The Artisan, the Sage and the Irony: An Outline of Knowledge Sociogenesis

Before wondering how to distinguish – or not – between technical, scientific and other knowledge, it would be helpful to ponder the periods and contexts that led to their separation, be it superficial, artificial or radical. And this task would, in principle, arise from the wide program of epistemology, which strangely does not seem to be concerned with it, possibly because removing it from social anthropology would pose tricky questions.

An apparent paradox of established epistemology lies, in fact, in its obsession with trying to place the effort to be rational in Man without going through his societies' mediation, with the diversity of their paths. However, science implies a collective dimension, underpinned by institutions, and its flourishing only marks a minuscule moment in our evolution, in a relatively narrow category of cultural systems elaborated by our species. A dominating institution would want sociology to stay out of question deemed too important, or intimate, to be embarrassed with a heteroclitic mass of contingencies. Thus, the history of science, with few exceptions, is interested in history within science, but not the science within history.

Everything happens as if an unavowed course of action that was taken refused *a priori* to consider this phenomenon outside of fate, like an accident caused by chance circumstances. However, this fear will only fill minds stating that the social manages a subaltern stratus of our essence: it would ensure logistics dealing with contexts, but it would participate little in our "being". In this sense, it would come back to the logic, psychology and biology of extracting the sap from scientificity, or of going back toward its

"ultimate source" in order to make it our common point of reference. Or better yet, our compass.

Against this ostracism, sociology and social anthropology defend a stance that has become so widely dominant in the course of the last quarter century that certain people no longer see another way out: science, an ordinary belief, has neither "substance" nor an original impetus. This consecutive antagonism leads the protagonists to agree on one precondition: the social provides nothing but shifts, as it surrounds primordial realities without permeating them.

In short, in reading contemporary literature, one will regularly stumble upon this alternative: either *science stands out through its own form of existence, but it then escapes sociological competence*, or *sociology earns the right to visit science insofar as this is reduced to an absolutely banal cultural fantasy*. On these subjects, read anthropologist Jean-Luc Jamard [JAM 93].

At a time when interdisciplinarity could still be hoped for as the fruit of a sincere, shared effort, Jean Piaget had thought up the "genetic epistemology" project where all the human sciences and biology would come together [PIA 70], except that on the list of domains invited, the social sciences were already relegated to the waiting list: neither refused nor really sought after. A psychogenesis of scientific activity formed the heart of the matter, and from this point of view, the "cognitive sciences" ensure its prolongation today, averaging the same tacit depreciation of an intervention by *real* social connections (i.e. those that cannot be formulated by "social psychology").

1.1. Knowledge sociogenesis? Necessary introduction

From this viewpoint, a solution logically imposes itself: opening the door to a sociogenesis of science, "to see". It will be genetic, if you will, in the literal sense of the term, taking care to immediately clarify that the main monitoring over the education in question will fall on history, if only to make up for a considerable delay compared to reflections that have become subtle and constraining, long before returning to interdisciplinarity with the intention of bringing its components back into balance.

1.1.1. *Evolution, history and conjecture: Radcliffe–Brown's block*

Nevertheless, a formidable trap threatens the aspiration: the suspicion of an evolutionist intention, a convenient condemnation for the global evacuation of a wide range of debates that it brings about under the pretext of the inflammatory nature of one party among them. One of the key masters of English anthropology, Alfred Radcliffe-Brown, thus gave the name "conjectural history" to the movement to be banished:

> "My objection to conjectural history is not that it is historical, but that it is conjectural. History shows us how certain events or changes in the past have led to certain other events or conditions, and thus reveals human life in a particular region of the world as a chain of connected happenings. But it can do this only when there is direct evidence for both the preceding and succeeding events or conditions and also some actual evidence of their interconnection. In conjectural history, we have direct knowledge about a state of affairs existing at a certain time and place, without any adequate knowledge of the preceding conditions and events, about which we are therefore reduced to making conjectures. To establish any probability for such conjectures we should need to have knowledge of laws of social development which we certainly do not possess and to which I do not think we shall ever attain" [RAD 68, pp. 114–115].

Conjecture excludes history, which returns the courtesy. A methodological block will rarely have obtained as much docility: the dominant anthropological movements in England and France applauded this rejection and placed it at the foundation of their pedagogies, giving that exclusion, however, inflections and variable fields of application. Philippe Descola, for instance, applauded this author for being "the vigorous apostle" of an "epistemological clarification" that would lead to "a separation between an order of phenomena relevant to necessity, and thus susceptible of being translated into the language of general propositions" [DES 88, pp. 22–23]. The link between contingency and history indicates a reading that has gone through the sieve of *La Pensée sauvage* [LEV 62].

The Briton's report takes these inflections itself, precisely because it does not clarify anything. Quite the contrary, it hides behind an untenable epistemological bricolage, arbitrary methodological choices: respectable

insofar as they do not claim to be supported by exterior legitimacy. False concepts offer themselves to the reader's instincts to more or less reject history, conjecture, cause, etc., from a distance. Awaiting a detailed analysis, too long to take place here, let us quickly note the worst distortions:

– *History/evolution*: Radcliffe-Brown dismisses history by rebelling against evolutionist ambitions. A story is never characterized as well as when the limitations of a beginning and an end are set, between which the interactions take shape and which, in this way, allows the action of social facts to be emphasized. An evolutionist discourse, however, aims at tendencies where the beginning and the end evaporate in the distance. The strength of Darwinian theory arises precisely from a method treating evolutions as histories: the biologist is not supposed to conceive of a natural selection without connecting it to a time and space scale, even if, of course, the temptation to imagine tendencies does not save the life sciences [GUI 97].

– *History/event/contingency*: The notion of event generally has no need for a definition and is often seen with reference to history, just as an indivisible atomic element could be organized into a vast heteroclitic group, and so history greatly resembles a large sack of marbles, and it is only filled with "contingencies". Radcliffe-Brown, Lévi-Strauss or Descola's perceptions, however, primarily express a disinterest or ignorance concerning the methodological problems of historical science. Here again, structuralist anthropologists have largely profited from the repression of the event by New History [GUI 99], and the epistemology of processing the event (which is also realized on different levels) remains one of the most desolate, appalling wildernesses in the social sciences. In the rest of this chapter, we will deal with an event whereby no one can say with certainty over how many years it took place. Structures play with certain events, not with all. Some events weaken certain structures, not all.

– *Event/situation*: Radcliffe-Brown carelessly "sticks" the event to the situation, while the analysis of an event depends on the situation within which it is observed and a single event will reveal different meanings according to the logic – sociological, economic, historical, etc. – defining a situation that tests its arrival. Once again, the methodology on this subject finds itself spread across a multitude of empirical approaches that, in the best of cases, only communicate with neighboring approaches.

– *Conjecture/speculation*: The condemnation of conjectural history is announced long before Popperian epistemology spreads a fine representation of conjectural work across the sciences. Radcliffe-Brown sees no difference between a conjecture formulated to confront the results of ongoing research and a speculation made to avoid all criticism. His wage on the impossibility of reducing or pinpointing problem types is in line with a global evasion in this regard. Nevertheless, in anthropology, as in other fields, conjecture, disguised or not, is an integral part of research [GUI 95].

– *Conjecture/law/cause*: We only cite this final and enormous foggy area as a matter of form. In the absence of a veritable development on the role of conjectures and the way to control their extent, the opinions given on laws and causes do not leave the domain of metaphysics because scientific laws and causes only exist through the stipulation of a domain of application and the epistemology of the forms taken by this stipulation determine their consistency. They in no way depend on previous dissertations on their essence.

This barrage of alarms, despite the ghastly coarseness of the presentation made of each of them, suffices for a simple conclusion: avoiding the exercise of conjectures cannot be justified with an epistemological argument. Research is never imprudent because of its objectives: the recklessness lies in a relationship between the means taken and the arguments developed.

1.1.2. *Techniques outside science, science outside techniques*

Now that we have explained why we refused the mind-blowing veto on our exploration, let us turn to the motivations that make it advisable. Curiously, they will flood our minds from a renunciation. At the start of a pedagogical description from *Anthropology of Knowledge*, Nicolas Adell resigns himself, considering the enormous mass of materials, to sacrificing certain aspects and announces with scrupulous clarity that we shall shamelessly take advantage of. Criticism is not, however, aimed at the author, but at the atmosphere and orthodoxy that presides over the selection:

> "It has been decided not to treat techniques as such and for which French anthropology in particular has reserved a special place witnessed by the creation of the magazine *Techniques and Culture* in 1983. This separation, which is far from being evident and which absolutely must not be held as

unsurpassable, finds its origin in an ancient tradition, found in Antiquity, distinguishing and hierarchizing thinking and doing to the advantage of the former, a hierarchy of which Plato was one of the most radical disciples (cf., among others, the famous image of the bed made by a carpenter, which will never be as perfect as the idea of the bed that he was able to form in his mind). This idea has remained vividly ingrained in Western culture, found in the asymmetric opposition of the intellectual and the manual and even in *The Encyclopedia*, whose exact goal was to reassert the value of practical knowledge" [ADE 11, p. 22].

Let us keep in mind the evocative reference point of the carpenter and the bed, and far from holding a grudge, let us thank Adell for having mentioned *Techniques and culture*, a magazine that the authors of this volume have often turned to and which, via Robert Cresswell, founder of the eponymous team, continues André Leroi-Gourhan's intellectual movement. Forty years ago, this movement, unknown to English speakers, represented "the" competition in France to Claude Levi-Strauss's triumphant structuralism. It has since diminished, notably undergoing a series of institutional snubs that likely attacked materialist issues in general more than a particular school of thought.

Beyond these twists and turns, a vast question emerges concerning the decision made: did Adell really have a choice? Let us imagine the opposite resolution: including the technical dimension in his work. One need only skim through the table of contents to feel the inevitable havoc that would follow. In order to reduce disorder, an isolated part would have to be rearranged, creating such a contrast with the rest that the split would become haunting. Preservation of the initial aim thus required the reduction made.

The statement retains the virtue of not simply turning to an omission that would easily hide the problem, considering the unsettling number of readers able to detect it. It also does not reduce its significance by calling to mind an ancient remanence that directly relates to the famous "great divide", that typically western perversion that the intelligentsia is now invited to hunt down and ban without showing any signs of weakness.

Suddenly, though, an incongruity arises from this clarity: the contestation of the great divide reinforces itself subtly, discreetly indulging itself. On the

one hand, it is recommendable to condemn the dichotomy of knowledge: let us do away with the gap between technical knowledge and others, as well as that between science and beliefs! On the other hand, to that end, a lock is put on one of the two fields, the key thrown away, and the great divide ends at the price of side's ignorance.

Concerned with the integrity of his teaching, Adell cannot reasonably eliminate or even marginalize the contemporary domination of relativist issues. These cultivate the reprobation of caesuras, against Plato and the Enlightenment, if necessary, but their fascination with hybrids hardly shows haste in providing instructions (that would immediately stir up the suspicion of scientist arrogance, thus of a veiled return to the great divide). How, then, to approach what must not be distinguished theoretically but that practically resists confusion? In direct opposition to the treacherous fractioning of the universe is the allegory of a snake biting its tail in order to transcend continuity solutions: forget extremities!

Showing that the nature/culture relationship and the techniques/sciences relationship were born as a result of abominable ulterior motives is not at all the same as refuting the potential reality of these disconnects, with or without alteration. Thus, the argument according to which nature and culture are not differentiated as states falls short in light of the fact that their dynamics represent distinct phenomena: cultures change according to the unheard-of modalities in "the rest of nature" [GUI 14]. In the same way, despite the interdependence of their knowledge, technicians and scientists divide their professions in our societies and this fully justifies the fact that a sociological test does not rule out the hypothesis of a gap in their knowledge *a priori*.

The issue advocated here of a sociogenesis of the divergence of kinds of knowledge, thus gains its legitimacy in contrast with a multitude of sophisticated thoughts, finally united on the horizon of relativism, pleased with their unfinished state, and at peace with their inconsequence. Our process, admittedly rustic and conjectural, will consist of *taking back up the research of the irreversible through the thresholds, emergences and transformations that would historically lead to recombinations in social prescribed knowledge*. This return implies, of course, formerly unknown and ignored data, but also a consolidated use of conjecture. With a completely modest initial hypothesis: the process should unearth parts of examination that an anthropological philosophy hungry for disillusionment ignores in its

deconstructive undertaking unless it subconsciously avoids the risk of stumbling upon an energized scientificity.

