

9

ESSAY REVIEW

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POSTMODERN? NO, SIMPLY AMODERN! STEPS
TOWARDS AN ANTHROPOLOGY OF SCIENCE

Steven Shapin and Simon Schaffer, *Leviathan and the Air-Pump: Hobbes, Boyle and the Experimental Life* (Princeton University Press, 1985); Michel Serres, *Statues* (Bourin: Paris, 1987); Sharon Traweck, *Beam Times and Life Times, The World of High Energy Physicists* (Harvard University Press, 1988).

"Science is shadowed, at a constant distance, by its own anthropology" (Serres, *Statues*, p. 41)

I. False Starts

SINCE THE time of Lévy-Bruhl, anthropology has always been interested in science, but in the sciences of the Others: how come that for Them the cassowary is *not* classified as a bird, this was a legitimate question; how come that modern taxonomists do classify the cassowary as a bird was not in the purview of anthropologists. Either they took it for granted or they left this question to historians of science. The courageous questions raised twice by Horton have remained isolated.¹ The result of this asymmetric treatment of Us and Them is that although ethnoscience has been for many years a thriving domain of cognitive anthropology since Mauss's essay with Durkheim all the way to Conklin,² putting to use the methods of anthropology in order to understand *our* sciences is only recent.

The extraordinary difficulty of the task is illustrated by Lévi-Strauss' *La Pensée Sauvage*.³ In order to save the savages from the accusation of being intellectually inferior, Lévi-Strauss finds no other solution but to transform the savage mind into an *alter ego* of the scientific one — that is of what Lévi-Strauss takes to be a scientific mind: ideas, abstractions, reflexion, combinatory power. But horrified at the possible confusion between the two know-

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¹R. Horton, 'African Traditional Thought and Western Science', *Africa* 1 (1967), 155-187; 'Tradition and Modernity Revisited', in M. Hollis and S. Lukes (eds), *Rationality and Relativism* (Oxford: Blackwell, 1982), pp. 201-260.

²H. Conklin, *Ethnographic Atlas of the Ifigao. A Study of Environment, Culture and Society in Northern Luzon* (New Haven: Yale University Press, 1983).

³C. Lévi-Strauss, *La Pensée Sauvage* (Paris: Plon, 1962).

ledges that he wants nevertheless to maintain as distant as possible, he falls back on the most classic dichotomy: They live in cold societies and remain bricoleurs; We, on the other hand, live in warm societies and think like engineers starting always from first principles. The two have to be similar — so as to avoid the discriminatory bias — while remaining infinitely distant — to avoid the pollution. The confusion is so complete that sentences contradict each other making the book extremely difficult to read.

In a later book which might mark the beginning of anthropology of science, Jack Goody (1977)⁴ derides Lévi-Strauss' dichotomy and offers to replace the Great Intellectual Divide by a series of smaller *material* divides: writing, practices of list making, skills at handling proto-libraries. A pragmatic of inscription that is empirically studiable replaces a whole series of unverifiable questions about the mind, *Theirs* as well as *Ours*.⁵

Still, Goody and cognitive anthropologists have remained interested in what is the classical domain of anthropology: the Tropics; they rarely show any interest in the air-conditioned sterile rooms of the modern laboratories. On the other hand, the few people, myself included, who have used ethnographic methods to get at modern sciences have used the most outdated version of anthropology: the *outside* observer who does not know the language and the customs of the natives, who stays for a long time in one place and tries to make sense of what they do and think by using a metalanguage which is as distant as possible from those of the natives who are not supposed to read what he writes. As Woolgar has pointed out many times,⁶ this is a very naive version of the naive observer — a version that is now abandoned in mainstream ethnography and which seems to survive only in so called "lab studies".

The total disregard of science by anthropologists, the asymmetry of ethnoscience, the confusion of Lévi-Strauss, the interruption of Horton's and Goody's research programmes, the naïveté of ethnography of laboratories, show the enormous difficulty of the task: if there is something of which we cannot do the anthropology, it is science, *our* science. Even if it were understandable in cultural terms, which is far from granted, we Western scholars, who live inside the world built for us by science, would be unable to carry out the study. Only really complete outsiders might be able to perform it — and we would not like their results . . .

This is why the three books chosen for this essay review are so important: they all show a way out of the confusing use of the expression "anthropology of science" that I coined so clumsily a decade or two ago. There is a price to

⁴ J. Goody, *The Domestication of the Savage Mind* (Cambridge: Cambridge University Press, 1977).

⁵ B. Latour, 'Visualization and Cognition', *Sociology of Knowledge. Studies in the Sociology of Culture* 6 (1986), 1–40.

⁶ S. Woolgar, *Science: The Very Idea* (London: Tavistock, 1988).

pay of course for the renewed and principled use of the expression: most of what we believe anthropology to be has to be abandoned and so has most of what we believe science to be . . . But the reward is infinitely greater: we are finally ushered out of the *modern* world without becoming post-modern, the most sterile and boring intellectual movement ever to emerge.

II. In the Beginning were Hobbes and Boyle

Insofar as we have displayed the political status of solutions to problems of knowledge, we have not referred to politics as something that happens solely outside of science and which can, so to speak, press in upon it. The experimental community [set up by Boyle] vigorously developed and deployed such boundary-speech, and we have sought to situate this speech historically and to explain why these conventionalized ways of talking developed. What we cannot do if we want to be serious about the historical nature of our inquiry is to use such actor's speech unthinkingly as an explanatory resource. The language that transports politics outside of science is precisely what we need to understand and explain. We find ourselves standing against much current sentiment in the history of science that holds that we should have less talk of the "insides" and "outsides" of science, that we have transcended such outmoded categories. Far from it; we have not yet begun to understand the issues involved. We still need to understand how such boundary-conventions developed: how, as a matter of historical record, scientific actors allocated items with respect to *their* boundaries (not ours), and how, as a matter of record, they behaved with respect to the items thus allocated. Nor should we take any one system of boundaries as belonging self-evidently to the thing that is called "science". (S & S, pp. 341–342).

This long citation at the end of the book by Shapin and Schaffer (hereafter S & S) marks the real start of an anthropology of science. Their work has been often mistaken for a book on the social history of 17th century science. Were this to be the case the only way to assess its quality would be to check if the social context of revolutionary England could explain the development of Boyle's physics and the failure of Hobbes's mathematics. As this quotation indicates, they refuse to do that; theirs is a book of social theory — and this is the reason why it was lost on historians of science and of the 17th century. It is a book about the theory of the *co-production of science and its social context*. Far from framing the science of Boyle into the social context of England, or "pressing" society onto science, S & S explore how both Boyle and Hobbes struggled to invent a science *and* a context *and* a divide between the two. They cannot explain the content by the context since — in the most literal sense — neither of them exist *before* Boyle and Hobbes achieve their respective goals and settle their disputes.

The beauty of the book is that they dig out the science of Hobbes — ignored by political philosophers who are ashamed at their hero's rambling mathematics — and rescue from oblivion the politics of Boyle — ignored by historians

of science who are ashamed at the organizational work of their hero. Instead of an asymmetry and a divide — to Boyle the science, to Hobbes the political theory — S & S obtain four quadrants: Boyle has a science and a political theory; Hobbes has a political theory and a science. This in itself would not be interesting if the two heroes of the two divorced histories were far apart — if one were, say, a Paracelsian philosopher and the other, say, a legit in the manner of Bodin. But, on the contrary, they agree on almost everything. They want a King, they want a disciplined Parliament, they want a disciplined unified Church, and they are all for a “mechanistic” philosophy. Although they are both firmly attached to the rationalist tradition, they nevertheless differ in a few crucial ways on what to expect from experiment, from scientific reasoning and from the air-pump. Hobbes’ and Boyle’s disagreements in the middle of Revolutionary England are turned into the “fruit flies” of the new social theory of science the authors develop.

