André Leroi-Gourhan on Technology

A Selection of Writings from the 1930s to the 1960s

Cultural Histories of the Material World

Nathan Schlanger, editor

André Leroi-Gourhan on Technology

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Edited and introduced by Nathan Schlanger

Translated by Nils F. Schott

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Series Editor's Preface

ANDRÉ LEROI-GOURHAN has had a strange fate. He was exceptionally well known in France, where his work on prehistoric art and archaeology, on the one hand, and the study of tools, techniques, and technologies, on the other, were recognized as equally important as that of his colleague Claude Lévi-Strauss. Yet few outside France, especially in the Anglophone world, were familiar with his name and ideas. There were some translations (now themselves artifacts of past interest), but Leroi-Gourhan was basically unknown. And yet, a single, suggestive anecdote can signal just how important his work was, and how influential it could have been. In 1949, at Lucien Febvre's retirement from the *Collège de France*, the question of the renewal of the chair and its occupant was raised. In the choice between *Civilisation moderne* and *Civilisation matérielle*, the former topic won with the election of Fernand Braudel, and not that of Leroi-Gourhan, supported by those in favor of Civilisation matérielle. The irony should escape no one that it was Braudel who later published a book entitled *Civilisation matérielle, économie et capitalisme* and became known throughout the Anglophone world as the leading spokesman for "Material Culture," *à la française*. In a sense, then, this volume aims to go back to that 1949 election and

recuperate the theoretical vision of Leroi-Gourhan for the practice of material culture. We cannot, with this, change the past. But we can hope to change the future.

This volume should contribute to that aim. Containing essays from across Leroi-Gourhan's career, but focusing on the arc of specific themes, notably those connecting objects and object study with meaning, this project aims to restore a missing voice to our contemporary debates about how to study things. *L'Homme et la matière* (1943), for example, contains hundreds of drawings made by Leroi-Gourhan of various tools and objects he had encountered during his researches in eastern Siberia and northern Japan. But the materials were shown in motion, as used. It was as if Leroi-Gourhan were telling us in images that things cannot be understood at rest but are only properly grasped as they fulfill the purpose for which they are made. In words, he said this and more, developing a set of terms—techniques, *technicité*, technology—to capture that relationship between humans, things, and use. We find in that book from almost a century ago a ready-made antidote to vulgar material culture studies that, like a specter, always threaten to stalk the field. No surprise, then, that it was a random encounter with this particular book that sparked the translation project of this volume as a whole.

But once entrusted to Nathan Schlanger, whose previous work on Marcel Mauss, on the history of archaeology, and as a prehistoric archaeologist covering the same spectrum occupied by Leroi-Gourhan during his lifetime, the outlines of a still broader project hove into view. By looking at where Leroi-Gourhan came from, and where he wound up, this volume offers a window into a part of the spectrum of the human sciences in France ignored by those familiar only with a Barthes-Derrida-Foucault highway, whether or not they passed through Althusser junction. Yet Leroi-Gourhan's career illuminates the place of ethnology between the field, the museum, and university departments and institutes of ethnology. In a way that is similar in outcome to the situation in the Anglophone world, but built out of very different components, Leroi-Gourhan's changing institutional location illustrates the difficult-to-place identity of material culture studies—a notion that, significantly, Leroi-Gourhan used very rarely.

It was Leroi-Gourhan who launched the term *chaîne opératoire* to capture the networked connection of agencies across space and matter that all need to be taken into consideration if we wish to accurately chart the meanings of things. This term has been taken up by among others anthropologist Tim Ingold and archaeologist Ian Hodder, as

well as by Bruno Latour, whose own actor-network theory could be seen as a variation on Leroi-Gourhan's theme. Similarly, the turn to appreciating "making" as a form of "knowing" resonates firmly with Leroi-Gourhan's notion of technology: it is the object in use that tells the fullest of stories. Experimental archaeology, making, and knowing—all these are different ways of returning to that fundamental truth.

Finally, Leroi-Gourhan's intellectual homes bounced between the museum and the university. This, too, reflected changing features of French intellectual life over the first three-quarters of the twentieth century. At its start, the museum was the home for ethnographic research. In part, this was because the museum was then a place for research and because ethnography had a marginal relationship with university disciplines. It also had to do with the relationship between ethnography and the colonial enterprise. This was true in France as it was elsewhere in Europe and the United States. The movement of ethnology out of the museum and into the university during the middle decades of the century, which Leroi-Gourhan's career also illustrates, had something to do with the increasing intellectual prestige of ethnology, something to do with the failure of that colonial enterprise, and something to do with the transformation of the museum from research center for the few to general educator of the many.

To stay with the history of museums—this volume, focused on France, takes its place in a series of books published by Bard Graduate Center (BGC) and devoted to the role of the museum as a generator of knowledge in the early decades of the twentieth century. *The Museum in the Cultural Sciences* (2021) examined the situation in Germany at the beginning of the twentieth century. "The Historical Museum," by Johan Huizinga, was translated into English for the first time and published in *West 86th* (2023) with an introduction by Martine Gosselink, director of the Mauritshuis in The Hague. And in upcoming years we hope to publish on Soviet museum thinking in the 1930s and 1940s. BGC has made museums and museum knowledge such a focus because of its own Janus-faced position, looking into the university on one side and the museum on the other. I often think that if BGC had existed (and had been in France) during Leroi-Gourhan's lifetime, it would have provided him with an ideal home.

Peter N. Miller

Preface

ANDRÉ LEROI-GOURHAN'S contribution to the study of techniques is not completely unknown to the English-reading public, mostly thanks to the publication in 1993 of *Gesture and Speech*, the translation of *Le Geste et la parole*, originally published in 1964–65. That book aside, however, the technology of Leroi-Gourhan has often remained difficult to access, decontextualized, and at times quite disconcerting. It is the principal aim of this anthology to remedy this state of affairs and to make his writings more relevant to both historical and contemporary debates. Alongside its archaeological and anthropological dimensions, Leroi-Gourhan's research on technology—understood as "the study of techniques"—is a key component of twentieth-century intellectual history, with wider implications across the human and social sciences. The eleven texts selected here, most of them originally published as stand-alone papers, form a sequence stretching from 1936 to 1962 (or 1971, in the case of the revised text 3). Wide-ranging in time, these texts also cover broad disciplinary grounds, with their targeted audiences including historians, ethnologists, and sociologists, as well as prehistorians, palaeontologists, psychologists, and both Catholic and secular intellectuals. This distinctive theoretical and disciplinary breadth has

made it all the more important to provide a substantial introduction to Leroi-Gourhan's thoughts, achievements, and reception. This introduction, in part I, includes some biographical milestones, touches on his better-known work on Palaeolithic parietal art and archaeological excavation techniques, and emphasizes the main subject of this anthology, namely, the anthropological and archaeological study of techniques. A more extensive and broader-ranging study of the disciplinary, intellectual, and philosophical development of Leroi-Gourhan's technology in the twentieth-century human and social sciences has been published in 2023.[1]

For permission to undertake this anthology project as a whole and to reproduce the texts assembled here, I thank first and foremost Martine Leroi-Gourhan for her generous agreement on behalf of the Leroi-Gourhan family, as well as the indispensable help warmly provided by Philippe Soulier (see the editorial note in part II for further details). At the other end of the project, and on the other side of the Atlantic, special thanks are due to Peter N. Miller, former dean of Bard Graduate Center in New York, intellectual historian, and publisher of this book. The fine combination of patience and perseverance he has shown over the years has been immensely helpful for bringing this all-too-long-drawn-out and tortuous project to its completion and, indeed, for making it possible to pursue its further developments in other publications. For their friendliness and efficiency, I thank Daniel Lee, former director of publishing, and Katherine Atkins, editorial director, at Bard Graduate Center, and especially Florence Grant for her simultaneously conscientious and flexible copyediting of this book. As well, I thank Frédéric Keck and HAU Books for readily welcoming this anthology in the HAU open-access "Classics" series, and for making this collaboration possible. So far as the introductory text is concerned (part I), I am grateful for useful readings of advanced drafts by Michael Chazan, Ludovic Coupaye, Oscar Moro Abadía, Eduardo Palacio-Pérez, and especially Anna Belfer-Cohen.

Finally, I dedicate this work to the memory of Françoise Audouze (1943–2024).

Nathan Schlanger

1 Schlanger 2023 (an English edition is forthcoming in 2025 at Cambridge University Press).

Part I. Reading Technology—Introducing Leroi-Gourhan

Nathan Schlanger

1.

Presenting Leroi-Gourhan—Presenting the Anthology

MOSTLY KNOWN ACROSS the Anglophone world as a prehistorian specializing in the analysis of Palaeolithic parietal art and "paleo-ethnological" open-air excavations, André Leroi-Gourhan was also among the foremost twentieth-century thinkers on techniques and technology. Indeed technology—meaning here, as will be clarified throughout this book, the study of techniques, of "materially creative activities"—was very much at the forefront of his scientific and intellectual oeuvre. In addition to the numerous articles, conference talks, and university courses he dedicated to the topic, his sustained interest found its expression in his major publications, issued some twenty years apart: the two-volume works *Évolution et techniques* (1943, 1945) and *Le Geste et la parole* (1964, 1965)—the former anchored in ethnology and museology, the latter oriented toward human evolution. Just why Leroi-Gourhan's specifically technological oeuvre has remained patchily known and insufficiently appreciated outside the French-reading world (and sometimes within it too) is a question well worth attention. Linguistic and academic constraints are of course relevant here, but so are changing disciplinary circumstances and indeed broader theoretical and ideological considerations. For all its fame and influence,

Leroi-Gourhan's oeuvre has long suffered from a perceptible "epistemological deficit." Alongside the numerous homages and scientific appreciations that followed his death in 1986, biographical and analytical studies on Leroi-Gourhan have been written in English by Randall White, Anick Coudart, and especially Françoise Audouze. In French, in addition to Leroi-Gourhan's own autobiographical conversations published in 1982, edited volumes have appeared with the suggestive titles *Autour de l'homme* and *L'Homme tout simplement* and, above all, *André Leroi-Gourhan (1911–1986), une vie*—a richly documented and comprehensive biography by Philippe Soulier.[1]

This introductory essay aims to address, and as far as possible to remedy, this state of relative ignorance and unevenly exploited potential. The following pages do not constitute a full-fledged critical and intellectual history of Leroi-Gourhan's technology in the social and human sciences.[2] Their more targeted goal is to present the main aspects of Leroi-Gourhan's career and lifework, to focus on his contributions to the study of techniques, to consider the reception and impacts of his contributions in French and international scholarship, and finally to underline their salient features and current relevance—all the while enhancing the reading of eleven texts he published between 1936 and 1962, brought together and translated into English for the first time in this anthology.

Born in Paris on August 25, 1911, André Leroi-Gourhan died in that same city on February 19, 1986, after a long, disabling illness. Following a period of self-schooling and adolescent jobs (notably in a public library), Leroi-Gourhan enrolled to study orientalism and ethnology in the early 1930s. This gave him the opportunity to conduct extensive ethnographic and archaeological fieldwork in Japan, from

1. The "epistemological deficit" is noted in Audouze and Schlanger 2004a. See also White 1993; Coudart 1999; Audouze 2002 (in English); Leroi-Gourhan 1982; Audouze and Schlanger 2004b; Soulier 2015; and Soulier 2018. My own long-standing and somewhat recursive research interests in the technology of Leroi-Gourhan (Schlanger 2004, 2015) have recently benefited from access to several of his archival collections, held at the *Musée de l'Homme* (now at the *Muséum national d'histoire naturelle*), the *Collège de France*, and above all the archives deposited at the *Maison de l'archéologie et de l'ethnologie* (now *Maison des sciences de l'homme-Monde*) at Nanterre. These sources—whose custodians are thanked again for their friendly and professional assistance—have also served me for a different project, wider in its aims and scope, dealing with the invention of technology (Schlanger 2023).
2. See the above noted publications and references within.

1937 to 1939. Back in France, he gained employment in Parisian museums dedicated to Far Eastern arts and in the nascent *Centre national de la recherche scientifique*, until his appointment in late 1944 to a chair in colonial ethnology at the University of Lyon. In 1956 Leroi-Gourhan obtained a professorship in general ethnology at the *Sorbonne*, and in 1969 he was elected to a renewed chair of prehistory at the *Collège de France*. Chronologically as well as conceptually, his worldviews and achievements effectively spanned the middle of the twentieth century, rooted in part in the social and scientific approaches of the Third Republic, and reaching toward the increasingly globalized and technocratic perspectives of the *Trentes glorieuses*—not forgetting, in between, the Second World War and its aftermaths. From Marcel Mauss back to Émile Durkheim and forward to Georges Friedmann, from Henri Bergson to Pierre Teilhard de Chardin, from museological and ethnological interests in "material civilizations" and "object witnesses" to palaeontological and psychological concerns with "operational behavior" and "the evolution of technicity," Leroi-Gourhan's impressive work rate and enduring curiosity clearly enabled him to cover unprecedented ground in the study of humankind, past and present.

Polydisciplinary Challenges

Acknowledging these numerous achievements, we should also recognize outright a slight sense of missed or mishandled rendezvous. The challenge has partly to do with uneven access to Leroi-Gourhan's publications, including the belated translations of his works into

Fig. I.1 André Leroi-Gourhan with Michel Brézillon, Pincevent, 1972. Album Pincevent/MSH - Mondes archives.

Fig. I.2 André Leroi-Gourhan, Harper Kelley, Alice Kelley, and the Abbé Henri Breuil (seated) examine faunal remains at the Middle Palaeolithic cave site of Arcy-Sur-Cure, 1956. MSH - Mondes archives.

English—and this is of course a state of affairs that itself calls for an explanation. For one thing, Leroi-Gourhan's oeuvre appears at times awkward to grasp and to build on. Second, and without surprise given the wide thematic range of his writings, several of the propositions he advanced over the years have inevitably become empirically or theoretically passé, and so have the terms in which they were couched. Besides various since-disproved claims he advanced in the fields of prehistory and human palaeontology, this criticism applies to aspects of the "material civilization" ethnological diffusionism he endorsed in the 1930s and early 1940s and also, in an admittedly more nuanced way, the seemingly ortholinear or transcendental evolutionist interpretations he promoted in the late 1950s and 1960s.

However, even if we were to grant this partial obsolescence, we would be quite mistaken to typecast Leroi-Gourhan's work as being of "merely historical interest." Besides missing the wider purposes of both intellectual history and science studies, such a dismissive appraisal would also lead us to belittle the demonstrable impacts and current potentials of his technological contributions. In fact, as we will appreciate later on, several original aspects of Leroi-Gourhan's technological propositions have hardly aged at all and have actually increased their potential for generating new research questions and perspectives today—be it regarding the material efficiency of technical actions, the ethnographic and

sociological appraisal of the *chaîne opératoire*, or indeed the development of cognitive archaeology. In addition, Leroi-Gourhan's writings on techniques and technology have influenced important strands of contemporary philosophical and anthropological reflections, emanating from such authors as Jacques Derrida, Gilles Deleuze, and Bernard Stiegler. For quite a few Anglophone readers, in fact, it may well be through these post-humanist intermediaries (themselves swiftly translated) that Leroi-Gourhan's name is first encountered. In any case, Leroi-Gourhan's oeuvre proves to be remarkably open-ended, encompassing the disciplines of archaeology, ethnology, and anthropology as well as technology and material culture studies, and more broadly reaching large swaths of twentieth-century social sciences and humanities, including aesthetics, psychology, linguistics, and philosophy.

Empirical shortcomings and theoretical elaborations aside, there remain some structural specificities to consider when appreciating Leroi-Gourhan's works. Partly of his own making, these challenges have left their marks on the gist of his technological contribution, as well as on its broader appreciation and appropriation—including by his international readership. These difficulties, it should be noted, do not really stem from the formal expressions of his work. Leroi-Gourhan's language was generally clear and mostly devoid of overspecialized jargon or abstractions, all the more so that he quite willingly and effectively engaged throughout his career with popular audiences and generalist publications. Rather, the difficulties ensue from the somewhat "self-made" and even idiosyncratic disciplinary elaboration of his claims. Deliberately or not, the "polymathic" Leroi-Gourhan practiced throughout much of his career a fairly heteroclite form of pluri- or interdisciplinarity, touching on various fields of knowledge, reshuffled through a number of "changes of horizons."[3] Still in the early 1930s, while studying at the *Institut d'ethnologie* and volunteering at the soon-to-be *Musée de l'Homme*, he actively claimed interests in both the natural and the social sciences. In the subsequent decades, and notably during the 1950s (which were for him highly productive), he went on to contribute to such diverse fields as vertebrate palaeontology and archaeological excavation methodology, Asia studies and orientalism, technology, behavioral psychology, ethology, and museology, not to mention prehistoric art and religion.

Such wide-ranging versatility undoubtedly fostered the remarkable thematic and methodological cross-fertilization that is the

3. Leroi-Gourhan 1982, 13.

hallmark of his oeuvre, but it did not always enhance his scholarly identity or for that matter his employment prospects. Nor, more importantly, did it secure him and his diversified contributions a distinctive and univocal position within the disciplinary constellation of his times. The main intellectual currents and protagonists to emerge in contemporary French social sciences, on either side of the Second World War, included proponents of Marxist approaches in ethnology and sociology, such as Marcel Cohen, Georges Friedmann, and Charles Parain, and later André-Georges Haudricourt and Maurice Godelier. Equally dominant, beginning in the late 1940s, was the structural anthropology school of thought, soon upgraded into paradigmatic "structuralism," steered by Claude Lévi-Strauss at the *École pratique des hautes études*.

Mention of Lévi-Strauss (1908–2009) raises some questions. Why, of the two of them, has he become so much better known among Anglophone readers? What broader significance can we discern in their differentiated reception? They were, after all, long-standing (if rather distant) colleagues, first at the *Musée de l'Homme* in the 1940s, where they both served as vice-directors under Paul Rivet, and later at the *Collège de France*, to which Lévi-Strauss was elected in 1959, a decade before Leroi-Gourhan. Overall, Leroi-Gourhan's recourse to "structures" appears to have been of a generic or organizational kind, as in his chapter "The Technical Structure of Human Societies" (see text 3b in Part II here), or else biologically inspired, following the "structural anatomy" of his hero, the early nineteenth-century palaeontologist Georges Cuvier. Specific references to Lévi-Strauss by Leroi-Gourhan were infrequent (albeit mostly positive), including allusions to his colleague's systematic and mathematical approaches to documentation and, notably, his precious set of Human Relations Area Files kept in massive wooden drawers at the *Collège de France*. By the late 1950s, as he elaborated his interpretation of Upper Palaeolithic parietal art (see chapter 3), Leroi-Gourhan came closer to bona fide "structuralist" arguments (spatial structure, underlying relations). These affinities were, however, mediated, at least in part, by his student and colleague Annette Laming (also known as Laming-Emperaire, 1917–1977), who had definitely read and integrated Lévi-Strauss's propositions on structures of kinship and matrimonial exchanges. By 1968, a somewhat unexpected endorsement of Lévi-Strauss by Leroi-Gourhan posited physiological common grounds around the notion of "structure":

> The base of the structuralist method is directly posed on the bio-psychological foundation [of humankind]; action and

> language being inscribed on contiguous and interconnected planes of the cerebral setup [. . .]. The two procedures [structuralist and palaeontological] are however very similar, in that in both cases one begins with a previously known organizational scheme, which is then put in parallel with the organizational scheme to be discovered. Both the inversion of methods and their profound analogies are striking when we compare the *Mythologiques* [of Lévi-Strauss] and [my] *Préhistoire de l'art occidental*.[4]

Whatever the soundness of the link posited here between these two publications, it is intriguing that Leroi-Gourhan chose for comparison his analysis of Palaeolithic art, and not his contemporary book *Le Geste et la parole*—as if tacitly recognizing the latter's far greater appeal to a *post*-structuralist readership.

Lévi-Strauss, too, had long been aware of his colleague's contributions. Several passages in the 1952 *Race et histoire* provide a case in point. On the one hand, Lévi-Strauss targeted the "false evolutionism" of stone tools "engendering" each other as horses do—this being undeniably a Leroi-Gourhanian outlook. On the other hand, Lévi-Strauss made more positive allusions to the would-be technical apex represented by Neanderthal Levallois flintknapping practices, as posited by Leroi-Gourhan.[5] More than three decades later, in his posthumous homage to his *Collège de France* colleague, Lévi-Strauss offered a more conciliatory view of their relationship:

> There were probably differences in temperament between us that made contact difficult. Throughout my career, I knew that I was made for working alone. He [Leroi-Gourhan] on the other hand has always insisted on the necessity, in proceeding for example with the horizontal excavation [*décapage*] of a prehistoric layer, to be assisted by a team of well prepared and qualified people. [. . . T]he rapports between us were not as close as they should have been, so much so that there were moments when we could appear in opposition. Reading his work again, I am on the contrary deeply struck by the fact that, while he and I were working in different domains, we have been trying to do more or less the

4. Leroi-Gourhan 1968, 1818–19. See also chapter 3 and discussion in Moro Abadía and Palacio-Pérez 2015.
5. Lévi-Strauss 1952a, 24–25, 71 (trans. 1952b, 14, 21); very probably responding to the arguments advanced by Leroi-Gourhan in 1943 and 1945, and in 1952 (texts 3, 4, and 7).

same thing [. . .]. One can see that [his] guiding idea has always been to study relations rather than things, to try and reduce the chaotic diversity of empirical evidence to invariant relations.[6]

This is not to say, of course, that Leroi-Gourhan was in any way inattentive to "chaotic diversity," which he actually relished describing and documenting in minute detail.

Aside from his positioning vis-à-vis colleagues and currents of thoughts, the challenging appreciation of Leroi-Gourhan's oeuvre has also to do with our own ongoing difficulties (notwithstanding decades-long intellectual and institutional protestations to the contrary) in recognizing and endorsing genuinely deep-seated inter- and transdisciplinary constructions. As already noted, Leroi-Gourhan's own frequently circumstantial and disjointed disciplinary maneuvers over the years have not simplified matters. Alongside sincere claims of fundamental unity and convergent purpose across his publications, he proved quite willing to engage in fairly eclectic forays, as the occasion arose. These included, to give some examples, a couple of scholarly presentations to orthodontists' conventions in the mid-1950s (following conversations on facial morphology with his dentist); a 1952 contribution to a lecture series titled "The Structures of the Universe and Their Scientific Perception," attended by engineers, mathematicians, and specialists in cybernetics; and indeed a series of lectures on "material and spiritual life" and "the biological originality of humankind" for gatherings of missionaries and Catholic intellectuals. Leroi-Gourhan's occasionally changing methodological, theoretical, or ideological "horizons," including the shifting research directions and disciplinary frameworks they entailed, appear thus all the more abrupt for being mostly left unaccounted for and implicit.

Given the overall scarcity of reflexive comments or "position statements" in Leroi-Gourhan's own work, the diversity of venues and publications to which he contributed can give us a sense of his multidisciplinary reach. In fact, the range of texts on techniques and

6. Lévi-Strauss 1988, 203. A similar outlook prevails in Lévi-Strauss's conversations with Didier Eribon, whereby "we saw each other frequently without really knowing each other" (Lévi-Strauss and Eribon 1990, 97–98). Leroi-Gourhan formulated it better: "we [now] bear each other with friendship after having endured each other with suspicion" ("Et nous nous supportons avec amitié après nous être endurés avec suspicion"; Leroi-Gourhan 1982, 109). See also the comparative analysis by Joulian (2015), and the recent proposal by Collins (2020) to align both authors.

technology assembled in the present anthology aims quite deliberately to reflect this diversity. Besides extracts from his books *Milieu et techniques* (text 3; 1943) and *L'Homme et la matière* (text 4; 1945), these contributions have appeared in a social sciences encyclopedia (text 2; 1936), in the historian's *Revue de synthèse* (texts 1, 7; 1936, 1952), in the sociological journal *Année sociologique* (text 5; 1948), in the missionary review *Rythmes du monde* (text 6; 1950), in the "Recherches et débats" publications of the *Centre catholique des intellectuels français*, known as the CCIF (texts 8, 10; 1957, 1960), in the proceedings of a human evolution colloquium (text 9; 1957), and, last but not least, as an address to socially responsible business leaders (text 11; 1962). To be sure, quite a few of the themes and insights explored in these publications subsequently converged in 1964–65 into *Le Geste et la parole*, and likewise several of these articles were gathered anew in the 1983 anthology titled *Le Fil du temps: Ethnologie et préhistoire* (*1935–1970*). Nevertheless, the sheer breadth of these contributions—each more or less attentive to its specific disciplinary circumstances and then tailored to its selected audiences and readerships, each with its own paradigmatic and ideological motivations at stake—will clearly need to be taken into account in the overall appraisal and interpretation of Leroi-Gourhan's lifework.

Academic Monolingualism

An additional factor in the appreciation of Leroi-Gourhan's technological work, especially for an international audience, relates to seemingly practical linguistic and editorial considerations—considerations that actually lead us beyond the mere question of academic monolingualism. The fact that French was Leroi-Gourhan's language of conceptual thought and scientific expression did not keep him from developing, from early on, quite a range of linguistic skills and interests. His adolescent contacts with White Russian émigrés led to his Slavonic studies at the *École des langues orientales*, to which he soon added Chinese language and civilization under Marcel Granet at the *École pratique des hautes études*. This proved useful for his acquisition of Japanese, during two years' fieldwork on the archipelago. In his curriculum vitae of the 1930s and 1940s Leroi-Gourhan listed (somewhat ambitiously) English, Russian, and Chinese as his spoken languages and German, Italian, and Spanish among his reading languages. His Russian, in any case, was good enough for him to read and review, during the 1950s, recent archaeological research in Soviet publications. Likewise his English-language skills are evident from his publications as well as his archived

correspondence. Besides citing numerous English-language references in *Le Geste et la parole* as well as his 1946 thesis *Archéologie du Pacifique-nord*, he appears to have written at least some of his articles or notes directly in English.[7]

On all counts, then, Leroi-Gourhan's linguistic skills far exceeded those of his contemporary Lévi-Strauss, who readily admitted—though possibly with false modesty—his lack of gift for languages and his rudimentary skills and atrocious accent in English.[8] Nevertheless, Lévi-Strauss could claim some "mitigated bilingualism" following his wartime sojourn in New York and his teaching there. As he put it in the (French) foreword to *L'Anthropologie structurale*, "one does not think or expose one's thought the same way for a French or Anglo-Saxon audience."[9] This is probably the key point—namely, Lévi-Strauss's interest in securing a faithful audience among Anglophone anthropologists and linguists, both for scientific exchanges and for institutional and intellectual enhancement. Leroi-Gourhan, for his part, simply did not have these specific strategic aims in mind. Let us, however, recall his 1934 study visit to the British Museum and the Natural History Museum in London, his research interests in Circum-Pacific and thus North American ethnology and archaeology in the 1940s, his hosting of numerous international students in his excavations at Pincevent from the mid-1960s onward, and indeed his lecture tour at Harvard in 1969. All this, in any case, invites us to reappraise the rather trite notion of "French insularity."

To this revision should be added the fact that several of Leroi-Gourhan's books *did* actually appear in English during his lifetime, indeed fairly soon after their original publication. This was the case with the 1955 trade book *Hommes de la préhistoire: Les Chasseurs*, translated in 1957 as *Prehistoric Man*. A new French edition of this book appeared in 1983, to be translated in 1989 as *The Hunters of Prehistory*. With greater scientific impact, *Préhistoire de l'art occidental* (1965) appeared a couple of years later as *Art of Prehistoric Man in Western Europe* (in London) and *Treasures of Prehistoric Art* (in New York). The same applies, in a more roundabout way, to *The Dawn of European Art: An Introduction to Palaeolithic Cave Painting* (1982), translated in the year following its initial publication in Italian. What characterizes these translated publications is their prehistoric art subject matter

7. Notably his paper for the Wenner-Gren foundation in 1953, or for *Scientific American* in 1968.
8. Lévi-Strauss and Eribon 1990, 47–48, 125.
9. Lévi-Strauss 1958, ii.

and their targeted popular audience—aspects that could presumably enhance both diffusion and sales. The contrast is all the starker with the translation history of his seminal (and actually no less approachable) works, *Évolution et techniques* (1943, 1945) and *Le Geste et la parole* (1964, 1965). The latter two volumes were translated into English as a single book, *Gesture and Speech*, only in 1993—that is to say, nearly three decades after their original publication date and seven years after their author's death. As for *L'Homme et la matière* and *Milieu et techniques* (which together compose *Évolution et techniques*), they have never been translated into English—until, that is, the selected chapters (texts 3 and 4) in the present anthology.