1.2. Extra-human or peri-human technicities

For the moment, freely thinking computers and extraterrestrial civilizations have not left the realm of the imaginary, which restricts the exploration of non-human knowledge conditions to the animal world. An immense field in the eyes of ethnology and psychology, but clearly more restrained compared to a strictly sociological perspective (i.e. one not affiliated with the aforementioned disciplines). Two eminent sources impose themselves: social insects and monkeys.

1.2.1. *Involuntary society and impersonal knowledge: termite mound and workers*

Coquetry or incongruity? The invocation of invertebrates seems highly superfluous here, and yet the collective nests of arthropods isolate an essential variable to be extracted from the magma of evidence.

Let us consider one of these African termite mounds, commonly compared to "cathedrals". Its *architecture* results entirely from the *work* done by the biological caste of *workers* and it is an *artificial* location where the humidity, temperature or circulation of air break away from the environmental conditions and ensure the continuation of *society*. The terms italicized above can really irritate us with their analogical content and their anthropocentrism; the fact remains that they reinforce one another and encourage long-lasting perplexity. Could a termite mound represent the product of a technical system?

The key to the mystery was delivered half a century ago by zoologist Pierre-Paul Grassé and his theory of stigmergy [GRA 59]. In short, the workers do not make up separate working teams where, for instance, n teams were responsible for building the n colonies in a given sector. The termites walk around in an uncoordinated manner and are confronted by situations. Situation S1 leads to a behavioral reaction c1 ("carry dirt to this location", for example), which, repeated by a thousand individuals, ends up producing situation S2, which will set off action c2, and so on. In the definition of a situation, we do not only include topographical or physical information: the

presence of a particular phenomenon often shows itself to be determinant[1]. Since then, information has confirmed that a small number of orders executed successively by multitudes of insects led to the complex structures observed.

Each species is characterized by a construction style: termite mounds are not always completely identical, of course, but they all respect a precise plan. The irresistible assimilation of this process into a technique responds as a matter of priority to this loyal replication of central sequencing around which the variations seem trifling, so the initial component, without which an action will not enter this category, negatively pours out from the technical fact.

Western societies have above all else discerned the existence of the technique through the loyal replication of efficiency. A technique is recognized in a practical cause always demonstrating the same anticipated effect.

Here is a necessary condition. By stopping there, it will be said that the termites apply a construction technique. By accepting the collective as the first degree of the social, the technique will even be considered social. However, in that case, a species which, from generation to generation, biologically creates invariable tendencies on its petals or its feet joins technicians, and the natural factory produces unlimited series of technical marvels "on an assembly line".

Fans of the great divide need an additional criterion: the technique mobilizes knowledge. We stop looking at termite mounds as technical works when stigmergy teaches us that no will, no decision, and no choice participates in the elaboration of these structures. The genome itself does not memorize these plans, the species limiting itself to selecting a catalogue of finely conditioned reflexes.

As for vertebrates, learning joins automation: the discussion that deals with weavers' nests where absolutely every kind of knot invented by sailors can be found, or in other similar cases, the innate/acquired argument is

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1 For more extensive reports, see the writings of Guy Theraulaz and his teammates [THE 99, THE 14].

completely incorporated. But for all that, does the allusion to "techniques" and "tools" provide necessary meanings? They only show up to anticipate analogies with a human reality on the horizon: beyond this aim, there is no imperative reason to distinguish a subcategory of learnings. *For want of an acquisition and transmission of knowledge able to externalize knowledge in relation to the acting individual, the concept of technique does not latch onto any original phenomenon*. The idea of the tool, while easier to define concretely, does not contribute any more to the determination of a pertinent threshold: the *deus ex machina* of a comment on the psyche is necessary.

1.2.2. *Techniques and culture in chimpanzees*

Confirmation shows itself in chimpanzees, where termites are found to be engaged despite themselves in recognized animal techniques: in the form of prey. In 1960, Jane Goodall observed that chimpanzees in their natural environment choose twigs with great detail and carve them before inserting them carefully into the opening of a termite mound, then slowly retracting them: they then dine on the insects that bit onto the stick [GOO 63]. The announcement of this discovery quickly echoed around the world: our "cousins" use tools! Scholars cheerfully dreamed of the dawn of human culture. Justified hope, though extremely premature at that point.

Tools, agreed. But techniques? Zoologists later proved that the New Caledonian crow performs the same operation with the same goal, substituting the chimpanzee's hand with its beak [HUN 00, CHA 02]. With this restriction, an Oxford team reproduced an identical behavioral sequence in the same species with juveniles in captivity [KEN 05]. No need for a professor or a long learning process: the animal need only be placed in the right condition and provided with the proper materials.

What in this case distinguishes the primate from the bird has nothing to do with the performance, but with the fact that the monkeys… are not talented. A juvenile observes its mother for years before correctly performing these gestures and profiting from them. Sometimes the beginnings of teaching emerge [BOE 91]. This time, the tool is clearly manifested in a technique.

The question rises to the next level: techniques, agreed, but a culture? Let us think back to how, at the start of this essay, Lévi-Strauss had outlined things in 1949:

> "Let us state, then, that for man, all that is universal stems from the order of nature and is characterized by spontaneity, that all that is obliged to a norm belongs to culture and presents attributes of the relative and the particular" [LÉV 67, p. 10].

A simple criterion elegant enough to position itself in the prolongation of the methodological principles that the life sciences acquiesce to. And now, in their species, chimpanzees clearly validate its application. They all have their techniques, but their number changes from a population to another, outside all ecological constraints. Nuts are broken with stones in zone A and not in zone B, when the tree and its fruits are plentiful there. Primatologist William McGrew dared to go for it, deducing the existence of a "material culture" in these hominids [MCG 91, MCG 92]. Without going into details, one element is worth mentioning: differences in *traditions* also come into play and searching one nut-breaking site established a use over multiple centuries [JOU 95].

For the first time, ethology is not trying to pilfer the concept of culture from anthropology to resize it to their measurements: it is applying it, as is, to an animal species, and no shortcoming requires the precautionary addition of the prefix "pre" or "proto". Yet *this authentically primitive modality of culture blooms in the company of the conjoined emergence of techniques and tradition, as if each of these terms was united to the advent of the two others*.

Does this partial commentary arise from the proper use of conjecture? No, under the condition of turning it into an issue that future research will have to keep. Primatology must now position the "material culture" among all the types of intergroup behavioral variations, starting with those that influence communication, in order to explain which other relationships open themselves up to cultural diversification and the perspective of a tradition. A vast program, certainly, but not inordinately so.

1.3. Junctions, divergences and disparities

The vast majority of ethologists and anthropologists cannot stand the event of a principal, even final, debt of the cultural phenomenon to

techniques. The former would like to see culture take root in the DNA or in interindividual relations ranging from altruism to sexual selection, passing through care for the young. The latter brandishes symbols as the only "raw material". Traitors or apostates infiltrate each field: biologists believing in the liberating conquests of learning and ethnologists persuaded that their peers are researching profit like animals. These enemies consider one another to be the necessary evil against which they must assert themselves. The gene against culture, okay. The protein against the verb, very well. But for the love of God, not modeling clay!

1.3.1. *Putting words to action?*

Throughout the 20th Century, this dualism was ardently defended against the entrance of a third path into the arena and through a comical expedient: renouncing the great divide by attacking it from both ends. When a biologist or an anthropologist condemns the "obsolete" confrontation of materialism and idealism, we will almost immediately bet that in the end, the biologist will defend reductionism and the anthropologist spiritualism.

Speaking concretely, we have three entryways on the elementary level of human manifestations: biological, linguistic and technological [GUI 14]. The last has always suffered, indirectly or not, theoretical and institutional repression from the other two, and it owes a great part of its persistence to prehistory, for obvious reasons.

The denial of the great divide in the name of the monism inherited from "social Darwinism", or under the heraldry of whichever cultural relativism, is always equivalent to protection against a materialist methodology joining the progressive study of the relationships between heteroclitic beings, against the interminable proposition of veiled but omnipotent causalities anywhere in Man. Cultural technology could not explain the human condition by itself, but it sets itself apart just by the awareness that it has of its own limitations, an awareness that it cannot rid itself of and that leads it to suggest small divisions by way of scientific experimentation and exploration.

PROOF.– The emergence of culture as an observable reality, that is, as a formalized comparative field, reveals technique at the forefront, and notwithstanding, no theoretical school wishes to discuss the in the least. Genes and symbols continue to show their teeth as if they were alone in the world.

Do chimpanzees' performances teach us about the paths taken by our own hominid ancestors, apart from an in-depth evaluation to decide if the Paleolithic Oldowan people were more skilled or not than the quadrumana in the Ivory Coast?

We *Homo sapiens*, on the other hand, commonly speak about "putting action to words", which underlines a precedence extolled by common sense. Monkeys do not put action to words any more than they put words to action, and the question would be knowing when and how our ancestors got into this habit. Paleontologists have long answered "approximately" by articulating undefendable but slightly consistent convictions: most of these bookmakers hesitate between *Homo habilis* and *Homo erectus*. Prehistorian and ethnologist André Leroi-Gourhan refused to bet, identifying a dominating preponderance of hominization in the relationship between techniques and language [LER 64].

From this point of view, the observation of chimpanzees offers a truly unforeseen development to this reflection: multiple techniques are acquired there because of long-term learning that takes place manifestly through *imitation*. And curiously enough, here we come back to the intuition of a great ancestor of French psychosociology, Gabriel de Tarde, whose "interpsychology" was meant to be founded on *The laws of imitation* [TAR 90], basis for the "social link". It is too often forgotten that this rival of Durkheim first crossed swords with "social Darwinism" and Herbert Spencer: "imitation", which he gives a rather broad meaning, is thought of in certain respects in contrast to heredity.

The learning through imitation that chimpanzees show themselves capable of, "following" for years before managing to master a technique, is rarely found in confrontation to the other methods of learning that ethnology analyzes in depth: however, everything indicates that this distinction takes place at the beginning of culture. *How far along the trajectory to hominization does this mode of knowledge transmission go?* Must we dismiss the eventuality according to which man's lithic industries would have depended on this unique means throughout the Lower Paleolithic? Even a growth of investment in "teaching by example" (whose debut is seen in chimpanzees, although this effort seems to be rather rare) would not noticeably change the enigma of its silent development.

Not long ago, we defended a thesis in this sense [GUI 94] by starting out with a statement from ethology: *through all the species, including those that*

demonstrate great richness in both domains, shaping matter and interindividual communication occupy different, even entirely separate ranges of activity. Human sciences – including biology, here – have spoken of the issue of the parallel evolution of technical and linguistic aptitudes, as if they existed by and for themselves, beyond the analysis of their respective ecological – and socioecological – relevance. Leroi-Gourhan himself does not quite manage to go beyond this restrictive issue.

From this perspective, *a neglected section of hominization consists of the history of the growing overlap between techniques and communication under the living conditions of prehistoric societies*. Anthropologists have always imagined that progression on one side automatically profited from the other, while this comparison should rather be understood as a complex and probably long process that we only know the result of: at a certain time, men started frequently speaking about their techniques, and at a certain time – not necessarily the same – they frequently used their techniques to express meanings alongside their words, even beyond then, for in a certain way, culture does not say everything about itself.

It is here a matter of a properly formulated conjecture, in the sense that it emphasizes a question obliterated by the institutions dominating in the last century by claiming that the data available give it real consistency. It does not evaporate *a priori* in the inaccessible, and means of information analysis could help it progress, or refute its significance. This thesis has not aroused any direct commentary: denied several times from afar, without any source being mentioned and accompanied by a concise refusal of credibility. Thus, without giving in to paranoia, we do not currently see what research besides our own the following passage could aim at:

> "*Homo habilis* made rudimentary tools, this is true, but following standardized forms. It is quite appropriate for us to note in this regard that the cerebral center that controls the right hand is adjacent to Broca's area, and that the two centers developed in concert. Nothing allows us to affirm that *Homo habilis* spoke, but he had the first means for this.
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> On the other hand, doubt is not allowed concerning *Homo erectus*, our direct predecessor, who carved stone tools with symmetry demanding more than a dozen successive operations 500,000 years ago. It is unimaginable for these complex

techniques to have possibly been passed down from generation to generation without any form of teaching.

All these considerations reject the apparition of conceptual thought, articulated language, therefore life in society, in times so far back that hypotheses cannot be exaggerated without showing a naivite that verges on foolishness" [LÉV 98, p. 83][2].