(a) *Two social theories of assent and dissent*

When philosophers of science invent models to follow scientific change they always take it for granted that scientists do experiments, report their work and discuss each other’s arguments. The fascinating first chapter of S & S reconstructs the archeology of this very organization of assent and dissent.

Boyle, in the middle of dozens of embedded civil wars over who has the authority, chooses to give credence to a way of arguing which the longest scholastic tradition derided, that of *opinion*. Boyle and his colleagues abandon the certainty of apodictic reasoning for the doxa. This doxa is of course not the rambling imagination of the credulous masses, but a careful management of what trusting gentlemen can come to accept — no gentlewomen are allowed here. Instead of using logic, mathematics or rhetoric, Boyle relies on a para-legal metaphor: witnesses surrounding the scene of action can testify to the existence of something, the matter of fact, even though they do not know its real ontological nature. The very empirical style we still use today is crafted by Boyle in order to manage this witnessing. No wonder literary theorists have difficulty in applying semiotic tools from the literary literature to the scientific one: Boyle forced a widening gap between the adorned style and a dry style of reporting:

In almost every one of the following essays I . . . speak so doubtingly, and use so often, perhaps, it seems, it is *not improbable*, and such other expressions, as argue a diffidence of the truth of the opinions I incline to, and that I should be so shy of laying down principles, and sometimes of so much as venturing at explications (cited p. 67).

If you find scientific literature boring, well it was intended to be so! Only a carefully boring lengthy reporting full of modalities and of the circumstances of the experiment, could turn the weakness of relying on doxa into a strength,

the strength with which Boyle hoped to reverse all matters of dissent that fuelled the civil wars.

This new way of arguing is possible only because the gentlemen are not asked to give their inner opinions but to watch an artificially produced phenomenon. The irony of the authors’ interpretation of Boyle is that the very question of social constructivists — are facts artificially produced in the laboratory? — is precisely the question Boyle raises and solves. Yes, facts are made up in the new set-up of the lab and through the artificial mediation of the air-pump. “*Les faits sont faits*”. But if they are made up, are they false? No, because Boyle, like Hobbes, extends to man the “constructivism” of God — God knows things because he creates them.⁷ The Leviathan is known because it is fabricated by us; the matters of fact are known because they are manufactured under controlled conditions by us. What could be a weakness is now a strength on the condition of limiting knowledge to the instrument-made matters of fact and leaving aside the interpretation of the causes. Here too Boyle turns a weakness — we only produce local laboratory-made matters of fact — into a strength: facts will never be modified whatever happens in theory or in metaphysics or in religion or in politics or in logic.

All the resources we take for granted — matters of fact are different from interpretations, artificial instruments may bear witness to genuine phenomena, experiments can settle disputes about matters of fact, disagreements about reported facts are not *ad hominem* critiques of the reporter, absent witnesses may still judge the reliability through the accurate report of the experiment, everyone can have access to the report and to the production of science — are circumvented by S & S’s rendering of Boyle’s “technologies”. Before their book they were the resources we employed ourselves to write science and to interpret its development; now they become *what is to be explained* by historians of science. The explanation that was part of the solution is now part of the problem. Yes, the very existence of “fact” has a history, too, that is made by Boyle and his fellows in order to turn civil wars into organized assent. The ratchet is in place that is going to give modern science its most spectacular feature: irreversible accumulation. The pay-off in the long run will be worth the apparent limitation of rationality to a few artificial trivia extracted from an expensive air pump.

Hobbes disagrees with the whole management of dissent Boyle has set up. Hobbes also wants to put an end to civil war; he also wants to do it through a materialistic science; he also wants to set aside the free interpretation of the Bible by clerks and common people. But he wants to achieve this goal through a *unification* of the Body Politic. The Sovereign created by the social contract,

⁷A. Funkenstein, *Theology and the Scientific Imagination from the Middle Ages to the 17th Century* (Princeton: Princeton University Press, 1986).

"that mortal God to which we owe, under the immortal God, our peace and defence", is nothing but the representant of the multitude. "It is the *unity* of the representer, not the *unity* of the represented that maketh the person *one*". Hobbes is obsessed by this unity of the Person who is, as he puts it, the actor of which, we citizens, are the authors. It is because of its unity that there should be no transcendence. Civil wars are raging when there exist supernatural entities to which citizens feel entitled to appeal when they deem themselves to be persecuted by the authorities of this base world. The dual loyalty of the old medieval society — God and the King as two parallel crowns — is no longer possible if everyone may appeal *directly* to God. Hobbes wants to get rid entirely of this dualism. In effect he wants to reobtain Catholic unity but by blocking all accesses to God's transcendence.

For Hobbes, Power is Knowledge, which means that there should be only one Knowledge and one Power if one wants to settle the civil wars. This is why most of the Leviathan is an exegesis of the Old and New Testament: no interpretation should be allowed to appeal to a higher authority than the civil one. Especially dangerous is the belief in immaterial bodies like spirits, ghosts or souls, that people can wave around in order to transcend the force, the flesh and the authority of civil power. Antigone, claiming the superior rights of piety above the "*raison d'état*" of Creon, is dangerous and so are Levellers and Diggers appealing to the living powers of matter and the free interpretation of the Bible to disobey their lawful Princes. An inert and mechanical matter is as essential to civil peace as is a symbolic message of the Bible. In both cases what should be rendered impossible is the appeal by factions to a superior Entity — Nature or God — that is not fully controlled by the sovereign. This reductionist argument is not of course a plea for totalitarianism, because Hobbes applies it to the sovereign *itself*: the Sovereign is *nothing but* the designated actor of the multitude's wishes and wills. It is not a superior entity to which the King, or whoever occupies the place, could appeal in order to behave as he wishes and break down the Leviathan. In this new regime of Knowledge *qua* Power *everything* is reduced: the Sovereign, God, Matter, the Multitude.

Hobbes goes even further and seals off the very way of turning his own science of the state into an appeal for a transcendence of some sort. All of these scientific results are obtained not through opinion, observation or revelation, but through a demonstration, the only form of argument that forces *everyone* into assent, and this demonstration itself is not obtained by some sort of transcendental mathematics, as for Plato's King, but by a purely computational instrument: the mechanistic brain. Even the social covenant is a computational result obtained at once by all the terrorised citizens striving to escape the state of nature. Such is the coherent reductionism that Hobbes produces to settle civil wars: no transcendence whatsoever; no appeal to God, to a living Matter, to a super Divine Right of Command or to Mathematics.

The stage is now set for the beautiful confrontation between Hobbes and Boyle. After all that Hobbes had done to reunify the Body Politic, here come the Royal Society fellows who break it apart again: a few wealthy individual citizens claim the right of independent opinion, in a private space, the laboratory, over which the State has no control; they do not argue through demonstration everyone is forced to accept, but through experiments watched by a few gentlemen of wealth and means and these experiments are unexplainable and inconclusive; and in addition to that, of all their new coterie's gadgets they chose to focus on an air-pump that produces *immaterial bodies* again, as if it had not been difficult enough for Hobbes to get rid of ghosts and spirits! So here we are again, Hobbes argues, back to the civil war! We will no longer have the Levellers dispute the authority of the King in the name of their private interpretation of God and of the manifestation of matter — they have been crushed to death. But we will have the old-boy network which will dispute the authority of everyone in the name of Nature and of artificially produced laboratory events. If you leave experimenters to produce their matters of fact, Hobbes tells the King, and if they let vacuum sneak into the air pump, then you will have again divided authority; ghostly spirits will again prompt every one to revolt. Knowledge and Power will be divided again. You will be "seeing double".

In Hobbes's view the elimination of vacuum was a contribution to the avoidance of civil war. The dualist ontology deployed by priests spoke of existents which were not matter: this made men "see double" and resulted in the fragmentation of authority which led inexorably to chaos and civil war (p. 108).