On the face of it, the long delays or unavailability of these technological works in translation might be attributed to some disinterest by Leroi-Gourhan or his French publisher—in both cases, Albin Michel. Such a presumption is, however, undermined by the observation that the books in question, like several of Leroi-Gourhan's other publications, have actually been assiduously translated and published in quite a range of languages. As can be appreciated in table I.1, prior to its translation into English, *Le Geste et la parole* had already appeared in Spanish, Italian, Japanese, German, Portuguese, Romanian, and Slovenian—and, since then, in Greek and Korean. For its part, *Évolution et techniques* can be accessed in its entirety in Spanish, Portuguese, and Italian, but not in English. The same goes for other books by Leroi-Gourhan: *Le Fil du temps*, a selection by Leroi-Gourhan of his own articles from 1935 to 1970, is available in Italian, while his revealing autobiographical conversations with C.-H. Rocquet, *Les Racines du monde*, can be read in Spanish, Japanese, Italian, and indeed Basque . . . but not in English.

These data highlight the dearth of translations of Leroi-Gourhan *in English* (in comparison, most obviously, with Italian). Clearly, it would be germane here to situate Leroi-Gourhan's case within the broader history of the (English-language) translation and dissemination of French twentieth-century academic publications in the social sciences and humanities, including literary criticism, postmodern philosophy, and "French theory" writ large. Pending such a comparative study, our observations here should suffice to cast the absence or ignorance of Leroi-Gourhan in English in a new light (in comparison notably with the Anglophile Lévi-Strauss). Why was it that English-language publishers did not see fit to translate Leroi-Gourhan's books as they appeared? More specifically, why has there been—until recently, at least—a feeling that Leroi-Gourhan's writings on techniques and technology had little academic market or intellectual audience to speak of,

in the Anglophone world (unlike for the Italian-, Spanish-, or German-reading publics)? Equally intriguing, why have the Russian translations of Leroi-Gourhan's books been limited to his research on religion and parietal art (somewhat bourgeois topics), while his technological publications, with their materially based interpretations of "anthropogenesis" have been effectively ignored?[10] While these points require further research, the very force of the question is justification enough for our project here, which is to highlight, in English, the originality of Leroi-Gourhan's thinking and writing about technology.

Table I.1

Translations of Leroi-Gourhan's books	*Évolution et techniques*, 2 vols. (1943–45)	*Hommes de la préhistoire: Les Chasseurs* (1955; rev. ed. 1983)	*Le Geste et la parole*, 2 vols. (1964–65)	*Les Religions de la préhistoire* (1964)	*Préhistoire de l'art occidental* (1965)
Arabic				1982	
Chinese				1990	
English		1957 (1989)	1993		1967
German			1980	1981	1982
Greek			2000		
Italian	1993–94	1961	1971	1970	1980
Japanese			1973	1985	
Korean			2015		
Polish				1966	
Portuguese	1983		1983–85		
Romanian			1983		
Russian				1971	
Slovenian			1988		
Spanish	1988		1971	1987	1984

10. For more information, see Schlanger 2024.

2.

The Making of Technology

WHAT, THEN, OF "technology"? From the outset, it should be emphasized that the meaning of Leroi-Gourhan's *technologie* is quite distinctive and differs from prevailing or commonplace usages today. Granted that such meanings are inevitably variable and open to debate,[1] the increasingly dominant usage of "technology" worldwide (including in French) refers to materially grounded practices that are explicit, industrial scale, mechanized, science based, eventually computerized, and in any case quintessentially "modern." "Technology" is thus distinguished from, and often taken to represent a progressive leap over, "techniques," which are in this view more implicit, artisanal, skilled, experience based, and traditional. The fishing technique of the angler, for example, differs from the fishing technology of the trawler, while the virtuoso technique of the pianist is captured by sound-recording technologies. Since at least the end of the nineteenth century, the French research tradition has invested different meanings in the dyad

1. On various uses of the term "technology," as a concept and a category, see among others Sigaut 1994; Ingold 1989; Schlanger 2012; Loeve, Guchet, and Bensaude-Vincent 2018; Schatzberg 2018; Coupaye 2021a.

technologie-techniques, effectively giving it an epistemological scope rather than an ontological one. *Techniques* in this respect refers to the object under consideration per se, while *technologie*, taken in its etymological sense, represents its logos, discourse, and study. Thus *technologie* is to *techniques* what musicology is to music, or criminology to crime: while the latter designates an independent body of observable "things" (as Durkheim would have put it), real-world phenomena, or practices, the former refers to their systematic description, analysis, and interpretation, as carried out within the framework of the human and social sciences.

The designation *technologie* draws attention to the disciplinary scope and relevance of what Leroi-Gourhan occasionally called "the study of material life." *Technologie* thus bears useful comparison with the anthropological and archaeological strands of research known as "material culture *studies*," as they emerged in the Anglophone world from the 1980s onward—with of course an additional and welcome emphasis on the irreducible materiality of *techniques* (see chapter 4). With admittedly occasional variations and inconsistencies, the notion of *technologie* and its semantic relations with *techniques* remain fairly stable and straightforward throughout Leroi-Gourhan's writings. In fact, this dyad has proved central to Leroi-Gourhan's contribution in at least two main respects.

First, the term *techniques* is made to cover a striking breadth and diversity of observable phenomena. Ranging from "the television set [back] to the flint tool," *techniques* encompasses all "materially creative activities," as Leroi-Gourhan once put it—eventually reaching, so he speculated in his latter-day evolutionist writings, some form of "universal technicity." Throughout these variations on techniques, the position of objects, tools, and material products has remained central but by no means exclusive, making room (as we will see below) for immaterial gestures and skills. Such an all-inclusive sense of "techniques" can be at times challenging to grasp and unwieldy to work with—as when it is equally applied to, for example, "Levallois flake production" and "nuclear fission." Nevertheless, the very breadth of this term can usefully caution against the imposition of unwarranted divides and premature dualisms, notably of the implicit/explicit and traditional/modern kinds. It becomes in any case easier and more compelling for such would-be dualities to emerge as the *outcome*—and not the *premise*—of a critical study of the phenomena in question.

Second, this dyad opens the way for the term "technology" itself to recover its critical and epistemological vocation, precisely because the phenomenal importance of "techniques" shows them to deserve

dedicated and methodical investigations of their own—as "material culture *studies*" have demonstrated with such success over the past thirty years or so. The same critical vocation applies of course to the semantic derivatives or declensions of these terms. "Technics," as notably promoted by the historian Lewis Mumford in his *Technics and Civilization* (1934), seems to overlap with the French conception of *techniques* as a generic system, insofar as "technics" includes the modern specificities of "technology" within it. A possibly comparable notion in French would be *la technique*, in the singular, as used, for example, by Jacques Ellul in *La Technique et l'enjeu du siècle* (1954), translated as *The Technological Society*, or again by Bernard Stiegler in *La Technique et le temps* (1994), translated as *Technics and Time*. In turn, both "techniques" and *la technique* foster the notion of *technicité*, "technicity"—a notion that Leroi-Gourhan extensively used (alongside the likes of Teilhard de Chardin and Gilbert Simondon) to refer to the generic quality of being technical.

As might be expected, Leroi-Gourhan's enduring interests in *techniques* and *technologie* unfolded over the years in function of his research and teaching activities, his professional standing, his disciplinary allegiances, and indeed his interpretative or ideological approaches. Although he was naturally quite keen in his retrospective moments to underline the ultimate coherence of his oeuvre, Leroi-Gourhan also recognized, explicitly and implicitly, the evolving aspects of his technological interests. As already suggested, three main "horizons" or sequential phases can be distinguished in this respect: a first formative phase primarily concerned with "material civilization" (texts 1–5 in this anthology), a second focused on "operational behavior" (texts 7–9), and a third addressing more ambitiously "the evolution of technicity," represented here by texts 10 and 11 and, most famously, by *Le Geste et la parole*. Appraising these overlapping and intertwined phases will lead us, here and in the coming chapters, to consider more widely the reception and relevance of his oeuvre.

After Mauss and Rivet—from the Museum to the Training Center (1936–1949)

With all the cross-disciplinary originality he displayed, Leroi-Gourhan's approach to techniques and technology clearly emerged from within the French social sciences of the interwar years. The essential figure in this research tradition, both with regard to his pedagogical role and in light of his own decisive contributions to the topic, was the sociologist

and anthropologist Marcel Mauss (1872–1950).[2] In his youth, Mauss attended the lectures of his uncle Émile Durkheim (1858–1917), the founding father of sociology, and also those of Alfred Espinas (1844–1922), an atypical philosopher and social scientist equally interested in the organization of animal societies and the origins of technological thought in classical Greece.[3] At the onset of the twentieth century, as he surveyed the sociological domain in the flagship journal *L'Année sociologique*, Durkheim sought to include within its remit the study of techniques[4]—the premise being that the "moral density" of societies could be correlated with their "material density," as notably reflected in their settlement patterns, communication networks, and overall morphology.[5] While Durkheim subsequently directed his scientific and moral attention to the study of social superstructures in *The Elementary Forms of Religious Life* (1912), Mauss readily took on board these material and morphological considerations.

In an early essay on "Eskimo seasonal variations" (1906), for example, Mauss brought together the multicausal relations between social organization and ecological conditions. Three decades later, his presidential address to the French Psychological Society introduced the notion of "the techniques of the body."[6] Mauss's pioneering appreciation of the jointly sociological, physiological, and psychological *homme total*, alongside his dedicated teachings on techniques and technology, gained increasing attention. Especially influential were the lecture courses he delivered on these topics at the *Institut d'ethnologie* of the University of Paris, which he cofounded in 1925 with Paul Rivet and Lucien Lévy-Bruhl. When Leroi-Gourhan began to attend Mauss's lectures in 1931–32, following his initial training at the (privately set up) *École d'anthropologie* and the *Institut des langues orientales*, he benefited from a particularly erudite and thought-provoking presentation of techniques and technology in their sociological and ethnological dimensions—a perspective that nevertheless lacked much firsthand

2. Mauss's principal writings on techniques and technology have been translated in Mauss 2006. See also Mauss 2012, and my editorial introductions to these volumes (Schlanger 2006, Schlanger 2012), as well as Bert 2009, 2012, and more broadly the biography by Fournier 1994 (trans. 2015).
3. Espinas 1878, 1897.
4. The rubric "Technology" was created in 1901 by Durkheim and Hubert, as a fairly low-key affair (Schlanger 2012).
5. These notions featured in Durkheim's first and most "materialist" work, the *Division of Labor in Society* (Durkheim 1893; trans. 1933).
6. Mauss 1906, 1935. Both texts are translated in Mauss 2006. See also Schlanger 2019.

empirical and experimental substance, in line with Mauss's acknowledged standing as the ultimate "armchair anthropologist" of his day.

In contrast, Leroi-Gourhan clearly intended his own technological efforts to be more hands-on than those of his teacher. While his resolute experimental posture largely reflected his disciplinary aspirations and professional ambitions, his eagerness to engage with techniques at their most tangible was evident. In fact, his first major contribution stands out for its emphasis on the classificatory and explanatory potential of the "elementary means of action on matter" (text 2). Favoring a logical rather than chronological or morphological classification, Leroi-Gourhan stated outright his perspective:

> The form of an instrument in all ages and under all climates is conditioned by the material to be worked and the result to be obtained. [. . .] It follows that, given two samples of a single material and two essentially identical results to be obtained, the character of the percussion used will be identical, be it at opposite ends of the globe [. . .]. This leads us to consider successively the material [*la matière*] and then the action—it is from these two orders of considerations that the instrument spontaneously emerges. (text 2)

Leroi-Gourhan's chapter appeared in an encyclopedia volume dedicated to the human species, directed by historian Lucien Febvre and edited by Paul Rivet, his other mentor in these early years. Trained as a military doctor and specializing in Amerindian linguistics and physical anthropology, Rivet (1876–1958) acceded in 1928 to the chair of anthropology at the *Muséum national d'histoire naturelle*, which included in its tasks the renovation of the *Musée d'ethnographie du Trocadero*, an accumulation of ethnographic exotica left over from the 1878 Universal Exhibition. Combining organizational zeal and political acumen, Rivet mobilized over the next decade a range of talented volunteers and collaborators, including the pioneering museographer Georges-Henri Rivière (1897–1985), to create the new *Musée de l'Homme*, with its distinctive scientific, pedagogical, and indeed ethical agendas.[7] Leroi-Gourhan joined this body of volunteers in the early 1930s and contributed at first to the museum's documentary policies, drawing no doubt on his previous training in librarianship. As he expounded in a brief note from 1936 (text 1), the museum epitomized the hub of

7. De L'Estoile 2007; Conklin 2013; Schlanger 2016.

collaborative research that the social sciences aimed for. At its core was the collected object, necessarily accompanied by its structured descriptive *fiche* or index card, with its various entries: provenance, shape, function, materials, indigenous name, and so on. Using such *fiches*, so went the (over)optimistic expectation, the documented and collected object could readily become a reliable and workable "witness of itself," an object that "has a name, materializes a technique, preserves the imprint of a myth, plays a social role, and has aesthetic meaning" (text 1).

Leroi-Gourhan would effectively transcend this object-centered approach by the following decade, once his technological attentions had turned toward "behavior," "operations," and indeed "gestures." Back in the mid-1930s, however, this *fiche*-based "documentary positivism" laid the framework of the objective research methodologies he was to pursue throughout his career—beginning with his ethnographic and museological investigations (starting with Japan in 1937–39) and moving later on to his archaeological excavation projects and his prehistoric art research (see chapter 3). Even more importantly, at a thematic level, this object-as-document emphasis formed a key component of his "material civilization" approach, as variously expressed in his early works (texts 1–5).

With anthropology firmly shifting from an evolutionist paradigm to culture-historical and diffusionist expectations by the early twentieth century, questions regarding the spatial movements and temporal changes evidenced across human cultures or civilizations came to the fore. In the French strand of civilization studies, as advocated by Mauss and by Rivet, ethnology was considered outright to be a comparative science, within which the study of objects primarily served to establish cultural affinities and routes of circulation. As demonstrated at the *Musée de l'Homme*, it was important to reach beyond singular or extraordinary masterpieces and consider whole assemblages of objects, with their functional logic and repetitive shapes. Mauss in particular was adamant that such quotidian items could provide significant cultural evidence in their own right. Just as the rarity or uniqueness of the collected items was downplayed, so was their postulated "purity" put in question. In one way or another, the types, forms, and functions of the objects researched by comparative ethnology appeared useful for identifying contacts or intermixing, to be untangled and interpreted by the researcher, be it in the field or the museum.

Over the first decade or so of his career, Leroi-Gourhan worked broadly within this enhanced culture-historical approach, with

of course some distinctive inputs of his own. Given their durable and "objective" qualities, technical instruments and procedures proved particularly valuable insofar as they represented tacit, subsistence-related matters bearing on the slowly acquired and collectively practiced habits of the *homme moyen* of given civilizations—rather than deliberate expressions of symbolism and identity. The identification and specification of any possible "technical determinism" was therefore important here, serving to establish whether the shape or usage of a given (collected) object represented the materialization of a universal and inevitable *tendance*, as Leroi-Gourhan called it (responding everywhere to the same physical constraints), or rather reflected some specific inventions, a *fait* tightly localized in a given temporal, spatial, and cultural framework (text 3a). The notions of *tendance* and *fait*, alongside those of *milieu technique*, *milieu intérieur*, and indeed *inventions* and *innovations*, represent the somewhat open-ended theoretical apparatus developed by Leroi-Gourhan in *L'Homme et la matière* and *Milieu et technique* (texts 3, 4). In his 1946 thesis, *Archéologie du Pacifique-nord* (subtitled *Matériaux pour l'étude des relations entre les peuples riverains d'Asie et d'Amérique*), and likewise in his 1949 contribution to the rubric "Technologie" of the *Année sociologique* (text 5), Leroi-Gourhan put these theoretically informed studies of techniques to distinctive use. They served him to critically assess the available evidence, identify misleading affinities, and expose "false witnesses"—that is, to distinguish, as a prosecutor might, between similarities in given objects and traits that are due to specific historical and cultural contacts and those that reflect independent inventions or broader evolutionary convergences. Although such critical "evidential" studies have since lost much of their appeal, they had the signal merit, so far as Leroi-Gourhan himself was concerned, of providing him with unprecedented insights into the workings of techniques, into the ways things were made and made use of.

From Technical Behavior (1950–1965) . . .

By the year 1950 or so, Leroi-Gourhan's thematic and disciplinary outlooks underwent a substantial (and unacknowledged) reorientation, approaching something of a paradigm shift. As he settled into his university lectureship in Lyon, the wider resurgence of postwar intellectual life combined with his new academic and pedagogical responsibilities. Notably, this involved the dedicated training of his students in the fields of ethnology and prehistory, with the creation of the *Centre de formation aux recherches ethnologiques* (CFRE) and the *Centre de documentation et de*

recherches préhistoriques (CDRP), and the setting up of archaeological field projects in the environs of Lyon. As Leroi-Gourhan wound down some of his former areas of inquiry, he gave new impetus to other pursuits and considerably broadened his interests in several new directions. Unfolding in the following decades and culminating in *Le Geste et la parole*, these new "horizons" brought together prehistory, psychology, and human evolution under the overarching heading of technical or operational "behavior."

So far as prehistory is concerned, an important factor behind these changes was Leroi-Gourhan's "discovery" of experimental flintknapping (stone tool manufacture). While stone implements have been at the core of prehistoric research since the mid-nineteenth century, his own interest was initially quite minimal. Having usefully classified their raw material as a "stable solid," worked by subtraction through "direct or indirect percussion" (text 2), his brief discussions of stone artifacts in *L'Homme et la matière* remained restricted to their potential as evidence of contacts or progress. In fact, his evolutionist expectations rather led him to belittle their informative potential: prior to the Reindeer Age and the arrival of *Homo sapiens*—so he asserted in 1943—"we have nothing: [only] flaked flint."[8] This dismissive attitude was overturned by the late 1940s, however, once Leroi-Gourhan became aware of the systematic flintknapping replications by prehistorians Léon Coutier and François Bordes.[9] Although they were mostly couched in culture-historical and typological terms, these experimental results were taken by Leroi-Gourhan toward promising new directions, boldly setting out "à la recherche de la mentalité préhistorique" (text 7)—and indeed, to use the term retrospectively, leading the way toward "cognitive archaeology" (see chapter 4).

While it may have long faded into obscurity, the presentation he gave in November 1950 at Henri Berr's *Semaine internationale de synthèse*, published in 1952 as "*Homo faber . . . Homo sapiens*" (text 7), actually represents one of the most innovative and fecund contributions made to mid-twentieth-century prehistoric archaeology and technology. This article largely aimed to overturn the sequential dualism between *Homo sapiens* and *Homo faber*—a distinction that Leroi-Gourhan had himself endorsed a decade earlier, in *L'Homme et la matière* (text 3). While *Homo sapiens* was a straightforward Linnaean taxonomic entity, *Homo faber* was a philosophical creature first advanced by the *Collège*

8. Text 3a (this passage was omitted in the 1971 edition).
9. Bordes 1947, 1950.

de France philosophy professor and Nobel Prize winner Henri Bergson (1859–1941) in 1907, and subsequently conjectured to be both primitive and incipient.[10] With neophyte zeal, Leroi-Gourhan now rejected the idea that "a threshold was crossed beyond which beings who had been only makers [*faber*] gained the prerogatives of thinkers [*sapiens*]." To transcend this distinction and rather "follow the chain of documents," he turned to the processes of manufacture of stone tools, as made intelligible by systematic experimentation. As he put it,

> over the past twenty years, experimental technology has made it possible to untangle the series of gestures that lead to such and such form of tool. [. . .] This immediately enriches our materials of study: to follow the gestures, flake by flake, is to reconstruct with certainty an important part of the mental structure of the maker; to observe the technique become more rational from epoch to epoch is, without forsaking the strict objectivity of the historian, to give this tenuous chain of technical evidence a significance that reaches far beyond the arid chronological disposition of minerals struck by some vague anthropoids. (text 7)

By "following the gestures, flake by flake," by calling attention to "mental procedures" and "sequences of actions" (text 7), Leroi-Gourhan was indeed able to give new intelligibility to stone artifacts and their manufacture across human prehistory. As he argued in some detail (but with barely any illustrations or empirical support), flintknapping techniques became more rational, more efficient, and more productive from period to period. Beginning with the few hammer blows required for making crude Clacton-Abbevillian choppers, continuing with the symmetrical and aesthetically pleasing handaxes of the Acheulean period, these techniques reached something of a milestone with the predetermined Levallois flake production by Neanderthal Mousterians (text 7).

In parallel with his unprecedentedly "thick description" of prehistoric flintknapping, another notion became increasingly preeminent in Leroi-Gourhan's thoughts and writings, that of operational or technical "behavior." Indeed he had no qualms by 1950 to present technology as "the study and description of human technical behavior" (text 6), and furthermore to define "technical behavior" as "the

10. Bergson's famous discussion (Bergson 1907, 138–40; trans. 1911, 138–39) is further addressed in chapter 4. See also Schlanger 2023.

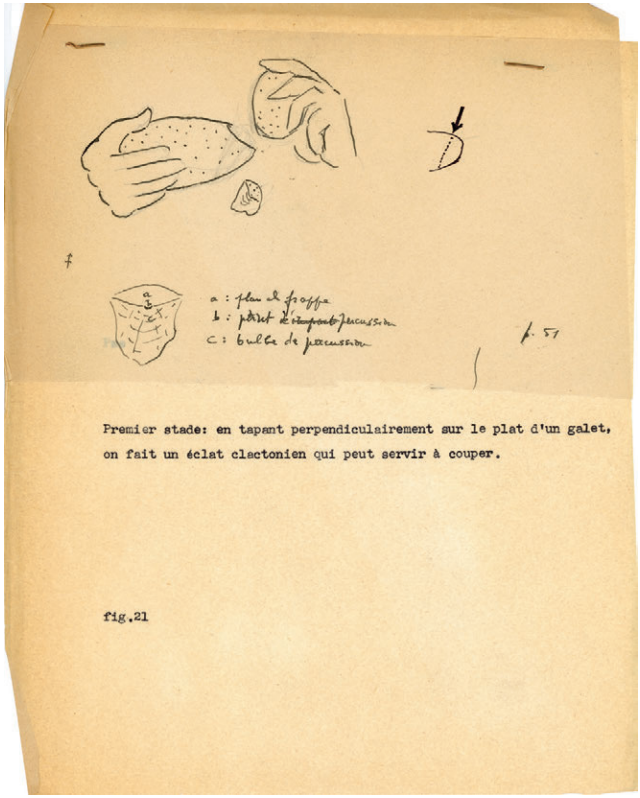


Fig. I.3 "The first stage [of flintknapping]: by striking perpendicularly on a pebble, one obtains a Clactonian flake that can be used for cutting." Preparatory drawing for the book *Les Chasseurs* (Leroi-Gourhan 1955; see also Leroi-Gourhan 1957, 1989). MSH - Mondes archives (ALG 70-6).

ensemble of psychosomatic attitudes that, for a given organism, result in a material action on the external milieu" (text 9). A critical history of the concept of "behavior" or *comportement*, including its gradual ascendency across the human and social sciences, is still to be written.[11] Long associated with moral conduct and social norms, this notion began, by the first decade of the twentieth century, to be equally applied to rats, children, and neurotic patients (and soon to machines) to designate sensorimotor actions and reactions. Given its objective and observable qualities, "behavior" rapidly joined and overtook "consciousness" as one of the central objects of scientific psychology—much as the "culture" concept did for anthropology.

Differing from the North American trajectory that led from the behaviorism of J. B. Watson and B. F. Skinner to the "behavioral sciences" of today, the French understanding of *comportement* spanned in equal measure the sociocultural and physiological branches of

11. Williams (1976) 1983; Schlanger 2023.

psychology. The former strand found its expression in the aforementioned *homme total* of Marcel Mauss, bolstered by the historical psychology of his colleague Ignace Meyerson (1888–1983). The latter strand was notably championed by Henri Piéron (1881–1964), who in 1908 authored a pioneering manifesto on "the evolution of psychism and the objective study of behavior" and subsequently became the holder of the physiology of sensations chair at the *Collège de France*. By the early 1950s, Piéron's contributions to experimental and animal psychology proved to be of considerable interest to Leroi-Gourhan—an interest actually reciprocated by Piéron, who cited the technologist's work in his own studies on the origins and evolution of human psychology.

Leroi-Gourhan's penchant for lawlike generalizations and determinisms, valid across "technical behavior among animals and humans" (as in the title of text 9), was also manifest more specifically in the notion of *chaîne opératoire* or "operational chain" (for more, see chapter 4). In fact, this term appears to have been inspired or even paraphrased from Piéron's 1941 treatise *Zoological Psychology*. Piéron's discussion there bore on instincts, the degree to which they were innate or acquired, and indeed the extent to which they could result in, as he put it, "generally quite complex activities including a succession of interlinked acts [*une sucession d'actes enchaînés*]" that can take on an inevitable or even "ritual" character.[12] Such questions of instinct, intelligence, consciousness, and memory featured prominently in Leroi-Gourhan's own writings on technical or operational "behavior." These *ethological* affinities did not, as it happens, preclude Leroi-Gourhan's simultaneous interests in the *ethnological* and sociological appreciation of techniques, as will be attested by the expanding success of the *chaîne opératoire*. It is nevertheless true that in the mid-1950s the sources of his inspiration and formulations were primarily physiological and psychological:

> In the technical operation, behavior manifests itself by a chain of gestures, the operational chain [*la chaîne opératoire*] whose unfolding involves, among both animals and humans, complex reactions that may be qualified for the sake of convenience as *operational memory* [*mémoire opératoire*]. This operational memory, which is identical in its object at all degrees of the series that links invertebrates to humans, appears in its essence in two different guises at each extremity of the scale; that is, aspects traditionally associated with instinct, and with intelligence. (text 9)

12. Piéron 1941, 156–62, passim.

In the spectrum spanning from invertebrates to humans, Leroi-Gourhan distinguished three stratified, continuous, and cumulative "thresholds" (as he called them) in operational behavior and memory. The first, labeled *automatic*, reflected hereditary reflexes and impulses; the second, *machinal* (meaning "by rote," as distinct from *mécanique*, "mechanical"), was acquired through training and social immersion; while the third, *lucid* threshold relied on superior forms of socialized memory and brought about "technical consciousness" through verbal or written forms of communication (text 8). Further elaborated by Leroi-Gourhan in his writings and teachings of the mid-1950s, this triple-threshold conception of technical behavior and technical consciousness featured in considerable detail in *Le Geste et la parole* (notably in chapters 7 and 8 of the 1993 translation).

. . . To the Evolution of Technicity (1950–1965)

A complementary claim advanced in *Le Geste et la parole* (and also tested in previous venues; e.g., in text 9) concerned the evolution of "technicity." As Leroi-Gourhan saw it, the functional organization of all animated beings rested on the coordination of three types of organs: the organs of *locomotion*, allowing the exploration of the milieu; the organs of *prehension* for the grasping and acquisition of food; and the organs of *relation*, which provided the organism with information. From the amoeba onward, the development of organs dedicated to locomotion (fins, wings, legs) led to postural and anatomical changes, resulting, in some species and phyla, in the concentration of prehension activities in the upper limbs and the paws, notably in a seated position. The hands thus acquired and magnified their dexterity, while the face, once released from the need to reach and grasp with the jaws, was able to specialize its organs and activities of relation. This included an expanding braincase and a sound-producing larynx, leading to the rise of articulated language and conceptual thought (text 9). With manual technicity and conscious phonicity thus entangled, Leroi-Gourhan could conclude that "speech is a verbal tool that can be isolated from the mouth that emits it, in the same way the manual tool can be isolated from the hand" (text 8).

From striding toes to upright posture to freed hands and expanding crania, Leroi-Gourhan's conception of the incremental evolution of technicity clearly linked and intertwined anatomical and behavioral causes and effects. To a large extent, this feedback conception reflected his wide-ranging interests in machines and indeed in

cybernetic mechanisms of control and communication. His predilection for "new technologies" is long attested, including documentary cinema, large data sets in the humanities, and indeed computers as both tools and metaphors for human thought. Without being a systematic follower of the cybernetic movement (and in any case less attracted than Lévi-Strauss to its mathematical and logical propositions), he did refer to Norbert Wiener's work and, at least on one occasion, lectured on prehistoric flintknapping and the origins of scientific thought to the French cybernetic circle.[13] More to the point, Leroi-Gourhan drew quite extensively in his technological and biological studies on mechanical notions and metaphors of various kinds, including "scaffolding," "equilibria," and "thresholds," as well as "operations," "programs," "tapes," "control centers," and the like—all the while implying some forms of contiguity and even continuity between the technical "behavior" of animals, humans, and machines as well (a continuity that, as we will see in chapter 4, could not fail to appeal to antidualist posthumanist philosophers).