The professor's well-known courteousness led to his omission of an offender's name, made even easier given that the text appeared in an Italian newspaper with no bibliography. However, why such irritation concerning naivite, foolishness and flights of fancy? And what to say of a refutation that abruptly travels far from the centers of its author's competence? Let us pass on the allusion to "Broca's area", apparently borrowed from memory from a remark by Leroi-Gourhan, 30 years earlier, explaining an old-fashioned style.[3] But when none other than Lévi-Strauss dares to use his authority in technology, there is good reason to feel unsettled! Especially if we add the totally unacceptable objection of a "symmetry demanding more than a dozen successive operations" as clear proof of the presence of spoken teaching: the thing presumed to be "unimaginable" remains absolutely acceptable, at least as a hypothesis, in the eyes of ethology, prehistory and cultural technology [HUB 03]. In 1997, a Japanese team conducted a compared learning experiment that concretely legitimizes the eventuality even on the Levallois technique, but largely posterior to the scenario mentioned by the eminent accuser [OHN 97].

Neither pride nor hard feelings would excuse our inserting this profession of anecdotal faith into our pages. The signature of a big name in anthropology has greater value, of course, but particularly this fierce degeneration, unusual in his person, must be seen in connection to his work's content. Let us not forget that, in his inaugural conference at the Collège de France, thus at the very moment where he received the crown in his discipline, Lévi-Strauss redefined anthropology as a science of signs and that, asking himself the question of the place that techniques have in this field, he accepted them insofar as he saw them as having meaning [LEV 73, pp. 19–20]. We are thus clearly leaving the trivial category.

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2 Translation from an article published in Italian, in *La Repubblica*, in November 1995.

3 Incidentally, the "function" of Broca's area on language faced heavy contest not long ago.

Lévi-Strauss responds severely, or sovereignly, to a question whose function he intends to eliminate, for he refuses to give it its rightful place. A spontaneous and therefore positively naïve reaction that draws suspicion of unconfessed stakes. Researchers who, in his trail or ulterior ramifications, maintained that the empire of signs monopolizes the responsibility of the human social refuse all competition.

The competition of biology, first of all, impossible to obliterate and in the face of which structuralism and its derivatives assert themselves, but also that of an ordered set of material relationships with nature, focused on techniques and which carries in itself a conception of history not reducing itself to a jumble of "contingencies". When Lévi-Strauss or Marshall Sahlins debate with Edward O. Wilson's sociobiology and Marvin Harris's cultural materialism, they favor enemies who seize the gene or the protein as ultimate explanations [LEV 83, SAH 77, SAH 79], which reinforces the false image of an alternative between the material cause and social relationships. The third term of a technical mediation between men and their environments breaks down this reinforcement: this is doubtlessly the source of the sporadic access of a condescendence and aggressiveness that the most narrow-minded scientists frequently escape.

Sending very high language back in time controls the degradation of the *social* efficiency of techniques, which is contrary to the supremacy of the sign. A hypothesis, despite everything, must rise above the claimed "unimaginable": *in the absence of the appropriate language to comment on and contest actions, learning by imitation agrees a priori with extreme docility, whereby nothing allows us to presume that it diminished very quickly, or very early, in the course of hominization*.

In chimpanzees, we have seen the rise of divergences from material culture join the birth of traditions. This even seems to be self-evident when we speak about the phenomenon of culture: if it is not socially durable, it becomes synonymous with acquisition. But let us think of the famous Acheulean hand-axe, which Lévi-Strauss likely was referring to: we are interested in a cultural object that has preserved the essential part of its shape for hundreds of thousands of years. There are variations arising from material restrictions, and prehistorians eagerly scrutinize the others, but the sensation of consistency is not easily swept away. What if tradition was much better maintained without language, capable of pointing out an infraction giving it the status of an innovation to be imitated?

Let us admit that the scenario of a prehistoric society developing speech for certain aspects of collective life and neglecting it in technical actions seems strongly counterintuitive when it is understood from a world where all human societies designate the things they do with words and highlight their ideas with works. However, a large gap worming itself between the development of techniques and that of languages reduces the shock value of the image according to which work and communication did not immediately favor the same hubs of activity without even considering the statement that in most animal species, communication and subsistence activities very rarely cooperate.

The ecology of our species torn between an extreme specialization of biological reproduction and equally remarkable opportunism concerning the exploitation of environments would have contributed to the maintenance of this disparity by investing the resources of language in the stipulation of interindividual relationships and matrimonial exchanges, technical learning long remaining reserved to imitation [GUI 14].

1.3.2. *Diversity and disparity, conjunction and separation*

The initial divergence of knowledge would thus correspond to this competition that philosophers have discussed at length: *Homo faber*, for Henri Bergson [BER 08], versus *Homo loquax,* quickly set against one another by various thinkers as if a choice absolutely had to be made on which of the two would rebuild the foundations of Rome. Alas, the image of an ecological tension progressively resolved by sociological solidarity disturbs the duel, and it will bore metaphysics of the great divide as much as its contestation, let us say, postscientifically: the inept analysis of interactions attracts neither of the two.

Initial divergence, therefore, but tied with another: the *sexual division of labor*, leaning against an exogamy that exercises the displacement of one sex from its birth group to another. More widely confirmed migration for more than 30 years among all primates [DEP 87]. When Lévi-Strauss places the prohibition of incest as the single pivot for the nature/culture relationship, for universal in its principle and variable in its realizations, why does no ethnologist immediately object that the sexual division of labor shares this disposition without reducing itself *a priori* to an accessory expression of exogamy? As much as the systematic interdependence between the

evolutions of one and the other imposes itself on a practical level as an obvious need.

Contrary to a common presumption in primatology [GAL 81], the sexual division is not content with prolonging a behavioral difference between males and females: as its name indicates, it implies a division, and this affects both production and consumption. Therefore, feminine activities, more specifically those revolving around harvesting vegetables, and a cynegetic category leaning rather toward the masculine, lead to a division of technical skills among societies of hunters, with two visions of the world that society employs to make them compatible without completely unifying them [TES 86, GUI 95]. Exogamy ensures the regular circulation of this cultural trait through the population that envelop the network of matrimonial exchanges. However, when the rule of migration is strictly applied to only one sex, the diffusion of techniques by means of imitation is likely facilitated in a one-sided way.

The separation of action/word attributions tends toward a growing interpenetration, unlike a sexual division whose principle persists, and even increases in many areas as a result of transformations originating in the Neolithic period.

Trying here to temporally situate the interconnection of responsibilities assumed by word and action would be foolish. Such a complex phenomenon does not lend itself to dating, for lack of being able to establish the existence of a break in continuity or several irreversible crossings. The eventuality would again require the input of several disciplines, with special cooperation for each threshold. We need only remember the sentiment expressed by Leroi-Gourhan half a century ago: cultural diversity and innovation raise a sort of "wall" at the end of the Middle Paleolithic, analogous to the increase in an exponential curve. His juniors will pout, though nothing that we have learned since then rids us of this impression.

Our species' current form should date back around a hundred thousand years, at the least, but apart from the testimony of the first burial sites, the sensation of an historic outburst clearly relates to a much later era. It suffices to say, therefore, that in the Upper Paleolithic, men used techniques to materialize their beliefs (art), the opposite requiring a precautionary condition, with all due respect to Lévi-Strauss's – very sectoral – lack of imagination. The extraordinary longevity of certain styles of wall painting

gives us food for thought when we imagine a school of drawing successfully setting extremely precise norms for a duration equivalent to that of the construction of the Great Pyramid of Giza or the Empire State Building. The wonderful obedience of students to an authority that, apparently, would not stand for any… discussion.

From the evolutionary standpoint that blinds us concerning these questions, the distance between the advent of the modern man and the Neolithic period represents but a brief interval. However, should we not rather think of this time from an historic standpoint and tell ourselves that the space between the arrival of our like and agricultural societies is eight to 10 times greater than the one separating the present from the first plantations? From this point of view, although all the conditions are assembled in the eyes of biologists, concretizing this history which replaces evolution through trails of change in the same way as the sluggish acceleration of old steam locomotives. The result of a regrettable poverty of "contingencies", or the manifestation of a force of inertia that is more worthy of study?

A paradox of human societies becomes visible: the more they increase their technical means of guaranteeing a tradition and the more these weaken the tradition before variations. Everything happens as if an additional communication technique would insinuate the possibility of unprecedented alterations and would intrinsically create the "risk" of innovation. Traditions transmitted simply by imitation would last for tens of thousands of years. When speech is added to translate the tradition into words, the degree of consistency would become significantly weaker. And the writing system that gives tangible form to these words would further increase the instability, if only by raising doubts and debates on the meaning of terms.

Would a culture today manage to create such allegiance for a thousand years? Certain supports lend themselves better than others to a prolonged resistance, even in societies nationalized until the end of the 20th Century: the tools and techniques that we call "fossils" do not just endure under the effect of passivity: the tradition has a variable restrictive efficiency. Nevertheless, the progress of comparative analysis on this vast subject would require the collective effort of perfectly *developed* cultural technology.

Then, everything comes tumbling: men are no longer content with expanding the range of milieux that they occupy, they multiply the ways of

occupying them, and each society can establish itself in several environments to exploit the different resources there with, in each case, appropriate technical systems. The question of needing words does not fall in the face of the ethological limits of imitation, but rather the plethora of techniques to be assimilated.

Similarly, not only does the sexual division of labor not diminish, but quite the contrary, a social division of tasks increases it. The storage means allow unheard of inequalities, etc. Let us not go too far: we are summarizing the classical program of an introduction to anthropology. Diversity doubles from a disparity, the hierarchy accompanies specializations and concentration phenomena arise, draining from social interdependence and techniques from afar. Words discuss practices more or less, but in any case, it names them all. Inversely, people spend the greater part of their time speaking about gods or kings by means of stone, wood or metal representations that require experienced technicians.

The intermeshing of words and action in all circumstances does not dismiss their relationship : it does not unite them in any way; it only intensifies their interactions.

Culture no longer maintains one technical system, but rather different categories of techniques whose transmissions reinforce one another with complementarities ruled by a distant power. The reader must understand that we are not trying to outline the Neolithic period: it is a matter of looking for a new threshold where the division of knowledge falls into place and whose identification determines the subsequent birth of technique/science tension: that phase where every technician confronts a single control and a centralized authority due to the installation of a State. Not the political power of a monarch, but the influence of priests, bearers of a skill in direct relation to that of the artisans.

An ethnographic illustration will serve as a marker. For the Ngbaka horticulturists of the Central African Forest, each clearly distinguishes between techniques and witchcraft. Except that placing objects on a cultivated plot that will harm the intruder coming to steal the harvest belongs among techniques: this distant action provoked by the sole guilty character of the rude individual, the European, of course, sees there a belief in magic. The Ngbaka (and also the Pygmies who are among the rude visitors) see it as a banal, practical defense: the ground holds this undetectable poison in plain

view, and witchcraft does not enter the fray. The planter uses a natural force that Europeans have no access to and which they do not recognize, but which, in the culture concerned, seems as trivial as slash-and-burn farming or the care given to cultigens. And, *de facto*, ethnology itself conceded technical efficiency, of a psychological order, to a method that noticeably reduces robberies.

However, in an Ngbaka community, a man accumulates the knowledge of a warrior, a hunter, a planter and a wizard, all of which is transmitted from fathers to son. If, in each person's mind, these four kinds of knowledge are used to place the cultivator's immaterial poison among the hunter's fatal infusions, the problem does not exist. The difficulty gradually increases as the knowledge is dispersed and forms affiliated professional groups. The State centralization of this social puzzle then requires more than the concentration of a repressive power: a coordination of convictions cementing everything together. In other words, a religious cosmology, classifying beings and prescribing common rules, with agents responsible for reconciling the beliefs of the ideology with the legal rules.

By admitting that art offered language its initial materialization, writing represents the second stage: it creates its own relationships to space, time and action. And to reaction: the initial art shows something like the chimpanzee instructor, but there is no response to be given. The inscribed phrase can travel or be classified. It can be stolen, intercepted, destroyed or arrive at its destination. The recipient can sit alone on a throne or fill a village, docilely acquiesce, but also refuse, become angry and kill the messenger. Writing is immediately implied in the existence of a contradiction between the authority of the "it was written", on the one hand, which personifies destiny and the gods, and, on the other hand, the contestation whose eventuality finally accesses evidence. The classic synonymy between "societies without writing" and "societies without history", despite its flaws, reveals this mistake: the resolution of an established order to be preserved through a "set in stone" expression triggers the awareness of a fragility of the timelessness proclaimed through that of its material substrate.