(b) *A counter-Copernican revolution*

This interpretation of Hobbes's plenism however would not qualify the book for inclusion in anthropology of science. After all, good intellectual historians could have done the same job. In the three following chapters S & S break away from the confines of intellectual history, they move from the world of opinions and arguments to the world of practice and skills. For the first time in the literature of science studies, it is through the details of the practice of an instrument that all the ideas about God, the King, Matter, Miracles and Morals, are translated and made to pass. Others have studied the *practice* of science; others have studied the religious, political and cultural *context* of science; but none so far have been able to do the two at once. It is the ingenuity of the 17th century that makes it possible. Boyle wants to bypass the experimental setting altogether; Boyle forces the discussion to go through detailed counterargument about the leaks, and the joints and the cranks of the machine — mechanical philosopher he is indeed. Philosophers of science and historians of ideas wish to bypass the world of the laboratory altogether, this disgusting kitchen where ideas are suffocating in trivia; S & S force them to

scrutinize all the possible details of the laboratory set-up — ethnographers of science they both are indeed.

This is where the book becomes so important. In what is no less than a reverse Copernican revolution, S & S make their analysis and that of their characters turn *around the object*, around *this* specific leaking and transparent air pump. The practice of object-making regains the central place it had lost with the Critique. The book is not just empirical in the sense that there are many details, or in the sense that experiments from now on settle otiose disputes. It is empirical in the sense that it does the archaeology of any empirical claim in the same way as Michel Serres is doing the anthropology of any object, what he calls *pragmatology* (see below). S & S do in a quasi-ethnographic way what philosophers no longer do: show the realist foundation of science. But instead of raising the questions of reality far away in what nature is "out there", S & S solve it practically *in here*, in the laboratory. We can read all of Kant and most philosophers of science, Bachelard and Hacking excepted, without hearing a word on instruments. They take for granted that there are instruments, and laboratories, and witnesses, and resources to interpret success and failure. But the "trouble with experiments" is that they do not work. They leak. They have to be patched up. Those who are unable to explain this irruption of objects into the human Collective, with all the skills and practices they entail, are not anthropologists of science since they miss what is, since Boyle's time, the most important feature of our cultures: we live in societies built on laboratory-made objects; ideas have been replaced by skills; apodictic reasoning by managed doxa; universal assent by old-boy networks of professional colleagues. The beautiful order Hobbes was trying to reobtain, is shattered by private spaces invoking the transcendental power of man-made/not man-made unexplainable/explainable matters of fact! Fancy that, a society based on matters of fact!

The triumph of Boyle is to transform a bricolage around a patched up air pump into a decisive way to win the partial assent of gentlemen about matters of fact; the triumph of S & S is to explain how and why discussions about the Body Politic, God and His miracles, Matter and its power, could be *made to go* through the air pump. This mystery is never explained by the social contextualists of science. They take for granted that *there is* a social macro context — England, Dynasties, Capitalism, Revolution, Merchants, Church — and that this context somehow influences, shapes, reflects, reverberates, presses upon "ideas about" matter, elasticity of air, vacuum, and Torricelli tubes. But they never account in the first place *for the establishment* of a link between God, King, Parliament and a suffocating bird in the closed transparent container of a pump the air of which is sucked out by the crank manned by a technician. Why is it that the experiment on the bird *translates* all the other disputes, and

does it in such a way that those who control the pump also control the King, God, and their retinues of macro-factors?

What irritates Hobbes so much is that Boyle modifies the *relative scale* of phenomena: macro-factors about matter and God's powers may be made amenable to an experimental solution and this solution will be a partial modest one. For major ontological and political reasons, Hobbes rejects the possibility of vacuum and insists that there is an invisible aether even when Boyle's workman is too exhausted to exhaust the pump any more. He requests a macroscopic answer to this "macro" argument, a demonstration that would prove that his ontology is not necessary, that vacuum is politically acceptable. What does Boyle do instead? He refines his experiment to show the effect on a detector — a feather! — of the aether wind postulated by Hobbes thus hoping to disprove his contradictor (p. 182). How ridiculous! Hobbes raises a big problem and he is rebutted by a feather inside a transparent glass inside a laboratory inside Boyle's mansion! Sure enough the feather does not tremble a bit, and Boyle draws the conclusion that Hobbes is wrong. But Hobbes can't be wrong since he denies that the phenomena he is talking about can be made to *change scale*. He denies the possibility of what is becoming the essential feature of modern power: change of scale and displacement through workshop and laboratories. Boyle, like Puss in Boots, is going to grab the Ogre that has become no bigger than a mouse.

The beauty of S & S's book is that they push to the limit their argument on objects, laboratory, skill, and variation of scale. If science is not idea-based but practice-based, if it is not outside but inside the transparent container of the pump and inside the transparent private space of the experimental community, then how does it extend "everywhere" so as to become as universal as Boyle's laws? Well, it does not. This point is made magnificently in a chapter which counts, on a par with the work of Harry Collins,⁵ as the most telling example of the fecundity of the new science studies. By following the replication of each prototype of the air pump through Europe and the progressive transformation of a costly, unreliable, and cumbersome piece of equipment into a cheap routinized blackbox that becomes an unproblematic part of every laboratory, S & S transform the universal application of a physical law into the *inside of a network* of standardized practice. Sure enough, Boyle's interpretation of vacuum spreads, but it spreads exactly as slowly and as fast as the extension of the community of experimenters and their equipment. No science can jump out of its network of practice. Simply, the skill and the equipment may become routinized to the point where the production of vacuum becomes, so to speak, as invisible as the air we breathe.

⁵H. Collins, *Changing Order: Replication and Induction in Scientific Practice* (London: Sage, 1985).

The strange thing about this chapter is that the routinization of the air pump happens without the authors' complete recognition. They are committed to a definition of skill and local contextual know-how that makes them extremely good at "Collinsizing" the belief in easy replication. Take any experiment and S & S will show you all the ways it could leak and break apart. Take a replication, they will show you that no two pumps are the same and that each transportation through Europe means a transformation of the pump. But the notion of local know-how in itself does not allow them to explain the *shift* in who knows how to do what. Instead of requiring major investment and great skill deployed by big scientists the pump may now be activated with little money and little competence by little scientists. This erosion of skills, this displacement in the point of application of the know-how, this fascinating way through which talked-about instruments become silent pieces of equipment, this shift from physicists to instrument makers, from Ph.D.s to technicians, is not well captured by notions such as practice or skill, since what is to be explained is a redistribution and reorganization of skills. The skills that were necessary at the beginning of the century are no longer necessary at the end. They have been delegated to reskilled (or "enskilld") non-humans.

III. The Founding Fathers of the Modern Constitution of Truth

We, moderns, are the children of the Critique and of the imperial gesture of Kant asking the things, from now on, to turn around the Transcendental Ego. There have been many quibbles inside the Critique to decide who should occupy the locus of the new sun — society? mind? theory? language games? epistémès? structure? brain? neurones? — but there has been no argument that this focus is the only thing worth occupying. S & S open a new way, the way of anthropology of science, because, like Serres, they *débase* the Critique's traditional centre of reference. If science is skill-based, laboratory-based, network-based, then *where* is it located? Where is its focus? Surely not on the side of the things-in-themselves since the facts are manufactured. But surely not on the side of the subject — society/brain/mind/culture — since the suffocating bird, since the cohering marbles, since the descending mercury column, are not of our making. Is the practice of science then somewhere in the *middle* of this line going from the Object-pole to the Subject-pole? Is it a hybrid, or a mixture? A little bit of Object and a little bit of Subject?

S & S do not provide a complete answer to that question, and no one expects them to do so because, on the dispute between Hobbes and Boyle who agree on everything but the management of experiment, the authors, who also probably agree on almost everything, disagree about the management of the "social" context. The last chapters of the book waver between a Hobbesian explanation of their own achievement and a Boylean account. Such a tension

makes their work all the more interesting and offers to the emerging anthropology of science another set of ideally suited "fruit flies" differing by only a few traits.