In any case, the heady mixture of functional anatomy, palaeontology, ethology, and psychology that characterizes Leroi-Gourhan's technological approach during the 1950s and early 1960s clearly attests to his conceptual agility and his polydisciplinarity—including some of the "eclectic" caveats indicated earlier (see chapter 1). What was equally original—and typical—was the fact that these rather materialist and "evidential" behavioral concerns were deployed within a resolutely idealist evolutionary framework. His long-standing interests in zoology and palaeontology expanded from his 1930s monograph on the Reindeer Civilization to his craniological and zoo-archaeological research at both Arcy-sur-Cure and Pincevent. These empirical studies aside, Leroi-Gourhan's all-embracing views regarding human evolution remained profoundly inspired by the philosopher Henri Bergson and the Jesuit-palaeontologist Pierre Teilhard de Chardin, as well as their followers Jean Przyluski, Edouard Le Roy, and neo-Lamarckian spiritualists Lucien Cuénot and Albert Vandel—rather more, in any case, than by the precepts of Darwinism, let alone the claims of the neo-Darwinian genetics and population-based "modern synthesis." Both the linearity and the universality of the evolutionary process as he saw it were already postulated in the 1943 *L'Homme et la matière*:

13. See the bibliography of *Gesture and Speech* (Leroi-Gourhan 1993) and Leroi-Gourhan 1953. On Leroi-Gourhan's cybernetic affinities, see Geroulanos 2017; Tresch 2019; Schlanger 2023.

> Everything seems to happen as if an ideal prototype of a fish or a knapped flint had developed along preconceivable lines from fish to amphibian and reptile, then to mammal or bird, and from undifferentiated flint to finely worked blades, to copper knives and steel sabers. Let there be no mistake, these lines simply render an aspect of life, that of the inevitable and limited choice which the milieu proposes to living matter. (text 3a)

Two decades later, with the added impetus of his Catholic convictions, this conception of preconceivable inevitability was enhanced by expectations of uninterrupted and cumulative continuity. As he noted with regard to stone tools,

> the unity in the evolution of stone knapping techniques and the *enchaînement* of the different stages make it possible to highlight one of the most consistent facts in the history of techniques: innovations appear by the addition of new operations without the abandonment of the ancient series that serve as their substrate. Right up to the last flintknappers [of today], the gestures of the Pithecanthropus will subsist in the preparatory phases of the nodule.[14]

The empirical and theoretical solidity of such claims—even as we withhold judgment on their spiritualist implications—is clearly open to question. However, in pursuing such lines of research, Leroi-Gourhan seems to have successfully forged some original insights and methods with which to "overtake" them.

14. Leroi-Gourhan 1962b, 17–18.

3.

Drawing the Gestures, Digging the Text—Leroi-Gourhan and Prehistoric Archaeology

BEFORE WE TURN in the final chapter to appreciate the reception and relevance of Leroi-Gourhan's technology, it will prove useful to briefly address those fields of prehistoric research for which he is equally famous. Indeed, his contributions to Palaeolithic art studies and to archaeological excavation methodologies are not only well known and influential in their own right—to the point of overshadowing other dimensions of his work—but they will also help us make further sense of his technology. At a methodological level, there are clear affinities between his technological and his prehistoric concerns: the emphasis on objective observations, the development of documentation practices (from *fiches* to photographs), and perhaps most significantly the reliance on experimentation, for the purposes of both replicating techniques and "experiencing" them. In thematic terms, Leroi-Gourhan's gradual shift from ethnology to prehistory (as further detailed below) opened up a new temporal depth to his technological studies. He was now wont, as famously exemplified in *Le Geste et la parole*, to reach deep into the past to account for the development and future prospects of "technicity." This *technologie des profondeurs*, as we may call it, did not fail to attract philosophical and postmodernist attention.

We have already encountered several shifts in Leroi-Gourhan's research interests, most notably when his concern of the late 1930s with objects and museum-based "material civilizations" made way in the early 1950s for the study of "technical behavior" and the "evolution of technicity" (chapter 2). A further reorientation took place in the second half of the 1950s until the mid-1960s, leading him to add the domains of prehistoric art and archaeology to his already well-furnished research and publication palette. On the face of it, this shelving of technology might be attributed to a sense of accomplishment or even closure on his part. After all, given the rapid across-the-board acclaim garnered by *Le Geste et la parole* (see chapter 4), Leroi-Gourhan might have felt that he had had his say on "the question of techniques." That granted, paradoxically, he might also have been responding to a sense that his contributions to "general ethnology" (and technology within it) were somehow falling out of step with the emerging academic and intellectual currents of his times. Such professional and institutional tensions, involving debates with both Marxist- and structuralist-inspired anthropological schools,[1] contributed undoubtedly to his increasing reorientation toward the disciplines of archaeology, prehistory, and human evolution—within which the study of techniques found itself repositioned, and to a large extent circumscribed. Be this as it may, Leroi-Gourhan's empirical and theoretical efforts, including his research, publications, and teachings, gradually came to focus on two major fields: the study and interpretation of prehistoric cave art in the Franco-Cantabrian area, especially since the mid-1950s, and, from 1964 onward, "open-air" archaeological excavations at the Upper Palaeolithic site of Pincevent, south of Paris. This is not to say that Leroi-Gourhan's disciplinary realignments were necessarily new or unprecedented. Given his insatiable polymathic curiosity, it should come as no surprise that his interests in both prehistoric excavations and prehistoric art studies were actually long in the making.

Structured Panels

So far as prehistoric art is concerned, several aspects of Leroi-Gourhan's contributions clearly followed on from his initial orientalist and art historical pursuits.[2] His detailed examinations of the Far Eastern collections at the *Musée Guimet* and *Musée Cernuschi* in the late 1930s and

1. On these disciplinary and theoretical manoeuvres, see Cresswell 1972; Digard 1979; Lemonnier 2011.

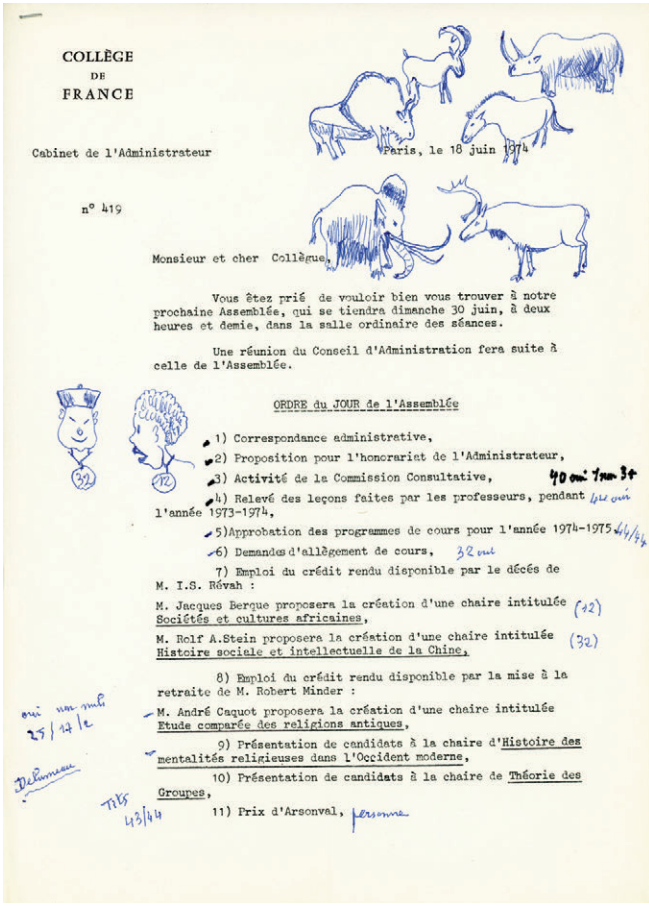
early 1940s had concentrated mostly on animal motifs, both abstract and figurative. With his initial Maussian training, *Musée de l'Homme* practice, and Japanese experience, Leroi-Gourhan was clearly more at ease with *fiche*-based studies of serial or ordinary productions by "anonymous craftsmen" than with the lavish description of exalted masterpieces. His specific research interests in the Palaeolithic parietal art of the Franco-Cantabrian region can be traced to a 1947 visit to Lascaux in the company of the Abbé Breuil, the so-called pope of prehistory. Henri Breuil (1877–1961) had of course long dominated the field of prehistoric art with his methodological expertise and innumerable recordings of cave panels in Europe and across the world. This enabled him to bring to the forefront two major questions regarding prehistoric parietal art: its dating and chronological sequencing and its interpretation, either as spontaneous expressions of human genius (or human leisure)—the *art pour l'art* hypothesis—or as pragmatically motivated depictions related to shamanic rites and hunting magic.[3]

Such were also, to a considerable extent, Leroi-Gourhan's own preoccupations. While not specifically concerned with hunting or fertility rites, he took prehistoric art to be deeply religious in nature, even if its specific belief systems and symbols remained unfathomable.

> There is no valid reason to deny to Palaeolithic anthropians preoccupations with the mysterious [this being his definition of religion in 1964] if only because their intelligence is of the same nature if not the same degree as that of *Homo sapiens*, and implies the same reaction in front of the abnormal, the unexplained.[4]

Questions of chronology and historical development in the parietal art of the Franco-Cantabrian region led Leroi-Gourhan to formulate a four-part stylistic periodization scheme, spanning from Aurignacian to Magdalenian times (ca. thirty thousand to ca. twelve thousand years ago). This scheme has actually been deprived of much empirical relevance over the years by the rapid development of radiometric dating and the discovery of new cave sites. This was all the more

2. For recent overviews and analysis of Leroi-Gourhan's contributions on prehistoric art, see Conkey 1989; Audouze and Schlanger 2004a, 2004b; and particularly Moro Abadía and Palacio-Pérez 2015; Palacio-Pérez and Moro Abadía 2015 (on Leroi-Gourhan's "structuralism"); and Palacio-Pérez and Moro Abadía 2020 (on the influence of Marcel Mauss).
3. On Breuil see Coye 2006; Hurel 2011; Breuil 1952a, 1952b.
4. Leroi-Gourhan 1964b, 5.



COLLÈGE
DE
FRANCE

Cabinet de l'Administrateur

Paris, le 18 juin 1974

n° 419

Monsieur et cher Collègue,

Vous êtes prié de vouloir bien vous trouver à notre prochaine Assemblée, qui se tiendra dimanche 30 juin, à deux heures et demie, dans la salle ordinaire des séances.

Une réunion du Conseil d'Administration fera suite à celle de l'Assemblée.

ORDRE du JOUR de l'Assemblée

1) Correspondance administrative,
2) Proposition pour l'honorariat de l'Administrateur,
3) Activité de la Commission Consultative,
4) Relevé des leçons faites par les professeurs, pendant l'année 1973-1974,
5) Approbation des programmes de cours pour l'année 1974-1975
6) Demandes d'allègement de cours,
7) Emploi du crédit rendu disponible par le décès de M. I.S. Révah :
M. Jacques Berque proposera la création d'une chaire intitulée Sociétés et cultures africaines,
M. Rolf A.Stein proposera la création d'une chaire intitulée Histoire sociale et intellectuelle de la Chine,
8) Emploi du crédit rendu disponible par la mise à la retraite de M. Robert Minder :
M. André Caquot proposera la création d'une chaire intitulée Etude comparée des religions antiques,
9) Présentation de candidats à la chaire d'Histoire des mentalités religieuses dans l'Occident moderne,
10) Présentation de candidats à la chaire de Théorie des Groupes,
11) Prix d'Arsonval,

Fig. I.4 Agenda of the meeting of the Collège de France professors, June 18, 1974. Drawings of prehistoric animals by André Leroi-Gourhan. Album Pincevent/MSH - Mondes archives.

so since his implied expectations of evolutionary progression in figurative art, leading from schematization toward increased naturalism, were rather naive and unsustainable. On the contrary, it proved to be upon the effective negation of such developmental concerns—in favor of atemporal "structuralist" considerations—that Leroi-Gourhan was able to make his most original and enduring contribution to the field.

In a series of publications from 1958, Leroi-Gourhan drew attention to the significance of the specific choice, placement, and composition of signs and representations within Palaeolithic caves, which could thereby be considered as veritable "organized sanctuaries."[5] Far from being randomly distributed, these figures demonstrated a certain coherence, a "grammar," in which representations of animal

5. Leroi-Gourhan 1958a, 307–8. See also 1958b, 1958c.

species (horse, bison, reindeer) in association with each other and with abstract or geometric signs were found to be recurrent and statistically confirmed across numerous cave sites. The retrospective overview he presented in his 1965 *Art of Prehistoric Man in Western Europe*, conceived in part to supersede Breuil's equally monumental 1952 album *Four Hundred Centuries of Cave Art*, is worth quoting:

> I was impressed by the unity each of the sets of figures [at Lascaux and at Altamira]. It no longer seemed to me enough to study superimpositions in order to make out the chronological divisions. Almost from the first visits, the cave as a whole began to interest me more than the dating problems [. . .]. Not only did I come to believe that there [was] no overlapping of epochs (except in accidental instances), but a real order seemed to me reflected in the arrangement of the figures—though what this might be was as yet confused in my mind. At this point both Mme Laming-Emperaire and I realized we were very much on the same tracks [. . .]. I came to the realization that the signs were one of the keys to chronology in the decorated caves, and my two preoccupations—with stylistic evolution, and with the structural arrangements of the groups of figures—merged into one.[6]

Widely disseminated (notably in English), taught at the *Sorbonne*, and later at the *Collège de France*, Leroi-Gourhan's proposals on Palaeolithic art secured lasting notoriety, as well as some opposition. These reservations concerned details of the stylistic sequence he proposed, his use of statistics, and also the "sexual" association he drew between horse figurations and male abstract signs—all the more so that Annette Laming-Emperaire had rather argued, drawing independently on similar structural and iconographic grounds, for the female associations of the horse and the male with the bison.[7] As it happens, Leroi-Gourhan appeared at times to be wavering between his interpretive vistas (on prehistoric religiosity, on the biological impulse toward rhythmicity and functional aesthetics, on the notions of mythograms, pictograms, and ideograms) and his empiricist epistemological desiderata to make use of recording methodology and descriptive vocabulary that were as neutral as possible, so as to "let the facts speak

6. Leroi-Gourhan 1965b, 2 (trans. 1967b, 2–3). See Breuil 1952a, 1952b.
7. Laming-Emperaire's 1957 thesis was published in 1962; see also Laming-Emperaire 1969, 1251.

for themselves." In this respect, his decreed rejection of any form of "ethnographic comparatism" proved particularly frustrating. To criticize the haphazard use of "primitive" analogies culled from travelers' accounts was one thing; to undercut the disciplinary and theoretical foundations of his own "paleo-ethnologie" was another. His concluding lines to a 1966 paper on "methodical reflections on Palaeolithic art" attest to these empiricist dissatisfactions:

> I have no constructive explanation to offer regarding the religion of the Palaeolithic people and during the past few years that the theory has reached the public, I am less and less keen on taking the responsibility of an explanation. Nothing looks more like a ghost than another ghost, and anyone can cover a shadow with the clothing of their liking, but they then have to present something else than [mere] suppositions.[8]

Horizontal Readings

On the vertical cave panels, as we saw, Leroi-Gourhan painstakingly recorded tracings and inscriptions of various sorts in order to reach deep-seated structures of aesthetic and religious significations. His horizontal archaeological investigations, on the other hand, though comparable in their documentary outlooks, rather sought to "read" or decipher the most ordinary structures of daily existence. As in the case of prehistoric art, Leroi-Gourhan's interest in archaeological excavations was a long-standing one. Adolescent diggings aside, he undertook some trial-trenching on archaeological sites during his mission to Japan. These interests were upgraded and professionalized upon his appointment to a lectureship in Lyon. He then created the *Centre de documentation et de recherches préhistoriques* (CDRP) in order to instill modern research practices among a still largely amateur community and to strengthen conservation and heritage policies on prehistoric matters. This led him to explore with his students several sites in the region of Lyon, and notably the Middle and Upper Palaeolithic cave complex of Arcy-sur-Cure (Yonne), where he developed a comprehensive and successful excavation program over the next two decades or so.[9]

8. Leroi-Gourhan 1966, 49.
9. D'Errico et al. 1998; Soulier 2018; and especially Ramírez Galicia 2019 on the CDRP and the excavation school at Arcy-sur-Cure.

Fig. I.5 The first season of excavations at Pincevent, 1964. André Leroi-Gourhan (left) and René Humbert overlooking Francine David, P. Guillaume, and Claudine Karlin. Photo by Claude Perpère. Album Pincevent/MSH - Mondes archives.

In March 1964, local amateur prehistorians identified substantial and well-preserved Palaeolithic remains being destroyed by quarrying works at Pincevent (Seine-et-Marne). Leroi-Gourhan, by then professor of ethnology at the *Sorbonne*, was rapidly alerted, in view of both his scientific interests and his patrimonial and administrative engagements. With his precocious militancy for "salvage archaeology," Leroi-Gourhan was able to convince André Malraux at the newly created Ministry for Cultural Affairs to protect the site's perimeter and to purchase it for the nation. A few months later, the minister could announce to the French parliament: "In France was discovered the site of Pincevent, the largest Palaeolithic site in the world, excepting the Russian sites. In three days, what has been requested has been obtained [with regard to protection and resources]. All this is only the beginning."[10] Indeed, more than half a century later, research and excavations are still very much ongoing at Pincevent, notably thanks to the questions and methodologies developed by Leroi-Gourhan to maximize the site's informative potential.

This series of ephemeral but extremely well-preserved camps of Magdalenian hunter-gatherers, returning every autumn some fourteen thousand years ago to hunt the reindeer at the river's edge, required in effect a radically different approach than the deep

10. André Malraux, speech at the Assemblée nationale, November 7, 1964. On Leroi-Gourhan's important contributions to archaeological policy and heritage management over the years, see Soulier 2018, 463ff., 575ff.

"stratigraphic" retrieval methods practiced in Palaeolithic cave sites. Only a micro-"topographical" approach, involving the painstaking *décapage* or horizontal peeling of the sediments with trowels, brushes, and dental tools, could identify the distinct "living floors" on which the Magdalenians dwelt and knapped flint blades and awls with which they processed and consumed their prey. The meticulous "dissection" and recording in situ of all the recovered finds resulted in high-resolution distribution maps for each material encountered, be it hearthstones, charcoal or ochre, flint nodules and chips, retouched tools, intact or fragmentary bones, and the like. Besides drawing on various "reading" metaphors ("the archives of the soil," "the pages of the earth," "the 'text' of which not a comma should be lost"), Leroi-Gourhan devised a specific vocabulary to characterize the identified structures ("evident," "latent," "homogeneous," "heterogeneous," etc.). This enabled him to interpret the vestiges with regard to the spatial and functional organization of the site's activity areas. This approach was enhanced by the possibility of conjoining stone artifacts so as to retrace spatial movements. It was also reinforced by the comparable methodology of Russian and eastern European open-air excavations with which he was familiar. All this enabled Leroi-Gourhan to lay the groundwork for a veritable *paléoethnologie* or *ethnologie préhistorique*.[11]

Some debates emerged within French prehistory regarding stratigraphic integrity, refitting, and typology, pitting Leroi-Gourhan's Parisian "ethnological" school against the "quaternary" approach of François Bordes at Bordeaux. At an international level, however, the excavations at Pincevent generated considerable attention and indeed served over the years as a field school for archaeologists from across Europe, Japan, and South and North America. For Anglophone archaeology, the methodology deployed and results obtained at Pincevent resonated with ongoing "New Archeology" developments, be they concerning the Middle Range "base-camps" and "drop zones" hypothesized by Lewis Binford or the cultural "site formation processes" highlighted by Michael Schiffer's "Behavioral Archeology."[12] Debates relating to "Pompeii premises" and expectations of "precise moments in the remote past" (of the kind that could be documented

11. On Leroi-Gourhan's excavation methodology and research results at Pincevent, see Leroi-Gourhan and Brézillon 1972 as well as overviews in Julien, Karlin, and Bodu 1987; Karlin and Julien 2012; Ballinger et al. 2014; Valentin et al. 2015; and Soulier 2021. On the Russian/Soviet connection, see Vasil'ev 2004 and Schlanger 2024.
12. On this, see Binford 1983; Schiffer 2010; and more generally Lucas 2012.

in great detail at Pincevent) raised questions regarding the nature of the archaeological record, and they also prompted the emergence, in France and worldwide, of the actualistic and experiment-based subdiscipline of ethno-archaeology—which in turn contributed, as we will see in chapter 4, to technological, "paleo-ethnological," and *chaîne opératoire* considerations.

Leroi-Gourhan's important contributions to both Palaeolithic art and excavation methods clearly cemented his global scientific reputation, yet they also encouraged an international audience to regard him primarily *as a prehistorian*. As a case in point, when he was invited to the Harvard graduate seminar titled "The Discipline of Archaeology" (Anth. 275, Summer 1969), Leroi-Gourhan dedicated his two lectures to "his detailed excavations and analysis [at Pincevent]" and "the interpretation of cave art"—rather than to any technological or evolutionary themes deriving from his recently published (and then as yet untranslated) *Le Geste et la parole*.[13] His election that same year to the chair of prehistory at the *Collège de France* undoubtedly increased his scientific stature, yet it also appeared somehow to narrow the breadth of his intellectual remit. From the mid-1960s onward, when Professor Leroi-Gourhan was invited to express his views by his academic colleagues or the popular media, it was primarily in his capacity as a prehistorian and palaeoanthropologist, indeed an "ethnologist of the depths." Leroi-Gourhan did contribute during these years to historical and historiographical writings, including some edited by *Annales*-inspired researchers, yet he focused there either on questions of method (exploring the possibility of "history without texts" or "history from the ground") or on the succession of prehistoric ages ("from early humans to the Neolithic revolution").[14] Ten or fifteen years earlier, he would have rather been called upon as a full-fledged technologist, as a scholar undertaking innovative research on such topics as the reality of *Homo faber* (text 7), the interconnections between gesture and speech, the subconscious aspects of "operational behavior" in animals and humans (texts 8, 9), or indeed the effects of technical transfers and acculturation among the cow-herders of Normandy and West Africa (text 6).

13. Harvard University 1969, 1.
14. For example, Leroi-Gourhan 1974.

4.

The Reception and Relevance of Leroi-Gourhan's Technology

NOW THAT WE have addressed the construction of Leroi-Gourhan's technology (and his reorientation toward prehistoric art and archaeology), we can in conclusion turn to its reception and its relevance, both immediate and long-term. *Le Geste et la parole* (1964–65) represents in many respects the best-known and most influential expression of Leroi-Gourhan's technological and evolutionary contributions. However, as the present anthology attests, these two volumes were not without their antecedents and trial runs. It might even be suggested that the very composition of *Le Geste et la parole* itself reflects Leroi-Gourhan's wider conception of the evolution of technicity, as a cumulative and incremental *tendance* in which nothing is lost and nothing deteriorates. Indeed, it seems to have been among Leroi-Gourhan's intellectual characteristics to "hoard" concepts and superimpose keywords at will across much of his career—and likewise to eschew scientific references or position statements, even when his "horizons" changed rather blatantly. This habit was obviously related to his wide-ranging "in-disciplinarity," as it were, spanning from the history of art to vertebrate anatomy, from excavation methods to philology, and from orientalism to ethology. These multifaceted and somewhat halting contributions undoubtedly

added to the relative elusiveness or even imperceptibility of his technology in the English-reading world, notably so far as its translations are concerned (see chapter 1). Our own modes of academic expression today have of course changed considerably, as have our disciplinary commitments and expectations. With the 1965 *Art of Prehistoric Man in Western Europe*, for example, one broadly knew what to expect; with the contemporaneous *Le Geste et la parole*, translated twenty years later as *Gesture and Speech*, things were far more uncertain. Tim Ingold, among the best-informed Anglophone connoisseurs of Leroi-Gourhan's works, concluded thus his comprehensive and insightful review of *Gesture and Speech*:

> The book is packed with speculations that are in turn perverse, bizarre, inconsistent, provocative, revelatory, and profound. For the contemporary reader, the effect is at times exhilarating, at times exasperating, but never dull.[1]

This assessment broadly applies to the ensemble of Leroi-Gourhan's technological oeuvre. Our task, as this introduction draws to its close, is therefore not to conclude, but rather to encourage the reading—indeed the multiple and diversified readings—of Leroi-Gourhan today.

Material Civilization, Material Culture, Materiality

As he pursued them over the first decade or so of his career, Leroi-Gourhan's "material civilization" studies were museum-based, object-centered, and records-driven. They helped establish his reputation as a groundbreaking technologist (see texts 1–5). This "elementary" emphasis clearly deserves a renewed reading in the light of current interests in "materiality." Leroi-Gourhan's early studies involved the assiduous recording and classification of technical practices and instruments among ethnographically observed and historically documented preindustrial societies, and they proved influential in several ways. For one, researching such items as handheld leather bellows, stone-tipped drills, or corded fishing nets, as illustrated across the pages of *Évolution et techniques*, made it possible to situate these techniques within their "civilizational" time and space, in relation to questions of invention, innovation, borrowings, and refusals. These detailed studies

1. Ingold 1999, 451. See also Ingold 2014, 158.

also confirmed the capacity of ethnographic collections to grasp the "ordinary" or "average" aspects of infinitely variable human existence, in line with the theoretical and ethical expectations of Mauss and Rivet. Lastly, these records effectively documented the last sightings of objects and practices "in action," prior to their disappearance under the global tide of occidental mechanization (and their eventual resurfacing in the guise of "traditional heritage"): in this respect, Leroi-Gourhan's meticulous compilations gain the status of an irreplaceable "archive" or "paper museum" for us and future generations to cherish.

With its experimentally and empirically based classificatory framework, the pertinence of this "material civilization" approach was readily recognized. The more theoretical aspects he advanced, including such notions as *tendance*, *fait*, and *milieu* (texts 3b, 4), proved influential for the development of "comparative technology" in the following decades, especially by researchers affiliated with the *Musée de l'Homme*. These aspects also attracted the attention of historians of civilization like Henri Berr and Lucien Febvre (both of whom welcomed some of Leroi-Gourhan's early publications; see texts 1, 2, 7), as well as sociologist and philosopher of technology Jacques Ellul. Philosopher of science Georges Canguilhem for his part went on to integrate some of Leroi-Gourhan's insights into the conclusion of his famous 1947 lecture on "machine et organisme."[2] Although more fleetingly, some echoes of *Évolution et techniques* can be found in Anglophone scholarship, be it through its listing in the 1951 edition of *Notes and Queries on Anthropology*, or indeed its appreciation by Lewis Mumford, who considered this "systematic comparative study of all aspects of material life [to be] invaluable."[3] Particularly noteworthy was the technological and orientalist appreciation expressed by historian Joseph Needham. While quite naturally relying on Chinese textual and iconographic sources for his monumental *Science and Civilization in China*, Needham turned to Leroi-Gourhan to address the question of Chinese mechanical engineering:

> The study of tools and the simpler machines borders of course upon the realm of anthropology, raising questions which can only be answered by comparative studies of all peoples in the eotechnic stage. Leroi-Gourhan, whose book on comparative technology is the most interesting of the kind which we have

2. Canguilhem 1952 (trans. 2008).
3. Mumford 1967, 310.

found, points at how illogical the conventional categories are, indeed how unconsciously Europocentric.[4]

Besides the "ethnological competence" he applauded in *Évolution et techniques*, what most attracted Needham to Leroi-Gourhan was the scheme he outlined in his 1936 encyclopedia article (text 2)—that is to say, the generalizable classification of "elementary" forms of action on matter.[5]

This "elementary" dimension of Leroi-Gourhan's early technological work marks one of the main differences between the "material civilization" perspective in which his work unfolded and the currently omnipresent notion of "material culture." Without expanding on the topic here, it may be noted that the notion of "material culture" has had a fairly checkered history in anthropology and archaeology over the past century, until it gained its current dominance. It long served to designate, in a fairly neutral way, ethnographically observed and collected implements and objects. These objects and their associated material behavior did not, however, feature much in Anglo-American anthropological and sociological theorization, and it was only from the 1980s onward that the materiality of culture received the attention it deserved, alongside dedicated museographic classifications and art historical descriptions.[6]

In France, on the other hand, "culture" was associated with highbrow and individualistic (and Germanic) connotations. A preference was clearly evident for the collective, rational, and historically based notions of *civilisation* and *civilisation matérielle*—as outlined, for example, by Mauss and Febvre in the 1930s and subsequently integrated into the *longue durée* approach by Fernand Braudel.[7] Until the 1980s occurrences of *culture matérielle* in French remained mostly episodic and unproblematized. In the 1936 encyclopedia to which Leroi-Gourhan contributed, for example (text 2), the term was used interchangeably with "material life" and "industries." At times, moreover, *culture matérielle* also featured in Leroi-Gourhan's work in a seemingly religious or ideational guise, serving as a counterpart or a foil to the notions of *culture spirituelle* or *vie intellectuelle*—as was the case with his address on "civilisation matérielle et vie spirituelle" to the missionary society of Lyon (text 6).

