiian society is heated up again.

Sahlins, almost unwittingly, shows us why the notion of prescription is futile. The distinction is not between prescriptive structures and performative ones, but between closed situations and open ones, between situations of repetition, where events that occur are known and treated as routine, and situations where events are unexpected (Cook arrived in Hawaii out of the blue) and trigger behaviors and analyses that tend to reduce them to known categories and events. We can therefore say that Radcliffe-Brown-type societies, those that remain closed in on themselves because they aren't fortunate enough to cross paths with a Cook, have performative structures, just like Hawaiian societies and their unexpected encounters. But in one

¹⁴ Sahlins uses the notion of performativity in a purely Austinian sense. Taking the example of friendship, and of assistance that a person in difficulty can expect from a supposed friend, he says that "the relationship is even more certainly created by the performance, than is the performance guaranteed by the relationship."

case the performance is repetitive: it is always the same roles, the same behaviors, that are enacted in identical situations; whereas in the other, when faced with unusual situations, it seeks adaptation, absorbs differences and turns them into novelties. Prescription is simply a particular case of performance, a borderline case corresponding to pure repetition, in what Sahlins rightly calls closed situations.

The same applies to economics: it does not alternate between prescriptivity and performativity; it is always performative. In certain cases the socio-technical *agencements* and the worlds corresponding to its models have ended up existing and producing recurrent events: for example, that share prices scrupulously follow a random walk. When this type of adaptation occurs, the performance becomes a prescription. But the performance may well fail, and the conditions of felicity may not be fulfilled. In that case the existing *agencements* have to be rearranged or even profoundly transformed: what MacKenzie calls counter-performativity prevails. The distinction therefore, is not between prescriptive structures and performative ones, but is rather between performances that manage to produce regularities and repetition, and performances that are constantly faced with unexpected events, that they sometimes absorb, but only sometimes, for a while. The Hawaiians made a god out of Cook, but only for a while. The market follows Black-Scholes, but only for a while.

Expression

Redefined by the pragmatic turn, the notion of performativity cannot be reduced to a mysterious mechanism (the "Fiat lux et lux fit" of the Old Testament¹⁵) which would cause the reality to which the statement refers to exist, without an addition of forces. The notion of enunciation underscores the fact that any statement defines its context and has meaning only in relation to that context. The question of the actualization of this context is therefore open. Moreover, enriched by science and technology studies, the notion of enunciation takes into account materialities: the context is not reduced to institutions, norms or rules; it is a socio-technical arrangement. Exit the idea that everything is a matter of language and that the performativity of statements is to be found only in the statement. Neither the notion

¹⁵ A usual translation is: Let there be light and there was light.

of self-fulfilling prophecy nor that of prescription make socio-technical arrangements visible.

The notion of expression, illustrations of which are found in the chapter by Didier (forthcoming), shares the same critique of the closely linguistic definition of performativity. A statement does not create the object to which it refers *ex-nihilo*; the notion of performativity is relevant only if it is further refined by the pragmatic turn and the ANT turn. Why not therefore opt for the notion of expression, rather than maintaining a term, performativity, that can be misleading? Despite frequent misunderstanding, I prefer the notion of performativity (and performance) to that of expression which might underplay the importance of the contribution of models and statements in the shaping of economies.

The notion of expression does have the advantage of emphasizing that there is no tabula rasa. Not everything is feasible. The notion of expression guards against the idea that the economy could be created from scratch by economics. Very specific work, new material arrangements, the implementation of tools such as shingling and the manipulations that these tools allow are necessary. To produce merchandise from things that are not yet completely economicized, one has to do with what exists, edge one's way in, articulate. This oblique work is highlighted by the notion of expression that shows the multiplication of elements and actants already there, who are involved and have to be taken into account. The notion of expression is a powerful vaccination against a reductionist interpretation of performativity; a reminder that performativity is not about creating but about making happen.

Employing the notion of expression nevertheless bears an inherent risk, that of overplaying material practices and leaving linguistic and textual practices in the background; in short, in our case of underestimating the models and elements of economic theory. Didier's chapter illustrates these difficulties (Didier, forthcoming). On several occasions he evokes the out-there-ness of the world and the innerness of subjects: the pickles are there, outside the statistics that apprehend them; the subjectivity of farmers, their beliefs and their convictions explain why statistics prove to be effective (p. 37). The notion of expression tends constantly to recreate the divide between an object-reality that is expressed and the subject expressing it. As for

the notion of performance, it has the advantage of focusing on a question that is essential: it refuses the distance between the object and the discourse about it. That is the inner meaning of the notion of an act of language. When the mayor says: "I hereby pronounce your man and wife," he is not expressing something that is already there; he is making it happen. And for that act to be successful, the appropriate *agencements* have to exist; the felicity conditions have to be met. Caricaturally- and generally-speaking we could say that the economy does not exist before economics performs it, and that when economic (or economicized) elements are already there it means that economics (at large) has already been that way. I prefer the risks of over-interpretation of this statement (which can be pushed so far as to become a caricature: some criticize me for saying that economics creates the economy from A to Z!), rather than risking the under-interpretation favored by the notion of expression (the idea that there are economic practices *per se* which exist and existed before economics put words to them). To be sure, it is unquestionable that things exist, that the discourse of economics, when successful, does not make the economy exist *ex-nihilo*! But to understand this process of economicization (Callon 1998) in which economics at large participates, it is preferable to use the concept of performance rather than that of expression which erases the process by which acts of language contribute towards the occurrence of radically new events.

Expression is a crucial *component* of performance, but it is not *all* performance. Talking of the combination, the association or the networking of existing elements, all concepts and metaphors that Didier uses, is insufficient. I prefer the concept of socio-technical *agencement* and opt for a description of these *agencements* that includes, primarily but not only, the elements of theories, models, etc. Each element of an *agencement* – and among these, hypotheses and models have to be included – contributes towards the performance of the whole. The wedding ceremony is a socio-technical *agencement* that will demonstrate, for example, two beings' wish to be married. But in that *agencement* the marriage pronounced by the official plays a crucial part: entangled with all the other elements composing the arrangement, it causes that which did not exist before to exist and to last, at least for a certain time; the event and the matter of fact that we call marriage.

Performance

The above discussion has shown the interest of the notions of performativity and socio-technical *agencement*, including the statements that describe these *agencements* and contribute towards putting them into action. This analysis echoes the discussion by Annemarie Mol of the use of the notions of performativity and performance in sociology. A long footnote in her book *The Body Multiple* is highly instructive in this respect: "When people present themselves to each other, Goffman said they present not so much themselves but a self, a persona, a mask. They act as if they were on stage. They perform." (Mol 2002) pp. 34-44). We thus dissociate that which happens backstage and concerns psychology, from that which happens front stage and concerns sociology; the personal identity on the one hand and the public identity on the other. Irrespective of the actor's adherence, the role she performs is therefore perfectly real and produces effects: it defines the social as such. Authors like Judith Butler have extended Goffmanian reasoning: all roles are performances; there is no backstage or back office: "There need not be a 'doer behind the deed' but [...] the 'doer' is variably constructed in and through the deed" (Mol *ibid.*). People's identities do not precede their performances, but are constructed in and through them. Butler is concerned about gender identity. She maintains that this identity is constantly reconfigured and realized through accomplished acts. We must therefore talk of contrasting identities as they are performed in a variety of sites and situations. Yet Mol is not convinced by the Butlerian analysis. According to her, this conception brackets off the crucial role played in the production of identities by entities, such as the vagina, which have come to be considered as natural and therefore outside the social. Even if the vagina does not make a woman, it contributes towards making her, at least in certain circumstances, just as the penis contributes towards the constitution of a man : "Bodies do not oppose social performances, but are part of them." As showed by Hirschauer they are also reshaped, restyled, redesigned.