Many prehistorians have noticed the relative simultaneity of Neolithic booms: the "cradles" of domestication appear in a narrow interval, related to the time elapsed since the dispersion of modern men. The interval dwindles further, it being a matter of primary budding of writing. Not all cultivators

abandoned themselves to the taste for hierarchy, but those who did, in Asia Minor, in the Far East, in Central America and the Andes, followed rather parallel paths. Writing saw independent births in Mesopotamia, China and the Yucatan.

Thirty years ago, archaeologists thought that Sumer had invented it for records and bookkeeping on sacks of grain, sheep or other riches. This assertion has since been nuanced; both legal and theological texts joined the movement prematurely [GLA 00].   However, the initial trigger for *management tools* remains primarily admitted. On a purely sociological level, the dilemma on the creative spark will have a hard time encouraging an ideal determinism against the economic or vice versa: in the background, the elite develops by playing manifestly on all fields: prestige and appropriation, legitimacy and productivity. On the epistemological level, the issue shows itself to be more attractive.

Goody [GOOD 86] and Herrenschmidt [HER 96]   detailed the information provided by the ancient layers of the city Suze, belonging to the southern Mesopotamian civilization: clay wallets, called "bulles", (literally: bubbles) bore the mark of the cylinder seal and contained small objects of different shapes, *calculi*:

> The whole of these three components "made up a way of recording a transaction, a transfer of goods. Identical bulles were likely made in two copies, one kept by the private person who participated in the transaction – the bulles were found in dwelling houses – and the other by the administration. In case of contestation, the accounting document could be revisited" [HER 96, p. 98].

> "One of the reasons why writing showed such great utility in commerce was that it allowed information to be stored for a certain time and therefore made a more reliable 'memory'; the confirmation of a transaction no longer rested solely on the lifetime of the 'eyewitnesses,' but on the conservation of the document itself, often verified by markings or signatures" [GOO 86, pp. 73–74].

Admitting that the existence of this tool precedes writing per se leads us to look at this in some way other than as a neutral application of the *technè*

to the *logos*, or a rough absorption of the former by the latter. In other words, not only the account book comes before the Bible, but technical ways of thinking also preside over the future conception of the *text*. The material message that we perceived above is born into a universe of transaction, personalization, duplication and contestation. The first sign modeled in clay delivers the mark of the *signature*, the *testimony*, a desire for *proof* and the guarantee of a *truth through its reproduction*: eminently social worries in this technique, matching eminently technical worries in that society.

Therein lie the hinges that the obsessive rivalry between the economic and the symbolic risk making us miss with their shortcuts. Through these Sumerian "bulles", the first impulse that leads to writing evokes technical knowledge that first resolves its own problems and unexpectedly makes history by providing the event with material expressions: *traces*, both durable and storable, that allow technicity to be custom-refined for an administration eager to be in control. From this perspective, writing can no longer be summarized as a technique subject to the sign. The sign is first filled with a socially preconceived technique. Then comes the text, associated with the idea of a tissue by its Latin etymology.

Let us repeat: far from explaining the beginnings of a future theory of writing, here we are providing parameters likely to change our path, for their omission makes it easier to transfigure the relationships between *technè* and *logos* in the long term through an influence on the classical representation of the relationship between techniques and science. Does not this systematically subjugate the creation of a new discipline by adding the second suffix?

1.4. Forming a triangle: technique, science and ideology

Writing was to cement the tradition, but it equally underlines its failures by making its desires perceptible to the eye of the official technicians: scholars. To avoid using a random example, in Latin, technique becomes art before Western civilization socially opposes the two notions, on condition that the one avoids the utilitarian work the other gets bogged down in. And what can we say about genius, the winged deity, exceptional aptitude transcending the inventive and adventurous spirits, or the constructive technical domain, each in turn!

We are approaching the nerve center of our study: it arises from the juxtaposition of two perfectly relevant and *a priori* totally incompatible statements. One comes from an anthropologist, André-Georges Haudricourt, and the other from an historian-philosopher, Jean-Pierre Séris:

1) "It is undeniable that the success and precision of current techniques are related to the progress of scientific knowledge, but this would be an utterly imprecise view of human history to think that it was always this way, for technology is older than science and their reciprocal development is far from being parallel" [HAU 87, p. 329].

2) "In the beginning was science without technique" [SÉR 94, p. 204].

How can Séris, having discussed traditional techniques in previous chapters, write this pithy statement at the start of a reflection on the science/technique distinction? And why does Haudricourt add something after reminding us that techniques infiltrated human lifestyles long before science? The gap between technique and science shows itself to be as ambiguous and elusive as the distance between art and technique, although, in most discussions where these relationships resonate, the reader immediately and correctly works out the meaning given by the authors to these terms and their confrontations. Cultural intuitions govern the issue, but the criteria set are not always the truly dominating criteria. Saying "the arts" when they encompass handicrafts is the same as speaking of knowledge acquired over time and progressing gradually: the hierarchy implied therein is never mentioned. Saying "art" opposite technique once again highlights freedom against utility, or creative energy vis-à-vis the adherence to conventions: no comment is made on the activity justified by its unique essence and the activity that earns its legitimacy from the perfection of repetition.

Technique radically changes in meaning and societal significance according to whether it is confronted by art or not. This also holds true according to whether or not it is put in the presence of science. We can understand Seris' quote in the following way: science is born without *its* technique. This does not, of course, strengthen the evidence for this, except that the means of clarifying the problem impose themselves: a comparison of "written" societies that pride themselves in having science and those that do

not care for it, though they benefit from the services of remarkably learned technicians.

1.4.1. *Astronomers and architects, priests and administrators*

Did the Sumerians and the subjects of the pharaohs use science… without knowing it? Or did they accumulate knowledge without recourse to the mysterious ingredient leading to the emergence of new access to knowledge? Archaeology provides abundant evidence of remarkable insights into astronomy, mathematics, physics, etc., that are found, implicitly or explicitly, in their most majestic structures. The most abundant documentation comes from the Nile, but it puts up a large number of constraints on conjectures made outside the community of specialists.

Let us take the example of the divinity meant to provide us with the most information: Thoth, master of language, inventor of writing, embodiment of intelligence, bearer and diffuser of all sorts of clarity. Plato tells us about him, but he is as far removed from the birth of the Ancient Empire as the reader of these lines is from the worshipers of Jupiter, Ishtar or Baal. Egyptologists reveal to us that temples primarily comment on his numerous skills after the birth of the New Empire [VOL 04], that is, 10 or 12 centuries after pyramids were built. The message therefore comes from people who have a millennium brimming with experience with monarchical centralization behind them, living in an era where hieroglyphics represent a esotericism detached from a more popular form of cursive. However, the Internet awakens the dormant gods: by sifting through the wealth of documentation a bit, it appears that in the New Empire, Thoth married Seshat ("she who is a scribe"), who became his trustworthy assistant. Except that the worship of Seshat had been attested to since the second dynasty and apparently she alone presided over the rise of mathematics, astronomy and architecture. Thoth would therefore have contracted a marriage "of convenience", with quite a hefty dowry. Under these conditions, it will not be difficult to speculate on the change in the sex of wisdom, but few conjectures will be made except on the highly significant conjunction of Seshat's primitive skills.

Let us consider the Sumerians, the Egyptians, the Chinese and the Maya as "seeds" on reading and the State. Regularities will strike the observer: astronomy assisting normative discourse on temporality, architecture to set

the centers of society's beliefs, mathematics to back astronomy and architecture, without forgetting writing's investment in the commemoration of victories. A pronounced taste, as well, for the very hard stones, inalterable, often imported from far away, that sculptors reserve for the image of gods and kings. Everything revolves around a double will for control over time and space, through the intermediary of a multitude of technicians giving rise to diverse specialties. Seshat, the original scribe, brings together a multitude of culturally and politically united enterprises.

This considerable mass of knowledge remains linked to power as an indissociable attribute. Mythology praises understanding, erudition, skill and wisdom, but science remains attached: dialogue over cosmology and technique is enough.

Providential, the work written by Joseph Needham and his collaborators – with, among others, the 25 volumes of *Science and Civilization in China* – offers the conditions for a complete comparison with the West, thus the means of *testing the existence of an identity of science as an objectively distinct cognitive process whose appearance would therefore go beyond the degree of reality of a regional cultural style*. Rather quickly, the accumulation of information led the sinologist to a crucial question:

> "Why, between the first century B.C. and the fifteenth century A.D. did Chinese civilization show itself to be much *more* efficient than Western civilization with regards to the application of their knowledge of nature to man's practical needs?" [NEE 73, p. 124].

According to Needham, the response is deeply anchored in social structures, nothing in the climatic and geographic environment justifying a divergence. There are therefore two enigmas to consider and not one: why has China clearly been advancing more quickly for 15 centuries, and why does the West get excited about the Renaissance? Regarding China, a bureaucratic-feudal organization, headed by scholars more so than military leaders, encouraged the development of the applied sciences [NEE 91]. Conversely, Needham thinks that the failure of the merchant class's political ascension could have blocked the flourishing of modern science there.

One argument strengthens this standpoint: China represents the archetype of what were called "vegetable civilizations" following Pierre Gourou.

Agricultural resources themselves make up the essence of the country's diet, which corresponds to intense ecological specialization: on the one hand, it allows high population density, but, on the other hand, it greatly exacerbates the catastrophic effects of an accidental crisis on the population, starting with periods of scarcity [GUI 14]. The awareness of this danger doubtlessly corresponds to a constant effort to plan harvests and manage granaries, which itself increases the weight of bureaucracy. Needham refuses to exaggerate the effects of this: this in no way boils down to a force of inertia and would even stimulate technical process on many, but not all, occasions:

> "Chinese inventions were often intended to realize a workforce economy in an agrarian society that needed bodies for the production of foodstuffs so as to be able to respond to the needs of a very large population, but it was difficult for them to become the point of departure for upheavals in production, as the agricultural workforce was often underemployed as a consequence of the seasons and its oversupply was hard to transport" [NEE 91, pp. 330–331].

Ultimately, however, these historic perspectives lead to perplexity: this view of changes established their contexts but gives relatively little insight into the construction of knowledge observed in them. Epistemology still lags behind, for the Briton compares science in China and in the West, assuming that it exists on both sides, as a result of the respect due to the undeniable and yet unrecognized successes of Chinese wisdom. He compares acquisitions, or successes, more than progressions. Taking sides in this way distracts our attention from the key point of a continuity solution, with *the potential invention in the West and not the East of a social structure called science*, which would have given no appreciable advantage to its creators until the 15th Century, but which then upset everything. Imperial China did not create a distinct category for scientists: there were mandarins, technicians and sometimes mandarin technicians.

Skills moved along this single access between the poles of an artisan and a sage, which the absence of a meticulous divine authority makes spectacular. Needham highlights this: bureaucracy does not behave like a clergy demanding the respect of religious laws. Its *credo* is limited to the empire, thought of as being beyond a European-style "aristocratic and military feudalism". Also far-removed from theocracies where, approaching the top of the pyramid, individuals unite the authority of one who knows the

necessary world layout and the authority of the technical expert: at the gods' invitation, the top scribe should alternate astronomy and architecture on his tablets. In China, the relationships between mandarins and engineers lend to fewer mixing, and in principle, scholars have the final say.

Overviews from Needham[4] interfere, however, in the method for constructing knowledge. For example, on the tendency of Chinese thinkers to see the universe as an organic whole thus led them to forget "to analyze the intimate mechanism of its parts": this was followed by "weak points on the heuristic level" [NEE 91, p. 321]. Another decisive point:

> "Language and its ideograms have always played a vital role, for they have definitively stopped the centrifugal forces that would have caused the country to divide into States founded on linguistic individualism" [NEE 91, p. 313].

This contributes, more or less, to explaining the fact that the Han make up the largest ethnicity in the world, far more than a billion individuals. From another perspective, however, this centralizing force is intimately tied to an almost irrevocable elitism: according to specialists, reading a Chinese text in classical writing requires the mastery of approximately 10,000 ideograms (while simplified Chinese, symptomatically, is content having a quarter of this number). In a similar vein, the education that produces a scholar implies a heavy investment, disproportionate with learning based around an alphabet. And, to better accentuate this, the very demanding technicity of the writing: calligraphy explicitly increases the constraint to the point of interfering in the evaluation of a candidate's qualities as a functionary: writing tends to intrinsically assert itself as a profession rather than simply a professional criterion. In China, wisdom does not depend on a theology held by priests, but rather on a technique conducive to forging a bureaucracy. Let us quote Needham one final time, explaining that, traditionally, important engineers only exceptionally had the chance to cross the chasm keeping them from top positions in the Ministry of Labor:

> "Doubtlessly the most numerous group of inventors is represented by *working people*, master artisans, artisans who

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4 Not claiming to know the mass of his team's original work, we are basing our analyses on reflections where he provides an overview.

were neither functionaries, not even minor officials, nor members of the semi-servile classes" [NEE 73, p. 21].