It is clear that S & S do not wish to replace the mind of the lone scientist by the micro social context — as Harry Collins would — since they talk at length about God, Nature, Matter and the Glorious Revolution. But it is also clear that they deny themselves the right to use the resources of the historical context since, through this new chapter in Plutarch's *Parallel Lives*, they show how Hobbes and Boyle themselves redefined the context in which they place each other's science. If the cohering marbles inside the leaking air pump are a locally situated historical achievement, so is the Glorious Revolution. Moreover, if notions like "discovery", "proof", "matters of fact", no longer provide an explanation since they became what should be explained, it is probable that notions like "context", "interest", "religious opinion", "class position", are also part of the problem rather than of the solution. If nature and epistemology are not made of transhistorical entities, then history and sociology are not either — except if one takes the asymmetrical Collinsian's position of being constructivist for nature and rationalist for society! But the probability of Boyle's law being *more* socially constructed than English society itself is rather dim . . .

The genius of having taken Hobbes and Boyle at once is that the new principle of symmetry — explain the construction of Nature as well as that of Society — is forced upon us for the first time in science studies by taking major protagonists at the very beginning of the modern era. Hobbes invents one of the main resources for talking about power — representation, sovereign, contract, property, citizens — while Boyle invents one of the main repertoires for talking about nature — experiment, matter of fact, colleagues. Hobbes invents this *artificial creation*, the Leviathan, while Boyle invents this other *artificial creation*, laboratory-made matters of fact. But what we did not know before, what is revealed for the first time by S & S's disputed studies of the dispute, is that this invention was a *dual invention*, the two faces of the same coin. It is not that Boyle invents scientific discourse and Hobbes political discourse, it is that *Boyle invents a political discourse where politics should not count and that Hobbes devises a scientific politics where experimental science should not count*. In other words, they are inventing our modern world, a world in which the *representation* of things through the medium of the laboratory is forever severed from the *representation* of citizens through the medium of the social contract. And thus, it is not by mistake that political philosophers "forgot" all about Hobbes's science and that historians of science "forgot" all about Boyle's politics of science. The very divide ushering us into the modern world was made for that very purpose: from now on every one should "see double" and make no direct connection between the representation of non-

humans and the representation of humans, between the artificiality of the facts and the artificiality of the Body Politic. The word "representation" itself is the same, but the very dispute between Hobbes and Boyle and their very achievement made unthinkable the similarity of the two meanings of the word — until, that is, S & S came across the dispute and stitched together again what had been so craftily severed. Now, but only now and through the beauty of their book, are the two meanings becoming again the *same* meaning.

But how to define this common meaning? The best way to make sense of our divided loyalty between humans and non-humans, is to think of a *constitution*. Boyle and Hobbes are like the Founding Fathers — they draft a constitution that allocates the rights, duties, appeal, and branches of our modern form of government. They are so to speak our "constituants". A constitution defines the competence of various actors or classes of actors, granting them legal protection, defining the limits of each power, portraying the checks and balances and detailing the procedures to solve the conflicts between various instances. In the extended meaning I give to the notion, the constitution also defines the limit of politics and distributes will, liability, respect, humanity, soul as well. What Nature is supposed to be, what women are allowed to feel and think, the way labourers are allowed to behave, how God is supposed to intervene and rule, all these allocations are part of the Constitution which, at any given historical period, defines the anthropology of a society. Except in a few philosophies like those of Plato, this Constitution is mostly unwritten; but it is the task of anthropologists to put it on paper — exactly as they do so cleverly when they portray foreign or exotic cultures.

Part of the 17th century English Constitution is to distinguish two domains of representation, that of humans and that of non-humans, much as the Executive branch is distinguished from the Legislative branch. Boyle's invention is especially striking. He seizes upon the old repertoire of witnesses in criminal law and of exegesis of the Biblical text, but he applies them to the *action of things* staged in the laboratory.

Hobbes wrote at the end of *Leviathan* that the "matters in question are not of fact but of right, wherein there is no place for witnesses." Witnesses gave no authority they were still private and fallible. This stood in contrast to the practices that experimenters and their allies used to make authority in the 1660s. . . . "How near the nature of *Axioms* must all those *Propositions* be which are examin'd before so many *Witnesses*," Hooke wrote of his microscopical reports. Wilkins, More, and Stillingfleet all presented arguments that applied the same criteria of testimony to Scriptural accounts. Sprat and Boyle appealed to "the practice of our courts of justice here in England" to sustain the moral certainty of their conclusions and to support the argument that the multiplication of witnesses allowed "a concurrence of such probabilities". Boyle used the provision of Clarendon's 1661 Treason Act, in which, he said, two witnesses were necessary to convict. So the legal and priestly models of authority through witnessing were fundamental resources for the experi-

menters. Reliable witnesses were *ipso facto* the members of a trustworthy community: Papists, atheists, and sectaries found their stories challenged, the social status of a witness sustained his credibility, and the concurring voices of many witnesses put the extremists to flight. Hobbes challenged the basis of this practice: once again, he displayed the form of life that sustained witnessing as an ineffective and subversive enterprise (p. 327).

Nothing much is new in Boyle's repertoire. Scholars, monks, legislators and intellectuals had rehearsed all these skills for more than a millennium. But their *point of application* was unheard of. Witnesses had been human or divine — never non-human. Texts had been written by humans or inspired by God — never inspired and written down by non-humans. Courts of law had seen many disputes about human and divine trials — never about the behaviour of non-humans in a legalized laboratory:

Laboratory experiments [for Boyle] were always more authoritative than testimony which was uncorroborated by reputable witnesses: "The pressure of the water in our recited experiment [on the diver's bell] having manifest effects upon inanimate bodies, which are not capable of prepossessions, or giving us partial informations, will have much more weight with unprejudiced persons, than the suspicious, and sometimes disagreeing accounts of ignorant divers, whom prejudicate opinions may much sway, and whose very sensations, as those of other vulgar men, may be influenced by predispositions, and so many other circumstances, they they may easily give occasion to mistakes". (p. 218).

Here is the new actor entering our Constitution: inert bodies incapable of will and prepossession but able to show, sign, write, and scribble inside the laboratory instrument and in front of reliable witnesses. And those non-humans, to whom is denied a soul but is attributed meaning, are *more* reliable than the vulgar humans to whom is attributed a will but to whom is denied the competence to indicate phenomena. In case of doubt, says the Constitution, *appeal from the latter to the former*. With their new semiotic competence, the non-humans are able to help in the writing of a new form of text, the experimental scientific paper, hybrid between the age-old exegetic skills — applied only to the *Scriptures* — and the new instrument — producing new *scriptions*. From now on, debates among witnesses will be pursued around the private space of the air-pump, about the significative behaviour of non-humans and will be written through the hermeneutics of layers of text that will include, among other things, the *signature* of both human and non-human witnesses. With such a court of law all the other powers will be reversed, and this is what Hobbes objects to so strenuously; but this reversal will be possible only on the condition that any link with the political and religious branches of government is made impossible, and against this, Hobbes was powerless since he had invented, in perfect symmetry, another new actor in charge of representing the humans.

The interesting point is that S & S are less clear on Hobbes's symmetric constitutional invention. In Chapter VII the authors believe more in Hobbes than in Boyle. They find Hobbes's macrosocial explanations of Boyle's science slightly more credible than Boyle's rebuttal of Hobbes. They have been trained after all in social studies of science and inside the Edinburgh school, which means that the macro social context is seen as less easy to deconstruct than the experimental micro scene. That there is no Nature "out there" to account for the success of Boyle's programme is obvious to them; but they seem to believe that there is a Society "out there" to account for the failure of Hobbes's programme. More exactly, they hesitate on this question, cancelling out in the conclusion what they set out to show in Chapter VII and then cancelling out again their argument in the very last sentence of the book:

Neither our scientific knowledge, nor the constitution of our society, nor traditional statements about the connections between our society and our knowledge are taken for granted any longer. As we come to recognize the conventional and artificial status of our forms of knowing, we put ourselves in a position to realize that it is ourselves and not reality that is responsible for what we know. Knowledge, as much as the state, is the product of human actions. Hobbes was right (p. 344).