It is because the notion of performativity has been linked to that of performance, which tends to ignore the socio-technical and especially the corporeal elements composing *agencements*, that Mol, wanting to avoid Butlerian-type culturalist excesses, proposes the notion of enactment. Identity is a process: even though it is constructed, the construction has no end, it is constantly under way. In

this approach, there is no reason to apply a different analysis to so-called objects. Criticizing the use – by sociology or by cultural (gender) studies – of the notion of performativity when it is equated to that of performance, Mol notes that: a) the (sociological or anthropological) analysis of the shaping of entities and of the expression of their identity must take into account so-called natural entities, the body for example and, more broadly, all the materialities composing what I call socio-technical *agencements*; b) the identity of each entity, human or non-human (including the vagina), is never set for once and for all, definitively constructed: it is a flow. Situations of closure, as assumed by Sahlins, are not situations in which identities are mechanically prescribed. As in situations of openness, they are under trial. Stability is a constant struggle which stems from the involvement of but is not determined by materialities.

Emphasizing the role of materialities- or of what I call socio-technical *agencements*, leads to the notion of performance. Statements and their world are caught in a process of co-evolution. The Black and Scholes formula or the theory of general equilibrium, confined to the academic world, can find their appropriate milieu, their felicity conditions. But when they move over to the Chicago derivatives exchange or to ministries responsible for economic planning, they may encounter or even trigger resistance, for their felicity conditions are not filled. The socio-technical arrangements that would have enabled them to survive in these strange worlds are not present or prove to be difficult to put in place. We can agree to call *performance* the process whereby socio-technical arrangements are enacted, to constitute so many ecological niches within and between which statements and models circulate and are true or at least enjoy a high degree of verisimilitude. This constantly renewed process of performance encompasses expression, self-fulfilling prophecies, prescription and performance.

Performance's Struggles

The success (or the failure) of an act of language becomes clear only at the end of the tests to which it is put, through the cooperation it triggers, the oppositions and controversies that it generates. Statements can survive and prosper in one particular place and at one particular time, and disappear in other places and at other times.

Within the academic world, marginalist analysis thrives without any problem. As soon as it leaves that world of textbooks and the students that suits it so well, it gets into trouble. Yet marginalist analysis has not, for all that, been invalidated, simply de-realized in some settings – which does not prevent it from surviving and even prospering in the academic world (at least in some US universities). All of the economists who say that the unrealism of their propositions are of no concern to them, have chosen their world, a world of papers, colleagues and students: the one that suits their theories. That is where they remain and do everything to ensure that it survives. On this note, it is to the process of adjustment of statements and their associated world (what I call the process of performance) that I will now turn.

Economics at Large

"The thread breaks when subjected to a force greater than its breaking strength"; "the human being is moved by her interests and knows her preferences and their hierarchy"; "the Black and Scholes formula gives the price of an option". Each of these statements can survive and be taken into account only if accompanied by its own world: Its diffusion is possible only if the environment that the statement requires is available throughout its circulation and in all the places to which it leads. To move a statement from one spatio-temporal frame to another and for it to remain operational (that is, for it to be capable of describing situations and providing affordances for them), the socio-technical *agencement* that "goes with it" has to be transported as well. In the process of circulation of a statement there are tests and trials that will determine its realization or de-realization, the fact that it remains set in its original world or, alternatively, spreads out and spreads its world with it.

Whether we are dealing with the natural or the social sciences, it is obviously very rarely the case that there is no doubt or ambiguity as to the world being mobilized by the statement. Many rehearsals are required (that is the purpose of experiments and laboratories), many trials, to know what those worlds in which the statement will succeed are made of. Under which conditions can two threads be considered as identical? What exactly does the phrase "apply a force to a thread" mean? What are the possible causes of the break? Is the recording of the deformation not influenced by other phenomena? Or: how can we construct the data needed to

calculate the price of a particular option? How can the price obtained be used to negotiate a deal? In which situations, with which equipment, does a human being become able to assess her own interests and to calculate them in such a way as to determine an optimal behavior? All these questions are futile when statements remain confined to their paper world: it does not require more than a few words to mention the possibility of observations. They become crucial and tricky when statements start to travel, to shift out of their initial location, to be translated from one frame to another.

The full answer to these difficult questions is rarely known before many experiments and trials have been completed. In other words, any shift of the statement reveals problems, causes the appearance of misfits, maladjustments, untimely overflowings. During these successive displacements and the consequent trials, the statement's world becomes more complex. Just as one discovers only progressively, through replications and movements, why an experiment succeeds (or fails), an equally long process is required to explore the socio-technical *agencements* that a statement or model needs to function in such-and-such a spatio-temporal frame (see the forthcoming chapters by MacKenzie and Holm). In the paper world to which it belongs, marginalist analysis thrives. All it needs are some propositions on decreasing returns, the convexity of utility curves, and so forth. Transported into an electricity utility (for example Electricité de France), it needs the addition of time-of-day meters set up wherever people consume electricity and without which calculations are impossible; introduced into a private firm, it requires analytical accounting and a system of recording and cost assessment that prove to be hardly feasible. This does not mean that marginalist analysis has become false. As everyone knows, it is still true in (most) universities.

Between perfect adaptation and total inadaptation, there is a wide range of intermediate configurations. Sometimes one simply has to amend statements, models and formulae to ensure their survival, by taking into account the reactions to their circulation in exotic and hostile places. MacKenzie shows that, for it to have been able to absorb the crisis that showed it to be wrong, the Black and Scholes formula could have been amended, for instance by choosing Lévy-type probability distributions, rather than log-normal distributions. This did not happen, because many

other programs were competing to impose other statements, other worlds and other socio-technical *agencements*. The alternative proposed by Leland and Rubinstein ("sunshine trading"), that would have made it possible to provide the Black and Scholes formula with an environment better suited to its functioning¹⁶, was finally excluded because the Chicago exchanges were opposed to "sunshine trading" and imposed their own solution. The performativity approach makes it possible to exhibit the struggle between worlds that are trying to prevail¹⁷; it makes the struggle for life between statements visible. Each statement, each model, battles to exist. But the Darwinian metaphor stops there. In reality this struggle between statements is a struggle between socio-technical *agencements*. It is not the environment that decides and selects the statements that will survive; it is the statements themselves that determine the environments required for their survival.

By examining the confrontation between socio-technical *agencements*, we have to take into consideration statements other than those produced by scientists, in our case other than those produced by academic economists. To understand the failure, from 1987, of attempts to adjust the financial world to the Black and Scholes formula (which, despite its partial de-realization, continues to survive, although hidden, since it is a part of the informational infrastructure of markets), we need to take into account the programs with which the formula enters into competition. Some of them, probably the majority, are produced outside academic circles. It is impossible to understand the effects of (academic) economics on the economy if we fail to consider it – with its statements, models and analytical tools – in the context of the struggles opposing it against all of the other actors who also perform the economy, format it, produce their own statements and models, and organize their own trials.