Needham is right to point out in the merchants' political failure the obstacle that blocked the progression of Chinese wisdom in contrast to the modern West. Do not alphabetic or symbolic designs, in contrast, emerge right where commerce gains the means to impose its technical necessity? *Entrusted to merchants, writing imposes itself as a technique for the circulation of information: one technique of economy. Inversely, writing, protected by a restricted elite, persists as the technique of political isolation.* In Egypt and the Yucatan, the prince has a scribe to represent him. Corresponding to the hieroglyphics are the Mayan combinations, where the multiplication of symbols invented for one syllable or one idea probably play a role analogous to that of Chinese calligraphy: that of an esthetic sophistication reserved to a minority, to the antipodes of a desire to spread understanding. As it grows older, the use of (ideographic) Sumerian will also specialize in the liturgy of the well-versed. As for the Phoenicians and the Greek, they opt for an alphabet: trade sails along with its diffusion.

One aspect remains in the shadows, as the result of an accidental deviation, due to Aristotle's charisma: so many schoolchildren or students have worked on art and technique "by imitating nature" that sclerosis has stiffened the issue. Let us leave the decision to philosophers of whether or not the creative artist must, in one way or another, imitate nature, if only by taking the opposite stance. The artisan and the technician operate differently: *they specialize nature* in the ecological sense of the term. They amplify, orient, truncate and isolate a natural disposition, but above all else, these kinds of considerations end up obliterating the pedagogical dimension of imitation, and its use by the mediator between nature and art, that is, the teacher. Apparently, if today's specialists are to be believed, the Mayan scribe was encouraged in his school to invent glyph combinations for purely formal neologisms (respecting the synonymy concerning the idea uttered). Chinese writing, however, does not at all facilitate innovation: calligraphy tends toward a strictly preconceived perfection and students "of literature" are subject to the empire of imitation: they must conform to the model and the little initiative that they can hope for is put off for the period when they will have the badge of a confirmed master. Can we imagine a social device more inclined to serving conservatism? From the *decisive* perspective of the mandarins, did technical invention mean something more than a

transgression that had to be stopped if it were to be accepted, or not, by way of exception?

Science can only help technique, or technique can only help science if society grants a "permit to innovate".

1.4.2. *Logic and theory without technique: first birth*

We arrive at the troubling and yet shrewd words of Jean-Pierre Séris: the start of science, in the total absence of any stimulation exercised by techniques, a means of achievement that justifies the hackneyed concept of the "Greek miracle". Between the sixth and fourth century B.C., "there is a general uniformity in the level of technology attained by all the countries in the Eastern Mediterranean and the Middle East", says Geoffrey Lloyd, who adds forthright:

> "Technical progress was very limited, and particularly *in Greece* itself, there is no significant technical progress that can be held responsible for the intellectual advances characteristic of Greece or that can only be associated with it" [LLO 90, p. 243].

There we have an embarrassing hiatus, except for the philosophers who make of this an additional source of appreciation for Athens. Two technical inventions, however, took place during the three preceding centuries that epistemologists see as being far from science, though they concern the manipulation of universal values: none other than the *alphabet* and *coin money*. Techniques that do not transform nature, but "only" society. Techniques that "Antiquists" notice appear far before their "miracle", the second spreading rather slowly across Greece: a century for such a change, when we depart from a reading of Needham, does not seem to resemble nonchalance. Coins are said to have appeared in Lydia, in western Asia Minor, at the start of the seventh century B.C.: right next door, then, to Ionia, connected to Athens, which a short time later will be the cradle of memorable pre-Socratic thinkers (Heraclitus, Thales, Anaximander). Starting in the sixth century, in Greece, "each city, small or large, integrated or not into trade" prints its own money with a "distinctive feature" [MOS 84, p. 105].

There again, China could doubtlessly claim a remarkable advance, except that the phenomenon that spreads in the Mediterranean quickly shows itself to be better adapted and more adaptable for large-scale commerce. Neither the alphabet nor coin money "founded" Greek science and we do not claim to defend a view on their influence in the short or intermediate term on the economy of that region. Nevertheless, they indicate practical transformations in interindividual and intergroup relations, jointly inspired by a quest for a "skeleton key". And the dawn of "calculating thought" [HER 99, HER 03]. In other words, the alphabet and coins participate in a widespread hope for shared understanding at the same time that these innovations stimulate the credibility of this aim.

It is here that the confrontation with China highlights a major dissonance: the centralization of a large empire around a conservative bureaucracy, as the antithesis of the moving cloud of economically interdependent and politically scattered cities. Ideograms freeze ideas under the protection of the mandarins, while the alphabet accelerates its circulation at the fully assumed risk of it being altered. *A merchant economy first calls for a legal revision with underlying communication techniques that go beyond States, for an ideological instance where the long-term potentials of common codes are discussed. Codes that would frame man's legislation by referring to the world's lesser known laws.* The dissipation of political entities is less important when a framework of common rules protects exchanges.

Needham sometimes wished to excuse, or veil, episodic proximities between his issue and historic materialism. Nevertheless, an ingenious idea from Marx was mostly ignored (including by an economism asserting its authority), whose brilliance bursts forth here: faced with infrastructure, a superstructural block confusing the two instances that inhabit this ideological and legal-political level must no longer be imagined. These proximities do not move to the same rhythms and they do not always respond to the same unrest. "The history of ideas" does not often realize that coin money calls to mind both ideology and the alphabet, and it senses social practices with little more ease than the alphabet modifies them. In addition to their quality as teachers, philosophers from Ionia to Athens combine the reflections of the logician and the legislator. A rarity in this process comes from the legal instance demanding that the ideology produce new clarity.

What the Greeks create, the Romans name science: the relaxed image of a container and its contents, softly blurring the singular modus operandi of

the filling itself. As for the Greeks, they still do not dream of refining an institution. They speak of *logos* and *theôrein* in the face of *technè* and *praxis*. Reasoning and observation/representation (*theôrein* gives rise to *theory* and *theater*) monopolize their attention, the social status of these thinkers inciting them, people say, to scorn techniques and practices. Stopping there reduces sociology to a list of attitudes to be removed before deciding on the relations' meaning:

> "The sphere of law and justice proposes important models of a cosmic order… In this perspective, it is the experience of a society ruled by regular legal institutions that provides the indispensable context in which the idea that the world is an ordered whole can develop" [LLO 90, p. 253].

The inverse vision of the cosmos guiding the elaboration of the legal also "functions" well, and ethnology knows that a number of societies rely on this. But in the present matter, should we really opt for one direction against the other? A myriad of cities underlies the "Greek miracle", with their institutions and mythologies, similar but interspersed with singularities filled with potential contradictions. A unique cosmology in the background would promise coherence on this level. Logic expresses in ideology this aspiration for communication without borders and general values that coin money and the alphabet started to make plausible. Interpretation does not conceal any degree of utilitarianism: an ideology is built on the unlimited extension of the growing premonition that it is possible to "control" all beliefs.

Séris' remark thus calls for a complement: science starts before what the Greeks call technique. Except that the notion has considerably expanded its field of application since then, thanks to them: what monopolizes all these philosophers' attention would be defined today as techniques of reasoning, demonstration, classification, etc. Techniques that target the relationships between men themselves, more than their relationship with nature, techniques that our time recognizes as such without reservation. *A constructed logic and methodology deliver operational techniques, nothing more and nothing less*. And the mathematicians who give rise to what Lloyd calls the "model of exact science" and "concept of the supremacy of pure reason" [LLO 90, p. 129] do not break with the universe of technical applications when they are no longer consecrated exclusively to architecture.

There remains one final problem: from this standpoint, what ingredient could science add that is not already part of acquired or potential technicity? The response can be found in a partnership that develops between reasoning and examination. Or, to use the original terms, between *logos* and *ironeia*, best illustrated by the famous "Socratic irony". The connection between the *irony of logos* and the *logos of irony* proclaims a permanent collusion between beliefs founded outside reason. This character, the ironic man, doubly confronts the technician and the sage, introducing a *legitimate doubt* between the engineer and the scribe: Greek thought literally gives *contestation its rightful place*, which disrupts the construction of knowledge. Science emerges from the incredible structure that follows.

The divine essence of kings, emperors and pharaohs could not tolerate a third pole, characterized by professional skepticism: only reason can slow, suspend and especially limit the contestation authorized by the law, and this by raising another contestation against it. In these essays inspired by the rupture created by the Greeks, Jean-Pierre Vernant discerns the places where the fracture grows deeper:

1) "From the time a text was written down in prose, when it was 'placed in the center,' as the Greek expression goes, that is, made public, placed in the middle of the community, it was henceforth, by that very fact, subject to controversies and criticism. In my opinion, we are now delving into a completely new system compared to what we know of those of the ancient Middle East, one that was also new compared to the myths of Hesiod…" [VER 96].

2) "In the myths there was an order of the world since at a given moment there was a power. For there to have been order there had to have been a power that founded it, established it, instilled it, and preserved it. That perspective was completely altered. Henceforth, for there to have been order, it was necessary for no power to possess complete supremacy" [VER 96, p. 159].

Democracy and science interweave in a unique momentum, one profiting from the other to advance the common project that revolutionizes the expression of thought: *discussion between equals*, where arguments come together independently of the social status of the individuals who maintain

them, until a polemic breaks out. Did not the cynic Diogenes fascinate the Athenians by personifying the subversive *logos* that asserts itself at the expense of riches and power? A number of societies without writing systems have developed verbal jousts where the competitors confront one another in flawless parity. Nevertheless, it is a matter of rites, not in line with "real" social life: moments of controlled transgression.

"The ironic man" does not only speak as an equal with the scribe and the engineer. His presence forces the artisan and the sage, or the technician and the philosopher, to dialogue on equal footing by inciting them each in turn to take an ironic position toward the other's convictions. The science that is born in Greece gives rise to hardly any inventions in wood, earth or metal, but it certainly forges the citizens that it contaminates. However, without ignoring that this remodeling initially excludes women, the lower classes, slaves, and most "metics", the fact remains that debate was solidified and socially implemented as a full-blown technique, albeit in the extended meaning that this notion will take on after a 20 Century hiatus.

During these 20 centuries where China progresses noticeably more quickly than Europe, science, without disappearing completely, will experience the domestic government under the yoke of authorities limiting its expression.

1.4.3. *Science thanks to techniques: second birth*

The most curious, bar none, is found in the project's persistence despite the triumph of monotheism, even, to some degree, with its competition and conditional approval: Christians regularly discuss as equals, until a superior provides the final word. With their blessing, the divergences between philosophers, or between their schools of thought, feed the educations of certain elites on the condition that they bend to the dogma's principles. To avoid all digression, let us simply remember a form of continuity in passing over the ambiguities. The only circumstances that count are those that preside over the resurgence of the complete goal. In the enormity of the *Renaissance* movement, it helps to identify the sources that activate the phenomenon in question. Among different innovations, three dominating forces form a system that suddenly skyrocketed at the start of the 16th Century.

First of all, *the expansion of the accessible world and the discovery of previously unknown countries*. Starting in the 12th Century, Europe received

a growing flow of information from the South and East, benefiting notably from more frequent commercial contact with the Arabs. Although they were subject to the tradition of a technician/sage duality, they had made considerable progress[5] in this regard: certain lost Greek texts and certain discoveries, mathematical or technical, reached Venice, Genoa or Toulouse because of these encounters, beyond the fall of the Muslims in Andalusia. The revival of technical progress largely preempted the landing in America, which, of course, lead to an enormous explosion of knowledge, with an expansion in discussions that Catholicism particularly managed to channel as it simultaneously confronted the *swift Lutheran opposition*. In parallel, though, this event sanctioned the social expansion of a highly determinant technical invention: *printing*. It is because of this that Luther's theses on the indulgences, translated into German and published as posters, spread across Germany in 1517 in a matter of 2 weeks. Forces and counter-forces in the country indulged in a war of posters, exceeding 630 between 1520 and 1530 [FEB 58, p. 433]:

> "All these posters are, beyond all doubt, the most visible sign of the battle that is taking place; they can be found on walls, church doors, carriage gates, be it pages posted in secret at night, attacking mass or insulting the Pope, or official texts announcing the measures taken against heresy, denouncing evil books, ordering their surrender. The public can expect punishment for reading them. Behind these, however, is the mass of 'foul' or heretical books – whose spread we must now invoke" [FEB 58, p. 432].