No, Hobbes was wrong. How could Hobbes be right on that since he is the one who invents monist society in which Knowledge and Power are one and the same thing? How could he be used to explain Boyle's invention of a complete dichotomy between the production of knowledge about matters of fact and the production of politics? Yes, "knowledge and the state are the product of human actions", but this is the very reason why, on the whole, Boyle's invention is much more astute than Hobbes's one — and why social studies of science of a Hobbesian persuasion are so much less astute than anthropology of science. The funny thing is that the authors are still wavering, three centuries later, on the very same issue they have themselves so magnificently reopened. They use for the cover of their book Hobbes's beautiful drawing of a mortal extra-human King made of little human bodies, forgetting all the problems this drawing shows and that Hobbes does not solve: the big crowned Head which is *not* made of bodies, the sword that Hobbes does *not* explain, to which they add the air-pump that, precisely, Hobbes did *not* put in the left hand of his mortal God. Their dust cover is more symmetric, more anthropological, more enigmatic than their book and runs deeper!

To understand what is now the only obstacle standing between us and a full-fledged anthropology of science, we have to deconstruct Hobbes's constitutional invention — and hence the Edinburgh school's contention that there is a macro Society "out there" more sturdy and robust than Nature. Hobbes invents the naked calculating citizen whose competence is to hold property and to be represented through the artificial construction of the Sovereign. He also invents a language of power-equals-knowledge that is at the source of all

modern Realpolitik. He also invents a repertoire of qualities for human interests which is still the core vocabulary of the whole of sociology. To be sure we have learned a lot since Hobbes about society, groups, classes, liberalism and political representation, but no one has yet deconstructed his vocabulary of power, society, group, calculation of interests and sovereignty. In other words, although S & S teach us how not to use the expression "matter of fact" as a resource but as a historical *political* invention, they do not do the same job for the language of politics *itself*. They happily use the words "power", "interest", "politics" in their Chapter VII. But who invented these words with their modern meaning of Realpolitik? Hobbes! Thus, S & S also "see double" and go around lopsided, one side for the critique of science, the other taking for granted politics as the only explanatory resource worth using. But who told us that? Hobbes, again, and his construction of a monist macro-structure inside which all knowledge makes sense only so as to maintain social order. The authors magisterially deconstruct the evolution, diffusion and blackboxing of the air pump and of vacuum — but why don't they deconstruct the evolution, diffusion and blackboxing of "power" or of "force"? Is "force" less of a problem than "vacuum"?

This task is all the more necessary since the two Branches of government that Boyle and Hobbes are drafting apart are to be implemented only if clearly separated: Hobbes's State is powerless without science and technology (without the air-pump and the sword of the dust cover), but Hobbes talks *only* of the representation of naked citizens (of the scepter in the hand of the sovereign); Boyle's science is powerless without carefully distinguishing spheres of religion, politics and science, and this is why he is so careful in eliminating Hobbes' monism. The mistake of S & S is to grant to Hobbes more foresight and more explanatory power than to Boyle. If they have to be treated both at once, it is symmetrically, without one being allowed to see through the other. They are two Founding Fathers, drafting *one* and the same constitution but writing in their draft that their Branches should have *no* relation whatsoever. They conspire to make one and the same innovation in political theory: to science the representation of non-humans and no possibility of influence by or appeal to politics; to politics the representation of citizens with no influence by or relation to the non-humans produced and mobilized by science and technology. The modern world is to live under this Constitution — and much of the fascination of S & S's book is in ushering us almost to the extreme verge of it, without they themselves escaping from it. At the last minute they cling to Hobbes and prefer one Branch of government to the other, believing in force more than in reason. They don't see that they are one and the same, that this dichotomy comes from one major *common* decision. For an anthropologist of science, there is no more Force than Reason, no more Society than Nature. Hence, there is no, nor has there ever been, any modern world.

IV. A Pragmatology

To understand what has interrupted, at the last minute, S & S's enterprise we have to dig much deeper in the archeology of things. To do so I will turn to Michel Serres's latest book. Although Serres holds a chair in history of science at the Sorbonne, no books are in style more foreign from one another than *Statues* and *Leviathan*. But none are closer in content. They work like two teams on the same archeological field site, one on the 17th century stratum while the other goes down to its prehistory. While one works on historical facts, the other unearths mythological artefacts. Both try to account for the emergence of the object in the making of our society. Both try to struggle against the *tacit* dimension concealed by language and ideas.

We want to describe the emergence of the object, not only of tools or of the beautiful statues, but of the thing in general, of the thing as it is ontologically. How does the object come to what is human? (p. 162).

But the problem is that

I can't find anything in the books that say anything about this primitive experience through which the object in itself constituted the human subject, because the books are written to entomb this very experience and to condemn any access to it. Speeches are noise covering what happened in that complete silence. (p. 216)

Like all books in this new genre of anthropology of science, *Statues* starts with a surprising symmetrization of the pretechnical past and of our technical present. Instead of balancing out Hobbes and Boyle, Serres, who reaches deeper and farther, treats at once the explosion of the shuttle *Challenger* on our television screens and the sacrifice of Carthaginian children inside the white-heated iron statue of the God Baal in Flaubert's *Salambo*. Sacrifice, statue, fire, container, fascination, scream and terrors on both accounts. Who is modern? Who is primitive? Both.

We see the light, the child, the idea, blind at their roots, at the foundation, at the past: in front of the same corpses, we do not recognize Carthage at Cape Kennedy, nor the God Baal into *Challenger*. Nor the statue into the rocket, although both are white hot black-boxes full of humans. Like Carthage in the past, Chicago, Boston, Montréal or Paris are looked over today by tutelary gods, in the Urals and Siberia, whose colossal statues sleep half hidden in their launch pads, each bearing the name of these cities toward which they are pointed. Same thing for Kiev, Leningrad or Moscow, in the underground sites of Nebraska or North-Dakota. We mind our daily business, threatened, some say protected, by the power of these statues, ready for fire. (p. 19)

To follow Serres's many books the reader should have a small user's manual at hand.⁹ For him science and culture, technology and mythology, mathematics

⁹B. Latour, 'The Enlightenment without the Critique: An Introduction to Michel Serres's *Philosophy*', in J. Griffith (ed.), *Contemporary French Philosophy* (Cambridge University Press, Cambridge, 1988), pp. 83-98.

tics and literature, past and present, occupy the same situation and none can cancel out the others. There is no epistemological rupture for him between a text and an equation, a fable and a machine, an outdated story and a brand new theory. All of them are strictly contemporary and equally accessible and should be retrievable together to understand our destiny. No Copernican revolution has ever happened in his world.

However, he is not travelling at random zigzagging through poetic free associations. From his first work on Leibniz he has been interested obsessively by a few structural features that all our scientific, literary and mythical productions may have in common. If Baal occupies the same structural position for the Carthaginians as our atomic missiles for our own collective, then Serres will stop at no anachronism, at no gap in genre, style and detail, to underline that similarity and to make the two metalanguages exchange their properties:

Let us call religious what gather us and link us together by requesting from us a collective attention so tense that the smallest lapse will threaten us from destruction. This definition fuses the two probable roots of the word religion, the positive one — tying together — with the negative one — the opposite of neglecting. (p. 47)

Who will deny that the slightest oversight will kill us all at once? Who will deny that we are tied to and by these gods? Are we talking of rites or of atomic silos? Of both at once. Religious anthropology is now connected to strategic debates. This is Serres's *effect*. He writes the Constitution I mentioned earlier by forcing us to let structures jump from our forgotten primitive past to our brand new technical present.