Academic economics does not have a monopoly on performance. It is only one possible source of transformation of the economy. Many historical studies emphasize the role of economist engineers (Hughes 1983) (Porter 1995). The

¹⁶ "Sunshine trading [...] could be seen as an attempt to repair the Black-Scholes world, to create a world in which the mere placing of 'informationless' orders did not affect prices" (MacKenzie 2004, p.323).

¹⁷ In the following, I use the terms programs, worlds and socio-technical *agencements* interchangeably.

contribution of accountants, marketers and, more generally, market professionals has now been amply documented (Hopwood and Miller 1994; Clark and Pinch 1995; Power 1996; Cochoy 1998; Barrey, Cochoy and Dubuisson 2000; Strathern 2000; Kjellberg 2001; Cochoy and Grandclément 2005). One might imagine that by shifting from the theoretician economists' world to that of practitioners (including economic agents themselves), we would change to another register, because it would no longer be a matter of economics but of regular engineering and social technology, and the notion of performation would loose its relevance in the process. But that is not the case.

First, the distinction between science and techniques is often used only to disqualify certain practices (qualified as techniques), which are not fundamentally different from those considered to be theoretical and supposed to be the monopoly of academic research. Preda gives a striking evidence of this (Preda forthcoming) when he shows that technical analysis or financial chartism, which developed alongside the use and diffusion of the stockticker, is entirely theoretical in the most classical sense of the word. It produces concepts and interpretations, proposes models, clarifies causal relations and organizes experiments. The so-called experimentalist economists who help to design spectrum auctions (see the chapter by Mirowski and Nik-Khah, forthcoming) produce as much theory as do game theorists. In both cases the words "technique" (or "technology") and "theory" serve more to impose social hierarchies and scales of legitimacy than to describe practices and types of production¹⁸.

Second, transporting a theoretical statement from one point to another and implementing it requires the intervention of new actors who will contribute to (or oppose) the actualization of the socio-technical *agencements* implied in the statement. These socio-technical *agencements* can be explored, created, tested and tinkered with only if engineers and practitioners are mobilized. To make a formula or auction system work, one has to have tools, equipment, metrological systems, procedures etc. To establish relations that "exist" between monetary masses and price levels, to act on the one in order to control the others, there have to be institutions, systems of observation, codification and data collection, tools for analyzing large numbers, etc.

¹⁸ The situation is the same in physics: see Galison (1997) and Knorr Cetina (1999).

A host of professions, competencies and non-humans are necessary for academic economics to be successful. Each of these parties "makes" economics. They are engaged in the construction of a world described and performed by statements and models that we readily agree belong to the world of economics, in the strict sense of the word. The world conveyed by the statement is realized only after a long collective effort, which one could call economic research, involving 90% engineering and 10% theory.

There is a third reason for expanding the meaning of the word economics: the statements and models that perform reality (in our case the economy) are not limited to the propositions formed like ordinary sentences ("the thread breaks", "the price rise is caused by variations in monetary masses and flows", etc.). As the Black and Scholes example shows, a formula or equation effects the same articulation or performance as a statement in ordinary language, but with even more precision and effectiveness. With the help of a few signs, the Black and Scholes formula encapsulates the financial market (its variables provide its constituent elements) and causes it to function (when one calculates the formula one obtains the market price). Applying the formula and calculating the price means making the world that the formula articulates and describes exist.¹⁹ Any tinkering with the formula can have considerable consequences because it changes the world that the formula is supposed to activate. It happens that practitioners are often producers of formulae. Some, like accountants, are even specialized in this type of activity. The formulae that they devise are not different from the statements and models of professional economists. And they have the same fate as classical linguistic statements: they can succeed or fail. They are entirely economics, as I use the term, and as economics they perform the economy.

What I have just said about formulae applies to operating methods, calculation tools and technical instruments. They are statements like any others. Like all

¹⁹ It is amusing to note the problems involved with putting into ordinary words a mathematically simple formula describing a new product conceived of by engineers rather than economists (Lepinay, forthcoming). The formula's signification is contained entirely in its calculation and in the result of that calculation.

statements (that which is stated can be an ordinary sentence, a formula or a technical device), they are "uttered", put into circulation, sent out, and like all statements they convey a world. Rather than being made with words or reduced to simple equations, they are composed of tables, abacuses, pre-programmed series of operations, assemblages of silicon and software packages.²⁰ The case of automation of the Paris Stock Exchange, analyzed by Fabian Muniesa, shows that behind the choice of quotation algorithms and data transmission procedures, it is the concept of an efficient and fair market that is at stake (Muniesa 2003). The decision to install electrical meters and the choice of the technical characteristics of meters imply an economic world that differs from the one in which such meters do not exist. Madeleine Akrich has demonstrated this in detail in the case of an African country: conceiving of electrical meters and uttering them (putting them into circulation) means creating consumers, citizens, and a market for electricity (Akrich and Law 1996). As she showed, the resistance triggered by the initiative was not resistance to change or to progress, but was a struggle against the economy of meters, that is, against a particular form of economy among many others that might exist. Economics can be inscribed in the hardest technologies, and when they are put into circulation those technologies manage or not to impose their world.

All in all, I simply apply to economics what everyone agrees with in respect of ordinary techno-scientific innovation: that it is collectives that innovate.²¹ In these collectives there is no point in opposing those who articulate statements to those who make them function. Everyone does economics with different means, and through different modalities of enunciation (models, theorems, formulae or technical devices). I have suggested the term "economics at large" for this collective (joint) performance, this co-performance of the economy.

²⁰ As MacKenzie shows, the Black and Scholes formula ends up being all that at once (MacKenzie, forthcoming).

²¹ I could simply have referred to the work on innovation that highlights the role of non-academics and particularly the role of research in the wild, and of research collectives. For a recent illustration of this point see Hippel (2005).

Co-Performance as a Historical Process

With the concept of performance, observable reality is considered as the temporary outcome of confrontations between different competing programs, including scientific ones. The historical dimension of processes is emphasized, as well as the fact that history matters and that the economy and markets are the temporary and fluctuating result of conflicts and the constantly changeable expression of power struggles. The history of these struggles is incorporated into markets, just as a living organism retains traces of its evolution. As MacKenzie and Millo say in their description of the transformation of markets due to the application of the Black and Scholes formula: "By the late 1970s, then, Black and Scholes was widely used by CBOE (Chicago Board Options Exchange) traders, and in the 1980s it began to be incorporated into the CBOE's informational infrastructure. Gradually, 'reality' (in this case empirical prices) was performatively reshaped in conformance with the theory" (MacKenzie and Millo 2003, p. 127). Once it has been accomplished this incorporation is no longer challenged. The Black and Scholes formula was transformed into an element of the market and of its functioning. The theory has become part of the market. But the story does not end there. The skew calculation (at least in the US), coupled with the Autoquote system, adds an additional layer which enhances and alters existing performances, without challenging them. There is nothing extraordinary about this historical process; it is no more than a trivial matter of lock-in and path dependency. But instead of lock-in being produced by a hard technology, it is produced by a soft technology that directly concerns the market organization and the formatting of agents' calculative capacities (and that readily resorts to hard technologies to consolidate and perpetuate its effects). The dead grips the living. By taking the struggles between programs into consideration – what I have called co-performance of the economy by economics at large – enables us to study the incorporation of theories, statements and tools which, transformed into algorithms, into routines, become infrastructures and revive the possibility of a new cycle of performances and counter-performations.