To the point that in France in 1535, Francis I, suddenly furious and suffering, prohibited printing by royal edict and closed book stores. He calmed down afterwards. On closer observation, the phenomenon cannot be reduced to a simple multiplication of the written fact: it will be beneficial here to reread the previously cited reflection from Jean-Pierre Vernant on the prose text "placed in the center". Luther's attacks were released in Latin but immediately translated and diffused in German. The social center is now occupied by the text, which avoids the physical center of the *agora: reproduction creates ubiquity and consequently a path of resistance against repression*. Burn all the Cathars: only ashes remain. Massacre the

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5 Despite period reminders, it is forgotten, God knows why, that in the time of the Crusades, the role of barbarians turned to the Christians and that of the civilized to the Muslims.

Protestants: they leave contagious papers behind, like those sparks carried by the wind after a fire, floating away to light other hearths. The omnipotence of the State found itself demolished by words that "stayed" because of writings that "flew away". Francis I was repulsed as a monarch, then "got over it" as a protector of the arts.

Printing technically reestablishes the integrality of dialogue on equal footing, thus the resurgence of a science that will henceforth discuss everything. Including techniques to be perfected, preconceived ideas, unexpected findings, etc. Luther's poster highlights an already-initiated phenomenon: the first word that Christopher Columbus sent across the Atlantic from the West to the East was "canib", cannibal. And since the early 16th Century, books, edited various times across Europe, established conflicting interpretations on the subject of men who eat their own kind: quickly salvaged by the Catholic/Protestant antagonism [LES 90, LES 94], they last today in the lasting contradiction between the noble savage and the ferocious primitive. Incidentally, explorers, classically trained, also "see" headless and dog-headed men, not to mention the Amazons (in the Congo, the Antilles, then Brazil), but those legends slowly fade away, the Europeans' sights breaking away from the flood of old stories [GUI 12].

Contrary to appearances, we are not moving away from our subject at all. The stakes identified in the strong resurgence of what minority epistemology calls "thematic dyads", in the allegedly "hard" sciences [HOL 81, HOL 82] or… soft [JAM 93]: pairs of incompatible presumptions, lasting divergences concerning the root of the interpretation of a real domain. Christianity had carefully preserved a small number of them (Plato/Aristotle, or Heraclitus/Parmenides) by keeping them under its control. Yet it is here that each theory suddenly incites its antithesis, obsession wins out over science and dogma regularly has lag time on the ideas that afflict it. Except that, this time, beyond debates on man, discussions on nature use new tools to support their assertions. On the one hand, this leads us right to Galileo's setbacks: as for Copernicus, he was *neither worried nor published*. Printing makes the spread of conflicts, both large and small, increasingly unmanageable. The circulation of ideas goes hand in hand with the circulation of conflicts.

The birth of complete science asserts itself in a social metamorphosis that creates an unprecedented form of society, congruent with the second remark taken above from Vernant: from here on out, the order will practically

depend on the absence of a supreme voice and an inviolable foundation. It is no longer about a horizon to be reached.

To be more concrete, *before crossing this threshold, each society had one and only one culture*. Not necessarily a homogeneous one, of course: in many leaderless communities, men and women divide knowledge with different approaches to the world, dissimilar magic, different rites. Nevertheless, a commonly acknowledged logic places these tensions under the regimen of shared competences, or the real: opposition does not turn to incompatibility. As for highly centralized States, they often bring various ethnic groups, i.e. various cultures, together. Furthermore, they tend to contain several representations of the universal order: Buddhism and Taoism in China, for instance, or even the coexistence of various polytheisms in Rome. So long as the proselytism tied to the Christian and Muslim monotheisms does not become a priority, this juxtaposition poses no threat to the collective organization: society obeys the culture of its master and bends to the degree of dispersion that it tolerates. If the sovereign leader changes beliefs, as with Amenhotep IV (polytheist) becoming Akhenaton (monotheist), a temporary crisis will break out: one of the two cultures must eliminate the other.

In Europe, the 16th Century combined the ingredient likely to cause a cultural chain reaction: a confrontation of rival proselytisms on all grounds, access to new worlds to be appropriated, a flood of surprising information that conventional thought was not ready to interpret, the States' loss of control over the spread of theories, everything contributed to an evaporation of "complete supremacy": political, legal, economic and "cultural" powers formed unstable alliances, established uncertain networks and collapsed on a web that came unraveled. In a certain way, Westerners wanted to define "primitive" societies based on their inability to understand what the West had created. Societies "without this" or "without that" explained the ignorance of what we had invented: there is no primitive society, but there is effectively a "modern" social structure to be identified.

The Renaissance initiated a process that lead to *societies structured by contradictory tendencies*. Before, a culture ordered a society around a common direction. Hereafter, *a society implies an irreconcilable ideological rivalry at every level and on every spectrum*. It is not enough for the society to support them; it feeds on them and builds the future on the friction between them. Lévi-Strauss set cold societies repressing history against

warm societies that accept it [LEV 73], though they resist him, for every social structure strive to defend its cohesion against the changes that threaten it, in order to absorb their shocks. In its complete form, science endorses that success in history is to be found in progression and no longer in steadiness. *It is henceforth necessary to distinguish (one-)culture societies and (multi-) ideology societies, the latter forming the necessary basis for the perseverance of a science committed to studying everything*.

All science henceforth raises antinomies of "wisdoms" assuming guidelines on the world. And each science translates them in its own domain by theoretical discords that, as soon as conditions allow it, call on the help of technical confirmations or refutations. Then, techniques penetrate the discords with growing frequency, which end up inscribing themselves into the norm on equal footing. Except that these techniques that *are expressed* between wisdom and irony inevitably modify their texture, thus their definition, in relation to those that were perfected in a vacuum. By taking action against this definition, however, we reestablish techniques as a set of detectable facts, both as part of and outside of science. A heterogeneous set where countless activities coexist to different degrees: carpentry, metallurgy, informatics, and genetic engineering, and, in parallel, the worker specializes in a gesture, the artisan takes over production, the expert is in charge of diagnostics, the engineer for fabrication and research. A set whose coherence must consequently be questioned in light of its internal definitions, knowing that an understanding of them remains out of reach – concerning the last centuries, at least – if the criterion of cooperation is not fully integrated with scientific research.

Therefore, let us remember two observations, *a priori* antagonistic, borrowed above from Haudricourt and Séris. These two authors spoke about two different worlds, but they both sensed this dissonance that was strangely pushed aside, whose analysis now presents an undeniably urgent character in the eyes of modern science: practice.

1.5. The abandoned mystery: "technicity"

In French, the word "technique" appears in 1684, applied to the principles of grammar. Around 1750, the word takes on a more modern sense: "that which belongs to a specialized area of knowledge or activity". "Technology" also emerges in 1750, and "technicity" in 1845. We must wait

until the end of the 19th Century, however, for this idea of a science "of techniques and technical objects" to be defined [REY 92, pp. 2091–2092]. The concentration of this family of notions toward the material efficiency of actions is therefore a rather recent development, without the initial sense being completely abandoned. Concerning technologists, in the "century of the atom", they are seldom recruited by technicians: even if some become professors, they teach their specialization, "the rest" stick to theory. No one, however, aims at the root, or essence, of technicity, *especially not epistemologists*.

Ethnologists quickly felt the need for more clarity on this issue and in 1926, Marcel Mauss, with his *Manual of Ethnography*, delivered a definition of techniques that is still authoritative in the discipline: "traditional actions grouped around a mechanical, physical, or chemical effect, acts known as such" [MAU 67, p. 29]. In 1948, he gave a slightly more refined version: "a group of movements, actions, generally and predominantly manual, organized and traditional, contributing to the achievement of a goal known to be physical or chemical or organic" [MAU 04, p. 435].

With guarded reverence and reference, this formulation can only be applied safely to a set of societies, so-called "traditional" societies, for which anthropology's attention was primarily reserved. The "known as such" stumbles over chimpanzees or Paleolithic peoples. Concerning the "traditional", it goes down the drain in a laboratory. In a broader context, two major difficulties immediately stand out:

1) Techniques are torn between the mental operation and the physical action, without completely isolating themselves from the former, but mainly leaning toward the latter. What is worse, if the grammarian can resolutely turn to the mental side, and if an artisan can exclusively highlight his material efficiency, the two perspectives can only be separated very fleetingly on the scientific stage.

2) Following the biological tradition of the genome and the linguistic tradition of a language, the technical tradition insists on maintaining a *status quo*, but it captivates our attention upon failure. When a society internalizes change with the reality of its history, it anticipates the event. Our techniques are more quickly "deformed" than our genomes and, only recently, our languages, for we devise techniques "with deliberate improvement".

Finally, the comments discreetly ceded the acknowledgement of the "technique" to a perception of "pure common sense", in order to save themselves a representation of technicity: separations like *hardware*/*software* thus derive from unstable evidence. Escaping the rut thus requires some editing of Mauss's formulation: regardless of the commendable brevity, this still involves too many criteria and leads to complicated situations. A definition must situate a central reality: it makes a mistake by wanting to plan a description that leads it to anticipate the analyses it will bring about.

1.5.1. *Immediate markers of technicity*

The conciseness of the quote that is established just below unresolvable contradictions seems to discourage every constructive perspective while highlighting a threefold dissociation, obliterated by additional remarks: techniques are acts grouped for the purpose of a product [GUI 03]. Or, more precisely, *techniques are acts coordinated by the intention of attaining a product*.

The sequence of acts, the sought-after finality, and the result effectively result in three issues whose concurrences will only become beneficial after a certain minimum progression of each in its analyses. Inversely, the absence of mental/physical, or ideal/material, separation does not favor mixture. From two things, one: either techniques purely made up of intellectual operations and those that transform a material have nothing in common, and it would be time to stop classifying them together, or there is a real logic that leads us to liken them, and the acceptance of the technical must be placed before this hidden connection to prepare ourselves to understand it. In the second case, we would need to ask ourselves – though not in the context of this work – how epistemology, psychology and sociology managed to reflect on the content of knowledge while completely rejecting this point.

Let us admit, then, that a chimpanzee carving a twig and sticking it into a termite mound to gather insects involves a technical action. The same goes for a *Homo erectus* creating an Acheulean hand-axe, a potter making a vase, an architect deciding on the materials for a house, a programmer fixing a broken device, or a biologist using a statistical test to evaluate the adequacy of an experiment. Through these images, the intentions and products

incorporate outside variables into a single technicity, and the constant events to be flushed out to start analysis will emerge in the "grouping" or "coordination" of acts. From general culture to the views of specialists, the perceptions expressed reveal the promising regularity of numerous traits that show us new paths to follow. The "indicators" that follow emphasize constants whose interdependencies remain to be seen.

The *first indicator*, for memory: the existence of a technique incorporates *transmission*, if only by example (the case of imitation). The path followed by teaching supports an essential relationship with the object that the technique works with, which more or less discourages the chance of variations: the shape of the Acheulean hand-axe does not remain the same for hundreds of thousands of years due only to the mentality of these Paleolithic people, but also as a function of the properties of flint allowing its production. The symmetries that delighted Lévi-Strauss in no way emerge in an area where men, for lack of any better resource, labor away with quartz. The *trending* dimension of a technique, be it short- or long-term, is systematically confirmed in a negotiation between the acquisition of knowledge and the intrinsic resistance of the object to variants.

The *second indicator*: technical, even "traditional", knowledge does not demand total immobility, but it does require the technician's confirmation of the ability to precisely reproduce what has already been done: this is not at all the same. Invention is only distinguished from mistake if the inventor's ability to abide by the "betrayed" model does not raise any doubts. The view on this novelty, which the precision of imitation curbs and which the miscalculations of tradition bring about, often makes us forget that innovations crush the previous stability anyway, which is indispensable for the existence of a technique. And the evidence according to which the new upsets a habit diminishes the fact that this conformity, too quickly swallowed back into routine, does not amount to inertia: a technique must be repeated, it owes it to *itself* to perfectly achieve reiteration: one does not become a technician by creating a product one time. This idea will lose its idle appearance if we call upon a term whose epistemological stakes, far away, no longer escape anyone: *techniques imply the reproducibility of the modus operandi meant to lead to the desired product*.