4. Needham 1965, 3. The "eotechnic" stage is of course part of Mumford's classification in *Technics and Civilization* (Mumford 1934).
5. Needham 1965, 51.
6. For historical overviews, see Buchli 2002; Hicks 2010; Schlanger 2021.
7. See the texts assembled in Berr 1930; Braudel 1979.

However implicit, this "profane" approach to culture, so to speak—which could be equally qualified as "material" and "spiritual"—brought with it a welcome appreciation of materiality. As Leroi-Gourhan noted in 1964 with considerable acuity,

> Except for the Russian school of historians of material culture, the technoeconomic infrastructure has been taken into consideration only where its effect upon the superstructure of matrimonial practices and rites was blatantly obvious.[8]

This led him to argue more broadly, no doubt with Lévi-Straussian anthropology as his target, that

> the continuity between the two faces of the group's existence has certainly been adequately grasped by our best sociologists, but rather as the outpouring [*déversement*] of the social into the material than as a two-way flow whose deeper-set impulsion comes from the material. As a result, we know today more about the exchange of prestige goods than of ordinary ones, more about ritual gifts than mundane services, more about the circulation of dowry coins than that of cash crops, and much more about the thoughts of societies than about their body.[9]

The ineluctable presence of substances, forces, frictions, inertia, resistances, and malleability, as made intelligible by Leroi-Gourhan's "elementary" or "fundamental" technological approach to materials and actions (texts 2, 3), need not lead us to determinist or "vulgar materialist" conclusions. On the contrary, such an approach appears quite compatible with the notion of "affordances" as outlined by psychologist J. J. Gibson in the 1970s and since then iterated in numerous material culture studies. The same can be said of the more recent theoretical debates surrounding the notions of "materiality" and "material theory."[10] All in all, there is much in Leroi-Gourhan's perspective to complement and, if need be, to challenge the more idealist strands still prevailing in contemporary material culture studies. Perhaps dazzled by the intriguing diversity of phenomenal differences, these publications all too often emphasize disincarnated "symbols in action,"

8. Leroi-Gourhan 1964a, 210 (trans. 1993, 148). Translation amended.
9. Leroi-Gourhan 1964a, 210 (trans. 1993, 148). Translation amended.
10. Gibson 1979; on materiality, see Ingold 2007; Olsen et al. 2012.

"grammars of meaning," or "systems of exchange" in which the materiality of techniques seems to serve only as a coat hanger for signifiers or as material tokens of social interactions. The "social life of things," so influentially addressed by Arjun Appadurai and his coauthors in the mid-1980s, may be taken as a case in point. While usefully highlighting "the outpouring of the social into the material" (to quote Leroi-Gourhan), too little attention has been directed at the *material* trajectories of these "things" or their technical modes of existence.[11]

Meandering *Chaînes opératoires*

There are indeed several substantial differences at play between Anglo-American "material culture studies" and the French *technologie culturelle* or *anthropologie des techniques*, largely inspired by Leroi-Gourhan. A different emphasis on consumption on the one side and production on the other is accompanied, in the latter case, by a greater willingness to pay attention to the more material or deterministic aspects of technical realities and processes, and a corresponding commitment to their painstaking empirical study.[12] All the more so that, beyond such underlying documentary or "salvage" intentions, these technological studies (be they museum- or fieldwork-based) have amply confirmed their interpretative potential. A particularly distinctive expression of this technological value is captured by the already encountered notion of the *chaîne opératoire*, which designates, in a nutshell, the processes of transformation leading from naturally occurring raw materials to finished and used cultural products and related by-products and waste.

The fact that the *chaîne opératoire* is nowadays reprised in the international literature in italicized French represents a linguistic and typographic confirmation of its distinctiveness. Just how much of its diversified use—be it in prehistoric archaeology and cultural anthropology or more broadly in material culture studies and science and technology studies—can actually be referred to Leroi-Gourhan's specific influence remains an open question, given the great variety of formulations and objectives in evidence. What is quite certain is that Leroi-Gourhan provided the *chaîne opératoire* with both its designation and its initial orientation. Our observation that he himself was inspired by studies of animal psychology (see chapter 2) is in no

11. Appadurai 1986; Pierre Lemonnier, personal communication.
12. For useful overviews, see Naji and Douny 2009; Coupaye and Douny 2009; and for a semio-technological perspective, Bromberger 1979.

way incompatible with his vitalist-cum-cybernetic intentions to situate human "technical behavior" at the culmination of a nearly universal *tendance* toward technicity. Leroi-Gourhan's conjectured diachronic succession of "automatic," "machinal," and "lucid" *chaînes opératoires*, spanning from insects to humans and from instinct to intelligence (texts 8, 9), clearly expresses this trend.

These initial affinities did not inhibit Leroi-Gourhan from mobilizing this concept also in his specifically ethnological teachings, as provided within the *Centre de formation aux recherches ethnologiques*. Thus in his 1952 lectures he postulated a tripartite "economy of consciousness" in the small-scale rural communities he took as his example. More specifically, he distinguished (a) semiconscious "elementary" or "daily" *chaînes opératoires* such as food preparation and consumption, practiced as a matter of routine "verbal and gestural *habitus*,"[13] from (b) *chaînes opératoires* implicating "complex practices of normal character" such as seasonal agricultural operations, and lastly (c) even less frequent *chaînes opératoires* associated with "exceptional practices" such as communal house building, during which the actors were placed in a state of "technical freedom" that allowed for the emergence of consciousness, language, and innovations.[14]

Of equal interest was Leroi-Gourhan's use of the *chaîne opératoire* to reach beyond the object-centered emphasis characteristic of more traditional technological studies (including, as we know, his own earlier "material civilization" studies):

> In fact, while the tool is a necessary element in the unfolding of the operational cycle, it exists only through this cycle and within this cycle, and it is inseparable from the gestures that render it technically efficient. That is why the study of the tool is in itself only of museographical or functional-morphological significance. (text 9)

These psychological and physiological perspectives granted, it was mainly left for his students and collaborators to place the *chaîne*

13. This notion of *habtius* was used very rarely and casually by Leroi-Gourhan, without the theoretical baggage intimated by Mauss in the 1935 "Les Techniques du corps," let alone fully expounded by Pierre Bourdieu (Bourdieu 1977, 1990).
14. See Leroi-Gourhan's lecture notes for 1952–53, preserved in his archives at the *Maison des sciences de l'homme-Monde*, Nanterre, as well as Leroi-Gourhan 1965a, 27ff. (trans. 1993, 230ff.).

opératoire approach at the heart of what became *technologie culturelle* and *anthropologie des techniques*—a definite upgrade on *technologie comparée*, with "ethnology" replaced by "anthropology" in its wider sociocultural sense. From the 1970s onward, new studies by members of the *Techniques & culture* research team, such as Robert Cresswell and Pierre Lemonnier, as well as Hélène Balfet and Jean-Pierre Digard, reoriented their *chaîne opératoire* approach toward more sociological concerns.[15] Mauss's evocative suggestions regarding the unfolding traditional efficient acts and the "techniques of the body" of the *homme total* began to be followed through. At the same time, Marxian socioeconomic concerns with the relations of production, enhanced by an interest in the means and forces at work, came closer to constituting an operational research program.[16] A case in point is provided by Lemonnier's technological studies, from the salt marshes of western France to the Papua New Guinea Highlands, which highlight the combination of materials, physical forces, tools, and knowledge brought to bear in the course of "socialized action on matter." Unfolding *chaînes opératoires*—implicating both "strategic tasks" that cannot be deferred or altered (drying the clay before its firing, mixing the ore before smelting) and "variable moments" that allow for more flexibility—proved to be fertile ground for the shaping of collective representations and social relations.[17] With or without explicit reference to the *chaîne opératoire* or to Leroi-Gourhan, such material-oriented perspectives in the anthropology of techniques had repercussions for some strands of science and technology studies.[18] They have furthermore featured, with different degrees of relevance, in various formulations of "agency," "interactions," "entanglement," and "materiality" in the archaeological and anthropological theoretical literature of the past two decades.[19]

Leroi-Gourhan's own research interests, as we know, had veered toward prehistoric archaeology and human evolution by the 1960s. The emerging field of *technologie préhistorique* undoubtedly benefited from his encouragement, but the development of the *chaîne opératoire* as a guiding framework for the study of stone artifact manufacture

15. See Balfet 1991; Cresswell 1996; Digard 1979.
16. Geistdoerfer 1973; Lemonnier 2011.
17. Lemonnier 1980, 1986, 1992.
18. Latour 2011; Latour and Lemonnier 1994; Coupaye 2021b. See also the media studies and culture-techniques approach of Schüttpelz 2006; Heilmann 2016; Mersch 2017.
19. Dobres 2000; Knappet 2011; Hodder 2012, 54, passim; Coupaye 2015; Chazan 2018; and the comprehensive overview in Hussain and Will 2021.

and use was mostly due to his students and colleagues Michel Brézillon, Claudine Karlin, Michelle Julien, Françoise Audouze, and their successors. The "paleo-ethnological" approach to flintknapping and tool use they developed at the site of Pincevent (and subsequently at other well-preserved Upper Palaeolithic sites in the Paris basin) made it possible, through stone artifact refittings and distribution maps, to access evidence relating to activity areas and spatial differentiation, and thus to address questions of economy and efficiency in lithic production and use.[20] These interests clearly converged with the renewal of flintknapping experimentation during the 1980s, when the impetus provided by prehistorian Jacques Tixier inspired the more systematic and better-publicized works of Jacques Pelegrin, Jean-Michel Geneste, and Eric Boëda.[21] These studies have contributed considerably to the dissemination of the *chaîne opératoire* approach, both as an empirical method and as a research perspective, among prehistorians and archaeologists in France and abroad. Indeed, *chaîne opératoire* studies have also served at an international scale to transcend traditional chrono-cultural fixations with formal stone tool typologies—while at the same time enhancing studies of lithic "reduction sequences" and "site formation processes" with deeper-reaching technological and anthropological perspectives.[22]

One of the promising research directions following from these empirical and experimental *chaîne opératoire* initiatives concerned the issue of skills, know-how, and decision-making capacities brought to bear in stone tool production and use. For example, the approach deployed during the 1990s at Pincevent for distinguishing levels of skills among Magdalenian flintknappers and for grasping processes of apprenticeship, from novice to expert, was clearly an achievement Leroi-Gourhan would have welcomed.[23] In fact, his own sustained interests in *la mentalité préhistorique* make him an early promoter of what came to be known since the 1990s as "cognitive archaeology"—a highly promising interdisciplinary subfield, still prone, however, to academic monolingualism and uneven historiographical consolidations.[24] Given

20. Cahen et al. 1980; Karlin and Julien 2012; Karlin, Bodu, and Pelegrin 1991; Valentin et al. 2015. For an overview, see Soulier 2021, 111–24.
21. See, for example, Pelegrin 2009; Geneste 2010; Boëda 1995.
22. For recent overviews, see Audouze and Karlin 2017; Perlès 2016; and in English, Bleed 2001; Bar-Yosef and van Peer 2009; Soressi and Geneste 2011; Hussain 2018. See also Schlanger 2004, 2005.
23. Ploux and Karlin 1994. See also Roux and Bril 2005; Bril 2020; Schlanger 1996.
24. Compare, for example, Haidle 2011 with Overmann and Coolidge 2019.

his original combination of interests in "behavior" and "evolution," in functional neuro-anatomy and materiality studies *avant la lettre*, Leroi-Gourhan's work clearly remains one of its major and still largely untapped sources of inspiration. As we recall, he had drawn on experimental insights to dismiss the view of stone artifacts as mere "minerals stuck by some vague anthropoids" (text 7) and concentrated instead on the quasi-ethological description of the processes of their manufacture. In the case of Middle Palaeolithic Levallois flake production, for example, Leroi-Gourhan posited the precise detachment of dozens of preparatory flakes, coordinated into "six or seven successive operations, performed in a rigorous order, by calculating several strikes in advance the result to be obtained in a precise area of the core, with all the irregularities of a raw material that each time prompts new reflection" (text 7). More generally,

> The issue is to know whether we are "human" because we make tools, or whether we [anthropologists] can, as the philosophers do, conceive of two kinds of humanity, first existing in succession, and then combined in everyone's life: *Homo faber* and *Homo sapiens*. Furthermore, our challenge is to find out whether we think as *faber* and as *sapiens* using the same parts of our brain; whether the earliest humans did not start with a brain in which sapient thought occupied a limited number of slots; whether, initially, the technical brain [*le cerveau technique*] did not surpass the "cerebral" brain [*le cerveau "cerebral"*]. (text 10)

While there is of course much that is outmoded about these formulations, many of the questions raised here (throughout texts 7–10 and in *Le Geste et la parole*) remain highly pertinent for current research in cognitive archaeology and the evolution of technology. The links proposed by Leroi-Gourhan between tools, gestures, and language, their physiological and psychological interconnections, and indeed their scalar, modular, feedback-seeking, cybernetics-like accumulation, acceleration, and exteriorization across human evolutionary history have actually attracted some attention.[25] By the 1990s, with the expansion of the "cognitive sciences" toward the humanities and the

25. Both Alimen and Goustard 1962 and Atran 1982, for example, draw connections with Piagetian psychology (see also Wynn 1979, 1985; Schlanger 1994, 1996). Ralf Holloway, in his 1969 "Culture: A Human Domain," was one of the rare Anglophone researchers to integrate *Le Geste et la parole* (prior to its 1993 translation) in his palaeoanthropological theorization.

social sciences, these behavioral-cum-evolutionary links have become major research topics in their own right. Indeed Leroi-Gourhan's *ethnologie des profondeurs*, "in-depth ethnology," as he put it, appears quite compatible with the independently developed, biologically grounded "deep history" ventured by Daniel Lord Smail and Andrew Shryock with the added potential, in Leroi-Gourhan's case, of keeping in sight both levels of synchronic gestures and of diachronic evolution.[26] Pursued through various lithic-experimental and neuropsychological research projects,[27] these approaches have also generated, at another level, some wider-ranging and increasingly mainstream paleo-anthropological reflections on "the ancient mind" and on "tools and language in human evolution."[28]

Philosophical Perspectives—Overtaking Techniques and the Future of Technology

Leroi-Gourhan himself, we can surmise, would have gladly joined such wide-reaching speculations. With his indisciplined streak and his penchant for evocative and malleable concepts over more binding systems of thought, it is not surprising to find his work providing such philosophical "affordances." To begin with the rhetorical level, his double-edged use of the qualifier "philosophy" in his writings served him, at times, to dismiss some ideas as unwarranted speculations bereft of positive grounding but also, as the occasion demanded, to endorse others as incontrovertible faith-borne verities. Steeped as he was in the empiricist, *fiche*-based documentary tradition of Mauss and Rivet, Leroi-Gourhan was also heavily influenced, beginning in the late 1930s, by the alluring intuitionist and spiritualist philosophy expounded by Henri Bergson in the 1907 *Évolution créatrice* and the 1932 *Deux Sources de la morale et de la religion*.

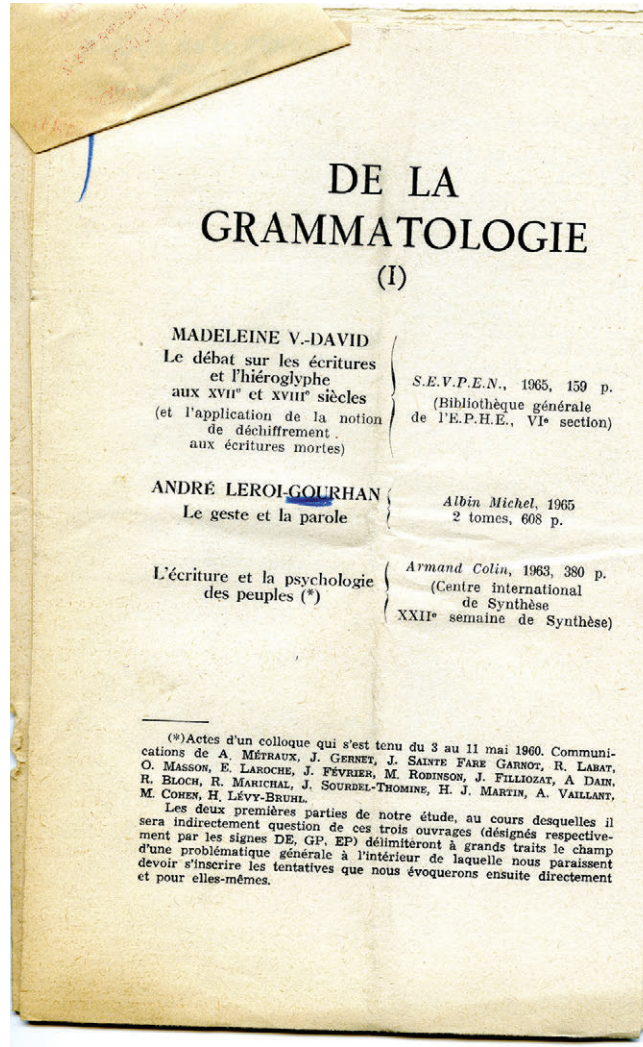
With only slight exaggeration, it can be suggested that Leroi-Gourhan undertook, more resolutely than most scholars of his times or since, to give scientific credibility to Bergson's key notion of *élan vital*. Alongside their metaphysical force, there was for Leroi-Gourhan some empirical substance to be found to these Bergsonian "thrusts"

26. Leroi-Gourhan 1965a, 211 (trans. 1993, 149); Smail 2007; Shryock and Smail 2011.
27. See, among others, Stout and Chaminade 2009; Stout et al. 2015; Haidle 2011; Wynn et al. 2016.
28. To cite the titles of two representative books, Renfrew and Zubrow 1994 and Gibson and Ingold 1993.

and "currents of will," unfolding in their becoming, overcoming in their different trajectories the resistance of matter, showing the past as a continuous progression that swallows the future while perpetually growing and conserving itself indefinitely.[29] It is not for nothing that Tim Ingold, with his own monist appreciation of the dynamic flows and fluidity of "becoming" in anthropological or evolutionary "life-worlds," acknowledged both Bergson and Leroi-Gourhan among his key inspirations.[30]

The trajectory of that other Bergsonian notion, *Homo faber*, shows more vicissitudes: while Leroi-Gourhan endorsed it in 1943 as an empirically confirmed human taxon (text 3), he subsequently cast it in 1950 as a mere "philosophical hypothesis" to be rejected by historical evidence (text 7)—only to reprise it at the end of that decade as a redeeming humanist proposition (texts 10, 11, and below). Leroi-Gourhan's recurrent leitmotif of *libération*, with its jointly military and theological undertones, belongs to the same philosophical drive, positing a freedom that spans and expands incrementally from the hand and the face to the constraints of raw materials, distances, and population numbers—and then culminates in the "exteriorization" of thought, information, and memory outside the body, onto the walls of the cave, the manuscript parchment, the printed book, and lastly "the artificial nervous system" (text 11). By the mid-1950s, these views were reinforced by the posthumous publication of *Le Phénomène humain* by Pierre Teilhard de Chardin. The conviction expressed therein—that the significance of the "human phenomena" was thoroughly rooted in organic life—effectively made of the sciences of humankind an extension of the life sciences. It was, broadly speaking, a secularized or at least naturalized version of this outlook, further synthesized, expanded, and reinforced with linguistic and palaeontological considerations,

29. Leroi-Gourhan 1943, 1945 (texts 3, 4); Bergson 1907; Deleuze 1968. More specifically to Leroi-Gourhan, see Stiegler 1994, 58n1; Schlanger 2004, 2023.
30. Ingold 1999, 2004, 2014. For his appreciation of stone tool production and the *chaîne opératoire*, see Ingold 2013, chapters 3, 8.
31. It was no doubt on the strength of that book that Leroi-Gourhan was invited in the early 1970s to join the *Groupe des dix*, a socioeconomic and cybernetic think tank launched in the intellectual and institutional aftermath of May 1968. Leroi-Gourhan's contributions to the group were mainly archaeological (regarding parietal art or excavation methodology), and he did not really address questions of technology and human evolution, which he had by then largely set aside. Nevertheless, this participation further enhanced his philosophical visibility and pertinence (see Chamak 1997, 2019; Dicks 2019).



DE LA
GRAMMATOLOGIE
(I)

MADELEINE V.-DAVID
Le débat sur les écritures et l'hiéroglyphe aux XVII^e et XVIII^e siècles (et l'application de la notion de déchiffrement aux écritures mortes)
S.E.V.P.E.N., 1965, 159 p. (Bibliothèque générale de l'E.P.H.E., VI^e section)

ANDRÉ LEROI-GOURHAN
Le geste et la parole
Albin Michel, 1965 2 tomes, 608 p.

L'écriture et la psychologie des peuples (*)
Armand Colin, 1963, 380 p. (Centre international de Synthèse XXII^e semaine de Synthèse)

(*)Actes d'un colloque qui s'est tenu du 3 au 11 mai 1960. Communications de A. Métraux, J. Gernet, J. Sainte Fare Garnot, R. Labat, O. Masson, E. Laroche, J. Février, M. Robinson, J. Filliozat, A Dain, R. Bloch, R. Marichal, J. Sourdel-Thomine, H. J. Martin, A. Vaillant, M. Cohen, H. Lévy-Bruhl.
Les deux premières parties de notre étude, au cours desquelles il sera indirectement question de ces trois ouvrages (désignés respectivement par les signes DE, GP, EP) délimiteront à grands traits le champ d'une problématique générale à l'intérieur de laquelle nous paraissent devoir s'inscrire les tentatives que nous évoquerons ensuite directement et pour elles-mêmes.

Fig. I.6 André Leroi-Gourhan's press cutting of Jacques Derrida's first publication of *De la grammatologie*, in the revue *Critique* for 1965. MSH - Mondes archives (ALG 115).

interspersed with observations from neuropsychology, figurative art, and "mythograms," that culminated in *Le Geste et la parole*.[31]

It is the case that philosophers, historians, and intellectuals have actually been reading and referring to Leroi-Gourhan since the mid-1940s, including the abovementioned L. Febvre, G. Canguilhem, and J. Ellul, as well as Emmanuel Mounier, Raymond Ruyer, or Gilbert Simondon.[32] Nevertheless, his apotheosis clearly came with the publication of *Le Geste et la parole*. Among the very first to have seized on its

32. See further in Schlanger 2023.
33. Derrida 1965.

philosophical potential was Jacques Derrida.[33] Already in December 1965, as he elaborated the critique of the prevailing "logocentrism" to feature in *De la grammatologie*—casting writing as an essential feature of language rather than one of its possible manifestations—Derrida drew on Leroi-Gourhan's discussion of prehistoric graphism, comprising traces, signs, mythograms, and pictograms (see chapter 3).

This recasting of writing as a constitutive human characteristic (*qua* inscription), rather than a distinctive and late-coming "civilized" (and soon abstract or decadent) acquisition, has been further seized on by other commentators, be they philosophers or literary theorists. Thus Roland Barthes relied extensively on Leroi-Gourhan in his attempt to retrace the history of writing as a manual activity. In his *Variations sur l'écriture*, he noted that the "pre-graphism" of the cave posed from the outset the question of the syntagmatic relations between the oral and the written. Leroi-Gourhan's clear distinction between graphism and writing (*écriture*) enabled Barthes to highlight the rhythmicity of graphic traces, such that "graphism begins not with the imitation of the real, but with its abstraction."[34] Moreover, Barthes drew from Leroi-Gourhan the conviction that "the hand has freed the speech (*parole*)." This made of language a tool among others, and also an instrument that now returned, via its writing, to the hand:

> Language [thus] returns to this bodily limb whose very independence has made its birth possible: a broad dialectical circuit is closed. Writing is *always* on the side of the gesture, *never* that of the face: it is tactile, non-oral. One better understands then that it can re-join, beyond speech, the first traces of parietal art, these rock carving, often abstract, rhythmical before being figurative.[35]

Incidentally, poststructuralist austerity aside, Barthes also drew from Leroi-Gourhan a refreshingly whimsical and romantic conclusion in a meditation aptly titled "*Parler / embrasser*":

> According to a hypothesis by Leroi-Gourhan, it was when he could free his upper limbs from the task of locomotion and, in consequence, his mouth from predation, that man could speak. I would add: *and kiss*. For the phonatory system is also

34. Barthes 1973 (trans. 2002, 278, 280).
35. Barthes 1973 (trans. 2002, 307; original emphasis).

> the osculatory system. Shifting to upright posture, man found himself free to invent language and love. This is perhaps the anthropological birth of a concomitant double perversion: the speech and the kiss. Following this account, the more liberated men have been (with their mouths), the more they have spoken and kissed; and logically, when progress will have further freed men of all manual tasks, they will then do nothing but discourse and embrace each other![36]

Other deconstructivist usages of *Le Geste et la parole* have since contributed to its notoriety. The triadic relations between organs of locomotion, prehension, and relation, for example, and the ensuing idea that humanity began by its feet rather than its braincase—that is, by being set in motion rather than mired in contemplation—were expanded on by a range of commentators. Just as an increasingly upright humanity proved to be "deterritorialized," as Gilles Deleuze and Félix Guattari put it, so its poor specialization proved to be its strongest generic feature, a species eminently adaptable to all circumstances, including to its own machines and machinations.[37] Derrida's original interpretation seems to have been the most enduring. Leaving aside the question of graphism, his focus on the notion of "gram" had wider repercussions, casting the "pro-gram" as temporally and conceptually anterior to the distinction between humans and machines. Leroi-Gourhan's references to programs, so Derrida intimated, served him to bypass the usual traits by which humans have been distinguished from other beings (intelligence, speech, or sociability), reaching in the process, through a form of cybernetic intelligibility, a fundamentally nonanthropocentric anthropology.[38]

In Derrida's wake, finally, Bernard Stiegler further expanded Leroi-Gourhan's technological contributions: in constructing his philosophical essay *Technics and Time,* Stiegler marshaled extended commentaries on Bertrand Gille (the technical system), Gilbert Simondon (regarding the mode of existence and individuation of the technical object), and above all Leroi-Gourhan. In the first part of his book Stiegler drew extensively on the notions of *tendance* and *fait* (from *L'Homme et la matière*)[39]—notions that are now available in English for the first time (texts 3, 4). Later on, in his discussion of the "invention

36. Barthes 1975, 169 (trans. 1977, 140–41). Translation amended.
37. Deleuze and Guattari 1980.
38. Derrida 1967, 19, 124–25 passim (trans. 1974, 8–10, 83–84).
39. Stiegler 1994, 57–80 (trans. 1998, 43–65).

of the human," Stiegler turned to *Le Geste et la parole* to emphasize the idea of (as he put it)

> *the pursuit of the evolution of the living by other means than life*—which is what the history of technics consists in, from the first flaked pebble to today, a history that is also the history of humanity—a statement that will lead us to the unusual concept of "epiphylogenesis."

Lastly, pursuing Derrida's main insight, Stiegler noted that

> since the *grammé* is older than the specifically human written forms, and because the latter is nothing without it, the conceptual unity that is the *différance* [also] contests the opposition animal/human and, in the same move, the opposition nature/culture.[40]

Some years later, in one of his "digital" meditations, Stiegler proposed a trajectory across this antidualistic landscape, involving the notions of prosthesis and memories: "The fabrication of inorganic organs, made possible by the liberation of the upper limbs from locomotion, engenders supports of exteriorized psychomotor memories which represent the first forms of tertiary retentions."[41]

If nothing else, such readings clearly underscore the pertinence of Leroi-Gourhan's views regarding the "extrasomatic vitalism" of techniques, as we may call it, allocating a constitutive role to the exteriorization and materialization of organic-cum-artificial life. The same goes for his inspiring recourse to the notions of "program," "memory," "exteriorization," and indeed "behavior" as both evidence and drivers of universal technicity.[42] This appreciation notwithstanding, it is far less certain that Leroi-Gourhan himself had in mind such destabilizing, antiessentialist, decentering, or *diffèrance*-seeking objectives. The ambiguity of his position is conveyed in the following statement, whereby language and tool use both appear "as the solidary consequences of the specifically human version of a process whose development can be traced back to the origins of the living world" (text 8). With all

40. Stiegler 1994, 146, 148 (trans. 1998, 135, 137). Translation amended. See also Stiegler 2004.
41. Stiegler 2017, 153.
42. See also Stiegler 2004, 2017. On Stiegler, techniques, and Leroi-Gourhan, see Johnson 2011, 2013; Guchet 2015; Noland 2009.