Marie-France Garcia's postscript to her article – an article (finally available in English in this volume) which was so useful to me for proposing the thesis of the performativity of economics – shows how actors can reformat a pure and perfect

competitive market (Garcia-Parpet, forthcoming). The performance of this perfection required heavy investments, so that ironically it ends up becoming more like the market described by economic sociology (in the manner of Granovetter or Fligstein). What seemed to be verified because it was actualized at a particular point in time and a particular place, is "de-realized" when circumstances change, that is, when other socio-technical *agencements* are established for a variety of reasons.

The other chapters of MacKenzie, Muniesa & Siu (forthcoming) help to further our understanding of the historical process of co-performance of the economy by economics. These chapters show the diversity of configurations, from a pure and simple complementarity of programs to their open opposition resulting in compromises, both within 'confined (or academic) economics', and between 'confined economists' and 'economists in the wild'. Since I use the word "economist" to denote all agents who participate in the analysis and transformation of economic markets, an economist may be an academic researcher whose job is to produce theories on the market and to collect data in order to demonstrate statistical regularities that reveal laws or causal links. He or she may also be the head of an international institution or a central bank who applies economic theories, sometimes enhancing them with his or her own analyses, for the purpose of making decisions or designing regulations or institutions. Or he or she may be a market professional who designs market devices, algorithms for comparing supply and demand. Finally, the economist may be a consumer union that sets up tests to qualify products.

Having effaced the distinction between all these agents who participate in the analysis and collective configuration of markets (in a more or less abstract, more or less direct and professional way), and who cooperate simultaneously in the production of economics at large, I do find it convenient to distinguish between those working in laboratories and those engaged in scale-one activities. Thus I will introduce a new distinction between I call "confined economists" and "economists in the wild."

Cooperative Performance

Do Norwegian fishermen fit the anthropological model proposed by certain confined social scientists? Are they calculative by nature and motivated by their own

interests? Are they inclined to put their own welfare before the common good? The history of fishing in Norway shows that the answers to these questions depend on the period under consideration. Community regulation requiring powerful entanglements between human beings and the fish with which they live – entanglements that are so strong that the survival of the one depends upon that of the other – is obviously a falsification of the anthropological program that affirms the universality of selfish human beings. Yet this does not allow us to say that the statement "human beings in general and Norwegian fishermen in particular are selfish, calculating beings" is false. History shows that it can become "true" if the circumstances change and if the environment needed by such a being starts to exist. The history described by Holm (forthcoming) shows precisely how we go from one *agencement* to another, how the world supposed by neo-classical economics is actualized.

This neo-classical *agencement* was made possible by the spectacular metamorphosis of fish, by what can be seen as nothing less than their ontological mutation. The initially invisible and slippery fish, to which it was difficult to attach property rights, were progressively transformed into identifiable, graspable fish that accommodated such rights. They became "distributed" fish, which Holm suggests calling cyberfish. Cyberfish are traceable, identifiable, predictable and controllable. They correspond to a new stage in the ongoing process of evolution of the species. This latest mutation has required a huge effort involving documentation, fleets of boats to observe catches, cohorts of statisticians to implement the models and make them work, airplanes for watching the fishermen, traceability tools so as not to lose the elusive fish along the way, international institutions and negotiations to ensure that the calculations were right and to take the "necessary" decisions. To achieve all of this, it has been necessary to transform the dark and mysterious ocean into a transparent aquarium. When fishermen turn into *homines economici*, they are able to live well only when seas are reconfigured as aquariums.

Without this new fish the Norwegian fisherpeople would not have been able to calculate their interests. Once the cyberfish had been performed by the technosciences (halieutics, marine biology, population dynamics) and by politicians, the scene was set for the entry of *homo economicus*. Economics then, had only to propose the tradability of fishing quotas, for the Norwegian fisherman to become

calculative and selfish. The convergence of techno-sciences, politicians and economics, and their co-performation of the fishing world, has resulted in the invention and "implementation" of a new cosmos inhabited by new animal and human species whose co-existence has been made possible. This new cosmos is a radical innovation which is both destructive and creative. Its case history shows that the contribution of economics is productive in so far as it participates in the actualization of a world in which it becomes or is true. But this story also underscores the importance of the verb "to contribute" in the sentence: "economics contributes to the construction of the reality that it describes". Without economics the market would not exist (it is the Individual Transferable Quotas –ITQ– concept that makes this market operational, and the fishermen's calculative and maximizing rationality cannot be investigated as long as this market does not exist). Yet economics alone is not enough to make it exist. It is also necessary to have all of the investments, models, observations, calculations and institutions so accurately described by Holm. In short, the cyberfish is needed. In this case as in many others, economics as such is necessary but not sufficient.

The importance and specificity of what I have suggested calling 'economics in the wild' are evident here. Economics in the wild is not pure economics; it is mixed with engineering, life sciences and management science – its complexity and heterogeneity constitutes its strength and makes it irreplaceable. But it is also about calculations, optimizations and the management of rare resources. It is imbued, and impregnated by the anthropological program of 'confined economics'. Moreover, as Holm so neatly puts it, there is constant traffic, continuous interaction, and endless coordination between those who perform the cyberfish and those who perform homo economicus. The alliances that this cooperation implies and the *agencements* that it allows, obviously include the law. Property rights support what has *already* been assembled and arranged. As Mitchell shows in his chapter (forthcoming), and contrary to what is often said, property rights do not constitute the cornerstone of markets, nor do they provide the foundations on which it can be built.

In a sense, Didier's story echoes that of Holm (forthcoming). Didier focuses on a particular time in the process of reconfiguring a market and the different entities comprising it. At the origin of this transformation we find not academic economists

but an economist in the wild concerned by pickles, whose obstinacy soon led to a reconfiguration of the pickle such that that it became a sort of *cyber-pickle* which was visible and could be counted.

The performance of the cyber-pickle was achieved after a series of manipulations which perfectly illustrate the process of disentanglement/re-entanglement that I explained in *The Laws of the Markets*. Initially the farmer and his pickles could hardly be dissociated. This close entanglement made the pickles invisible at a distance and precluded their circulation. Gradually the pickle became autonomous; its ability to circulate increased. Its standardization and the comparisons and aggregations that it allowed paved the way to its economicization and to that of the agents who produced, packaged, traded and consumed it (the farmers who filled in questionnaires on their production, the cooperatives who commercialized the pickles, the federal agencies that centralized the data and decreed regulations, etc.). The stage had to be prepared for categories such as supply and demand to be enacted, for the market to be unified and for prices to be set in relation to the (aggregated) demand and the (aggregated) supply. The basic categories of economics are present in this reconfiguration. What is striking here, as in the case of Holm, is the cooperative aspect of these mutually complementary interventions. Didier does not tell us the rest of the story, but we can imagine that an acceleration of the economicization became possible once this infrastructure was in place.