When scientificity commends itself on its "hardness" by celebrating its ability to *reproduce* its experiments, it unknowingly proves its legitimacy

with the power of techniques. The regret to be fostered in no way affects the aid itself, but rather its unconscious dissimulation and the unavowed recovery of an outside factor. The epistemology speaking to the reproducibility of the experiment avoids rejoining it to the reiteration that authorizes a technique to assert itself as such. How can we avoid associating this systematic circumvention of the pretensions attributed to science – from the outside, by epistemologists! – of selfishly directing the path of knowledge? The philosopher extols science above technique with the single end of subjugating science by making it mirror an absolutely idealized identity. Thus, the intertwining is either simplified or turned into a confusion of principle. We will absolutely come back to this.

The third indicator: below the problem of improvements, temporary or not, every technical practice can be perfected. The apprentice becomes skilled, then he surpasses the master, virtuoso or expert. The execution is evaluated on its speed, its reliability, its precision, or its thoroughness, sometimes also on its "elegance", and finally, on the product's degree of completeness. Stopping this observation at that state of pure evidence is, however, equivalent to depriving it of its social correlate: *the technical world permanently hones considerations of a hierarchical order* that spread out the actors and their work. The technique is measured, and the technician with it.

A documentary on Persian rugs shared an anecdote stating that weavers in certain tribes place a small "defect" in their work on purpose, perfection belonging exclusively to God. If this is true, the sage's humility symptomatically covers the pride of a technician who refrains from achieving absolute success, a forbidden fantasy to all sorts of cosmologists and "scientific irony". As soon as ideology, science and technique are organized into an autonomous research system, the technical standpoint implies hierarchies, taken from the ideological standpoint to expand on them through extrapolation, far from their tested field of application. The usual "invention/conservation" duality then veils complementarity on another level: *innovation and perfection*, where the latter component constantly distills the sense of scaling values that the former periodically disrupts.

The fourth indicator: all techniques are marked by a start and an end. They are concentrated on an internal logic to be more or less strictly protected against environmental disturbances, the environment then

incorporating the climate, rivals, clergy, a new raw material, etc. The focal point is the moment when, as Robert Cresswell so wonderfully writes, the technologist notices that "logic shifts in history" and when it would have to face a challenge: "infers the predictable from the unpredictable" [CRE 93, p. 53][6]. The artisan perfects a technique on an established support, while innovation causes a recomposition of it.

Starting from that, the discreetly unfriendly character of technology in anthropology, glimpsed above with Lévi-Strauss: the fashioning of a material, whatever it may be, binds the producer and his society to a temporality, with a before and an after, in contrast to the symbols that the observer more easily extracts from the context. The "swinging" of the trend, evolving in a foreseeable and logical way in facts that contradict it, not only materializes technical acts, but also social relations responding to other logics.

Yet this fixation in a defined reality transforms the physiognomy of science, subtly but radically, when, after the Renaissance, it engages more and more techniques. By working opposite sages, who think in a supposition of the absolute, the scientist's "critical irony" is condemned to seek only anomalies and incompatibilities: with the company of technicians, everything encourages him to take portions of the world and search through its contents. The technician's largest gift to science thus lies within the realization that reality must be understood in stages and pieces. In less rudimentary terms, *techniques teach science the art of reasoning in the defined frames of reference, where the question asked remains controlled*. Protection against unverifiable analogical deviations is gradually put in place. At this moment, the artisan becomes the scientist's preferred collaborator in long-term complicity that marginalizes the involvement of metaphysical *credos*. Science henceforth provides theories that, like techniques, have a start and an end. When common sense shows technicians to be "restricted", this should also mean that they make sure not to cross the line.

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6 A backdrop for these statements is found by returning to the crucial "trend-and-fact" concept [LER 43, LER 45], which our issue, focused on the difference in knowledge, could not include at this stage of laying the groundwork. See the colloquium from which Cresswell's words are taken [MAR 93].

1.5.2. *Technicity, scientificity and ideology: the distinction of functions with overlapping roles*

In this vein, epistemological and sociological analyses come to seemingly opposite realizations, because the former will distinguish intellectual operations while the latter will notice their cohabitation in the actors involved.

From an epistemological standpoint, we recognize three positions. First, that of ideology, which produces an affirmative image of the world, without obliging itself to respect frames of reference. Then that of the technician, which produces affirmations in fixed frames of reference. And that of the scientist whose critique of established frames of reference leads to reconstructions that tend to eliminate the contradictions, or gaps revealed [GUI 91]. This representation contradicts the bright-line test proposed by Popper [POP 84], the refutability whose exaggerated strength conceals an arbitrary, ultimately partisan choice.

Scientific activity first and foremost disproves. Its refutable character emerges secondarily in an alliance with the technique, which transposes these refutations into positive knowledge in the frames of reference where the experiment is reproducible. Popper pursues a double goal: on the one hand, to create a category of real sciences, and on the other, to exclude the humanities from scientificity, epistemology incidentally becoming the only source of rational knowledge on society. This philosopher's work thus ignores the dimension of technical knowledge to secretly make it his… tool, averaging a truly astounding manipulation that his successors, meek or rebellious, did not show. In short, experimentation refers to a premeditated form of comparison: it thus joins comparative practice as a subset. However, the philosophy of knowledge has never related refined technicity in this sector to an analysis of the comparisons as a whole [GUI 15]. The reasoning of Popper and his followers, just like the reflections that contest it, take for granted that the seed of scientificity exclusively figures into the part without going to the trouble of examining the whole: a tremendous impasse, made believable by the materially visible technicity of experimentation, opposite the technicity, just as consistent but "prosaically" methodical, of unreproducible comparison! But cannot the technocratic abuses of experimentation, with their string of hasty and simplistic conclusions, be seen in failures of comparison?

Why, *from a sociological standpoint*, does not tripartition have an obvious consistency? The mandarin and the engineer, the scribe and the architect, either separate their activities or not: society decides. Science structured after the 16th Century changes the deal: it remains possible to be a "pure ideologue" to decipher the nature of the universe by adopting the position of Rodin's *Thinker*, and furthermore, the perfectionism of the "pure technician" does not evaporate, but no one would know how to assume the role of the "pure scientist". The full-time researcher exists as a professional category, not as an epistemological situation.

Let us consider the textbook example: Albert Einstein. This great theorist spent more time in front of blackboards than workbenches and machines. And we all know the power of his scientific irony toward Newton's gravity and Planck's constant. However, a journalist is said to have interviewed him about the measures taken of the 1919 eclipse that tested and confirmed his assertions: the wise man is said to have given a look of disdain toward this news, no doubt showing in his eyes owing to the results. Let us imagine the true story: this distancing of the technical confirmation would connote something quite different from scientific irony. On another level, when this professor suspects "hidden variables" in the quantum mechanics developed by Niels Bohr, because he does not believe that "the old man" was just having fun, regardless of whether or not God is a metaphor: the conviction of a more strongly determined cosmic order belongs to an ideological vision.

Researchers today devote themselves to different sorts of technical operations and they are filled with intuitions on faraway horizons. Inversely, a scientific career can be achieved without *reassessment*: in disciplines prioritizing observation, be it describing the morphology of an insect or a magic ritual, data collection often takes place according to explicit and required procedures. If worst comes to worst, beyond his/her personal vocation, the official researcher could easily do away with taking the initiative to return to the examination stage, as long as observation and comparison protocols are not identified as techniques. In contrast, technicians are henceforth trained to invent far from theorizing frames of reference; "research engineers", or researchers in "engineering sciences", they oscillate between the tradition of perfecting things and the unbridled engagement in innovations whose usefulness frequently can only be seen in retrospect.

Each feels an undeniable acceleration in the sociological intensification of intermingling and the multiplication of overlaps. Does the process tend to

render "basic" epistemological divergences obsolete? It complicates their expression, which changes nothing about their pertinence, and refusing to use them is tantamount to considering science a muddled mess. An easy resignation that allows relativism to spare itself the hypothesis stating that social orientations underlie this disorder. The other solution involves joining Georges Gurvitch when he suggests harnessing the potential of epistemology to shed light on the fluctuating power relations that creep in between the "kinds of knowledge" in a society, or an era [GUR 66].

Today, common sense spontaneously evaluates the technicity of complex equipment in microscopy, computer science or molecular biology, but they just as easily examine it for statistical tests, probabilities or cryptography. In contrast, the procedures tied to comparison, or the methodic rules concerning the analysis of relatively complex events, hardly give rise to similar comments, despite clearly belonging to the category of reasoning techniques. The boundary traced by our societies thus does not lie between techniques tied to material achievements and "mental" ones. It draws the boundary between mathematically assimilated logical calculations, proclaimed to be techniques and operations that are still intangible for modelers.

Certainly, the evolution of bonds alternatively favored by mathematics with cosmological visions, techniques and science would deserve special analysis, which, however, would not be satisfied with some intuitive presumptions or a subsection within the present work. As with the present study, though, this clarification will be better off not being restricted to narrow timeframes before having determined focuses in the long term; this was Gurvitch's vision of it for a "genetic sociology" of knowledge. He insisted on the fact that studies needed to be done on:

> "the specific cases of the *gap* between social frameworks and knowledge made up of polarizations, ambiguities, and complementarities dialectic in their relations, imposing the search for effective but singular causality, sometimes applied in the direction of social frameworks' influence on the orientation and characters of knowledge, sometimes in the direction opposite knowledge's influence on the continuation or collapse

of social structures, and finally, sometimes manifesting itself as their reciprocal causality"[7] [GUR 66, p. 17].

This is where the lasting confrontation that he summoned from his wishes between the epistemology and sociology of knowledge effectively takes on its full meaning. Gurvitch's salient idea of fluctuating power relations between the "kinds of knowledge" that modulate their system in society places the key point of their intersection by not forgetting the influences exercised outside the scientific system, strictly speaking, by the resolutions of morality or the force of inertia of "common sense".

The present draft of a sociogenesis of the diverge of knowledge implied in and by science results in the intention to reconstitute a wide background within which observation of the relations between technicity and scientificity would stop utilizing a series of biases, all the more formidable than silent and unified. The technicity/scientificity relationship has been removed from the reflections of Popperian and post-Popperian epistemologies, which legitimized "technosciences", before their time, to the detriment of the sciences that we will provisionally call "qualitative" sciences (the term reflecting the opposite standpoint in particular). Now, then, we are at the foot of the wall: does the present issue shed light on the upheavals currently being caused by rationalist ambitions? We are going to attempt to prove this in the amount of time that separates us from the end of World War II.

1.6. Technocracy and scientificity

We have seen, on the one hand, that *techniques never reside in the rupture inherent to invention, but rather develop in the management of foreseeable invention*, and, on the other, that *a technical problem becomes scientific when the accumulation and sophistication of existing procedures is no longer enough to resolve it*. The 20th Century, however, increases the ambiguity of certain technicians by inciting them to anticipate the limits and to prepare solutions: management channels and creates innovation. Beyond theoretical interrogation, certainly, but, appropriately, the generalization of this form of exploration gradually insinuates the fantasy of progress

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7 Italics in the text.

accelerated by an alienation of scientific tergiversations. In the distant future, the technician and the politician could start a private dialogue, enjoying growing pleasure in doing away with the third pole's "ironies". As long as the sage surreptitiously joins the position of the politician's technician via elite schools of administration.

1.6.1. *Technocracy: two perspectives in the 1960s*

The terms "technocrat" and "technocracy" occasionally appear in English, then in French, in the 1920s and 1930s; they spread in the 1950s [REY 92] with the lessons to be learned from the ability of an unheard-of bomb to put an abrupt end to the worst war ever, all while heralding even more harrowing days to come. Though he had broken away from high-level theoretical physics, Robert Oppenheimer, director of the Los Alamos Laboratory (and in this capacity, the man responsible for leading a plethora of wayward Nobel laureates), assumed the archetypal image of a technocrat by symbolizing the authority of pragmatism over creativity. On the one hand, people of the nascent "atomic era" admired this dizzying flight; on the other, they doubted "techniques without awareness". Philosophy and science fiction gorged themselves on this subject, always leaving aside the specificity of the scientist, generally converted into a creative super-technician who would make techniques more methodical (that is ultimately more technical). A thinker like Jürgen Habermas – to choose one practically at random – deals with "the scientifization of the technical" without taking even a second to look at the eventuality of an infiltration in the opposite direction [HAB 84, p. 43][8].

Let us give voice to one of the first great figures of the modern technocracy, no negative connotation intended: Louis Armand, second in his class at the École Polytechnique, then a major from the École des Mines, was the general manager of SNCF and he set the foundation for Euratom, of which he later became the first president. In 1961 and thus at the height of his glory, this unmatched engineer published a "plea for the future", where he produced an initial response to the fear caused by the modern take-off of techniques:

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8 The original edition is from 1968.