Fig. I.7 André Leroi-Gourhan and Gilles Gaucher at Pincevent, late 1960s.

the posthuman insights his writings apparently provided, he seems to have been much more of a "new-humanism" advocate, stirring and scrutinizing the hopes and anxieties of late industrial modernity.[43] This clearly applied to his ecological anthropology insights, and also to his more mitigated musings regarding the "technological illusion" and "the future of *Homo sapiens*" (see texts 10, 11, and the last chapters of *Le Geste et la parole*).

While Leroi-Gourhan's technological optimism did fluctuate over time, it was never Panglossian or beatific. Contrary to some of the more pessimistic predictions regarding the atomic bomb and the demographic explosion, he was convinced that techniques were not necessarily doomed to "run out of control" so as to rule over—and ruin—our lives. In fact, calling on his archaeological and palaeoanthropological reconstructions of the deep past, he rather conjectured that techniques, understood as an extension of life, have had from the outset a constant and quite normal "margin of overtaking [*marge de dépassement*]." This, to his mind, confirmed "the ambiguity of techniques,

43. And he has been read as such by other philosophers and "fundamental" anthropologists, including Moscovici 1968; Morin 1973; and Castoriadis (1973) 1978.

which have long been overshadowed [*surplombée*] within ourselves by genuinely human thought, and which overshadow us, outside ourselves, following their own dynamism" (text 10).

In these circumstances, the figure of *Homo faber* could be revisited yet again, not as a taxonomic reality (as in 1943) or as a confusing duality (as in 1952), but rather as a source of comfort or even redemption: "the *Homo faber* that is contained within us is the barely elder brother [of that within] the Australopithecene" (text 10). Granted, it may be difficult to establish direct links between Leroi-Gourhan's musings and the current revival of anthropological and philosophical interest in *Homo faber* by the likes of Tim Ingold, François Sigaut, or Matthew Crawford.[44] Yet his claims that *sapiens* and *faber* go hand in hand—and that making is, as much as thinking, in the essence of humankind—are clearly more relevant than ever today. At the level of the species, proposed Leroi-Gourhan, we have to acknowledge our increasingly "natural" use of a single finger with which to push buttons: to set in motion programed machinery, to type texts, or, more recently, to send SMS messages. Taken at an individual, existential level, however, the risks are far greater and need to be recognized: "not having to 'think with one's fingers'"—so he cautioned, bringing together artisanship and nostalgia—"is equivalent to lacking a part of one's normally, phylogenetically human mind."[45] Just as Leroi-Gourhan convincingly argued that *techniques*, as "materially creative activities," are in the nature of human behavior, so he made it abundantly clear throughout his lifework that *technology*—that is to say, the materially grounded and concept-driven study of techniques in the human and social sciences—is more than ever essential for our understanding of ourselves.

44. Ingold 1986; Sigaut 2012; Crawford 2009. See also Sennett 2008; Loyen et al. 2018; Idhe and Malafouris 2019.
45. Leroi-Gourhan 1965a, 61–62 (trans. 1993, 255).

Part II. Selected Texts, 1936–1962

André Leroi-Gourhan

Editor's Note

THE TEXTS ASSEMBLED in this anthology, written and published by André Leroi-Gourhan from the mid-1930s to the mid-1960s, appear here for the first time in English translation. Each text is briefly introduced with editorial comments, mostly touching on the circumstances of its initial production and publication. Most of these texts are translated in their entirety, including their accompanying figures and the (few) footnotes and references that they contain. Texts 2, 3, and 4 are exceptions to this rule. Text 2, a stand-alone encyclopedia article, has been trimmed of some of its empirical enumerations, deemed too detailed (and at times obsolete) for our purposes—all the more so that a facsimile edition of the complete text is readily available online. Texts 3 and 4 are for their part chapters (introductory and conclusive) of the two volumes of *Evolution et techniques*, the 1943 *L'Homme et la matière* and the 1945 *Milieu et techniques*. The full translation of these books into English is in some respects long overdue, but this would represent quite a distinct project from the one undertaken here. A further complication ensues from the editorial history of these two volumes, which (as we will see in their presentation below) were reprinted in 1949 and 1950, respectively, and then revised in 1971 and in 1973. To facilitate

the contextual understanding of these texts (2, 3, and 4), the tables of contents of the volumes in which they appear are also appended. Finally, the translation of text 6 is augmented by a few paragraphs, mainly in the introductory section. These paragraphs, omitted from the published version, feature in the otherwise near-identical archived typescript of the conference at which the paper was delivered.

As already indicated, this anthology owes much to the generosity of Martine Leroi-Gourhan and the support of Philippe Soulier. All these texts were specifically translated for this publication by Nils F. Schott, who navigated their many linguistic and conceptual challenges with considerable dexterity. I have further extensively revised and harmonized these translations, and I have also chosen as the occasion demanded to reproduce some key concepts and formulations in the original French. For the rights to reproduce these texts, I thank first of all Eric Brian, the director of the *Revue de synthèse*, for his encouragement and generous agreement (regarding texts 1, 2, and 7). I likewise thank the relevant publishers at Albin Michel (texts 3 and 4), Presses Universitaires de France (text 5), Fayard (texts 8 and 10), and Flammarion (text 9). The same gratitude extends of course to the publishers and rights holders it has proved impossible to locate so far (texts 6 and 11).

Nathan Schlanger

1.

Ethnology and Museography, 1936

"L'Ethnologie et la muséographie." *Revue de synthèse* 11, no. 1 (1936): 27–30.

LAUNCHED BY HISTORIAN and philosopher Henri Berr in 1900, the *Revue de synthèse* served as an explicitly interdisciplinary venue for presenting and debating original research initiatives. At the instigation of Lucien Febvre, the February 1936 issue included a special section on the theme of "collective research and the future of history." Pleading against sterile individualism, Febvre argued that science was practiced by people who are in their time and social milieu and who carry with them these broader perspectives and challenges.[1] It was therefore necessary for scholars to collaborate around shared questions, combine their efforts and areas of expertise, and orchestrate their results. Understanding how the social and human sciences could undertake collective research was thus a necessity. In this 1936 issue of the *Revue de synthèse*, Febvre's introductory exhortation was followed by an article on "collective research in ethnology and folklore" (in both Algeria and France) by René Maunier, then by Leroi-Gourhan's paper translated here, and several shorter accounts of case studies on collective initiatives in France (the route of the Rhine), the USSR (by Charles Parain), Scandinavia, Belgium, and Switzerland.

1. Febvre 1936a.

Leroi-Gourhan's article briefly presented the practices and rationale of the "new museology" then emerging between the *Institut d'ethnologie* and the soon-to-be-inaugurated *Musée de l'Homme*, under the direction of Paul Rivet, Georges-Henri Rivière, and their team. Succinctly put, they considered the object as a crossroads, which could "carry with it its milieu," through its systematic recording on the *fiche*, or index card. Leroi-Gourhan's fixation with *fiches* and documentation was mainly inspired by Marcel Mauss's ethnographic teachings and the experience of the Dakar-Djibouti ethnographic expedition of 1931–33. These documentary practices were to accompany him throughout his career, and they remained important even when he drew closer to the intuitionist epistemology of Henri Bergson. The young Leroi-Gourhan was also impressed by Febvre's initiatives for the collaborative advancement of science, especially following his exhilarating experiences as a volunteer at the museum. Indeed, Leroi-Gourhan would repeatedly strive to find a balance between his solitary intellectual inclinations and the resolutely collective research and training initiatives he was developing, in both ethnology and archaeology, since the mid-1940s.

Not even ten years have passed since ethnology became an organized science in France. The creation of an *Institut d'ethnologie*, the reorganization of the *Musée d'ethnographie du Trocadéro*, and the theoretical and practical teaching provided by the likes of Paul Rivet and Marcel Mauss all have produced, in less than a decade, a school whose activities reinforce its characteristic personality by the day.

The first task at hand has been to give researchers the means to seek out, preserve, and provide access to documents: those that already exist and those collected by an ever-increasing number of ethnographic missions. While some ethnographers have been scouting the field [*terrain*] and sending thousands of pieces to Paris, others have been refurbishing the obsolete framework of the *Trocadéro* museum. All have been working along the same lines and following the same rules; that is how, in four years or so, we have reached the level of the best museums abroad.

These rules, whose public outcomes are now well known, have other aims than the visual highlighting of some rare or curious pieces; they rather pertain to a complete scientific organizational plan. Museography seeks to make of the museum more than just an occasional working tool, but rather a center for the systematic elaboration of knowledge.

Ethnology enlists a great number of disciplines, such as linguistics, technology, mythology, sociology, or aesthetics, and the specialists in these domains each pursue their investigations more or less independently. In the field, the specialist in technology [*le technologue*] may disregard the statistics of the sociologist, while the linguist need not be concerned with decorative arts. But all have a connection, a crossroads where all their disciplines meet: it is the object that has a name, materializes a technique, preserves the imprint of a myth, plays a social role, and has aesthetic meaning. Formerly, all these fieldworkers carefully collected such objects and handed them over to the museographer. In turn, the museographer would present them to the public with a label that served as a kind of identity card for each: *a certain so-and-so, born in X . . . with no further distinguishing marks.* Dr. Rivet and Marcel Mauss thought that more could and should be obtained from the object and that it should be made into a reliable and complete witness of itself [*un témoin sûr et complet de lui-même*].

The evidence [*témoin*] ceases then to be some exotic oddity to be stared at by Sunday visitors. In the field, all the particularities of its

birth and its kinship relations have already been recorded; indeed, the evidence leaves its country of origin taking with it its milieu [*il quitte son pays d'origine en emportant son milieu*].

But, one might ask, does this not render the [material] evidence itself superfluous? Might not a complete dossier be sufficient for the researcher to work with? This objection, already barely valid regarding the value of the evidence to the sociologist, becomes quite wrong when we leave the framework of modern history. There, beyond scientific records, beyond texts, all we have is material evidence. The whole of archaeology is based on it. In the case of numerous techniques, as well as rites and myths, only the solidity of contemporary milestones can actually secure our hypotheses.

Such a result can hardly be secured when in the field. There, the role of the ethnologist is not limited to searching for a specific number of pieces with a precise aim in mind. It is to record, by simple and nearly infallible means, everything in these items that may one day be useful to other researchers. Given the current state of the world [*Dans l'état actuel du monde*], ethnological activity ought really to concentrate on the systematic collection [of material evidence], given that year after year ever more evidence disappears. When we observe that some priceless treasures have actually been secured despite the incoherent notation procedures of the previous century, we can measure how the next generation will acknowledge our achievements.

The *Institut d'ethnologie*, as just mentioned, has devised some uniform and nearly infallible means for characterizing the evidence: the foremost, if not the only one, is the *fiche* [index card]. When completed, such a *fiche* includes ten headings, of which only the first five need concern us here in any detail. Indeed the latter five all pertain to the background history of the object, including the date of its collection, the researchers involved, relevant publications, and the life of the object since its entry into the museum.

The first heading of the index card concerns the exact localization of the object's provenance, in French, phonetic script, and the indigenous script.

The second heading identifies the name of the object, in the same manner as the first.

The third heading is a complete technical description: the materials used, forms, mode of fabrication, decorations, dimensions, weight.

The fourth heading considers the usage of the object, its religious or mythical content, the ensemble of which the object may be only one element.

The fifth heading concerns the owner, their race, and their civil status.

A completed index card may thus include nomenclature for some twenty indigenous names; the text of a myth; mention of the materials used; and the parts, tools, and decorative motifs in the indigenous language. It is accompanied by a drawing of the object or its parts and by photographs.

Taken by itself, this testimony is already priceless. What makes the current method of such invaluable interest is its capacity to bring together, through the work of one or several researchers, complete technical ensembles. Let us take an example from Indochina. When the museographer has been able to assemble, in store rooms, folders, or index cards, the various types of a given pottery ensemble, including its wheels and firing ovens, all the chisels, scrapers, burnishers, brushes, glazes, clay samples, drawings of decorations, and graphic material, then it can be said that the history of current Indochinese pottery within a circumscribed area has been secured. In a few years, with twenty more comparable ensembles, followed by a hundred, it will be possible to undertake a history of Chinese pottery, then of Asian pottery, and then of pottery worldwide.

Upon this, the museographer's duties toward the public are greatly facilitated: visitors are no longer left to wander in front of never-ending theories on pots and spears. The Sudanese forge or the Tibetan procession climb down from the shelf, as it were, into the showcases, photographs bring their realism, and index cards are reproduced in a descriptive text that reaches beyond a mere label.

We can now appreciate the importance of the museographical task. Collectors rarely undertake the description of the objects on-site; their role there is limited to recording what the indigenes know and what they themselves have been able to observe. The museographer, on the other hand, should not add anything to the indigenous comment but rather give a clear-cut technical description of the object. This presupposes that research is thoroughly organized and prepared. When a Finn from the Urals makes a pipe for his bagpipe, he uses the humerus not just of any bird but specifically that of an eagle. If the indigene has omitted to point this out, and if the collector has remained unaware of it, it is then for the laboratory to establish this point—a point that happens to be, for religious reasons, of considerable importance.

To be usable, the index card must be compiled in terms that leave no ambiguity: the handle of a spoon is not the same as the shaft of a spade or the bail of a bucket; terms like "edge," "border," "facing,"

"piping," and "fringe" must be employed correctly or else they risk inducing irremediable confusion in a few years' time and in the absence of the object. This brings us to a touchy point within the system: that of specialization. Today's museographer needs to be to various extents a zoologist, a botanist, and a mineralogist. He differs radically from the ethnographer in the sense that it is preferable for him to specialize in some technical ensemble, such as clothing, basketry, or aesthetics, rather than in a cultural area like Asia or the Semitic world. This is because, for the museographer, observation is above all a matter of terminology.

The French school of ethnology is still too young to have reached its full potential. Its material resources are still too limited to enable it to reach the scope required by the urgency of its mission. It is still at the stage of accumulating documents, and its publications do not yet faithfully reflect its perspectives. Until now, only the actions of ethnographers in the field and the public exhibition of their museographic labor are perceptible. This public expression is moreover suspended temporarily due to the ongoing transformation of the *Musée d'ethnographie*, but it is of great promise. Housed in a new and well-suited set of buildings, the school of Dr. Rivet will be able to continue its ongoing work with enhanced resources and renewed fervor. It will be able to ensure the coordination and the synthesis of those disciplines that can no longer ignore each other, if they are to work in coherence.

2.

Man and Nature (Elementary Forms of Human Activity), 1936

"L'Homme et la nature." In *Encyclopédie française permanente*. Tome 7, *L'Espèce humaine: Peoples et races*. Part I, "L'Humanité d'aujourd'hui," edited by Paul Rivet. Section A, "Les Formes élémentaires de l'activité humaine," 7.10.3–16, 7.12.1–4. Paris: Comité de l'Encyclopédie française édition, 1936.

Republished in Sophie A. de Beaune. "La Genèse de la technologie comparée chez André Leroi-Gourhan: Introduction à son article 'L'Homme et la nature' paru dans *L'Encyclopédie française* en 1936." *Documents pour l'histoire des techniques* 20 (2011): 197–223. http://journals.openedition.org/dht/1826.

ALTHOUGH THE TEXTS produced by Leroi-Gourhan for the *Revue de synthèse* (see text 1) and the *Encyclopédie française permanente* differed substantially in their contents, they were both published as part of the same intellectual endeavor orchestrated by Lucien Febvre and Henri Berr. In introducing the collective research dossier in the 1936 volume of the *Revue de synthèse*, Febvre had noted that the encyclopedia in the making—"an encyclopedia of problems, not of references," "a spirit, not a directory"—was designed to embody collective research, to be updatable, to bring together scholarship, and to have the actual "producers" of science, and not mere popularizers, reach out toward the enlightened public.[1]

Volume 7 of the encyclopedia, titled *The Human Species: Peoples and Races*, is composed of three parts: "Humanity Today" (edited by Paul Rivet), "Peoples or Races" (edited by physical anthropologist Henri Neuville), and "The Point of View of Number" (edited by sociologist Maurice Halbwachs and demographer Alfred Sauvy).[2] By 1936, just before the election of the *Front populaire* and the creation by Paul

1. Febvre 1936a, 12. See also Varagnac 1935.

Rivet and others of the *Comité de vigilance des intellectuels anti-fascistes*, it was recognized that the production and dissemination of solidly established knowledge also had political urgency. Solidarity between the sciences, so believed Febvre and his colleagues, would mirror and reinforce the solidarity between groups that, despite their divisions, all joined together to form the human species. Febvre drove the point home in concluding his foreword to the encyclopedia, dated April 1936:

> To purify the race. To accelerate or to slow down the rates of birth, the rhythm of the species. But where do they find this Race, where do they find this Species, these leaders of encyclopedic ignorance—these guides so poorly guided [. . .]? In truth, the only outcome of their interventions is to create myths and psychoses, to spread with both hands the seeds of conflict.[3]

Of course, not all encyclopedia entries were of militant intent—a militancy that was spurred by the rise of fascism across Europe (in Italy, Portugal, and of course Germany), rather than any concerns with colonial domination and exploitation. In any case, the entries and the contributors to "Humanity Today" were overall representative of the sociological and anthropological sciences of the 1930s. This is reflected in the table of contents, reproduced (in translation) at the end of the text.

Leroi-Gourhan was particularly present in the encyclopedia, with three chapters to his name and two in collaboration, in addition to the copyediting assistance he provided. By far the youngest of the authors (alongside Jacques Soustelle, born 1912), he was also, unlike the fully employed Soustelle, the least secure in financial and institutional terms. Indeed, part of Leroi-Gourhan's involvement in the project was certainly "alimentary," insofar as he was then—and for several years to come—in frequent need of such editorial jobs to supplement his income. Having had to read through, digest, and rewrite a range of information on the peoples of Europe, central Asia, the polar regions, and the Far East, Leroi-Gourhan accumulated quite a stock of facts and impressions (some more lasting and pertinent than others).

2. With its unusual combination of in-depth population statistics, demography, migration studies, and raciology, this third part was republished in facsimile in 2005, accompanied by a wide-ranging and detailed introduction by Marie Jaisson and Eric Brian (Jaisson and Brian 2005).
3. Febvre 1936b, 7.04–12.

Taking to heart the "elementary" brief, Leroi-Gourhan outlined in his chapter an innovative classification of techniques, which he subsequently took up and expanded in the two volumes of *L'Homme et la matière* (1943; see text 3) and *Milieu et techniques* (1945; see text 4). Following some introductory paragraphs, Leroi-Gourhan presented his principle of classification, involving a basic sequential division between "the preparation of materials" (comprising "general techniques") and "the utilization of materials" (which included "special techniques" and "pure techniques"). His focus here was almost exclusively on the first aspect, "the preparation of materials." Following this chapter came studies on social structure by Alfred Métraux and on religious phenomena by Jacques Soustelle.

The original headings and subheadings in the text that follows have been standardized, and quite a few details on specific materials and techniques have been omitted. Omissions are flagged by ellipses in square brackets, with notes that indicate their general subject matter. This trimming is designed to keep the text at a manageable length, bearing in mind that the full facsimile edition is readily available online.[4]

4. Beaune 2011.

Man and Nature (Elementary Forms of Human Activity), 1936

Technology is the study of the means by which humans act on their environment. More specifically, it is the study of the procedures that allow them to make use of the materials provided by the physical environment. This mobilization of the environment includes a series of stages. It begins with the unit, which is the *tool*, represented in its simplest expression by a stone or a stick, and it ends with complexes whose most elaborate expressions can be those of a fair, a parliament, or a religious procession.

A certain number of classifications have already been established to sequence [*ordonner*] the progression of techniques. Almost all lead to a tripartite division into "general," "special," and "pure" techniques. This division, based on the classification that follows from the teachings of Marcel Mauss, will be maintained here. Nevertheless, considerations of a purely mechanical order—considerations that have not so far found their place in the textbooks—lead me to propose a new division of the "general" techniques. The "special" and "pure" techniques will only be presented here in the form of tables that organize their relationships, since they are discussed in the section "The Peoples on Earth" [in this volume of the *Encyclopédie française*].

I. General Techniques

The classification adopted here for the general techniques is logical in mechanical terms—it is neither chronological nor rigorously morphological. The form of an instrument in all ages and under all climates is conditioned by the material to be worked and the result to be obtained. All mechanical action on matter is the result of some *percussion*. The character of this percussion is related to the properties of the material to be treated and the action to be realized. It follows that, given two samples of a single material and two essentially identical results to be obtained, the character of the percussion used will be identical, be it at opposite ends of the globe. Hence, the knife of the Ainu carver in Japan operates under the very same conditions as the plane of the European carpenter. This leads us to consider successively the material [*la matière*] and then the action—it is from these two orders of considerations that the instrument spontaneously emerges.

Ranked according to their properties [*constitution*], materials can be classed into high-density stable solids; medium- or low-density stable

solids; fibrous stable solids; semiplastic solids; plastic solids; flexible solids; and fluids. Actions for their part are generated by percussion, and they are classified into perpendicular, oblique, circular, and diffuse percussions. Instruments are either hafted or not.

I.1. *Means of Action*

I.1.1. Percussion

When the *percussion surface* of an instrument enters into contact with the material at the *point of impact* [*point d'attaque*], a *segmentation* occurs that leads to the separation of an *element of segmentation*, of variable volume. The surface thus brought to light is called the *segmentation surface*. These general terms imply a particular translation in each of group of materials: the segmented element can thus be called flake, sawdust, or scraping, or again chip, piece, bit, fragment, particle, grain, or drop.

Percussion is *direct* when the instrument is directly handled: an axe, a stone tightly gripped in one's hands, or a handheld knife used with one hand are all instruments of this kind. Percussion is *indirect* when the instrument does not have a handle, that is to say, when its hafting, where it exists, has no mechanical role. The instrument then receives its thrust [*impulsion*] from an independent force: a chisel used with a hammer, or a knife held in one hand and pushed with the other, is an example of indirect percussion. Direct percussion lends itself to broad motions, like that of a pickaxe, whereas indirect percussion rather applies to precision work of smaller reach, such as that of the sculptor's chisel.

I.1.2. Direction of Percussion

Perpendicular percussion, when the instrument tends to penetrate deeply into the mass [of the material], is thus destined for rough hewing and especially for flaking [*débitage*]. Such is the work of the wood-splitting axe or the quarryman's pickaxe. The cutting edge of the instrument is usually double edged [*double chanfrein*] (figure 2.i, no. 1). *Oblique percussion* leads to a progressive penetration of the mass, making precision shaping possible. The cutting edge is usually single edged, and the angle of impact (variable, but usually around forty-five degrees) must be calculated at the flat side of the blade, which corresponds to the *axis of percussion* (figure 2.i, no.2). *Abrasion* is a specific type of oblique percussion. Basic abrasion is obtained with a polishing instrument. When the mass to be treated is rubbed against a level surface on which has been affixed a certain quantity of very hard dust, this

mass is polished through the superposition of innumerable striations traced by the abrasive dust. This is the technique of diamond cutting. The abrasive particles gain hold within microscopic depressions in the polishing instrument, and this constitutes a real form of hafting (figure 2.i, no.3). This is even more effective in the case of the file, which is but the reproduction, in metal, of the polishing stone.

Circular percussion always aims to pierce a hole by rotating a cutting edge. The form of this cutting edge varies according to the solid to be pierced. The result can be the formation of a cone or a cylinder, whose deepening may lead to perforation, but the principle and the means of rotation remain identical.

[. . .][5]

I.1.3. Fire

Fire is the most commonly used technique for modifying the constitution of matter. Its direct action can provoke *flaking*, *softening*, *fusion*; its indirect action can lead to *boiling* when the interposed body is a liquid and to *desiccation* or *softening* when air is an intermediary. Fire and its modes of production should be studied before everything else, as it intervenes frequently as an auxiliary of preparation, in metalwork, for example, or as means for fixing shape in pottery. Discoveries of fossil human remains in situ attest to the use of fire since at least the Middle Palaeolithic. Given the absence of ancient evidence [*documents fossiles*] and the range of ways by which fire is produced nowadays, we cannot identify as yet the techniques used by Neanderthals to light their hearths. We may, however, surmise that the procedures of abrasion and sawing, employed by the most primitive peoples today, can give us some clues.

The sequence commonly established by ethnologists sees fire by friction replaced by fire by percussion. Such a distinction cannot be followed here, given our rule whereby all action on matter (barring the auxiliary techniques of fire and water) is due to percussion. We therefore maintain here the order of percussions [for the production of fire]: perpendicular, oblique, and circular. The increase in temperature that leads to ignition comes from the combined compression of the percussor and the percussed materials. This increase is all the more significant the stronger the compression is and, in practice, the shorter it is in time (since slow pressure would leave the elements time to lose

5. [The means of circular percussion: the hand drill, shuttlecock drill, pump-action drill, string drill, bow drill, and wheel.]

their caloric gains). The techniques of fire are therefore characterized by the rapidity of their movements.

Perpendicular percussion—Perpendicular percussion is the choice treatment for working stone, as we will see later. The impact of the percussor provokes a flaking that leads to the detachment of a segment. Increase in temperature is not simply due to the friction of the percussor on the worked material, but rather to the accessory compressions provoked by the flaking. It is the [detached] segment that sees the greatest thermal increase, since the mass itself absorbs the pressure too quickly to be heated. It is essential for the compression to be sudden: this is why the solids used are always stones of great density and so constituted that their flaking provokes an intense molecular compression. Flint responds best to these conditions, and it is therefore the "firestone" par excellence.

[. . .][6]

Oblique percussion—Fire by oblique percussion never includes the segmentation of large elements; rather, ignition is always provoked by the compression of tiny particles.

[. . .][7]

Circular percussion—The rotation of a wooden axis on a plank leads to the formation of a perforation cone, and at its bottom are gathered the particles detached from its edges. The compression of these particles causes them to heat up, and their contact with vegetal tinder leads to their ignition. To facilitate contact between the dust particles and the tinder, a slit is frequently carved into the side of the cone, leading the particles to the inflammable tinder. All the common procedures of circular percussions have been used for fire production (figure 2.i, nos. 13–17).

I.2. *Stable Solids*

What characterizes stable solids is that during their treatment they preserve a homogeneity that prevents their plastic modification. They can undergo changes of form only through the violent actions of an instrument that detaches segments from the mass to be treated. In some cases, such as slate or wood, their natural capacity for segmentation might be used, but this will not suffice to obtain results along all three dimensions. The characteristic form of segmentation of stable

6. [The stone lighter, the piston lighter.]
7. [Abrasion, sawing.]

solids is by *flaking*, and all the instruments used tend toward this goal. The form of the detached flake is constant; except in fibrous materials, the flake always presents an *impact surface* resulting from prior flakings and a convex surface with a *bulb of percussion*. In the following table, the stable solids have been distinguished using three categories:

Table 2.i

High-density stable solids	Hard stone (flint, granite, obsidian, glass, etc.) Quartz, jade
Medium- or low-density stable solids	Soft stone (sandstone, limestone, soapstone, slate), bone, antlers, shell, ivory, etc.
Fibrous stable solids	Wood

I.2.1. High-Density Stable Solids

The techniques that best highlight the treatment of stone are those used to work rocks such as flint, obsidian, or quartz. Stonework is by far the oldest technique attested. No need to embark here on a discussion regarding the first tools devised by humans to assist them in their efforts. Wood and stone are undoubtedly the most likely, and it is certain that both have served humans or their predecessors. Before they thought of shaping flint into a specifically determined weapon—before, then, the percussor became the first instrument—early humans must have used wood and stone in their raw state [*état brut*]. Observations of anthropomorphous monkeys by several authors, myself included, make evident their use of sticks or twigs, in order to draw toward them or beat closer objects that are out of their reach. It has not, however, been possible to find evidence of more precise utilization on their part. While chimpanzees are able to thrust the fruit they want to split open onto a hard body, they do not know how to make use of this hard body in a constant and reasoned way.[8] The stones that served in humans' earliest attempts must preserve the traces of such percussions; it is unfortunately difficult to determine on a piece of flint (that is not a distinctive tool type) the traces related to human use and those due to accidental impacts. More comprehensive information on this point will be found in Marcellin Boule's study on the problem of eoliths, *Les hommes fossiles*.[9]

The first attested tools, whether used as weapons or as shaping instruments, already reveal a developed mental organization. Their fabrication presupposes the existence of a working area [*atelier*] comprising at least an anvil [*support*] and a percussor (figure 2.i, no. 12).

8. [Leroi-Gourhan is most probably alluding here to the research on monkeys by Paul Guillaume and Ignace Meyerson in 1930 (see chapter 2 above).]
9. Boule 1921, 111.