Such cooperation and the irreversibilities that it produces are by no means ineluctable. The co-performance of the economy by economics at large is not always plain sailing. As Mitchell shows in his chapter, in Egypt, farmers have been successfully resisting programs inspired by neo-classical economics. We will now turn to situations in which intersecting performative programs, rather than being openly complementary (as in the case of fish and pickles), clash and end up reaching compromises.

Competition Between Confined Economists

Guala's work on the organization of spectrum auctions by the Federal Communications Commission (FCC), as well as the follow-up by Mirowski & Nik-

Khah (forthcoming), highlight situations in which different programs developed mainly by confined economists confront one another. This is a particularly interesting case, primarily because it illustrates the increasing role of experimentation in market engineering (see below) but also because it describes episodes in which different programs clash and end up reaching a compromise.

The story begins with the FCC's decision to discontinue traditional practices which consisted of granting communication spectrums on the basis of bilateral arrangements. A government agency, the FCC's aims were multiple and partly contradictory since it wanted to reconcile economic efficiency, technological innovation and social justice. To design the market for frequencies it understandably turned to economists privileging the most theoretical of them all, game theorists (GTs). What makes this affair complicated and interesting is that the difficulties posed by the market in question caused these economists to recognize that there were no ready-made solutions at their disposal. Known types of auction were ill-suited to the nature of the goods and the multiple constraints imposed by the FCC: "Game theory supplied no global discipline with regard to the type of recommendation tendered." Game theorists could certainly contribute to auction design, either very formally by using explicit models, (for example to invalidate certain solutions), or more informally by applying tacit knowledge, know-how and informed intuitions. But what they were unable to do was provide a turnkey solution. One of the reasons for their difficulty stemmed from the fact that auctioned goods are interdependent, a condition ignored by game theory.

As in any acceptable innovation history, there was soon a proliferation of actors, all defending their own programs. A point of key interest in this case is the fact that another family of economists, experimentalist economists (EEs), entered the game, simply because they were able to persuade the agency to launch real experiments using computer technology. It was then that the story started to take unexpected turns.²² The socio-technical *agencements* proposed by the

²² For the analysis of these changes of direction, typical of any innovation process, see Akrich, Callon, and Latour (2002).

experimentalists coincided only very partially with those that should have been deployed to make the GTs's statements, models and recommendations actual.

Mirowski & Nik-Khah (forthcoming) show the gap between the two worlds proposed by GTs and EEs. They show the depth of opposition between the anthropological programs and the socio-technical *agencements* presupposed by the different models proposed. These differences related to the agents' assumed competencies (Are they capable of (Bayesian) learning or not? Are they prepared to revise their preferences?), furthermore to the manner of conceiving of the role and effects of algorithms for organizing the encountering of goods and agents (EEs, who represent markets as combinatorial optimization procedures, are interested in "the attainment of a competitive equilibrium", while GTs represent markets as Bayes-Nash games). Theoretical models lead GTs to favor "the increase of the amount of information provided to agents", while leading EEs "to seek improvements in the capacity for information processing". Mirowski & Nik-Khah's striking translation of this opposition is as follows: for GTs, "the bidder who would create the most value from owning the license wins it", while for EEs, "the bidder who values the license the highest at the outset acquires it". The differences can be summed up in this way: EEs think that it is the algorithms that do calculations, while GTs locate them in agents' heads. Alternative theoretical positions cause the two groups to favor different organizations of auctions, two different socio-technical *agencements*. EEs are in favor of combinatorial auctions while GTs support the idea of simultaneous-multiple-round-independent auctions (SMRI). Mirowski & Nik-Khah describe in detail the alliances formed between the multiple actors (operators, economists, federal agencies, etc.) engaged in the design of auctions. In this history there are familiar elements, such as hierarchical relationships formed between theoreticians and experimentalists, or coalitions of interests between groups of scientists and economic or political actors. Economists are everywhere: everyone employs their own economist to defend the models assumed to be compatible with their economic and political objectives. There is even a fierce struggle to attribute the success of the operation to a particular group, (in this case GTs proved to be the strongest and cleverest) a group which, as in any history of innovation, was simply one of the many protagonists responsible for the final design.

We would be unable to understand what was happening in the design of the FCC spectrum auctions if we reduced its history to a mere clash between existing interests. All these actors, especially the economists, strive to construct the socio-technological *agencements* that they believe are compatible with their own models, statements and assumptions. To be in line with the overall argument I am putting forward here, and to avoid sociologizing or psychologizing interpretations, it would be more accurate to say that the confrontation takes place between socio-technical worlds that are struggling to exist, at the expense of other socio-technical worlds. What is original in this story is that none of the protagonists is able to push their own program through to the end, for none of them is able to completely frame the world that they create. They can only adopt a logic of compromise in which some elements of their world are realized and others are not. For example, EEs cannot avoid the adoption of the solution proposed by GTs (the Simultaneous Multiple Round Independent auction), but in the implementation of algorithms and procedures they reintroduce elements of their own world by imposing technical solutions drawn from experimentation that GTs initially exclude because they do not fit with their game theoretic models.

In the final workable compromise, which translated into a socio-technical *agencement* consisting of bits and pieces, and which partially, but only partially, made the assertions of both GTs and EEs true, we find elements of the different competing socio-technical *agencements*. The world that ended up existing was a patchwork, cobbled together with elements from competing worlds. Of course there is no point in asking whether the models were true. The only criterion is failure or success. In this case of two rival programs the result was mixed. But Mirowski & Nik-Khah are right to point out that other programs did not have the possibility of joining the struggle. The worlds excluded *a priori* are the losers in this affair.

In the history of the spectrum auction an important role is granted to academic economists, whether they are GTs or EEs. One of the advantages of the co-performance concept is that it establishes a symmetry between all of the categories of economists. Whether they are in the wild or confined, whether they state a formula, build a piece of software or devise an accounting technique, they all give themselves a

world or worlds so that the formula, model or software that they put into circulation (utter) finds an environment, *agencements*, enabling it to function.

Competition Between Economists in the Wild and Confined Economists

Preda examines the constitution of a theory of financial markets that was developed very early on, outside academic circles, and that was able to stand up to rival theories by being established as a theory in its own right (financial Chartism or technical analysis) (Preda forthcoming). This "vernacular" theory, the product of authentic research in the wild and a clear illustration of the importance of the concept of economics at large, draws its strength from its previous and continuing capacity to make the world that it describes, and that makes it true, exist. It is closely linked to the socio-technical *agencements* with which it interacts closely and tirelessly: to instruments (tickers) that make it possible to continuously record price variations and that produce those inscriptions, so useful to theoretical construction and to its performance; to professionals who specialize in the observation of those variations and in their interpretation; and finally, to users with interests and an identity that are well-established and taken into consideration. This world is closely linked to the tracing of price variation curves, and therefore to tickers. Without this technology for representing markets (curves traced with data from the ticker are both real and artifactual), the very idea of transforming forms into instruments of analysis and interpretation would be inconceivable. These inscriptions impose a principle of reality; they constitute an obligatory point of passage, a perfectly material reality to be taken into account. Chartism is not reducible to a convention; nor is it reducible to a belief or even a superstition outside the market that would enable it, once diffused and shared, to coordinate actors by making their expectations possible. It is not disconnected from the market; it is articulated to socio-technical *agencements* that produce the traces that it uses to describe the world in which it is a participant and on which it will, in turn, make it possible to act.²³ The curves to interpret are there. Analyzed by the chartists, they belie the hypotheses in terms of which price variations are correlated with political or economic events. As tools of refutation in a Popperian