"It is not the technique that represents the true danger for civilization; it is the inertia of structures. Our civilization's imbalance – felt by all today – comes from the organization's delay regarding equipment" [ARM 61, p. 87].

"Yet the technique ignores history. The dominating phenomena are called dimension, interdependence, complexity. They are always evolving. The sophistication of scientific progress and its rapid efforts thus impose flexible structures to avoid the organization's delay regarding equipment" [ARM 61, p. 87].

"TECHNIQUE + ORGANIZATION = CULTURE" [ARM 61, p. 153]

Here, the engineer clearly provides the thought pattern centered on a duality of efficiencies, conducive to the inspiration of all technocracy: technicians vs. politicians. Then, it is of little importance whether or not the social sciences join the kingdom of techniques or the Prince's servants, for the central motivation of this representation implicitly maintains the path that Habermas did not believe he needed to stroll down: *the internalization of science through the technique*, with the subjugation that accompanies it and the subordination of knowledge whose utility remains to be seen. The refusal of utilitarianism that consequently arises as the "natural rival" of the technocracy will rarely defend science against the tyranny of technicity, for it will prefer to invest itself in a non-rationalist image of culture. In this transition, let us note the perfect compatibility of the technocratic orientation and Popperian epistemology. When, for example, the latter endorses Darwin's theory of evolution, all the while denying the status of authentically scientific theory, he makes it wait for the technical confirmation that will come neither from ecology nor ethology, but necessarily from genetic experimentation.

Furthermore, the manner of equation with which Armand defines culture hides an inequality: techniques no longer adapt to the social organization, as the initiative for change falls to them. Society must then undergo reforms as a function of the specifications imposed by tempting but demanding techniques. The technocrat barely acknowledges this, contrary to Gurvitch who, almost simultaneously, makes a very similar statement by, nevertheless, presenting the matter from another angle:

> "We have reached an era in which techniques overwhelm social structures, particularly the kinds of societies where they originated. Yet the history of techniques shows that, until now, technical knowledge had never given rise to social frameworks, that to the contrary, it was the social frameworks that gave rise to new techniques" [GUR 66, p. 30].

The engineer and the sociologist observe the same relationship core from very distant positions, and their reflections give rise to complementary critiques. In short, Armand lets himself be guided by the idea of progress, bearer of inevitable mutations: "the technique imposes itself spontaneously" [ARM 61, p. 18], but since 1961, contestation of that motivation has increased: atomic energy and, more recently, genetically modified organisms (GMOs) represent model targets. Incidentally, though, at the heart of this resistance, mobilization showcases the rational evaluation of danger, but also kinds of knowledge outside a quest for rationality, starting with morality. The result of this is a debate where the technocracy believes itself to contain science and where its adversaries avoid questioning the technique/science relation for fear of shattering their cohesion. In a form of backwards irony, the questioning characteristic of science thus no longer leads to questions.

As for Gurvitch, is he wrong to state that the technique has never "given rise to social frameworks" before the 20th Century? Skimming through the effects of writing and printing, we saw that in times past, it largely regulated or suddenly transformed societies. A professor at the Sorbonne may indeed have nothing of a technologist to him, but he knows how to carefully choose his words: the expression that he employs is not synonymous with the triggering of social changes, even significant ones. And the technocracy asserts its own identity, indeed, by aspiring, as Armand shows, to schedule the creation of previously unseen social *frameworks*. Warm society raises to a higher degree: it is no longer content with accepting random history; it turned it into a project. From then on, ideological battles are willingly engaged in on the field of anticipation and the citizen is invited to opt for such or such badly shaped dimension between demographic curves, precautionary approaches, growth rates, etc. On one slope, science is diluted in the technical. On the other hand, it is erased behind it, and the promotional messages hit the public with the "scientifically proven" label as soon as a technical test obtains positive results.

In a troubling turnaround, science would neither refute nor unveil anything further, as it would be limited to legitimizing the technique's "winning shots" instead of entrusting the technical with the job of solidifying its assertions.

A conjecture looms in the distance, sinister enough to ardently wish to understand its refutation. Science could fall prey to a "fetishization" phenomenon, homologous to the one Karl Marx distinguished concerning money: it finds itself in the place of production, the technical taking that of money, while technical relations are responsible for usurping market relations. In both cases – material production and scientific production – the operation dissolves the social dimension so that it is removed from all interpretation.

Curiously, this installation of a sort of technocratic "remote control" on research will go just as unnoticed, as those years were incidentally marked by an intense theoretical febrility: in mathematics, physics, biology and the humanities, the 1960s leave behind the memory of theoretical bubbling, interspersed with unprecedented questions, the memory of large alternatives and a wide range of discussions. Investigation maintained its place of honor and the ebb took place, rather abruptly starting in 1975, marked by a sudden disenchantment concerning methods [FEY 79], on the one hand, and the fantasy of technical panacea capable of "styling" the development of interdisciplinarity, on the other. The technocratic imagination dreamed of generalizing system analysis, urged by Ludwig Van Bertalanffy [VAN 68], with "expert systems" resembling machines where the measured data just needed to be input for them to provide perfect responses to flawed questions [WAL 77, LIC 76, LIC 77, EUG 81].

1.6.2. *Technosciences: the example of molecular biology*

The idea of "technoscience", spread toward the end of the 1970s, absorbs an avatar comparable to the notion of the intellectual: the term slowly rids itself of its initially pejorative burden (which denounced abuse, or danger of technocracy) and conceals that ambivalence that the common sense of our days attributes to the technique in general: a strength even more formidable than it is admirable. Let us set aside philosophical discussions: the word has entered the unofficial language of researchers to conveniently designate disciplines that involve a heavy technical structure and thus diverge more

and more noticeably from other sciences. Two different motors tend to ceaselessly increase this gap:

– *Scientific investigation shows itself to be more and more dependent on the use of the available technical means to resolve its problems*.

– *The infrastructure required by techniques greatly increases the budget allocated to the discipline and widens the gap with the function of others*.

This in no way takes away from the need for interdisciplinary cooperation, but it considerably changes the conditions of dialogue. A "technoscience" appropriating the most expensive means of participating in the resolution of a wide range of enigmas (which expand far beyond those that it must formulate on its own initiative) simply finds itself in a position of power: it imposes its goals and, in the medium term, *its premonitions* on the reality to be explained. Gurvitch's issue, turned toward the power relations between "kinds of knowledge", could not dream up a more wonderful project, if only it managed to garner the slightest bit of specialists' attention.

Allow us to provide a very brief overview of the tensions involved through three anecdotes taken from molecular biology:

– The first is famous: at the end of the 20th Century, a genetic study concluded, contrary to what every concerned discipline argued, that the modern human and Neanderthals constituted two different species, thus without imaginable mixture. Vulgarization spread the news with incredible speed – without concern for the doubts expressed by certain biologists concerning the reliability of the study – when, around 10 years later, another study demonstrated the existence of a small proportion of Neanderthal genes in all or some modern *sapiens*. The thesis fell apart. Strangely, no one reproached genetics for jumping to conclusions that misguided specialists: paleoanthropologists even wholeheartedly applauded this decisive contribution.

As for genetics, it barely gave in to self-criticism. At most, some reflections dealt with "misunderstandings" between paleogenomics, archaeology and classical paleoanthropology [LAL 13]. The opportunities offered by paleogenomics undoubtedly represent a precious advantage, henceforth completely indispensable: who would wish to irritate a

community that, because it controls access to high-technicity tests, has a means of pressure, or worse, a right to veto, according to which it lends (or not) its competition to a program? No scheme: authority and obedience go without saying.

– The second was observed in 2014, in France, in a student working on his master in life sciences with a focus on research training. The student spent time in a genetics laboratory where he was supervised by a mentor working on their doctorate. This mentor was working under the supervision of a postdoctoral individual and therefore there was yet another level between the student and a supervisor with the recognized minimum of skills in overseeing this sort of work: a completely banal situation, today, that nevertheless leads us to wonder if the school content with this situation produces "top-notch" researchers or technicians, insofar as the student only has extremely limited access to anything originating in scientific investigation per se. A lack that this education will only compensate for if professors contest this situation, despite having been educated by it themselves.

– Even more recently, a book project bringing together specialists in social anthropology and a doctoral student in molecular biology who, before starting his doctorate, had outlined a reflection on the relations between relationship systems and population dynamics. His challenge stood out in refusing to initially adopt one of those reductionist hypotheses that immediately place ethnology among the biological: it thus authorized a discussion between equals. The author of this project, as a courtesy, contacted the geneticist's thesis director and found himself faced with an irrevocable refusal: the young researcher had to commit himself to international publications that would integrate him into the discipline. The "boss" sincerity raises no doubts and the strategy defended probably corresponds to the existing norms: however, the fact remains that this attitude subjugates the older, appropriates the younger *de facto*, and directs his fate. The innovative hoped-for cooperation collapsed under the weight of effective censorship: without a miracle, the book intended will never exist.

We are in no way insisting that "technoscientists" let a perverse tradition, zealously, upheld to the detriment of true science, corrupt them. The phenomenon clings to the very structure of the technical and we have already pointed this out above: *the hierarchization of positions and relations, inherent to technical activity*, favors a marginalization of theoretical activity.

Additionally, it shuts down interdisciplinarity ultimately depending on dialogue between equals. Though they may be tempting, the guarantee of technicity and the cohesion of a community focused on its particular efficiency can only be obtained at the price of this double infraction. And the reinforcement of this imbalance in an interscience confrontation is easily understood: those that publish unresolved alternatives and disputes are penalized against a technoscience that translates its internal oppositions into an esoteric language outside speakers cannot access: which facilitates the apologetic sighs over "misunderstandings".

That said, even in the absence of a conspiracy and "perverse tradition", the allergy of the ruling technicians before the intervention of theory is solidified by an undermining that must constantly be monitored. Thus, the fantasy of expert systems is followed today by that of Big Data: a formidable accumulation of data could end up making the competition of representations, and thus discussion, superfluous. This vision's incredible naivite – at least in its vulgarized expression – speaks greatly to a desire to caricature theoretical debate as logomachy with a hope of banning it in the future.

Controversy has not disappeared, of course, but most of it fervently opposes criticism of contemporary rationality (mysticism and moralization in particular) and technocrats. For example, sociobiologists are showing themselves to be more and more active concerning creationism as it bolsters their scientific image, all the while dissimulating the fact that they are avoiding debate with the critiques coming from their colleagues. The shortage of open contradictions between different representations within science thus finds itself hidden from all outside views.

1.7. The wilting of science, for lack of dissidence

This rapid clearance will have fully achieved its goal if it has convinced the reader that the analysis of science and techniques unduly deserted the vast domain of their connections and interactions, with the wide range of their entanglements. In our opinion, the double colonization of said domain by epistemology and sociology takes on an increasingly urgent character. At the same time that technocracy is increasing its hold on the planning of the sciences, philosophy and the "humanities" have turned irony against themselves: they have transformed it into blatant self-mockery, sending

methodology to graze, ridiculing scientific ambition and denigrating disputes about ideas. Marxism was the first victim of this disintegration: the fall of the Berlin Wall simply sped up the flagrant collapse of the 1980s. Structuralism gave way to poststructuralism free of all constraints; the end of history, even of ideologies, was announced. And Michael Serres scrapped "useless discussion" [SER 92, p. 55]. The obstinacy to once again draw closer to the truth would display a dominating arrogance, inherited from a civilization seduced by all presumptuousness.

However, would technology free of science demonstrate more modesty or restraint? And are we not forgetting that science was born as a *democracy of ideas* with goals to achieve and responsibilities to fulfill, just like the democracy of citizens? The logical outcome of this movement taking shape before us for nearly 40 years now can easily be guessed: a return to the isolated confrontation of the engineer and the mandarin, next to a sign reading "irony prohibited". Some will think that this is a temporary detour, meant to end with the belief in an end of all ideology. Authors will assume a lasting transformation of the game: be it regretfully or delightedly. However, rather than betting on the future, it will be better for them to work toward defending the structure of science, or possibly promoting a new one.

We mentioned Marxism: it invited us to consider that a *production process* breaks down into a succession of *work processes*, each marked by a *technical efficiency* and a *social efficiency* [BAL 68, TER 69]. To this day, Marxist or not, there is no better observation and analysis grid, and it can be perfectly applied to the production of knowledge. Science enters the category of possible social efficiencies and, as such, its intervention always results in a direction assumed by society. Today, the dominating tendency leans toward a reduction of scientific action opposite technical action. We must simply realize that this diminishment, contrary to what is implied, will not take place in a vacuum: renouncing that social efficiency is tantamount to supporting another, which no one seems willing to define.