Serres is a non-modern structuralist, a sort of symmetric Lévi-Strauss who would add to the diversity of primitive myths all of the scientific ones. This explains why he is so puzzling, treating with the same respect (and the same apparent casualness), thermodynamics and Jules Verne, Livius and Mandelbrot, etymology and scholarship. Serres is essential for anthropology of science not because of his cavalier treatment of facts, but because he is born immune from our original sin: *he is not modern*. He has lived for 50 years in a world that we only begin to glimpse. We reach his idiosyncratic books like a steamship reaching a Pacific atoll where a navigator has been stranded: how did he survive for so long, we wonder, in what appears to be at first Hell and then Paradise? By peopling the land with totems each of which look like some quaint production. If you think there is something of Naive Art in his dishevelled books, think of what it is to be the only non-modern in our modern world, and then you will realize why his totems will be necessary for grasping the non-modern era that is now opening. If we needed so many of what we call with condescension "myths" before becoming modern, then we will need *more* of them when we will cease to become what we had never been, that is modern.

Like S & S's *Leviathan*, *Statues* is a book about the co-production of object and subject. The problem for both is that we, scholars, intellectuals, moderns, have an asymmetric access to sources in order to reconstruct this mythical pragmatology: we possess hundreds of myths on how the subject (or the collective) builds the object — Kant's Copernican revolution being one in the middle of a long lineage. However, we have nothing to tell us the opposite part of the story: how the object makes the subject. S & S have thousands of pages of archives on the ideas of Boyle and Hobbes, but nothing on the skill and tacit practice of the air pump. Witnesses for the second part of the story are not made of texts or languages, but of silent and brute remains like pumps, stones and statues. Serres's archeology of *stones* is many levels beneath the air pump but he hits on the same silence:

The people of Israel are chanting by the dismantled Wall of Lamentations: of the Temple nothing is left but stones. What did the wise Thales see, by the Pyramids of Egypt, in a time as remote from us as he was from Cheops; why did he invent geometry by this pile of stones? The whole of Islam dream of travelling to Mecca where is kept, in the Kaaba, black, the stone. Modern science is born, at the Renaissance, from the study of falling bodies: fall, fall the stones. Why did Jesus establish his Church on a man by the name of Petrus, that is Stone? It is on purpose that I fuse religions and sciences in these examples of instauration. (p. 213)

Why should we take seriously such a wild generalization about stones, mixing the religious Black Stone and Galileo's falling bodies? For the same reason that we take seriously S & S's reconstruction of religion and science in the 17th century experimental setting. They too "mix on purpose religions and sciences in these examples of instauration". S & S load epistemology with this unknown actor, the leaking, dirty patched-up air-pump. Serres loads epistemology with this unknown actor, the thing, the heavy silent thing. And they all do that for the same anthropological reason: science and religion are linked through a deep reinterpretation of what it is to accuse and to try. For Boyle and for Serres science is a branch of the Judiciary:

The word thing, whatever its form, has for root and origin the word cause, taken from the judiciary, from politics or in general from the vocabulary of the critique. As if objects themselves existed only according to the discussions of an assembly or after the decision of a jury. Language wishes the world to come in existence because of language. At least, this is what it says. (p. 111) In Latin we call *res*, the thing, from which we derive our reality, the object of a judiciary procedure, so much so that for the Ancients, the prosecuted was called *res* because the magistrates were suing him. As if the only reality was coming from tribunals. (p. 307) Here we will see the miracle and get the answer to the ultimate riddle. The word cause means the root and the origin of the word thing: causa, cosa; similarly, chose or Ding. ... The tribunal stages the very identity of the cause and of the thing, of the word and of the object, it shows the substitution from one into the other. Here emerges a thing. (p. 294)

This is where Serres generalizes in three quotes the results painstakingly gathered by S & S: causes and stones and matters of fact are quite another thing than things *themselves*.

Boyle wondered how to stop the civil wars. By forcing matter to be inert, by asking God not to be present, by building a new engaged private space where vacuum may be shown to exist, by not indicting reporters for their judgment, by shifting arguments to experiments, and instruction to instruments. No *ad hominem* accusation will be made any more, Boyle says, no human witness will be believed, only non-human indicators and instruments witnessed by gentlemen will be relied upon. Stubborn matters of fact are now laying the foundation of the collective. Hate and dissent will be redirected and tamed.

But this invention of the matter of fact is not the discovery of the things "out there", S & S argue, it is an anthropological creation that culturally redistributes God, will, hate, love and justice. Quite so, Serres concurs. We have no idea how things would look out of the tribunal, out of our civil wars, and out of our trials and tribunals. Without an accusation, we have no cause. This anthropological situation is not limited to our prescientific past since it is more true of our scientific present.

Sometimes we experience that if causes are laid to rest, then, miraculously, things in themselves are born.

The world offers to us the things without cause and without accusation. Language is interrupted, and this is what the sculpture, mute, shows us. (p. 111)

Thus, we do not live in a society that would be modern because, contrary to all the others, it would at last be freed from the hell of collective relations, freed from religion, freed from the tyranny of politics, but because *after* all the others, it redistributes the accusations, replacing a cause — judiciary, collective, social — by a cause — scientific, non-social, matter of fact — replacing a *Ding* by a Thing. There is nowhere to be seen an object and a subject, a primitive and a modern society. There are only series of substitutions, of displacements, mobilizing people and things on larger and larger scale and size. Serres imagines a spiral, each loop of which represents a co-production of a collective, and of an object by the displacement of one social entity by another one which is more non-social, more thing-like.¹⁰

Serres tells a pragmatology, as fabulous as the old cosmogony of Hesiod or the modern ones of Hegel. His does not operate through metamorphosis or

¹⁰ "J'imagine, à l'origine, un tourbillon rapide où la constitution transcendante de l'objet par le sujet s'alimenterait, comme en retour, de la constitution, symétrique, du sujet par l'objet, en séries foudroyantes et sans cesse repris, revenant à l'origine ... Il existe un transcendantal objectif, condition constitutive du sujet par l'apparition de l'objet comme objet en général. De la condition même ou symétrique sur le cycle tourbillonnant nous avons des témoignages, traces ou récits, écrits dans les langues labiles ... Mais de la constitution constitutive directe à partir de l'objet nous avons des témoins tangibles, visibles, concrets, formidables, tacites. Si haut que nous remontions dans l'histoire bavarde ou la préhistoire silencieuse, ils ne cessent d'être là." (p. 209)

through dialectic like that of Engels, but through *substitutions*. (p. 279) Abraham is going to kill Isaac — it is a ram that he ends up sacrificing; Egyptians stone their hated Ruler to death — they end up building Pyramids, gigantic masses of stones entombing a mummified body; prehuman primates assemble around a cold corpse — they end up around a stone come from nowhere, around a statue; Carthaginians push their children inside the Body of Baal their God — they end up with a pacified personified Collective to whom they have sacrificed, they claim, only cattle. New sciences that deflect, transform, reform, the collective into things no one has made, are nothing but so many late comers in this long mythology of substitutions. S & S are simply catching up the *n*th loop of this spiral Serres is reconstituting. Modern science is an extended way of doing what we have always done: Hobbes builds a Body Politic out of naked living bodies — he ends up with a prosthetic artificial Leviathan; Boyle concentrates the whole dissent of the Civil Wars around an air pump — he ends up with *matters of fact*. Physicists were doing pure physics — they end up doing pure war.¹¹

Each loop of the spiral defines a new collective and a new thing. And we understand now S & S's hesitation. They have pushed Science out of the modern world, but they have left the State firmly inside it. This is why they left the job undone. By complementing their work with that of Serres we understand now that the ever-new collective organizing itself around ever-new things has never stopped evolving. We have never left the old anthropological womb — we are still in the old dark ages or, if we prefer, we are still in the infancy of the world. How will we call this retrospective discovery that we have never been modern? Post-modern? No since this would imply a belief that we have never had. We have never been. I propose to call it *amodern*.