²³ Inscriptions are crucial elements in the chain of translations which organize the shifting out and the shifting in of scientific statements (Latour 1987).

style, they furthermore make it possible to affirm the existence of regularities, of collective patterns, where others talk of random walk.²⁴ These theoreticians in the wild are often engineers, well trained in statistics, and they invent concepts to reveal regularities hidden by sudden movements: the normal line concept, for example, describes underlying trends hidden by short-term variations. The ticker and its curves are an intellectual technology which enables the human mind to see things that it is otherwise unable to see and to conceive of (Goody 1977). An epistemic community is formed, manuals are written and disseminated, traders are turned into users of these techniques and of this knowledge. Preda concludes that: "technical analysis becomes simultaneously a theory of financial markets, a theory-based technique for forecasting prices, a set of instruments, a commodity sold by the members of the group, a commodity around which data processing firms emerged, a media discourse, and a narrative". Financial chartism is being actualized. As its world is unfolding, groups, techniques, inscriptions and courses of action are becoming necessary. Theory performs in the precise sense that I have given to this term. And what explains the deployment of this world is the ticker and its circulation. As shown by Preda, the theory underlying technical analysis is highly elaborate. It was only with the Black-Scholes-Merton model that academic science reached the level of this theory in the wild, that is, not equally true, but powerful enough to make a world exist, its own world, one that is able to withstand the comparison with the world of tickers and to enter into a performance struggle.

Convergences?

The cases analyzed in this book correspond to situations in which the different programs that participate in the performance of the economy eventually prove to be compatible, even if they differ on a number of points. Just as the question was formerly posed of the so-called convergence of industrial societies – whether socialist

²⁴ Preda notes that those who, like Bachelier, maintain that the probability clause is adapted to price analysis, are precisely the same ones who had no instrument for observation and recording. Without the adequate technology, they were in a sense limited to the probabilistic hypothesis.

or capitalist – we can now pose that of the convergence of performing economics – whether academic or in the wild.²⁵

The thesis that I would like to present in this section is the following: a certain sort of convergence exists and is organized around an anthropological program that is not very different from the neo-classical one (broadly speaking). This explains why common sense refers to "the market economy" to talk about the economy, and why notions such as "neo-liberalism" are currently used to capture what seems to be an overall logic.

I will argue that this shared anthropological program has three main features.

1) It promotes the disentanglement of things and humans; 2) it asserts the centrality of individual human agencies; and, finally, 3) it tends to underplay the uneven distribution of calculative equipments and capacities amongst agencies.

Disentanglements (and Re-Entanglements)

The different chapters in MacKenzie, Muniesa and Siu (forthcoming) all recount stories of disentanglement through which, with growing force and clarity, a world exists in which entities are transformed (and retransformed) into things and then goods (Callon, Méadel, and Rabeharisoa 2002) that can circulate, passing from hand to hand, alternating between detachments and (re)attachments, and in which a deep divide has been created and maintained between these objectified things and the generally human agencies that produce, exchange and consume them.

Holm analyzes the mechanisms through which two new beings were simultaneously brought into existence: the cyberfish and its (ocean) bedfellow, the Norwegian economicus fisherpeople. This performance started with an initial series of disentanglements that broke up the fishing community - a community in which fish and fishermen had coexisted, attached to one another- until they became strangers. The fish were disentangled from the sea in which they had always hidden. They were

²⁵ Convergence must be understood as the construction of more or less extended compatibilities and not as the elimination of any difference.

reduced to bar codes, quotas that could be sold and taken advantage of, "stocks" of populations to conserve and develop, a dissuasive weapon in international power struggles. At many junctures, economics intervened decisively in this process. It allied itself with the forces that performed these new ontologies, bringing in its own, strategic one when it was a matter of organizing markets, that is, of attaching appropriately formulated property rights, creating the relevant incentives, and defining control procedures and devices. The selfish (fish)erman could then develop and prosper. This performance is no more miraculous than is the fishing that it allows. Didier in a story reminiscent of Cronon's work on the market in "futures" on grain (Cronon 1991), likewise describes the manipulations that allowed the constitution of the cyber-pickle (albeit a cyber-pickle produced by technologies that predate the digital computer) and that so marvelously illustrate the required disentanglements. As time goes by the divide between calculative agencies and calculable goods grows wider and establishes a market based on an anthropology well described by economics, especially neo-classical economics. It is clearly a convergence that is announced and initiated here.

A series of disentanglements is also found in the history of spectrum auctions. The first disentanglement was the one wanted by the FCC which imposed a reshaping of all the old Mafia-like networks within which licenses were granted. In the terms of economic sociology à la Polanyi-Granovetter, the auction aimed to disembed firms and administrations, and to bring new interests into play. The second disentanglement brought GTs and EEs into contact and triggered a lot of controversies. The definition (which I call "qualification") of goods to be auctioned generated debate. The question was whether to disentangle the frequencies that applied to different geographical areas, and consequently to multiply goods (GTs), or rather to entangle them in order to form a single good (EEs). The GTs won the battle and pushed the disentanglement process a step forward, deploying the market world further and further. Without economics (that of GTs) this deployment would have been simply unimaginable.

Financial markets also supply numerous examples of this convergence that deepens the disentanglement (re-entanglement) mechanism and allows the production of things and goods. For a long time and until recently, options were seen as barely-disguised forms of gambling. Their development has perpetually been submitted to

scrutiny on moral grounds. Millo has shown how these financial products were gradually disentangled from such moral issues and dissociated from gambling (Millo 2003). MacKenzie notes that with the Black-Scholes-Merton model this disentanglement is complete. The Black-Scholes formula defends the legitimacy of the very idea of an options market, on which rational calculations can be made. It imposes the market that it describes, by transforming options and derivatives into economic goods whose prices can be calculated objectively. The accusation of gambling and immorality automatically falls away. MacKenzie adds – and this point is strategic – that a difference is thus created: the new market is different from the preceding one. Economists do not simply legitimize, reveal or express practices and existing models: "The Black-Scholes-Merton model did more than simply express price patterns that were already there. The use of models altered price patterns [...]." Of interest from the point of view of convergence, under consideration here, is the fact that a competing economics, born before and outside academia (an economics in the wild), helped to lay the ground by furthering this disentanglement. The economics in question was chartism, the history of which has been studied in detail by Preda. Apart from competition between the two forms of economics (Chartism assumes the existence of significant regularities in the forms of price variations, whereas the Black-Scholes-Merton model posits a random walk), there is profound agreement on the economic nature of options (which no longer risk being likened to gambling). This might explain why chartist practices are still being used in the field, in parallel with or as a complement to the Black-Scholes-Merton model.

These cases indicate how economics plays a crucial role in making this convergence possible and in accelerating and finalizing it. All in all, what dominant economics does, in close collaboration (even when it is conflicting) with the leading productive forces of modernity that the natural sciences are, is to perform disentanglements which cause market goods to proliferate while dissociating them from the agencies that are in a position to produce and trade them (for a wonderful historical analysis of such a process see Mitchell 2002).