Perpendicular percussion—High-density stable solids are not usually extracted in masses of considerable volume. Most commonly, use is made of blocs of reduced dimensions, from which are extracted blades or masses of decreasing volume. To this end, use is made of percussors properly speaking: the mallet and the hammer. [. . .] When the treatment of the material calls for subtlety, the inconvenient aspects of hafted tools become apparent. The percussion surface shifts to the end of the arm or of the handle, or of the two together, following a trajectory of variable impact. The precision of the blows is therefore very relative. To remedy this inconvenience, percussion surface and pressure have been separated to obtain the chisel and the driving percussor. [. . .]

Oblique percussion—Oblique percussion is not normally applied in the treatment of high-density stable solids. Hard stones are rarely liable to be polished by the direct percussion of the polishing stone; only abrasion is commonly used. A layer of dust of the material to be polished is interposed between the support and the block to be treated. The abrasive particles act then as an infinity of microscopic planes. This is how flint axes in Neolithic Europe were polished on sandstone anvils and how jade in New Caledonia and the Far East was polished on anvils of volcanic origin.

Circular percussion—The different types of circular rotations encountered above are all applicable to stable solids; we will see their particularities when we turn to medium- or low-density stable solids. The only characteristic specific to hard stones is the interposition of abrasive dust between the tip of the drill and the perforation cone, as in the above case of the polishing stone. New Caledonian axes are perforated by means of a drill with a flywheel whose wooden tip serves as a support for abrasive particles. The Chinese make use of a lathe with interchangeable headstocks.

I.2.2. Medium- or Low-Density Stable Solids

Stable solids of medium or low density still show wide-ranging capacities for flaking, while the ease with which the dimension of the flakes can be controlled makes possible new types of percussions. Hard stones are characterized by the massive flaking obtained through perpendicular percussion. Soft stones, as well as shell, bone, and ivory, are mainly treated by oblique percussion, and the detached flakes are often reduced to segment dust. [. . .][10]

I.2.3. Fibrous Stable Solids

Wood is the only fibrous stable solid. Horn, which in some ways has a similar texture, will be discussed further below, in view of its relative plasticity. Wood is composed of overall parallel fibers. When it is split, the fracture plane normally follows the direction of the fibrous layers, from the center to the periphery. Thus if the instrument begins its action toward the bottom of the fibers, it will tend to cause a split that immediately runs up to the surface: this is percussion "with the grain" (figure 2.i, no. 5). If, on the contrary, the instrument attacks at the top of the fibers, it is drawn into the depth, and the splitting can cause irreparable damage ("against the grain"; figure 2.i, no. 6). Whatever the direction of percussion, when it is intended to lift off significant thick layers of fibers, the area of the splitting is generally limited by a series of perpendicular percussions placed ahead of the point of impact that cut the fibers and stop the segmentation (figure 2.i, no. 7).

[. . .][11]

Oblique percussion—Woodworking as such is done by oblique percussion. Besides the already discussed use of the adze and the chisel, treatment by oblique percussion consists mainly of *sawing* and *scraping*. Sawing is most closely related to abrasion by polishing. Instead of being practiced on a large surface by a multitude of microscopic percussors, it is limited to the line of serration of a single cutting edge. Each tooth of the saw tears off a reduced part of the material. Scraping consists of inverting the proposition. Instead of being practiced, like sawing, by a line of asperities taken along the length of the tool, it is a line taken in the width that moves across the surface to be treated. The serration of the cutting edge thus acts at ninety degrees from the first position and leaves a series of parallel striations, which in sawing are grouped along the groove.

The progression by successive tears is perceptible with the first motions of the saw cut. The edges of the groove are irregular because the torn-off particles are of different lengths. As the groove deepens, these tears are limited for mechanical reasons (which would be superfluous to go into here). Scraping, too, brings about tears, which are clearly evident when the scraping striae are examined under the microscope. Each tear moreover provokes a jolt of the blade that is translated along a certain length by a series of cuts perpendicular to the tool's

10. [Perpendicular percussion (pick, wedge); oblique percussion (adze, beveled chisel, gouge).]
11. [Perpendicular percussion (double-beveled chisel; wedge, axe).]

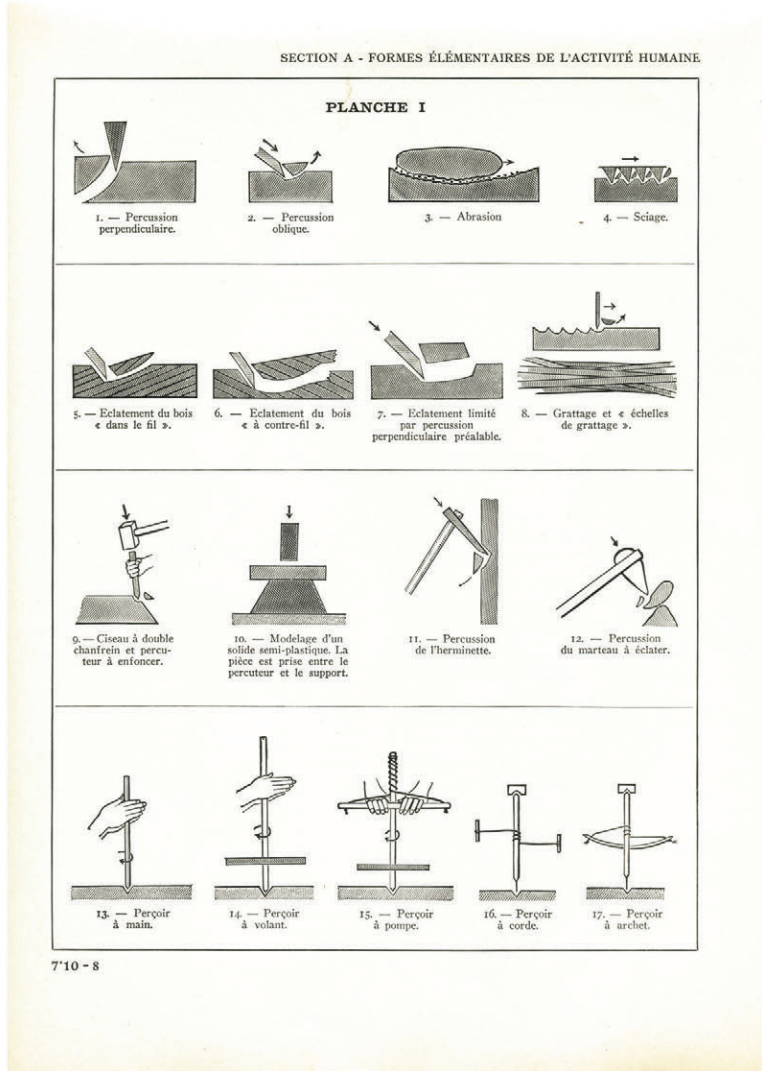


Fig. 2.i Plate I. Percussions. 1. Perpendicular percussion. 2. Oblique percussion. 3. Abrasion. 4. Sawing. 5. Chipping wood "with the grain." 6. Chipping wood "against the grain." 7. Chipping controlled by prior perpendicular percussion. 8. Scraping and "scraping scales." 9. Chisel with double bevel and driving precursor. 10. Modeling of a semiplastic solid. The piece is held between the precursor and the support. 11. Percussion with adze. 12. Percussion with flaking hammer. 13. Hand borer. 14. Rotating borer. 15. Pump-action borer. 16. Rope-action borer. 17. Bow-action borer.

axis of progression. These cuts, which are of great help in studying the use-wear patina for the dating of objects, are called *scraping scales* (figure 2.i, no. 8).

I.3. *Semiplastic Solids*

This class concerns the solids that do not yield to flaking with a tool (as do the stable solids), but rather stretch to the breaking point. In addition, they do not possess the essential characteristics of the plastic solids, which is the possibility of their permanent shaping during their treatment at a pressure higher than one hundred grams per square millimeter. Except for animal horns, the only semiplastic solids are metals.

I.3.1. Extraction

As a matter of principle, we may admit that most of the common metals, notably iron and copper, exist in native form only in small quantities and in rare locations on the globe. Copper in America and meteoric iron in Indonesia are in this respect exceptions. Gold is normally native, which explains its use among people where metallurgy is little developed. In all other cases, the metal needs to be extracted from the ore. [. . .]

I.3.2. Specific Properties of Metals

Elasticity is the property by which a metal, temporarily deformed, is able to regain its original shape once the pressure has ceased. When it is brought to the limits of elasticity, the deformation becomes permanent by virtue of the metal's plasticity. If the pressure continues, the metal reaches the limits of its plasticity and breaks. All the treatment of metals rests on the interplay of these three properties: *elasticity*, *plasticity*, and *breakage*. The harder the metal, the wider the margin of elasticity. Tempered steel reaches the limits of the elasticity margin very late and snaps after a very brief transition period of plasticity. The softer the metal, the wider the margin of plasticity. A lead wire has a very narrow elasticity margin, but its plasticity is such that it will only reach the point of breakage after considerable deformation. [. . .]

[. . .][12]

12. [Treatment (perpendicular, oblique, and circular percussions).]

I.4. *Plastic Solids*

The essential characteristic of plastic solids is to undergo permanent shaping during their treatment at a pressure lower than one hundred grams per square millimeter. Additionally, in these conditions, the application of an isolated lump onto the main mass will lead to the incorporation of this lump. This phenomenon of *agglutination* radically distinguishes the plastic solids from the other types of solids. In primitive technique, the loss of material for a stable solid, a semiplastic, or a supple one is irreversible, at least in practice. Plastic solids, on the other hand, when being worked, can see the reincorporation of elements of segmentation [within the mass of material].

The percussion of plastic solids always leads to a segmentation by the *insinuation* of the working tool within the mass of material, without a loss of substance. Their low degree of homogeneity means they can be broached at any angle. Lastly, the most characteristic percussion is the diffuse one, pertaining to modeling.

I.4.1. Plastic Solids of Low Density

The first plastic solid of low density [*de faible cohésion*] is the soil, whose principal treatment is its preparation for agricultural ends.

[. . .][13]

I.4.2. Clays

More than any other material, clays embody the properties of plastic solids: they spring to mind when thinking of plastic bodies, though in fact the treatment of loose soils occupies an infinitely more important place in human activities. Clay is not always fired after its shaping, in which case it behaves like a low-density soil. The resistance of some plasters is barely superior to that of heaped earth.

I.4.3. Shaping

The ideal instrument for working clay by diffuse percussion is the hand. The shaping [*façonnage*] of a piece of clay naturally includes its assessment on all sides. The extreme plasticity of the material, however, requires a support that would prevent squashing caused by direct contact. That is why the shaping of a vase always takes place by turning it on a base. We will soon appreciate the importance of this technical requirement.

13. [Perpendicular, oblique, and diffuse percussions.]

[. . .]

I.4.4. Firing

The consequence of firing is to shift the clay from the state of plastic solid to that of stable solid of medium density. Firing brings about a change of coloration; the whole mass first becomes blackened through the carbonization of organic elements (vegetal or animal) incorporated into the clay; then coloration changes from black to red, pink, and then white.

[. . .]

I.5. *Supple Solids*

The supple solids do not have the same unity of composition as the solids we have studied thus far. Their degree of suppleness, drawing from the complexity of their components, is quite variable. Indeed these supple solids, be they leather, bark, or fiber, are made of components whose [physical] contacts are loose enough to allow for the interposition of foreign matter. They are normally *imbibed*, and their suppleness varies according to the degree of viscosity of the fluids, or the plasticity of the solids, that compose them. Leather is supple insofar as it contains fluid grease in its fibers. Were leather to be impregnated with salt, crystallization would lead to its rigidity, such that only a treatment that pulverizes the salt crystals is likely to give it back some of its suppleness. The same goes for most other supple solids. Apart from softening, which requires diffuse percussion, the treatment of supple solids takes place by segmentation through *sawing* or *scraping*. Furthermore, most techniques applied to supple solids draw on the possibility of shaping them by twining or knotting.

[. . .][14]

I.6. *Fluids*

Fluids have the property, at normal temperature, and to a greater or lesser extent, of spreading toward the horizontal. A heap of fine sand, a bag of grains, should, *from a mechanical point of view*, be considered as fluids. It is indeed indispensable, in order to secure their transport, to keep them within a container. [. . .] We will consider only liquids properly speaking, and specifically water [. . .]. Containers can serve for the

14. [Leather; bark and fibers (spinning, basketry, and weaving).]

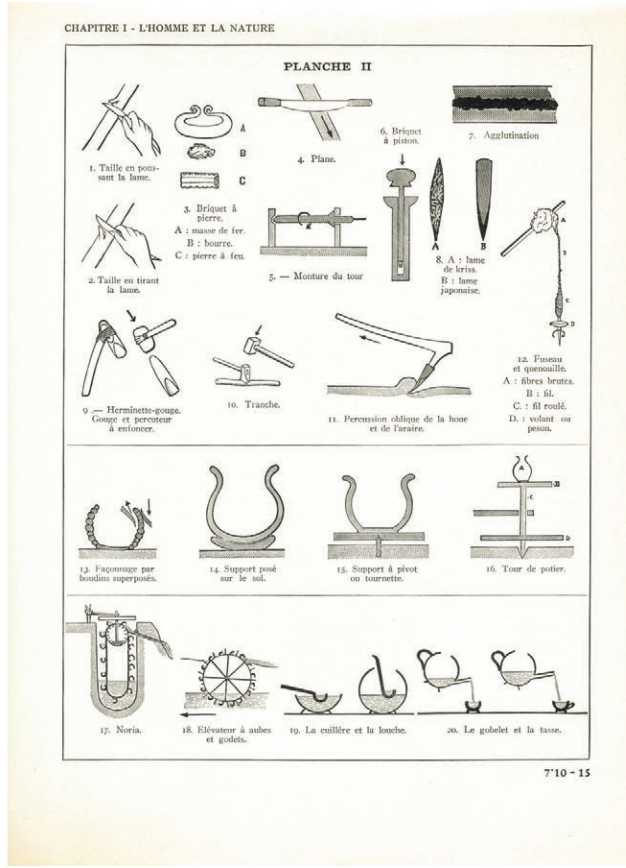


Fig. 2.ii Plate II. Solids and fluids. 1. Cutting by pushing the blade. 2. Cutting by pulling the blade. 3. Stone lighter. A: iron. B: stuffing. C: firestone. 4. Plane. 5. Rotary setting. 6. Piston lighter. 7. Agglutination. 8. A: Blade of a kriss. B: Japanese blade. 9. Gouging adze. Gouge and driving percussor. 10. Slicer. 11. Oblique percussion of hoe and plow. 12. Spindle and distaff. A: raw fibers. B: rolled thread. C: spindle whorl. 13. Shaping by superposed clay coils. 14. Support held on soil. 15. Support with pivot or rotation. 16. Potter's wheel. 17. Noria. 18. Paddle wheel. 19. Spoon and ladle. 20. Goblet and cup.

conduction of liquids—they are then permeable at their extremities—or for their conservation, when they are impermeable in all directions, expecting their neck, which can be temporarily sealed.

[. . .][15]

I.7. *Weapons*

This classification of weapons follows the principle used for the other techniques, of specifying the percussions used. However, only oblique and perpendicular percussions will be taken into account, as cases of circular percussions are extremely rare: at the most we could mention the New Caledonian lance, given a gyratory motion through a special spear thrower, and of course the bullet of modern firearms with a rifled

15. [Collection and conduction; conservation; treatment; consumption.]

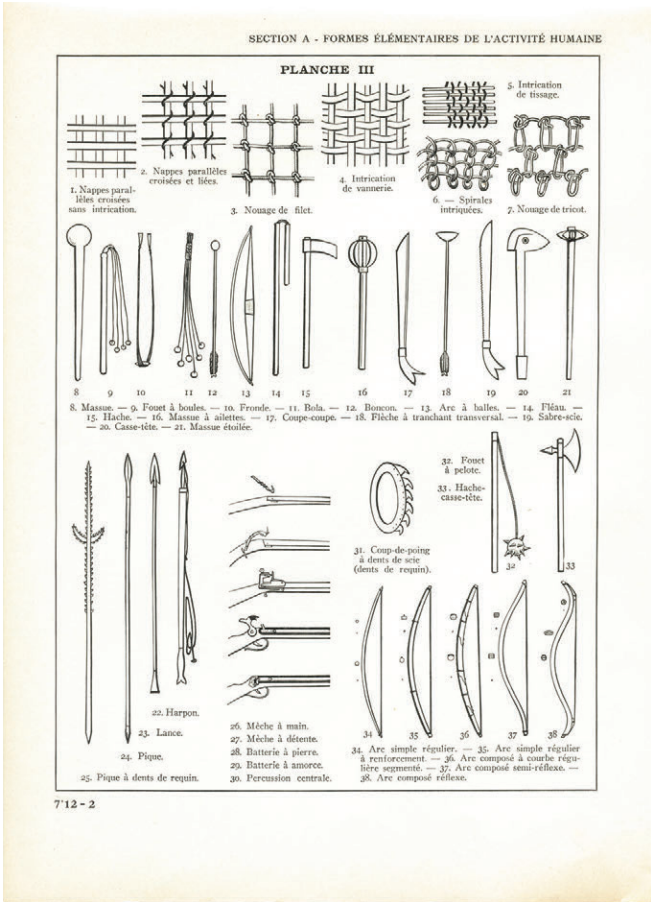


Fig. 2.iii Plate III. Nets, knots, and weapons. 1. Parallel crossed layers, unlinked. 2. Parallel crossed layers, linked. 3. Fishing net knots. 4. Basketry intermeshing. 5. Weaving intermeshing. 6. Intertwined spirals. 7. Knitting knots. 8. Bludgeon. 9. Leaded whip. 10. Sling. 11. Bola. 12. Boncon. 13. Bow. 14. Flail.15. Axe. 16. Finned mace-head. 17. Machete. 18. Transverse arrowhead. 19. Serrated saber. 20. Club. 21. Mace. 22. Harpoon. 23. Lance. 24. Pike. 25. Shark-toothed pike. 26. Hand wick. 27. Matchlock. 28. Flintlock. 29. Percussion lock. 30. Centerfire ammunition. 31. Knuckle duster with serrated teeth (shark teeth). 32. Flail. 33. Battle axe. 34. Simple bow. 35. Reinforced simple bow. 36. Segmented composite bow. 37. Semi-recurve composite bow. 38. Recurve composite bow.

barrel. On the other hand, certain types of weapons do not enter into our table. These are *explosive engines* (bombs, grenades, mines), *fixed organs of protection* (ditches, palisades, defensive walls, pitfalls, chevaux-de-frise, brambles), and *mobile organs of protection* (shields, armor, movable fortifications).

I.8. *The Uses of Materials*

General techniques provide humans with mechanical means by which to act on the natural milieu: beating a mass of red-hot iron into a blade, carving a wooden plank into a handle, slicing and stitching a piece of leather into a sheath, plaiting threads of linen into a belt—all these are the expression of general techniques that lead to the creation of a butcher's knife, which is an instrument for a specialized technique.

Different combinations of such general mechanical actions would lead to the saber, to the shepherd's hut, or to the windmill.

The equipment used for the categories "special techniques" and "pure techniques" should thus follow the chain of the "general techniques," whose products—the butcher's knife, the grain mortar, the bread oven, the cooking pot, the hearth, the lighter—express a special technique: that of cooking [*la cuisine*].

When these general techniques are used not only with the aim of shaping nature [*accommoder la nature*] but also to exploit the resources of the human spirit or the human body, we are dealing with "pure techniques." Sports, tattoos, and pantomimes are some examples.

Such categorical distinctions within human activity are mostly theoretical [*idéale*]. In practice we see the constant superposition of general techniques, special techniques, and pure techniques: [a group engaged in] singing while forging a plowshare opens up for ethnology the perspective of a complexus that covers a large technical domain. Likewise the general technical functions of instruments for alimentation are linked to most special techniques, such as hunting, fishing, or transports, and they touch on pure techniques through techniques of the body, through science, or through music.

The following tables provide an extremely succinct summary of the development of most special techniques and pure techniques. They represent, together with the analyses provided in the preceding pages, the stock from which elements will be drawn and assembled, in section B of this encyclopedia, to address the material lives of diverse human groups.

Table 2.ii

Special Techniques		
Food		
Cutting Cleaning	Knife	
Drying	Frame, heat of the sun or fire, open air	Permeable container: granary, basket, box, bag
Smoking	Frame, fire	
Salting	Salt, open-air drying	
Maceration	Antiseptic, water	Waterproof container
Crushing	Hammer, mortar, millstone	Partly permeable container: granary, basket, box, bag
Direct cooking	Fire	Support: *plancha*, grill, skewer
Indirect cooking	Fire, intermediary body: liquid, vapor, air	Container: dish, *marmite*, pot
Ingestion [of food] *Open container*		
Solids	Hands, knife, fork	
Liquids	Hands, ladle	
Gaseous intoxicants	Tobacco, opium, hemp Pipe, cigar	
Hunting		
Weapons (see 7.12-I)		
Traps	Receptacle	Simple pit Pit with spikes Net, panel
	Automatic receptacle	Box with door or see saw Snare
	Automatic weight	Bludgeon Automatic bow Trap with jaws
Fishing		
Weapons (see 7.12-I)		
Traps	Fixed container	Dam Pouch Fish-trap
	Mobile container	Dragged net
	Automatic container or trap	
Boat (see below)		
Husbandry		
Semiliberty	Pastoral husbandry (breeder linked to the herd)	Nomadism Semisedentarism Sedentarism
	Domestic husbandry (herd linked to breeder)	Enclosure, stables, ranging
Captivity		Cage Pool
Agriculture		
Gathering		Basket with or without handles, shoulder bag, sack
	Aboveground	Hand, cutting instrument
	Underground	Digging stick, hoe
Gardening		Watering, hoe, rake
Large-scale crops		Channeled irrigation Plow, harrow
Clothing		
Specific or coordinated protection of each part of the body		

Habitation		
Cave or rock shelter		Partly underground habitation Terraced villages (cliff dwellings [Southeastern US], aoul [Caucasus]) House with basement
Tent		Single or double canopy Quadrangular or circular hut Building on the ground
Elevated space		Elevated house Pile dwelling
Collective habitation	Religious in character	Temple
	Social	Men's house, palace
	Defensive	Fortress
Transport		
On land	Barefoot	
	Shod	Sandals, moccasins, heavy boots, boots, snowshoes, skates, skis
	Human portage	
	Animal portage	Pack-saddle, saddle
	Dragging	Travois, sledge
	Haulage	Roller, carriage
On water		Floater, dingy. Raft. Boat with oar, with pole, towed. Sail canoe. Decked boat.

Table 2.iii

Pure Techniques	
Techniques of the body	Childbirth, techniques of physical training; hygiene, reproduction; death, techniques [treatment] of the cadaver
Techniques of the abnormal	Pharmacology, manual treatment; surgical treatment, orthopedics, protheses
Games	Oral Manual and corporeal: simple, double, collective Aims of games: children's games, adult games, mixed games
Music	Isolated or coordinated with techniques of oral or corporeal figuration
Science	Knowledge of mechanical phenomena and their means of measurement Knowledge of the natural milieu Systemization of the supernatural milieu
Decoration of the individual	Naked body: painting, scarification, deformations, hairdressing Tattoos, jewelry: isolated or coordinated decoration of various body parts
Techniques of representation [*figuration*]	Oral representation: literature Manual and corporeal representation: pantomime, dance Additive representation: painting, modeling Subtractive representation: engraving, sculpture

Contents of *Encyclopédie française permanente*, vol. 7, *L'Espèce humaine*

3.

Man and Matter, 1943 (Revised 1971; Selection)

L'Homme et la matière. Vol. 1 of *Évolution et techniques*. Sciences d'aujourd'hui. Paris: Albin Michel, 1943. 2e éd., revue et corrigée, 1971.

Selected texts: a. "Introduction," 9–22; b. "Structure technique des sociétés humaines," chap. 1, 23–42; c. "Premiers éléments d'évolution technique," chap. 5, 313–26.

IN MANY RESPECTS, the two volumes of *Évolution et techniques*—*L'Homme et la matière* (vol. 1, 1943) and *Milieu et techniques* (vol. 2, 1945)—grew from and expanded the foundational article of 1936 (see text 2), which Leroi-Gourhan always considered as the basis of his subsequent contributions to technology. In 1940, soon after his return from Japan and with his innumerable *fiches* at hand, he began planning his manuscript. By April 1941 he was able to obtain a draft contract with the publisher Albin Michel for a book provisionally titled *Histoire des techniques primitives*. By that time, Leroi-Gourhan already had several publications to his name. In addition to the two articles presented here (see texts 1, 2), he had also published two books: a geographical, zoological, and ethological study of the Reindeer Civilization (*La civilisation du renne*, 1936) and a collection of art historical studies on animal figurations on Chinese bronzes (*Bestiarie du bronze chinois*, 1936). The two volumes of *Évolution et techniques*, however, represented his first magnum opus. They secured his scholarly reputation as a technologist and ethnologist for decades to come, and they inspired both fieldwork programs and exhibition displays at the *Musée de l'Homme* and the *Musée des arts et traditions populaires* (founded and directed by Georges-Henri Rivière).

These volumes are still regularly printed and prominently displayed in bookstores today, alongside copies of his other masterpiece, *Le Geste et la parole*.

As far as their inclusion in this anthology is concerned, these two volumes present a double challenge, pertaining to questions of selection and variations between editions. To translate these two weighty volumes in their entirety into English (as they have been into Spanish and Italian, for example) would have clearly represented a different project from the one undertaken here, and very possibly one several decades too late. As Leroi-Gourhan correctly noted, and as emerges from the tables of contents (reproduced at the end of this text), it is relatively straightforward to distinguish two levels in these volumes: a classificatory systematics for "material witnesses," rich in detailed *fiche*-based descriptions and illustrations of technical objects and practices, and (of greater interest to us here) a conceptual or theoretical part, leading to ethnological interpretations and evolutionary generalizations. The following have therefore been chosen for translation here: the introduction to *L'Homme et la matière* (text 3a), its chapters 1 (text 3b) and 5 (text 3c), and, in *Milieu et techniques*, a selection from its concluding chapter 9 (text 4).

The edition history of *Évolution et techniques* constitutes a further challenge. The first volume, *L'Homme et la matière*, appeared in 1943 and the second, *Milieu et techniques*, in 1945; as they became unavailable in bookstores, these volumes were reprinted in 1949 and 1950, respectively. While the 1950 reprint of the 1945 volume was strictly identical, the 1949 reprint of the 1943 *L'Homme et la matière* showed some minor changes, including the addition of some references (for example to his own 1946 thesis) and the omission of others (such as to J. Przyluski). By the late 1960s, building on the success of *Le Geste et la parole*, Leroi-Gourhan and his publisher Albin Michel decided to produce new editions of these two volumes, with new pagination and layouts, in 1971 and 1973, respectively. As far as *L'Homme et la matière* is concerned (and unlike the more straightforward *Milieu et techniques*; see below), two levels of changes occurred in the second 1971 edition—one explicit and the other unacknowledged.

At the explicit level, Leroi-Gourhan clearly stated in his brief "prologue to the present edition" that he intended to introduce some improvements on two topics across the book: prehistoric archaeology, which had secured a wealth of new data since the 1940s, and the classification of the "elementary means of action on matter," which required some fine-tuning. In addition, Leroi-Gourhan included two sets of new

paragraphs, explicitly labeled as such in the 1971 edition. The first is a two-page-long footnote added at the very end of chapter 1 (text 3b), where he admitted his dissatisfaction with his initial ranking of peoples on technical criteria and proposed an alternative framework based on degrees of artisanship. The second is in chapter 5 (text 3c), where, in the opening pages and elsewhere, Leroi-Gourhan updated his conclusions on the scientific analysis of techniques, the relations between technology and museography, and the articulation of techniques with society (with reference to the 1964–65 *Le Geste et la parole*). These additions of 1971 represent the most recent texts by Leroi-Gourhan to be reproduced in the present anthology. The emphasis they place on the centrality of the artisan, the reference to Lévi-Straussian-sounding systems of exchange, and the use of such notions as "technicity," "liberation," and "operatory behavior" all situate these additions clearly in the later phase of Leroi-Gourhan's technological theorizations.

At an implicit level, however, Leroi-Gourhan also introduced a further range of substantial changes to the 1971 edition—changes that he left unacknowledged and that require page-by-page comparisons to prize out. This 1971 edition gave Leroi-Gourhan an opportunity (however late in the day) to update, reformulate, and jettison altogether several of his original theoretical statements or propositions. These modifications include issues of terminology, the disciplinary scope of technology, and, above all, the notion of *Homo faber*—all matters on which his views had shifted quite considerably by the beginning of the 1950s (see chapter 2). In this respect, tracing the changes between the 1943 and 1971 editions can clearly help us further grasp important continuities and transformations in Leroi-Gourhan's technological thoughts and achievements.