V. An Anthropology without Anthropologists?

S & S are historians and sociologists of science forced into anthropology by the beauty of the 17th century rewriting of the Body Politic, of Nature and of God; Serres has slowly become an anthropologist by his long familiarity with the history of religions and of science. But what about the genuine anthropologists, trained in the trade and teaching officially inside the confines of the

¹¹ "Près de vingt-cinq siècles après Empédocle, dans la même île de Sicile où Archimède, le prince des mathématiciens antiques, mourut de la main d'un légionnaire romain, à la prise de sa ville de Syracuse qu'il avait défendue par de formidables machines de guerre issues de son savoir, dans la même île, dis-je, où la Haïne et l'Amour se transmutent en théories abstraites et en technologies, notre contemporain, Majorana, savant génial d'à peine trente ans, admiré par Heisenberg et Fermi, auteur de travaux profonds sur les particules, choisit aussi de disparaître, quand sa physique ou la nôtre apprit soudain à déchaîner par elle-même de mortelles éruptions. ... Agrigente, Syracuse, Catane, Syracuse, Palerme, nous avons fait le tour de l'île ou celui du monde, Empédocle, Archimède, Majorana, voici bouclé le cycle du temps, de l'histoire, des sciences, nous habitons désormais une sorte de Sicile isolée fermée sous la lumière noire d'Etna nombreuse, qui dépendent et qui ne dépendent pas de nous." (p. 273).

discipline? Are they not able to do for our societies what they do so well for savage ones? Aren't they able to do for the cosmology of Feynman what Carlo Ginzburg did so well for the cosmos of the sixteenth-century miller,¹² or for the production of purified chemicals what Mary Douglas did for the perception of beliefs on purity?¹³ No, they are all happily asymmetric — Ginzburg and Douglas all the more so. All of them resolutely ignore the very possibility of applying their trade to our science and society. They prefer losing students, fields and grant money, rather than risking their positivist certainty about hard science. But there is one recent book by Sharon Traweek, an anthropologist from Rice University, who shows what the discipline can do and thus offers an excellent contrast to the "amateurs's" job. The result of the comparison is as instructive as that between Hobbes's and Boyle's science: "real" cultural anthropologists cannot even dream of understanding our scientific culture that "amateurs" are now studying.

At first estimation this book subtitled "The World of High Energy Physicists" should be a breakthrough. Traweek studied the Stanford Accelerator for many years; she also did field studies in Japan on a related machine; she accepted the need to be trained as an ethnographer in order to become able to study her laboratories; she firmly committed herself to understand not only the social or cultural aspects of physics but also its content; and finally she spent many years in the writing of her book which all of us, amateurs, expected to read as a standard. The result, however, is a light, nicely written book full of interesting views, which eschews one after the other most issues of the field. It will please physicists, to whom it offers a pleasant and slightly exotic view of themselves, but it will maintain anthropology of science firmly inside its modern predicament. Traweek, like her anthropologist colleagues, has been paralysed by the culturalist paradigm S & S and Serres are now dismantling.

Traweek works under one and only one model: the Durkheim-Mauss thesis that there is some correspondence between the way we organize our society and the way we organize our cosmological classifications. This model, which is so prevalent in American and British ethnography, forces the author *not* to understand her own otherwise beautifully sensitive data. This case of paralysis induced by a framework is so extraordinary that I want to focus on two excerpts at the very beginning and at the very end of the book.

First let us see the paralysing framework:

Their [particle physicists] everyday anxieties about the terrible loss of time — terrors that are carefully maintained in the culture of physics, as if they were essential driving forces for the good physicists — seem to me a mirror image of the cosmological vision that transcends change and mortality. (p. 17)

¹² C. Ginzburg, *The Cheese and the Worms: The Cosmos of a 16th Century Miller* (London: Routledge, 1980).

¹³ M. Douglas and A. Wildawski, *Risk and Culture: An Essay in the Selection of Technical and Environmental Dangers* (Berkeley: University of California Press, 1982).

In this book I have examined the high energy physics community: the organization of the community, the stages of a career within it, the physical theories its members share, and the environment and machinery physicists build in order to do their work. Anthropologically speaking, I have described their social organization, developmental cycle, cosmology and material culture. I have explored a theory originally formulated by Durkheim and developed in many ethnographies over several decades, a theory which proposes that a culture's cosmology — its ideas about space and time and its explanation for the world — is reflected in the domain of social action (p. 157)

Why is there anything wrong with this idea? Is it not an acceptable although somewhat outdated research programme? Is not everyone free to use the framework that seems best to accommodate the data? No, if the data immediately contradict the argument. Just after the first sentence, Traweek writes:

I came to this view [about the mirror image of cosmos and society] by spending many hours and months around detectors, coming to see them as embodying all their builders' divergent meanings and experiences of time. The detectors in the end are the key informants of this study; physicist and nature meet in the detector, where knowledge and passion are one. (p. 17)

How on earth could one accommodate the innovation of detector-informant, of passion-knowledge, of physicist-nature, of divergent meanings, into the mirror image of cosmos and collective? If there is one thing the detector is not it is an image or a reflection of society. The monstrous hybrid of modern physics that would require a *redefinition* of the collective and of cosmology is conjured by the appeal to Durkheim's dualism. It is business as usual for the ethnographer although she talks to a detector she chooses as her informant — and indeed Chapter 2 is the most original of the book.

A few pages after the second sentence cited above, she goes on:

Where do the social categories of physicist and physics community and physics culture exist? I mean this book to address that question. I have presented an account of how high energy physicists construct their world and represent it to themselves as free of their own agency, a description, as thick as I could make it, of an extreme culture of objectivity: a culture of no culture, which longs passionately for a world without loose ends, without temperament, gender, nationalism, or other sources of disorder — for a world outside human space and time. (p. 162)

Anyone reading this sentence will believe it is the beginning of the book: how can you make a culture of no culture. Fascinating question indeed. But no, it is the very end! Every reader will see the quote as the destruction of Durkheim's model: the cosmos-society correspondence cannot explain a non-social cosmology. But no, it purports to be a *proof* of the validity of the model. Every historian of religion will be thrilled by this citation and will expect an explanation of how physicists came to free themselves from space and time

through particles instead of through prayer. But no, the religious overtone, so important for Serres, is not even noticed. Traweek, obsessed by her framework, does not even read what she writes. A culture of no culture, a non-social society, a detector, all these hybrids do not require, *should not* require any redefinition of the modern paradigm: society and cosmos unproblematically reflect one another.

The paradox is to pursue this paradigm where it is most unlikely to hold: experimental particle physics. To be sure, the paradox is so extreme that it gives the book an exotic atmosphere as if it were radical and new to treat physicists as Indians of the Great Plains. But this does not do justice to the physicists — because I suspect the Durkheim model does not do justice to the Indians either. The reason for my suspicion is that the very divide between society on the one hand and cosmology on the other is the result of Durkheim's own belief in science. The intellectual resource used to understand ethno-science cannot be used to understand science, as Traweek appears to believe. Not because it is scandalous to treat Us like ethnographers treat Them, but because it is scandalous to treat Them — and hence Us — with a model that already accepts the whole package of scientific society: society and knowledge are two different things that have later to be somehow related — the relation being of course impossible because of the very way the distinction has been made.

If we need a further proof of the self-inflicted tortures imposed by the framework of what could have been an important contribution to the field, one can look at the middle chapters. In spite of her claim to "thick description", Traweek is unable to relate the content of physics to the social organization. This cannot be due to the technical nature of physics, since any ethnographer is able to delve into esoteric mythologies and kinship systems infinitely more complex and foreign than any branch of quantum mechanics. No, it has to be because she really believes science and knowledge are apart and can only be related by correspondence. Thus, all the interesting observations she makes fall in the ditch she has herself dug right in the middle of her field study. In the most Mertonian tradition, chapters about career patterns, socialization and male biases follow Chapter 2, the only chapter that deals a bit with the content. At no point is there any relation between the two sets — except this most damning of relations, that of a reflection. Society and knowledge are again two immiscible liquids that settle apart. Hybrids appear indeed, but they are conjured one after the other. Perish the field study and its monsters, provided traditional anthropology remains intact. The title says it all: "Beamtimes *and* Lifetimes" are floating on one another without more than a thin surface of contact. Here again as for S & S the dust cover runs deeper than the book it protects from dust: the lines scribbled by the detectors are still begging for an explanation.