Human Individual Agencies

It is not enough to separate goods and agencies. One also has to profile the latter, and the options available for that profiling are obviously multiple. A second feature common to most performative programs of economics (confined or in the wild) is that they share an identical choice, that of producing individual human agencies capable of calculating their interests in one way or another. They tend to localize agencies in (individual) human corporeal envelopes and to equip them with tools, instruments, prostheses (obviously distributed but under the control of particular individuals) and rights, enabling them to construct something like individual interests (likened to income, indexes of satisfaction or welfare, or degrees of recognition of their legitimate dignity), and granting them the resources to calculate them. What "human" means in the term "the human being" is the outcome of co-performance in which economics plays a key part. The human being is not a starting point.

The "individualization of the agency", that is, the performance of a self-interested agency obsessed by the calculation-optimization of his or her own interest, is clearly visible in the case of the Norwegian fisherpeople. Petter Holm shows that once all the scientific, material, technical and institutional investments have been made to transform the sea into an aquarium and the wild fish into a cyborg fish, the ground has been cleared for the conception and construction of a market in which fishermen are transformed into selfish individual economic agencies. The convergence is evident here: an implicit agreement exists between different groups of professionals, experts, institutions, scientific disciplines, and public national and international bodies, to enact this anthropological model.

The same convergence can be observed at a micro level in the economic experiments analyzed by Mirowski and Nik-Khah (forthcoming). Economists (GTs or EEs) as well as federal agencies share the same general hypotheses: the agent has preferences (whether they are revisable or not) and the challenge is to equip that agent so that s/he is able to calculate and defend them as well as possible. Each player is thus supported by their computers, algorithms and favorite economists! This convergence is even clearer in the case studied by Lepinay (forthcoming): mathematicians, financiers, engineers and traders calculating with their bodies all

contribute in their own way towards the production of a calculation that enables them to qualify and price a disentangled product.

At this point we need to consider a question raised by MacKenzie and Millo (2003). They say that certain selfless behaviors of traders (who agree to integrate into their calculation a parameter – skewness – whose value is supplied by a designated primary market maker, and to refrain from engaging in free-rider strategies that would enable them to increase their profits) can be explained only by means of conventional economic sociology. These traders behave in a moral way, with a sense of solidarity, because they are entangled in social networks and communities.

Hence, MacKenzie's question: "How should we theorize the articulation between performativity and markets seen as networks, culture and moral communities?" (MacKenzie and Millo 2003). Reset in the terms of this book (MacKenzie, Muniesa and Siu, forthcoming), the question becomes: does the convergence of anthropological programs not encounter limits? Can it go so far as to produce a monolithic agency that is entirely calculative, to the point of imposing a homo economicus who is so well framed that he no longer overflows? MacKenzie and Millo's answer to this question is a resounding 'No': "With the aid of economic theory, of technology and of much else, a passable version of homo economicus can be and has been configured cognitively, so to speak. Whether he can be configured morally, out of real men and women, remains an open question" (p. 141).

MacKenzie and Millo are right to answer in the negative. Humans in their somatic envelope, made of neurons, genes, proteins and stem cells are constantly overflowing. A total, unambiguous configuration is impossible. There is always a remainder, something that hasn't been taken into account. But this must obviously not lead us to consider that moral behaviors are not framed and arranged in the same way as selfish ones. What MacKenzie and Millo observe is that the trader alternates between different framings, passing from one configuration of *agencements* to another. The question that they ask seems to be able to be formulated as follows: how can traders' alternation between calculative and non-calculative *agencements* be analyzed and described? This question is largely unexplored, but partial answers have been proposed. First, the symmetry between selfish and altruistic *agencements* has

been shown; both involve material, textual, procedural and other investments. When homo economicus becomes altruistic "again", he does not rediscover his true nature; he changes his equipment. Second – and this point is even more fundamental – calculative and non-calculative *agencements* are mutually interwoven. Thus, they cannot be conceived of as exogenous, exclusive or even hostile. They share elements, which makes alternation resemble the cross dissolves in the movies: non-calculation implies elements of calculation and vice-versa. In other words, there are no economic markets without moral *agencements*; or, conversely, any altruistic *agencement* is calculated (Callon and Law 2005). In any case, the question is crucial for the performativity program: the anthropology of economics is constantly confronted with other, equally performative, anthropological programs.

Finally, this work of performance of individual agencies and their calculative capacities translates – and this is a strong point of convergence – into a very high level of asymmetry between those individual agencies which are almost totally deprived of the prostheses and rights that would enable them to negotiate, calculate and defend their interests, and those which, by contrast, have immense calculative capacities. This inequality is due to the fact that performance of the economy by economics is always a co-performance, and that the programs represented in co-performance favor the agencies whose competencies are already firmly established. (A history of economics should be written, which shows up the mechanisms through which the strongest agencies – that is, the best equipped – become stronger by performing the very world in which they can thrive.)

Unequal calculating capacities

We have shown (Callon and Muniesa 2005) that economic markets are better described as collective calculating devices where socio-technical algorithms organize and, very often, facilitate encounters between agents endowed with unequal calculating capacities. The recent dissertation that Koray Caliskan devoted to the functioning of the global cotton market illustrates this point. It shows how dominant economic agents design and impose modalities of encountering, and consequently socio-technical algorithms of pricing that produce asymmetries and guarantee the domination of certain agencies over others. These asymmetries, Caliskan tells us, can

be explained by means of the notion of prosthetic prices (Caliskan 2005). At any point in time a large number of different prices exist in the cotton market. In the transactions that occur on various sites (in the Turkish or Egyptian countryside, in Izmir or Alexandria, or in the New York Board of Trade) certain agents have access to a wide range of existing prices that they transform into "prosthetic prices", that is, into inputs into a calculation that only they master and that enables them to decide on the price in the transaction in which they are engaged. The strongest agent is the one who can play with the largest number of prosthetic prices to calculate and set the price of the transaction. Caliskan notes that this calculative capacity is unequally distributed. The Egyptian farmer is soon submerged; the price he offers is reduced by his interlocutor to a prosthetic price among many others, and he loses control. He is calculated by one stronger than he as he delivers his bales of cotton, and at the same time he is rendered incapable of choosing another partner

These asymmetries, that scale-one markets produce and reproduce, are at the centre of the negotiations and compromises punctuating the design and implementation of the electronic economy. Muniesa, analyzing the automation of the Paris Stock Exchange, has shown that the choice of computer algorithms and digital equipment constantly raised questions of accuracy, fairness, transparency and equity. Existing balances of power frequently lead to options that favour certain asymmetries. Bergstrom and Mellet have shown how the technologies used to make labour markets more transparent or to "rationalize" calls for tenders (in the case of B2B markets), could sometimes deliberately result in an inversion of the balance of power between suppliers and buyers, just by reallocating calculating capacities (Mellet, Marchal and Rieucan 2005) (Lindberg and Bergström 2005).

The different anthropological programs developed – sometimes concurrently but very often in a convergent way – by economics at large and in particular by the different professionals and experts who equip markets, tend to overlook inequalities in calculating equipment and even more frequently are actually busy trying to produce such inequalities. They likewise disregard or even worse promotes the fact that the organization of encounters, for instance between buyers and suppliers, directs badly-equipped agencies towards well-equipped ones. In the bracketing off of these issues,

economics particularly in its most abstract and formal parts has played and still does play a decisive role in producing and reproducing inequalities.