For reasons of convenience and ease of access, the readily available 1971 edition of *L'Homme et la matière* is used as the baseline text in the translations that follow. The explicit additions made by Leroi-Gourhan for this edition (namely, at the end of chapter 1 and in chapter 5) are indicated with a different font. Those sections or paragraphs of the 1943 edition that were omitted or modified in 1971 are reproduced here in footnotes, with reference to the original 1943 pagination.

a. Introduction

Ethnology is composed of several disciplines whose cooperation leads, in principle at least, to an understanding of the links that unite individuals within particular ethnic groups. It is above all the science of human diversity, and its field of investigation is limited neither in space nor in time. If ethnology has found its preferred terrain in the nonindustrialized populations of today's world, this is because an established scientific tradition has led it to seek diversity outside our own [industrialized] cultures. This is the inverse of sociology, which, for practical reasons, has been primarily preoccupied with the modern world. But also the humanity of the industrial present provides us material for an analysis of its diversification into ethnic macrounits, just as humans of the prehistoric past make a valuable contribution to our knowledge of genuinely primitive forms of ethnic organization. Within the ethnological disciplines, technology constitutes a singularly important branch, being the only one to display a total continuity in time: this allows us to grasp the first specifically human acts and to follow them across millennia, all the way to the threshold of present times. When we travel back into the past, the different branches of ethnological information fade away more or less quickly: oral traditions pass away with the last generation to transmit them; written traditions dwindle rapidly, and the seventeenth century is already silent regarding the overwhelming majority of peoples. Only the products of techniques and art allow us to reach far back in time, provided that circumstances have assured their survival. Art, for its part, disappears rather quickly, and from around fifty thousand years ago at the earliest, we can draw only on techniques to retrace the human current all the way to its origins, one or two million years before the present.

The testimony of techniques is thus valuable because on it depends the very possibility of not confusing what we imagine to be the first steps of humanity with what we objectively know them to be. Philosophy has drawn a distinction between two successive humanities, that of *Homo sapiens*, which is our humanity, and that of *Homo faber*, a theoretical creature whose only human characteristic would be the possession of tools.[1] *Homo faber*, a convenient term yet devoid of palaeontological foundations, encompasses in fact the long line of anthropoids from which *Homo sapiens* issued.[2] The oldest among them, the Australanthropes, are more than a million years old; they already possessed our vertical posture and fashioned very primitive tools. Starting from this point—which, all things considered, cannot be

too far from the point of origin—the progress of the brain in terms of its volume and organization has as a corollary a double series, of skulls, on the one hand, and of ever more varied and perfected tools, on the other. From these beginnings to about fifty thousand years before our era, the thread unwinds without interruption. Yet this thread is thin, limited to the inventory of a few types of knapped stone tools. While it can prove [the occurrence of] progress, it conveys only a very small part of the cultural traits that the humans preceding us developed. From fifty thousand to thirty thousand years ago, the evidence diversifies, and from thirty thousand onward, with the first stages of *Homo sapiens*, we enter into current humanity, which forms a unified entity all the way to the present. While it is still quite incomplete, our knowledge of prehistory in both the Old and New Worlds represents a considerable technological field [*champ technologique considerable*]. The elements of this field are at the basis of the evolution of techniques and objects, whose careers have continued all the way to the present hour. The prehistory of *Homo sapiens* is now known more or less throughout the entire world: it shows that cultures were already very differentiated on the technical level and also that ethnic diversity was known in Europe or the different parts of Asia, Africa, America, or Australia—a diversity that appears all the more clearly the further our knowledge extends. The fact that regional cultures could develop implies long centuries of dwelling in the same regions; the range of equipment testifies to a slow maturation, which stands in contradiction to long-held ideas on the perpetual nomadism of primitive populations. To be sure, groups of mammoth or seal hunters were nomads, but within their own territory, and long-distance migrations have certainly played a less important role than one might be tempted to imagine. On the other hand, objects,

1. [First edition, subsequently omitted: "Evolution shows that the human that we know (*Homo sapiens*) was preceded by a coarser being (*Homo faber*) who did not possess the superior forms of techniques, art, and religion, and that this being appears tied, at the boundary between the Tertiary and the Quaternary, to superior forms of anthropoids. What does history know on these points? It has no knowledge of all the superior anthropoids of the Tertiary, it is ignorant of where and when the most crude *Homo faber* made its appearance, where and when the most crude *Homo sapiens* succeeded it, when and how the primitive race or races divided to give birth to today's main lines, and what has become of each of these lines since their origins. [. . .] Later on, the documents increase in number, but the example of one of the last and best-known *Homo faber*, Neanderthal man, is not very brilliant" (1943, 9). See further discussions in the Introduction, above.]
2. Leroi-Gourhan 1964, vol. 1 [1971, 10; note added].

or the idea of their existence, did circulate from group to group, sometimes all the way across continents.

Were it possible to fast-forward on a screen the movements of human beings and their technical creations, we might be tempted to think that they would show peoples on the march, races moving with their equipment, chasing and devouring one another. Yet there would probably be nothing in it: we would be looking instead at something as transient as the light playing on an oil slick on a body of water. The current of time would of course move human beings the way water carries an oil slick and distorts it, but what would strike us most would be an ungraspable shimmer moving on practically immobile molecules. Consider western Europe over these last ten centuries: the wars waged there by the great powers have sometimes displaced great masses of men, temporarily, but their [physical] anthropological distribution has not varied. Physically, tenth-century France is more or less the same as twentieth-century France, and Europe, seen through the skeletons of its millions of occupants, has hardly budged at all. Yet what gusts have shaken it in all directions! Are we to take tile-covered roofs, the Napoleonic Code, the English saddle, the pointed arch, the mechanical kneader, or the bicycle as indicators of migrations? Half of Japan's material life, and the most visible half at that, is Chinese-inspired: writing, official and scholarly language, Buddhism, the textile industry, and many other traits. Yet the Chinese never conquered Japan, and not the slightest trace of their skeletal remains will be found on the archipelago's great islands.

There are two kinds of movements that, given their lack of synchrony, blur the image of ethnology. The first are human displacements that, barring some exception, are extremely slow and little known. The second are cultural movements whose swiftness and apparent whim cannot be overstated. To these two movements we must add a third, of no less importance, the movement of evolution specific to each people, whose intensity and direction vary considerably, making some groups turn in a spiral while others progress in a straight line, to be then suddenly thrust forward. The movement of humans is associated with the problem of *races*; the general movement of products, with the problem of *civilizations*; and the internal movement, with the problem of *cultures*.

We might be tempted to seek in these three [elements] the unity of human development and occasionally to confuse race, civilization, and culture. I will not add here to the countless personal definitions of the three terms, of which I will make no further use in the coming pages except for some innocuous overviews. At a given point, these

three movements result in a more or less enduring ethnic unit; depending on its size, I apply to this unit the rather loose designation of human group, ethnicity [*éthnie*], or group of ethnicities, these being simple divisions of convenience susceptible to considerable overlap. There is no urgency to posit definitions that would crystallize a mass so little analyzed as that of human beings.

In this book, then, I shall abandon the movements of peoples as such and rather focus on the double movement, external and internal, of the most material techniques, with which we fabricate, produce, and consume those elements indispensable to our physical life. These techniques have preoccupied ethnologists since the origins of ethnology. They have been the object of classifications that, in the French tradition, were primarily perfected by Marcel Mauss and the *Institut d'Ethnologie*; they form a very important part of the admirable research instrument that is our *Musée de l'Homme*.[3]

The classificatory frameworks of techniques were not established by technologists but by ethnologists, who were more concerned with the distribution of the material products of the [ethnic] groups they were studying than with the analysis of their modes of fabrication. In other words, they saw forges rather than metalworking, baskets rather than basketry, items of clothing rather than textile work. A framework established on such principles is adequate for meeting the needs of cultural analysis, yet it leaves aside specifically technological issues. That is why, benefiting from a rather lively taste for manual activities, despite my theoretical training, I have handled axes, knapped flints, shot bows, and blown into blowpipes without methodological preconceptions. These ongoing experiments were undertaken in two ways: in the field, watching, imitating, and listening to the practitioners [*opérateurs*], and in the laboratory, following often very precise travelers' descriptions. The quantity of documents thus collected remains rather small, around forty thousand index cards [*fiches*] for the totality of the techniques to be examined throughout this book. Despite this

3. [First edition, subsequently omitted: "These techniques have preoccupied ethnologists since the origins of ethnology; they have been the subject of excellent classifications, which, in French usage, were primarily perfected by Marcel Mauss and the *Institut d'ethnologie*. These classifications form a very important part of this admirable study tool that is our *Musée de l'Homme*, they have been formalized for the benefit of travelers (*Instructions sommaires pour les collecteurs d'objets ethnograhiques*—Musée d'Ethnographie, Paris, 1931), and they have recently resulted in the creation within the museum of a department of comparative technology" (1943, 12).]

relative modesty, the record file acquires its value by being the first somewhat sustained effort in this direction. The untangling of a great number of technical ensembles, index card by index card, has enabled the documents to form their own associations [*se grouper d'eux-mêmes*] with only a minimum of personal interpretation. From this has ensued, since 1935 [*sic*],[4] a technomorphology [*techno-morphologie*] based on raw materials. The guidelines of that first attempt have been improved and fleshed out in the first volume of this book [*L'Homme et la matière*].

No one at present can claim to have even a superficial knowledge of humankind as a whole [*totalité humaine*]. No researcher can describe the activity of human beings at all times and in all countries, and yet broad classifications were proposed well before the science was completely worked out. Animals and plants were classified between the seventeenth and the nineteenth centuries (when the majority of species still remained to be discovered) within frameworks whose broad outlines turned out to be definitive. The same goes for the science of humankind [*science de l'homme*]. This is due, in zoology as in ethnology, to the permanent character of tendencies [*tendances*]. Everything seems to happen as if an ideal prototype of a fish or a knapped flint had developed along preconceivable lines from fish to amphibian and reptile, then from mammal or bird, and from undifferentiated flint to finely worked blades, to copper knives and steel sabers. Let there be no mistake: these lines simply render an aspect of life, that of the inevitable and limited choice that the milieu proposes to living matter. Because living beings must choose between water and air, between swimming, crawling, or running, they have a limited number of broad evolutionary lines to follow. In ethnology, it is because humans have no hold over wood other than by cutting it at a certain angle and with a certain amount of pressure that the forms of tools and their handles can be classified. Technical determinism is as pronounced as that of zoology: just as [Georges] Cuvier, having discovered a possum skull in a block of gypsum, could invite his incredulous colleagues to join him in clearing up the rest of the skeleton while predicting the marsupial bones that would be brought to light, so can ethnology, up to a point, infer from the form of a blade the shape of the handle and the use made of the whole tool.

Let us not forget, however, that Cuvier was often at a loss because there is a difference in nature between the determining tendency and

4. ["*Encyclopédie française permanente*, vol. 7" (1943, 13). For the *Encyclopédie française*, see text 2.]

the material facts: *general tendencies can give rise to techniques that are identical but without relations of material kinship* [*parenté matérielle*]*, whereas facts, whatever their geographic proximity, are individual, unique.* The custom of inserting wooden or bone ornaments into the lower lip has been found among Alaskan Eskimo, Brazilian Indians, and Black Africans. There is indeed a technical identity here, but so far no effort has seriously succeeded in demonstrating the kinship of these human groups. The Malay plow, that of Japan, and that of Tibet represent three similar shapes that were certainly related during the ancient history of these three peoples, yet each, by virtue of the soil cultivated, the details of their assemblage, the ways they are hitched up, their associated symbolic or social meanings, represent something unique, something categorically individualized. It seems as if there were a "plow" tendency [*tendance 'charrue'*], realized at each point in time and space by a unique fact, and at the same time, also some documented historical relationships, sometimes spanning considerable spatial and temporal scales. The slightest misstep and the specialist risks jumping from one register to the other and leaving reality behind.

No need here to insist on the interest of the historical aspects of our research. An important part of the human sciences rests on what it has been possible to trace of the great movements of peoples. This will be mentioned time and again in this book. However, to understand the trials and errors of ethnology, we must not forget that we are very far from knowing what still survives on the globe today and moreover that we know next to nothing even about peoples who lived less than a century ago. For the peoples currently closest to us, even for those of Europe, the enormous amount of materials collected still remains but a derisory portion of all the observable facts. Any attempted historical synthesis can only be limited to placing some milestones with the known facts and filling the voids with what the tendencies suggest. For the contemporary world, the degree of verisimilitude attained is no doubt closer to reality, but in following back the course of the centuries, hypotheses take up ever more importance. There are some privileged subjects: recent innovations such as tobacco, whose history can be quite clearly written, or firearms. These known topics urge caution: when we see tobacco arriving to Europe from America, then reaching all through Asia and Africa, its consumption at times blending with that of marijuana and opium, and then returning to the American continent both from the east (Sino-Japanese influence) via the peoples of Siberia, and from the west through our European importations, the jumble of borrowings, local innovations, and influences may well set

us wondering about any possible precision in the restitution of more ancient techniques. All this raises the problem of the origin of techniques, which is taken up in the conclusion of this book.

The problem of origin is implicitly conveyed by the term "primitive," which is still too often applied to peoples who do not live as advanced [*perfectionnée*] a life as ours, on the material level. One good dictionary defines a "primitive people" as "one that has appeared at the origin and preserves a certain character of this origin." This immediately conjures up the Australian Aborigines, the Eskimo, the Ainu, the Siberians, or the Polynesians.[5] Yet these peoples are no more primitive than we are. Now that archaeology has begun to identify a past to these cultures without writing, we see that in the course of the centuries and millennia they have undergone, so far as the nontechnical domain is concerned, an evolution that is as complex as our own. Also on the technical level, marked changes have taken place, such that societies, even isolated ones, constantly adjust their technical capital [*capital technique*] to their needs and to the evolution of the natural environment. If the term "*primitive*" can at all be employed, it is only in a strictly economic sense, to designate groups that live exclusively on wild natural resources. Hunters, like fisher-gatherers, do indeed practice the same modes of exploitation as the distant ancestors of current humanity, ancestors who were the only authentic primitives. As for the term *peoples*, archaeology is only rarely able to apply it to societies without writing. The notion of "people" rests, for a given longer or shorter period, on the relative coincidence of geographical, political, linguistic, and institutional criteria, none of which leaves traces in the ground. History can thus be based only on material evidence, the majority of which pertains to techniques. This history, moreover, concerns only a small part of cultural expression [*manifestations culturelles*], a part spared and preserved by the random agents of physicochemical destruction. The frequent evocation of the Ainu of Hokkaido in this book will enable

5. [First edition, subsequently omitted: "The reader is asked to abandon this illusion: after a century of research, *nowhere, in no case*, has it been possible to grasp something of the historical origins of any people. The problem has been taken back to the boundaries of geology, without success. The oldest human group we know well enough to speak of in ethnological terms is that of the Reindeer Age. At the time that we grasp it, it is at least equal to the Eskimo and certainly superior to the Australian in its material and intellectual culture. Beyond the twenty or forty thousand years of human activities to which the Reindeer Age attests (a minute period of time in the duration of our species) we have nothing: [only] flaked flints" (1943, 16).]

us to grasp the material importance of their culture: a century ago, as abundantly attested by Japanese travelers, they possessed large wooden dwellings, clothing as voluminous and complicated as ours, important wooden tool kits and crockery, and boats with several rowers. Today, almost nothing remains of their material evidence from the eighteenth century: some stone axes and some knapped blades, found in small hollows in the ground that barely mark the site of their former houses. When we realize that for at least thirty thousand years, a large part of the globe was populated by humans who led a material life as complex as that of the Ainu, and yet who have left us only a few tons of knapped stone and some rare skeletons behind, [we understand that] the task of historical technology [*technologie historique*] is a delicate one, hazardous and full of pitfalls.[6]

It is with the deliberate aim of provoking the reader's misgivings that I insist here on the fragility of the evidence: there are clear reasons why one will not read in these pages the history of techniques in a broad sense. Whenever possible, I will trace sections of the road. When a well-established case of origin or of innovation appears, it will be greeted with an enthusiasm befitting its rarity. All the rest will be arranged not historically but logically.

Indeed, while the document too often escapes history, it cannot escape classification. Within the masses of products of human activity, [classificatory] distinctions can readily be made: thus, numerous affinities can be found between clothing and hunting, such as the waterproof clothing used in seal hunting or the hunting of animals for their furs, but no confusion between them will last long. Over the past fifty years, attempts have been made in Europe and America to divide human activities according to rubrics: housing, clothing, agriculture, and so on. The number of these rubrics is relatively stable, around twenty for strictly material life. These logical distinctions are natural, and there is universal agreement on their value, but the order of their succession is wholly arbitrary: each country and each school of thought has its own order; each set of studies gives rise to its own ways of bringing out their specific characters. Since my goal is to describe techniques through their most material aspect, I have adopted here an order that is quite different from those usually suggested.

First come the most elementary means that all human beings have at their disposal: *grasping*; various *percussions* for breaking, cutting,

6. ["Historical technology" replaces "Ethnography" (1943, 17, subsequently modified).]

shaping; *fire* that can heat, cook, melt, dry, deform; *water* that can dilute, dissolve, soften, and wash and, in different solutions, thanks to its physical or chemical effects, can serve to tan, preserve, cook; finally, *air* that kindles a combustion, that dries or cleans.

Having possession of these elementary means, we can animate them through force: the forces of human muscles, animals, water, and air. These forces are not randomly spent; their *movement* is directed, amplified by levers or transmissions, harnessed by an *equilibrium*. As a synthesis of forces, *transportation* provides the means for accessing raw materials and distributing finished products.

The principle I posit here is that it is matter [*la matière*] that conditions every technique, and not the means [*moyens*] or the forces [*forces*] used. This leads me frankly to leave aside the body of evidence that has already been acquired and adopt instead a division of fabrication techniques that begins with [the most] *solid matter* and progressively reaches *liquids*. The solids whose state does not vary are called *stable solids*: stone, bone, or wood. Those solids that can acquire a certain malleability, for example, by heating, are said to be *semiplastic solids*; such is the case of metals. Those that are malleable when handled and become hardened when dried or baked are *plastic solids*: pottery, varnishes, or glues. Finally, those that are flexible at all moments but not malleable are called *supple solids*: skins, threads, fabrics, or wickerwork. Fluids are not subdivided; they conform to the type that is water and encompass all matter that in its normal state of handling or consumption is liquid or gaseous.

The elementary means, force, and matter have general uses, and their application leads to the instruments for the techniques of *acquisition* and *consumption*. From their combination comes the arrow, the shoe, or even housing. To a large extent, these elementary means, force, and matter are not differentiated in their usage. Equipped with these general possibilities of fabrication, we will address here the [produced] objects themselves, as known through research.

Everything that touches on the social, religious, or aesthetic aspects of life lies beyond the framework of the present work. Our study will be limited to the *acquisition* of the products necessary to material life: animal products (hunting, fishing, stockbreeding), vegetal products (gathering, agriculture), mineral products, and their *consumption* through food, clothing, housing.

Technicians [readers] will be struck by the elementary character of the nomenclature used here. Having undertaken a reasoned inventory of techniques, apart from those belonging to modern industrial evolution [*l'évolution industrielle moderne*], observers find themselves in

the situation where technology itself [as the science of techniques] stood in Europe at the end of the eighteenth century. The vocabulary of [Henri Lamirault's] *Grand encyclopédie* or that of the *Dictionnaire des métiers* can thus satisfy most needs. That is why I compelled myself to use only a minimum of neologisms and highly specialized terms. Another concern was not to overload the text with bizarre names, and I have therefore avoided indigenous terms except when they have no corresponding word in French; readers will easily find them by consulting widely available monographs.

Ethnology has limits that are imprecise and arbitrary: it is vaguely conceived of as the study of all the peoples who have not been absorbed by industrial civilization. To study Chinese pharmacopeia or surgery would then constitute *medical ethnology*; studying the same branches for medieval Europe would constitute *medical history*; studying them among us, in the twentieth century, would simply be *medicine*. Even without going so far as to say that the terms would be inversed for a Chinese physician, for whom we would pertain to pure ethnology, we can see how fluctuating the line of separation is. While studying certain techniques in the Far East, metal casting, for example, I frequently happened to start from the current industrial conditions (foundry); then move to current artisanal conditions (ethnology); to reach, through the texts, forms that disappeared several centuries ago (history); and to end with prehistoric excavations (archaeology). The distinction between history (of a nonpolitical kind), archaeology, and ethnography seems to be one that does not always even have the merit of convenience.[7]

Another common division is that between *ethnology* and *ethnography*. Ethnologists would be those who study peoples in the broad sense, while ethnographers are interested only in their description. In practice, there are so many overlaps that every ethnologist is also largely an ethnographer, and vice versa. The terms have frequently been confused in different countries, and in France itself, even the best authors have called ethnography what is now commonly understood as ethnology. Personally, I am tempted to be satisfied with the single term *ethnology*. But use of the term *ethnography* is very much alive, and for many people it refers to established evidence. I will therefore only

7. [First edition, subsequently omitted: "The distinction between industrial techniques and primitive techniques corresponds neither to geographical discontinuities nor to ethnic divisions. This is why we consider as ethnology everything that, in view of comparison, can contribute to the study of humankind without stopping at the frontiers of time or of technical evolution" (1943, 20).]

point out that the archaeological, historical, or ethnographic content of this book is taken to lead us, without demarcations, to a broad study of the forms of human material activity—such a study could not in my view be qualified as anything other than an ethnological one.

The facts to be examined [in this book] are taken from a large number of peoples and from very different ages. In each technical division, some human group excels: medieval Europe and the East stand out by their ingenious use of mechanical forces and organs of transmission; metallurgy is well illustrated by Asia Minor, Black Africa, and Indonesia; the pottery of China and Japan offers particularly telling aspects. Each technique is tied to a geographical center and to an epoch, which makes it possible to highlight simultaneously the wealth of procedures employed and the gradual distribution of the products. However, no claim to any kind of universality [in coverage] is made here, and I have largely drawn on the peoples I am familiar with, those of the Pacific Rim: Indonesians, Chinese, Japanese, Ainu and Siberians, Eskimo, and Indians of the northwestern coast of America. They offer quite a rich range, spreading across sufficiently varied states of civilization to guarantee noteworthy factual contributions at almost every rubric.

A large number of the objects mentioned [in this book] are to be found in Paris, in the storage rooms or the showcases of the *Musée de l'Homme*, so that their visual examination will easily remedy the shortcomings of their illustrations. A work such as this implies a great effort of compilation, since I have direct practical experience only of Europe and the temperate and arctic Far East. One may thus rightly expect a copious bibliography, yet I have had to limit it for several reasons. The authors who have dealt with techniques from a technological point of view are rather few in number, and they will be cited. The vast majority of the others, however, have simply named, described, or brought objects to a museum: to provide for each and every traveler a mere reference would make little sense in this generalist book. In addition, French sources are rare, while for most readers the titles of works in German, English, Chinese, Danish, Spanish, Dutch, Japanese, or Russian would only be of interest as typographic curiosities.

I would like here to express my gratitude to those who have prompted, guided, or encouraged my work, to Marcel Mauss, to Jean Przyluski, whose kind advice has often supported me, to the *Centre national de la recherche scientifique*, which guaranteed the material independence of my work, to the artisans, hunters, fishermen of the Pacific and of France to whom I owe the opportunity of undertaking on some solid bases my studies in the practical domain.

b. Technical Structure of Human Societies (chapter 1)

Knowledge of the physical human being is closely linked to the natural sciences.[8] From the palaeontologist's perspective, human beings are mammals that have emerged from the slow evolution of a series of other mammals, linking them across more than a million years, not to monkeys (who were already differentiated as such), but to a series of primates, already bipedal yet with a still-primitive brain.[9] As mammals, human beings do not pose any more [research] problems than do horses or rhinoceroses. We must, however, keep in mind that the fossils we place end to end to reconstruct their genealogical lineage do not necessarily stand in a relationship of direct ancestry, but rather constitute a logical arrangement of ever more ancient forms. This procedure does not result in some historical overview, but in a restitution whose very high likelihood practically amounts to an actual genealogy—a genealogy that is itself inaccessible, due to the scarcity of the available documents. As for the thinking human [*l'homme intellectuel*], documents other than those of technical activities are almost completely lacking except for the most recent forms, so close to us physically that the problem remains intact. The assumption that primitive anthropoids displayed some social cohesion is not ultimately supported by any unassailable fact. It is a purely logical argument based on the observation that very many animals, especially among the primates, present a high degree of social cohesion. Everything that can be said about other institutions is of the same [hypothetical] order.

What remains of technical activities are the sole witnesses, alongside skeletal vestiges, of the specifically human aspect of evolution. Does this evidence point in the same direction as the osteological remains, and does it abide by the same constraints? In other words, is it possible to imagine a parallel and synchronous development of [physical] human beings and of their products? Is it possible to speak of a continuous evolution of techniques, to reconstruct their chronological framework, to study properly their history by tracing paths of diffusion, by identifying centers of innovation, maybe even by providing a name to human groups, anonymous yet well defined? Even if we do not expect more from objects than from skeletons, such expectations are already largely met: thanks to knapped stone implements that are practically

8. [This and the following paragraphs, until table 3.i, were considerably rewritten in the 1971 edition, compared with the original (1943, 23–25).]
9. Leroi-Gourhan 1964, vol. 1 [1971, 23; note added].

our only evidence, we know, for all the cultures that have preceded *Homo sapiens*, that their tools have broadly followed a progressive line of evolution comparable to that undergone by the human [physical] forms, from the distant Australanthropes to the Pithecanthropians and the Neanderthals.[10] Each form of tools appears, from one period to the next, as if it had as its ancestor the form that preceded it. Just as we do not find a very perfected type of equid occurring prior to the ancestral forms of horses, so we do not observe any incoherence in the succession of human works: the tools link up [*s'enchaînent*] along the scale of time in an order that appears overall as both logical and chronological. We must nonetheless acknowledge that historical precision is far from fully achieved, that details still elude us, and that we would be fully justified, given that stone tools are infinitely more numerous than skulls, to expect a more detailed appraisal of the facts. Albeit to a lesser degree, prehistoric or historical technology [*la technologie préhistorique ou historique*] is in the same situation as palaeontology.[11] If we assume for any given technical trait a series of variations arranged in chronological order, three modes of exploitation can be imagined:

Table 3.i

	FORMS			
From the oldest series to the most recent series	A	B	C	D
	A'	B'	C'	D'
	A''	B''	C''	D''
	A'''	B'''	C'''	D'''

10. [First edition, subsequently omitted: "The intuitive sense of an evolution comparable on the two planes—animal life and human societies—can lead to seeking, as demarcations between races, some traits that are as marked as those that separate two [animal] orders. [According to this logic, there] would be, between the Bantu and Swedes as races, peoples, and civilizations, gaps comparable to those between the tiger and the bat. This is absolutely not the case. Whereas the possibilities of crossings between animals are extremely limited, and whereas the felines will follow their evolution alongside bears for millennia without ever interbreeding, all the human races can intermix [*métissables*], all peoples can fuse together [*fusibles*], all civilizations are unstable" (1943, 24).]
11. [First edition, subsequently omitted: "It is from the confusion between these two movements (chronological and logical) that are born the most seductive theories on the global evolution of human societies. Given, for example, chronological series of variations (whether they be mollusks, human races, funerary rites, or any technical trait), three modes of exploitation can be imagined" (1943, 25).]

The first mode is irreproachable: ABCD is the origin of A'B'C'D', and so on. It assumes complete knowledge of the forms between two limits in time and on a precise point: only very rarely does technology have occasion to apply [this assumption] to problems that are general enough to shed useful light on human history.

The second mode consists in positing A as the origin of A', A'', A''', and so on. Although apparently identical to the first, it contains a significant source of errors: the gap in evolution between A and A' is often inferior to the distance of variation between A' and B', which gives rise, for example, to the third and effectively mistaken mode, with a supposed prototype as origin of A', B'', C''', and so on.

These three methods have clearly been exploited by palaeontologists, who can take the risk of tracing out genealogical trees. For ethnology, the few general theories that exist have proceeded with less precision, owing to the great confusion of the documents. Most often, we are reduced to considering [for example] some Siberian fact (A''') as the vestige of an ancestral form common to several Asiatic peoples (A' B' C' . . .). Likewise, Breton, Russian, and Iranian facts (A''' B''' C''' . . .) are conceived as survivals of an ancient Indo-European state (A). The reconstruction is given a doubly hypothetical character when causes of error specific to the abovementioned variations are accompanied by the arbitrary attribution of the fact to a more or less precise chronological level.