She ends the book by saying:

I have never met a high energy physicist who would entertain for a moment the question of whether electrons 'exist' or not, and I can sympathize with that, for unlike some of my more reflexivist colleagues, I find it appropriate to assume that physicists exist. (p. 162)

It is ironic that this sentence be chosen for the dust cover since it could lead the reader to believe that Traweek has never met any physicists — and no reflexivists either. Her scientists might be sure of the existence of electrons but why do they spend years — not seconds — and billions of dollars to "entertain the question" whether (barions? or muons?) exist? Traweek, in rejecting her "more reflexivist colleagues" and in believing in the unproblematic existence of "Durkheimian" physicists, believes she sticks to common sense, whereas she is abandoning her only hope of understanding her physicists who are, at the same time, totally certain of electrons and totally uncertain of (barions? muons?).

If there is one thing the particle physicists do not do it is *reflect* their existing culture; this does not mean that they escape the confines of the collective, but that they are building a *different* collective.¹⁴ A society that collides particles inside gigantic accelerators is not the same as one that does not. If there is one thing that the anthropologists of science cannot do, it is to use the model invented by Durkheim to shield science from scrutiny in order to fathom the relation between knowledge and society. This does not mean that science will escape the study of ethnographers, but, quite the contrary, that ethnographers should be equipped with other intellectual resources and be prepared to study the co-production of collective and things.

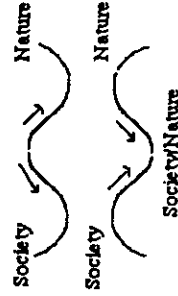


Fig. 1.

There are two attractors in the Durkheimian model that render impossible the anthropologists' task — and the failure of Lévi-Strauss 30 years ago as well as the disappointing result of Traweek prove how steep is the gradient one has to overcome. Anthropology of science will develop for good only if we reconstitute the landscape so as to create another attractor that concentrates all the resources and energy in the centre that is presently the point from which

¹⁴A. Pickering, *Constructing Quarks: A Sociological History of Particle Physics* (Edinburgh: Edinburgh University Press, 1984).

every intellectual resource flees.¹⁵ If anthropologists do not modify their position, we will have to develop the field without them, which will be a great pity since they are the only ones equipped with the culture, method, patience, insight and techniques that are necessary to study particle physicists, Trobriand islanders, computer engineers and Plains Indians in the same breath. Traweek's book is interesting because it shows in the most extreme case — particle physics — the danger for the field of failing to get out of the modern world.

VI. Conclusion: a Different Starting Point

The reason for the difficulty — I charitably refrain from saying impossibility — for most trained anthropologists in coming to grips with science, and the final hesitation of S & S in circumventing Hobbes's discourse as thoroughly as Boyle's, is now clear and will make, I hope, a good starting point. If we treat society as more transcendental than nature, as Steve Shapin and Simon Schaffer did, or if we treat the two as equally transcendental and mirroring each other — as Sharon Traweek did — we can't understand this mystery of mysteries that Michel Serres, in his idiosyncratic way, has tackled: there is only one transcendence and it is that of *collective things*. The reason why we cannot treat the social facts like things¹⁶ is because "things" are collective facts in the first place.

Durkheim and all the social scientists after him have subscribed to Hobbes's Branch of Constitution and have built their overarching society with *social* relations; in doing so they have *naturally* accepted Boyle's other Branch of Constitution and granted the transcendence to Nature. In doing so they became modern. Then, in a hopeless and desperate move they have tried to study the correspondence between the two. In doing so they have shown how much *more* modern they were, able to make the critique of science through their belief in society. Far from reacting against Kant's Copernican Revolution they have simply replaced his Transcendental Ego by the Transcendent Society. Nothing, strictly nothing, has been modified by this shift that even dialectical philosophers have failed to unsettle. All are children of the Critique and happy to be so. The postmodern "philosophers" are not so happy, but they maintain the same structure. They are simply disappointed by the whole Critique enterprise and fail to believe anymore in the joint promises of rationalism and socialism. They have not moved an inch beyond. In spite of their presumption this shows they are modern to the core.

¹⁵M. Lynch, *Art and Artifact in Laboratory Science: A Study of Shop Work and Shop Talk in a Research Laboratory* (London: Routledge, 1985), has been the most radical proponent of this view: there is no social explanation of a science to be given but its technical content itself; this does not mean that we are back to internalism, but that any practice creates its own context. ¹⁶"Traiter les faits sociaux comme des choses" is Durkheim's famous slogan.

Anthropology of science — even with its odd contradictory name — is showing another way. The very centre that was seen by the Critique as the *meeting point* of the two transcendences is now the starting point of their construction. Instead of explaining every phenomenon by a mixture or a combination of the two pure forms of Nature and Society it begins to be a progressive enrolment and redefinition of actants, and it is only later that it *sends*, elaborates, purifies, various transcendental forms that look like the Nature and the Society of old. But instead of providing the explanation, Nature and Society are now accounted for as the historical consequences of the movement of collective things. All the interesting realities are no longer captured by the two extremes but are to be found in the substitution, cross over, translations, through which actants shift their competences.

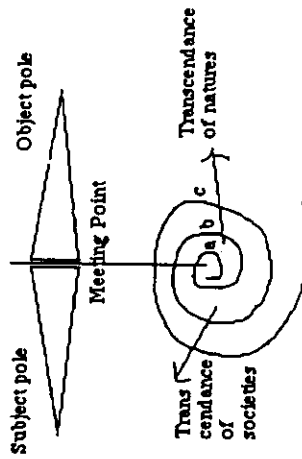


Fig. 2.

The major advantage for anthropology of this displacement of the starting point (see Fig. 2) is that it solves the Great Divide which Lévi-Strauss, Horton, Goody, and science students have struggled with for so long. As far as the shape of the movement — of the spiral in the diagram — is concerned, *all* collectives have to co-produce at once their natures and their societies and their gods — Us as much as Them. And, nevertheless, all the collectives are made different by the *scale* at which they construct the double transcendence of society and nature — a, b, c in the diagram differ indeed but only in scale. Various collectives are now made fundamentally identical while the differences among them are still, literally, of scale, of a *large* scale. The first part of this move is relativist, the second is not. It is, one could say, *relationist*; the first is symmetric, the second is asymmetric. The difference between science and ethnoscience first vanishes and then reappears in the size and nature of the collectives built by each of them. I do not claim that we have answered the questions of anthropology, but that we have put the question in a form that will stop this discipline from despairing of itself and that we have kicked it out of its (post)modern predicament. All our intellectual resources which were flying apart and made this mystery of mysteries still more unfathomable are

now focused on the only problem worth studying for an anthropologist of science: the collective-thing. Now at least we know how to do it and we can use the work done by other schools of thought to “anthropologize” our rationality” and our law. As Serres put it “There exists an anthropology of the sciences. Silent and extraordinary it shadows them along. It constitutes their legend: that is, how one should *read* the sciences.” (id. p. 273)

Acknowledgements — This review owes a lot to Chuck Nathanson and to the feedback I got from presenting it to the Stanford Program in History of Science. I am also grateful to my students at UCSD for many helpful remarks.

¹⁰C. Darbo-Peschanski, *Le Discours du particulier. Essai sur l'enquête hérodoïenne* (Paris: Le Seuil, 1987), has written the most interesting study that provides the tools, like that of S & S, to study many other inventors of our rational discourse. The whole school of Vernant has deeply renewed our view of Greek antiquity and has made rationality part of anthropology.