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This triple convergence (a disentanglements of goods and agencies, a shaping of individual agencies, either an ignorance or production of uneven distributions of calculating capacities), does not lead to the imposition of homogeneous markets. It does nevertheless impose a certain form of economy that, increasingly, is reduced to nothing but a question of "the" market and tends to confuse the possible plurality of markets and forms of competition with an anthropological model that is highly compatible with neo-classical economics.²⁶

Behind convergence, divergences obviously exist. As shown in great detail in the different chapters of this book, actual markets are heterogeneous assemblages that are integrated to a greater or lesser degree and are always capable of disassembling locally. The good news is that there is no overall logic, thanks to the struggles of performance. It is precisely these power struggles between competing programs which make the disassembling and reassembling process possible, necessitate investments that measure up to those by which actual markets were formatted. Only carefully prepared and organized experiments can achieve such a concentration of resources. They form an obligatory point of passage for a perpetually local production and exploitation of differences.

On Economics Experiments

The failure of so-called planned economies has contributed to free us of the belief in Kapitalism and of the myth of Revolution as the only alternative.²⁷ We are

²⁶ This model assumes the obviousness of the three elements described in this section (Non human/human divide; individual agency; competition between equal agencies).

²⁷ I use the word Kapitalism, with a capital K, to denote the reality imagined by everyone who considers the Western economic system to be a homogeneous reality, endowed with its own logic. The

no longer in a period when the only choice was between a program aimed at performing an entirely state controlled economy, and a symmetrical, equally monolithic, program of performance of self-regulated markets. It is time indeed, as Gibson-Graham suggests, to unpack the notion of markets as self-regulated institutions and to think of projects in which models or programs are experimented with for constructing multiple axes of economic diversity (Gibson-Graham 2003). Future societies will probably have to be pluralistic in all of their organizations, including the economy. There is no pre-given path to follow. Saying that the economy is performed by economics (at large), means implicitly highlighting the existence of a plurality of possible organizations of economic activity and of several programs than can be conceived of and tested, that is (co)performed. The notion of performance leads to that of experimentation.

Experiments can be organized in many ways. A first strategy consists of choosing the laboratory as a starting point. Guala's chapter perfectly illustrates this point (Guala, forthcoming). For him, the remarkable development of experimental economics in recent years has gone hand in hand with its the profound evolution. Initially designed to test the hypotheses of academic economics, experimental economics has gradually turned into an institution-building program. As Guala notes, it is by becoming aware of its performative dimension that experimental economics accomplished this transformation and is now both legitimate and influential. "Building new institutions" means aiming at constructing what I have proposed to call socio-technical *agencements*. That means also organizing trials of strength in order to validate assumptions and to enact procedures. The looping process can then take place; new hypotheses can be tested, new socio-technical *agencements* proposed and, in return, lessons learned that revive theoretical analysis. The design of laboratories where new forms of economic activities can be tested and experimented is a strategic site for those interested in the performativity thesis.

assumption of a homogenous economic reality is made by those who criticize capitalism, thus defined, as well as by those who defend it by talking of the market and its laws, in general. Experiments in the past decades have shown that Kapitalism could only be a fiction: no program has managed to make Kapitalism exist nor to overthrow it. There are only capitalisms; see Barry (2004).

Economic experiments include experimental economics, as redefined by Guala, but are obviously not restricted to it. Gibson-Graham (2003) describes in detail experiments in the wild aimed at constructing cooperative economies and an economics of cooperative actions. The Mondragon cooperative, constantly criticized from all sides, devised and applied original rules and devices that inspired experiments in other countries. The organizational innovations that were tested and progressively enhanced took into account a series of requirements, real terms of reference: choosing products that would link the cooperative to the regional economy; defining rules for calculating the surplus production and its distribution; testing original forms of savings. These innovations in the field were made, it seems, without the help of academic economists and sometimes even against them! The strategy followed was to abandon the project of substituting a new form of economy for another (replacing Kapitalism), and instead creating sustainable niches. The cooperative does not propose *the* alternative solution to a general problem but *a* particular solution to a series of very specific problems. In so doing it does not help to strengthen the illusion that global forms of organization of the economy exist. The thesis of performativity pays justice to these strategies which strive to experiment with new settings, new forms of *agencements*, and which raise the question of their transpositions.

Moreover, by inviting us to consider actual economic organizations as the outcomes of explicit or implicit performance struggles, the performativity thesis incites us to get rid of epistemological considerations and to adopt a more pragmatic stance. Mitchell's chapter perfectly illustrates how the change that Guala sees in experimental economics could be extended to *in vivo* experiments and economics in the wild (Mitchell, forthcoming). Property rights theory is one of the cornerstones of neo-classical theory and of ... de Soto's program. Instead of privileging epistemology (is neo-classical economy true or wrong?) and considering the (relative) failure of this program as a proof of its lack of realism, Mitchell describes it as the unpredictable outcome of a battle between two opposite (performative) programs, i.e. as an (even if involuntary) actual scale one experiment. Lessons can be drawn from this (unequal) trial of strength, in particular about the assumption of the existence of clear boundaries between markets and non-markets and also about the role of property rights in "formatting a form of exclusion-inclusion" by causing property transfers

from the poor to the rich.²⁸ By highlighting the confrontation between two property rights theories, one produced by confined economics and the second by economics in the wild, Mitchell's chapter invites us to go further and to raise the more general question of the emergence, conditions of survival and extension of certain forms of economy that are born outside academic circles and that illustrate the inventiveness and audacity of economists in the wild specially when they are confronted with stubborn professional economists.

The variety of experiment's sites and forms of organization – as illustrated by Guala's and Mitchell's studies (forthcoming) of very contrasted settings – raises the question of their typology. The chapter by Muniesa and Callon (forthcoming) proposes several analytical categories to grasp the diversity of modalities of experimentation, linked to different types of economics at large. They thus distinguish three types of site for experiments: laboratories, platforms, and *in vivo* experiments. They note that an interesting question is that of the choice of a particular type of site, but also of the categories of problems that are posed. One of the challenges for the future, they tell us, is the networking of these sites and its organization.

This networking should probably facilitate the cooperation/confrontation between different populations of economists, including confined economists and economists in the wild. Why not conceive of economists in the wild, who have been running experiments on cooperative economy for decades, conducting laboratory experiments in cooperation with academic economists, for instance to test different rules of distribution of surplus or different modalities of setting wages? Gibson-Graham (2003) points out for example the "lack of an appropriate economic analysis for building new cooperative economics" and more particularly "the underdevelopment of an economics of surplus labor distribution." Why not envisage, symmetrically, that laboratory economists may be invited to continue their work *in vivo*, or even to start it *in vivo* where relevant. These joint experimental networks should facilitate the appearance and evaluation of a wider diversity of forms of

²⁸ See also Elyachar and her analysis of NGO's micro-lending programs in Egypt (Elyachar 2005).

organization of economic activities²⁹ and introduce within academic economics more theoretical variety. Convergence will be no longer our only fate.

The territory that is opening up to the social sciences is vast. All the social sciences, not just economics, can contribute to this research program, alongside the agents engaged in economic activities (Barry and Slater 2005). We no longer have to choose between interpreting the world and transforming it. Our work, together with the actors, is to multiply possible worlds through collective experimentations and performances.

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²⁹ This evolution could be related to the growth of what Thrift (2005) calls "knowing capitalism".

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