All this is no hindrance to the philosopher, when he accounts for changes in forms from the level ABCD to the level A''' B''' C''' D'''. The historian, however, would be paralyzed—he who must account for the position of each element in time and in space.

It is therefore important that we make no mistake regarding the absolute value of the historical knowledge we have of human techniques. Our capital [of knowledge] is made up of an immense mass of very diverse documents, most of them very recent, a mass that [does not however] represent but the hundredth part of what we would need to trace our history over these last one hundred centuries. Even for the second half of the nineteenth century and the twentieth century, there is much that is still missing. From the fifteenth to the nineteenth century, the scant information is gathered in travelers' narratives not designed for scientific purposes. Beyond that, all we have is archaeology, made up of biblical verses, the tirades of Greek or Latin authors, Chinese allusions, or excavations that most often yield skeletons without grave goods, graves without skeletons, some bricks, bronze items, or flints. It is with these thankless materials that

ethnologists reconstitute history. Whether they follow a very general philosophical agenda, or rather remain within a bundle that includes race, material industry [*industrie matérielle*], and intellectual or social expressions, ethnologists will not stray from reality—nor would they go very far, given the increasing difficulties in establishing connections with any certainty. If they work on a very specific theme (agriculture, for example), they will on the contrary find it surprisingly easy to gradually reach ever-larger zones and to spill over from one continent to another. The golden perspective of an overarching theory, with its migrations and wide-reaching infiltrations, will be within reach with hardly any effort.

That explains why we know little about the history of people, while on the contrary our science is rich in overviews of techniques and institutions. This wealth in overviews increases as one moves away from material techniques [*techniques matérielles*] and reaches its summit in religious theories or in folklore.

Tendency and Fact

This double aspect leads us to see in human activities two distinct orders of phenomena:[12] phenomena of *tendencies*, which pertain to the very nature of evolution, and *facts*, which are indissolubly linked to the milieu within which they occur.

The *tendency* has an inevitable, foreseeable, rectilinear character. It is what drives the handheld flint [tool] to acquire a handle, or the bundle dragged on two poles to equip itself with wheels. Because decoration is a tendency, humans paint themselves with colored soil and follow the natural lines of their body. No surprise therefore in finding at the extremities of the globe the same designs along the legs or around the breasts. Humans inevitably attach ornaments wherever they can be affixed and will thread thorns or sticks of bone through their earlobes, lips, and nostrils, where they are clearly visible and where this can be done without too much pain, bloodshed, or anatomical encumbrance. Likewise, the presence of stones elicits walls, and the construction of walls gives rise to levers or hoists. The wheel brings with it the appearance of cranks, driving belts, and gears. In the field of tendencies, all extensions are possible: when a neighboring group supplies an improvement that *follows the logical order* of the state at which a people finds itself, they will adopt it effortlessly. Ethnologists, in the

12. ["Two orders of absolutely distinct essences" (1943, 27).]

absence of historical background, will have no better grasp over a local invention than over a borrowing, be it recent or age-old.

In contradistinction to tendencies, *facts* are unforeseeable and particular.[13] They may amount to encounters between a tendency and the thousand coincidences of the milieu (that is to say, an invention), or they may quite simply be borrowings [*emprunts*] from another people. Facts are unique, inextensible, an unstable compromise between tendencies and the milieu. The forge, for example, is an essentially flexible compromise between virtualities that are not usable in practice: fire, metal, combustion, fusion, commerce, fashion, religion, and so on and so forth, ad infinitum. The permanence of metallurgical activity is maintained by the reality of all these immaterial factors, independent of time and of space. Evolution amounts, then, to the time that challenges [*éprouve*] the equilibrium of the compromise expressed by the fact "Forge."

There is no tendency "Forge," but a fact that appears to be universal, to the extent that a minimum of simple tendencies are required to produce a metallurgic industry. Between the extremes of time and of space, between the forge of the Egyptians and that of the Malays, there are some relations, insofar as the tendencies come together in an identical way. Diversity increases when secondary traits are added; this diversity results first in the Sudanese or the Tungusic forge and then, lastly, in the forge of some particular artisans in specific villages.

Tendency and fact are the two faces (the one abstract, the other concrete) of the same phenomenon of evolutionary determinism [*déterminisme évolutif*]—a phenomenon that will be taken up again at the end of this volume.[14] Since evolution marks in the same way [*sens*] both the physical human beings and the products of their brains and their hands, it is normal that the overall result translates into a parallelism between the curve of physical evolution and that of technical progress.[15] In its

13. ["In contradistinction to tendencies, facts are unforeseeable, fanciful [*fantaisiste*]" (1943, 28).]
14. [This paragraph was largely rewritten in 1971. The 1943 original began: "The fact that the tendency and the fact are two contradictory and yet equally faithful aspects of human activity does not imply that reality is a synthesis. [. . .] If we consider that the definition of the tendency, as of the fact, implies local invention as much as long-distance borrowings (think of the sixteenth-century Portuguese and Dutch who brought directly from Europe to Japan several objects which, in the course of four centuries, have become genuinely Japanese), we can understand the legitimate need of control [of evidence] that prevails" (1943, 29).]
15. Leroi-Gourhan 1964, vol. 1. Cf. figs. 64–66, 77 [1971, 28; footnote added].

outcomes, the tendency implies both local invention and borrowings across vast distances: think of the sixteenth-century Portuguese and Dutch who brought directly from Europe to Japan several objects that, in the course of four centuries, have become genuinely Japanese. On the philosophical level, the tendency authorizes a restitution of the progressive movement [of evolution], but it is unable to go any further and lead us to an exact historical reconstruction. Such a reconstruction can only emerge from the continuity of facts in space and time. Far more prosaic and less spectacular than the technology of tendencies [*technologie des tendances*], only the gathering of *faits* (which must be collected in very large numbers so as to be continuous) can serve to address the problem of origins and trace possible routes of diffusion.

This is not, however, to deny the reality of all historical constructions. Incontrovertible facts of filiation do exist, and specialists may well discover within a single series of weapons or tools some unambiguous traces of the relationships that have linked groups of peoples. Yet all reconstructions of this kind contain risks and can acquire the value of truth only if other specialists, working on very different series, have [independently] reached the same conclusions.

The Degrees of Facts

[Scientific] control can be exercised only over facts that are well researched and grouped into bundles [*faisceaux*] that are as substantial as possible. These bundles will all the better shed light on the history of peoples the more they are composed of diverse themes (given the impossibility of encompassing all the activities of the people in question). Choosing as one's field of study agricultural tools, the agrarian economy, and rural morphology, for example, already provides a useful investigative tool. Correlating this picture across several groups, and comparing it with pictures of other techniques of fabrication and acquisition, will further provide us with a series of multidimensional images—images whose confrontation will clearly outline the historical problems [at stake], even if we are not always able to establish the history of the relationships between the different groups. Since it is impossible for us to provide for each people a complete picture that allows for infallible comparisons, I find I must prefer this second method [of confronting series of pictures]. It does not hinder the development of disciplinary specialization and furthermore keeps at bay the overly pleasant temptations of drawing monumental frescoes.

Control, as I said, can only be exercised over well-researched facts. Just as an animal cannot be known and classified with precision until it has been dissected and prepared in a laboratory, so will facts acquire their value only when their details are made apparent. Since the method of fact bundles [*faisceaux de faits*] applies only to peoples who are well known, all research must actually begin with the study of isolated facts. These isolated facts can be then sufficiently fleshed out so as to be dealt with individually as bundles, by bringing out their secondary characteristics. For example, to compare the plane tools [*rabots*] or the files used by different peoples is worthwhile only if we can establish for each object a list that begins with the dominant trait (filing instrument or plane) and extends to the most apparent characteristics (wood or metal to be treated, blade made of iron or stone), and then reach the distinctive details (the fastening of the handle, the ligatures, the symbolic meaning of the tool). At this point, isolated pieces from the same series acquire real comparative value, and the best proof emerges when we realize that the series does not cover the entire globe but rather inscribes itself readily within well-delimited zones. Having obtained such results, we realize that the facts display degrees of different values and that the most interesting characteristics are not those of the first degree, generally linked to the tendency, but rather those of the second and third degree, specifically attached to the people or group of peoples to which the facts under investigation belong.

To illustrate this way of proceeding, let us take the example of the spear-thrower (figure 3.i, nos. 1–9), a simple small board or stick ending in a hook or eyelet hole, which serves to lengthen the thrower's arm when throwing spears or harpoons. Its layout is uniform and simple: all the cases display one extremity for grasping, the other extremity where the weapon to be propelled is inserted, and [in between] a more or less elongated body. Its mechanism, moreover, is quite invariant, and we find ourselves in the best conditions for bringing out, by degrees, the characteristics particular to each form.

First degree [of the spear-thrower]: instrument intended to increase the propelling force of a thrown weapon. It is held at one extremity in the right hand, while the weapon to be propelled is held at the other extremity (ABC).

Distribution: Europe in the Reindeer Age, Australia and Melanesia today, Arctic America today, pre-Columbian America.

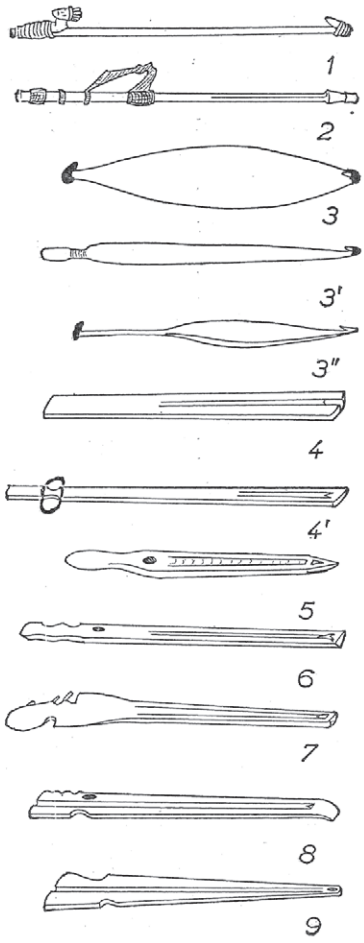


Fig. 3.i
The spear-thrower.

The subdivisions were taken up to the fifth degree only for the narrow spear-thrower with finger hold, so as to avoid making the table unnecessarily long. This suffices to indicate the mechanism of progressive individualization [undergone by] facts [*le mécanisme d'individualisation progressive des faits*]. It is by applying this mechanism that, with a minimum of intervention on my part, I have grouped the material of this book. While only incidental allusions to this procedure will be made from now on, it remains at the basis of all the divisions I propose throughout what follows.[16] In retracing the stages of its progression, we note that at the first degree the spear-thrower appears as a nearly universal fact since it embraces Europe, Australia, and America and spans a period from the Reindeer Age to the twentieth century.

Had we stopped here, numerous historical relationships could have been asserted.

Second degree / third degree / fourth degree / fifth degree [of the fact]

A. Cylindrical stick ending in a hook: Europe in the Reindeer Age, Melanesia, Peru
The Reindeer Age spear-throwers, poorly known, become unusable [as evidence] beyond the second degree
Appendix for the hand to grasp: Peru (Fig. 3.i, 1)
Appendix for inserting the spear: Melanesia (Fig. 3.i, 2)

B. Oval board with hook and pommel: Australia
Very large oval board: western Australia (3)
Board widening toward the pommel: northern Australia (3')
Board widening toward the hook: southern Australia (3'')

C. Subrectangular board with hooks and grooves: America
Without finger hold: Mexico (4)
With ring for the fingers: United States (4')
With finger imprint: western and central Eskimo, northwest coast
Narrow board: western Eskimo, northwest coast
Symmetrical imprints: northwest coast (5)
Parallel edges: southern Alaska (6)
Deep imprints: central and northern Alaska (7)
Wide board: central and eastern Eskimo (8)
Hook replaced by an eyelet hole: eastern Eskimo (9)

At the second degree [of the fact] (being the first stage I consider to be at all usable), some well-defined centers begin to take shape: prehistoric Europe, Australia, America. While the first degree only marks a tendency that is realized [*tendance réalisée*] (that of increasing the propelling force of a weapon by artificially lengthening the human arm), the second degree already delimits geographical areas. If we want from now on to draw possible historical relationships between these centers, it is necessary to appeal to a bundle of new facts taken from the following degrees.[17]

The third degree [of the fact] is that of great divisions within ethnic groups. The main divisions of the Australian tribes are reflected in the variations of the spear-thrower to the west, the north, and the south of their habitat. Among the Eskimo, the two types of spear-throwers,

16. [First edition, subsequently omitted: "We should not lose sight of the fact that these divisions apply to *all* domains of ethnology, and even more easily than to technology, sociology, or folklore: the choice of the spear-thrower here is only determined by the need to present through a very simple case the direction of this study" (1943, 32–34).]

17. [First edition, subsequently omitted: ". . . it is necessary to appeal to a bundle of new facts as I have attempted between the Reindeer Age and the Eskimo, through a diversity of elements (geophysical milieu, wild game, inhumations, dwellings, stone working, religion, and so on)" (1943, 34).]

with finger hold and with eyelet hole, clearly mark the separation of the eastern from the western groups. The spear-throwers of Indian America that disappeared before or a short time after [Columbus's] discovery are too little known for us to obtain very detailed information from them, beyond the third degree. Good descriptions provided by travelers do however allow us to work out the sequence with rather significant clusters of facts, which can already provide a serious check on historical constructions.

The fourth degree [of the fact] (to which further can be added if there is sufficient information) leads to a detailed description of the fact and its anchoring within a specific group. It can also serve to mark the relationships between the third-degree facts. It is extremely rare that facts starting at the fourth degree reach beyond the framework of a tribe or a confederation of tribes. This only occurs for objects of exchange, such as the Eskimo's stone pots, Japanese saber guards (which, however, as an ornament infiltrated the entire northern Pacific coast all the way to Alaska), firearms, and generally all objects that exceed the possibilities of local fabrication.

There is no need to insist on the dangers that the use of first-degree facts can pose to any given theory. This rarely happens, and only a few theoreticians have been led to build monumental speculations regarding the general settlement of the globe on such feeble documents. It is less rare to see "islands" of second- or third-degree facts linked together by "bridges" of first-degree facts: this trick makes it possible to join together two peoples one would like to see entertaining historical relationships.

As can be seen, the first degree of a fact corresponds to its function: hammer, harpoon, spear-thrower.[18] This enumeration implies the assimilation of the first degree of the fact with the tendency, since the tendency specifically corresponds to the logical divisions of human activity. A diagram will show the relationships of this ensemble:

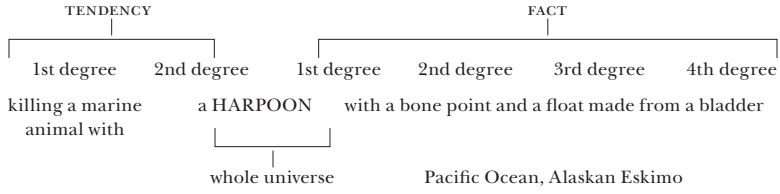


Fig. 3.ii Tendency and fact.

18. [First edition, subsequently revised: ". . . hammer, harpoon, spear-thrower, animal dances, endogamic marriages, expulsion rite at the year's end" (1943, 35).]

Upon this observation, our suspicion regarding the historical value of the first-degree facts appears justified. All that pertains to the tendency—that is, divisions of convenience within human activities introduced according to our own logic—is connected with the milieu, that is to say, with historical substance, by words alone. This first degree is all-powerful when it comes to organizing facts into categories. As such, its organizational value is precious, and we will make use of it throughout this book—a book that is but a logical projection of the unsettling tangle of observable facts on each point in time and in space. But given these limitations, I will refrain from the outset from advancing any historical construction [based only on first-degree facts].

The Hierarchy of Techniques

The insistence with which the problem of origins comes up in authors' minds should keep us alert. We have certainly found here a flaw in the [conceptual] construction: theoreticians shift unconsciously from the moving grounds of facts to the ostensibly solid terrain of the logical construction of tendencies. Within the mass of facts from all provenances, they choose and organize them according to their rigorous judgment and retrace the path of a given custom across the centuries in the hope of reaching its formative hearth. If these theoreticians turn to study a range of distinct peoples, those using stone tools will appear to them closer to the origins than those employing bronze, while those using iron will seem the more recent. Observing on the map that the most rustic groups are confined to neglected and marginal regions, they will trace outlines and concentric circles whose center, for them, will be the [point of] origin. Since such an ordering of facts has been so repeatedly applied, might it not contain an aspect of reality? Once again, we must turn to palaeontology for comparative elements.[19] Notwithstanding any notion concerning the evolution of extinct animal species, zoology fabricated for itself a logical framework ranging from invertebrates to fish, batrachians, reptiles, and birds, to reach mammals and humans. Within one century, [the discipline of] palaeontology has provided zoology with an immense capital of beings, classified no longer logically *but historically*, from the deepest strata of the Paleozoic to the surface soil. Moreover the historical progression

19. [First edition, subsequently revised: "Ethnology is too young and too poor [a science] to bring us what we seek, and we must turn to a mature and rich science like palaeontology for elements of comparison" (1943, 36–37).]

of these beings follows rather faithfully their logical classification: the invertebrates preceded fish, batrachians rose before reptiles did, birds and mammals appeared late, and the last arrival is the human species. When Georges Cuvier formulated, before 1812, the principle of correlation—whereby "the formation of the tooth bespeaks the structure of the articulation of the jaw, that of the scapula, that of the claws, just as the equation of a curve involves all its properties"[20]—he drew on pure logic to construct a law of tendency, to which the facts have brought numerous confirmations. Is not what we know of the human past comparable? Undeniably, knapped stone preceded polished stone, bronze followed copper, and iron is a late product, barely prehistoric.

To be sure, we find [species of] fish that traverse all the ages, from the Paleozoic to the present, without changing by as much as a scale, but we have also seen the birth of invertebrates a long time after the mammals appeared. The jaw of the abovementioned opossum was inevitably to be accompanied by all the anatomical characteristics of the marsupials, but we know of vertebrates that do not have the mandibular condyle that their teeth would lead us to expect, and whose shoulder blades are not in [expected] harmony with their claws. Knapped stones are indeed the first-known tools, and the Australian Aborigines who still make use of them can be compared to the cousins of today's fishes who bear witness to times immemorial.[21] But we also know of peoples who had lived in huts but returned because of their indigence to simple shelters, peoples who had possessed metal and returned to bone, people who had stone knives and replaced them with wooden blades.[22] We must face the facts: our chances of reconstructing the absolute history of humankind are derisory. For all the proliferation of discoveries, the bulk of the evidence regarding the life of our ancestors has been irremediably lost. We may have enough material to confirm the major outlines of the logical constructions, we may be able to broadly discern the succession of evermore perfected technical stages, we may provide a likely date for the appearance of humans—but still we will not be able to reconstruct in any detail the delicate pattern of movements that have marked the longest period of

20. [Translation given from Cuvier 1831, 61.]
21. [Leroi-Gourhan probably has in mind here the coelacanth "fossil-fish," discovered in the late 1930s.]
22. [First edition, subsequently omitted: "We see in the few prehistoric skeletons available pure racial types: it is an illusion which lasts as long as we have only a single sample of each ancient group; as soon as we have more, we see the hybrids [*métis*]" (1943, 38).]

our history, between the beginning of the Quaternary and the Metal Age. The interest of our task lies nevertheless precisely in seeking these nearly erased lines; in many cases, at least for recent times since the end of the Stone Age in Europe, we might be able to secure some comforting approximations.

Much can be extracted from a document, even a completely isolated one. It can be made to say the most interesting things about its author, and about the great human truths that are the tendencies. With some facts judiciously set on the scale of time, we can obtain much historical insight. However, deduction will have to focus on discovering, around each fact, the accessory evidence that helps prove that the documents in consideration do indeed all belong to the same historical current. This evidence almost always exists, and it can be exploited once its name and exact qualities can be identified. This work of denomination pertains entirely to the tendencies of logic since all science is founded on this, the only instrument our mind has at its disposal to divide the universe. We must employ this instrument to the full in order to catalog the facts with precision, and then discard it so as to group these same facts into coherent historical pictures.[23] It is to this preliminary work that the next chapters of this book are dedicated. Undoubtedly, these chapters may give the impression that only some elements of history are indicated, without ever getting to the heart of the matter. It will suffice, then, to consider this whole work as the critique of a great book that the author is a long way from ever completing.

What, then, are we to understand by *hierarchy of techniques*? It has been a while since researchers such as Lucien Febvre shook the outmoded edifice [which would have] peoples pass from being hunters to shepherds and then to farmers, in a progression that is so theoretical that it finds practically no confirmation in reality. There are [in reality] very complex states: very few groups can be said to be essentially hunters, fishermen, shepherds, or farmers, and none can be considered to be based exclusively on one of these simple states. Such a division cannot serve as our working basis.

It is thus the question of "the primitive and the civilized" that we need to take up anew: a conception so convenient, so persistent, that specialists constantly use these terms while at the same time deploring their inexactitude. The hierarchy [implied here] could serve as a

23. It is the second aspect of this research especially that I have tried to illustrate in *Archéologie du Pacifique-nord* [Leroi-Gourhan 1946].

double ranking of people, historical and geographical. It would lead to a map with several levels on which one would see, indicated in similar colors, all those peoples who were knapping stone since the beginning of time to the nineteenth century, all those who were tending herds, and so on. Such a representation has the great merit of placing each document in its time and its space; it could even be an ideal working tool, comparable to the double play of paleozoology and current zoology. But it is struck with two flaws: [first] it is only with fearsome lacunae in time as well as space that we can follow some technical or sociological themes from the beginnings to our own days; [second] we do not always know to which [physical] anthropological unit a given ancient document might belong, and practically never to which political or social unit it relates. And yet this is the method that would enable us to assert whether agriculture has preceded, followed, or existed alongside stockbreeding, or whether such and such contemporary people is more richly equipped, technically, aesthetically, or socially, than some other.[24] One may be convinced that it is through the patient accumulation of facts on the map that real historical questions can be addressed, but we are not [yet] authorized to resolve them. If I nonetheless suggest here some terms, this is because they appear indispensable as symbols, as shortcuts that can spare us constant definitions.

We may of course view with some caution all the cultural divisions proposed and debated over the past hundred years. Yet the fact remains that, at whatever point in its evolution it is taken, the human totality does contain levels [*étages*]. There still exist peoples who are unaware of the art of melting iron, others who have only spindles for spinning, others still who have no plows or draft animals. The error begins when we divide into little groups all those people who do or do not have such and such range of technical or religious traits, and then we try to derive from this [their] relationships. Yet all researchers have taken on board this commonsense observation whereby between the Australian and the Arab there is a distance that seems to be a progression. Even if we abandon the very notion of "progression," which can lead to ambivalence, there remains, specifically in the realm of material techniques [*terrain des techniques matérielles*] that we deal with, a real hierarchy whose divisions are variable but whose enumeration remains more or less constant. Taking agriculture, for example, we may find that the New Caledonians or the Peruvians with their digging sticks are

24. I develop this point of view in Leroi-Gourhan 1964, vol. 1, chapter 5, p. 205.

less well equipped than the Black Africans with the hoe; that the latter have less efficient equipment than the Arabs or the Chinese with their dragged swing plow; and that the Europeans have, in the wheeled plow, more efficient equipment than all of them. The same procedure may be applied regarding weaving, metallurgy, pottery, hunting, or navigation. There are [admittedly] contradictions, with true "savages" having better tools than we do for some very circumscribed tasks, but the overall variations of the lists remain constant. That is because there are not [isolated] *techniques* as much as *technical ensembles* [*ensembles techniques*] governed by general mechanical, physical, or chemical knowledge. When one has the principle of the wheel, one can also have carts, potter's wheels, spinning wheels, woodworking lathes. When one knows how to sew, one can have not only clothing of a particular shape but also vessels stitched together from bark, sewn tents, sewn boats. When one knows how to channel compressed air, one can have blowpipes, fire pistons, piston bellows, or syringes. Seen from this broad point of view, there exist people who are not exclusively hunters, shepherds, or farmers but who are better or less well equipped [for these modes of life]. It remains for us to find terms that would not have any formal historical or geographical significations—nothing, that is, that might in too zealous hands resemble a theory of technical evolution. The simple procedure would be to speak of technical states A, B, C, D by dividing the list of peoples into four or five sections. But doing so would be rather inconvenient and take a false air of scientificity, to which our hierarchy [of terms] cannot lay claim. I therefore suggest the following five terms of states: *very rustic*, *rustic*, *semirustic*, *semiindustrial*, and *industrial*—it being understood that these terms do not designate states determined by absolute concordance in all their details. I even refrain from providing a list of the peoples that enter into each of these divisions, because on their margins one passes imperceptibly from one state to the other. One might, for example, say of the Australian Aborigines that they are "very rustic" or of the Eskimo that they are "rustic" because their technical imperfection [*leur imperfection technique*] does not lead them to metallurgy; in other circumstances, they would both be qualified as "semirustic" insofar as they have pushed ahead far enough in some technical domain to merit the term. The Blacks of Africa would be semirustic because they know metalworking, without however having important mechanical ensembles. These three first divisions indicate *preindustrial* states. China, India, and the Islamic world would be considered in a "semiindustrial" state in analogy with medieval Europe, where mechanical ensembles were only served by means of material

action of little power. The term "industrial," finally, applies to what has become the *medieval* state of Europe from the seventeenth to the nineteenth century. We thus have [with these distinctions] some rough and ready passe-partouts. We would be wise not to overuse them, but they will prove useful for rendering in [admittedly] broad terms what is [still] too vaguely known, thereby preserving to ethnology its still-prevailing rustic complexion.

These terms (*rustic*, *semirustic*, . . .) have never satisfied me.[25] They are hardly appropriate, for two reasons: [first] "rustic" implies a judgment of aesthetic value, whereas "industrial" underscores a socioeconomic state; [second] neither term has any direct relationship with technology. If we consider the later developments of my work, and in particular *Gesture and Speech* (1964, 1965), it becomes clear why these two parasitic values, namely, aesthetics and socioeconomics, have imposed themselves unconsciously in this first book: the level of technicity [*niveau de technicité*] being potentially equivalent among all humans, there is no "hierarchy" other than the socioeconomic one. This fact was not sufficiently worked out at the time [of the first edition]: it would justify a classificatory framework that is both technological and socioeconomic—one that cannot however be developed in these pages. Such a framework presupposes that the relationship between technical availability [*disponibilité technique*] and alimentary acquisition has already been dealt with (see chapter 5 of vol. 1 of *Gesture and Speech*). It also presupposes that the different levels of exchanges of fabricated products have been defined (conjugal, familial at different degrees, intra- and interethnic), as well as the nature of the compensation corresponding to the exchanged objects. However, several systems can coexist in the same group, ranging from the simple unarticulated exchange between spouses all the way to paid artisanship. It is thus preferable to leave the [socioeconomic] classification of the makers [*fabricants*] outside the remit of a purely technological systematics [*systematique purement technologique*].

Since this classification [of the makers] cannot be purely technological, it is better, rather than having the definition hinge on a value judgment (i.e., rusticity), to have it pivot on some socioeconomic terms that imply, at least in part, some technological consequences. It seems to me that the sought-for pivot corresponds to artisanship [*artisanat*]

25. [This and the following paragraphs represent the contents of a note added to the end of this chapter in the 1971 edition (41–42).]

in the broadest sense. By this I mean a social state in which certain individuals devote their time to techniques of fabrication (metallurgy, in particular), this time being compensated for in kind or in coin, corresponding to loss of alimentary income due to their [engagement in] fabrication activity. The notion of artisanship brings to bear the entire society [*la société globale*], on the level of both social institutions and economic operations. The progressive degrees of social complexity have as their corollary (and as a constituent element) the gradual liberation of fabrication time by specialized individuals. This effectively amounts to relating the technical "hierarchy" to the level of the *favorable milieu* (see *Milieu et techniques* [1945], chapters 8 and 9), and also to realizing that "technical groups" cannot be separated from society as a whole [*la société totale*]. In this respect, the following divisions can be proposed:

—*Preartisanal*. Society does not distinguish with regard to fabrication among its members. Theoretically at least, all individuals (in couples) can take on the tasks of fabrication that correspond to their fundamental needs. This term corresponds better than *very rustic* to what I wanted to characterize, at the time I first wrote this chapter.

—*Protoartisanal*. Without ceasing to ensure the larger share of their own alimentary acquisition, one or several individuals fabricate objects that bear on the fundamental needs of the group. The group ensures a compensation, most often in kind. *Protoartisanal* might replace *rustic*. Beyond this point, however, the two terminologies only partly overlap.

—*Isolated artisanal*. At this level, individuals become full-time specialists (which does not exclude some activities related to alimentary acquisition, albeit remaining at a minor level). Artisans remain few in number, integrated individually into the group.

—*Grouped artisanal*. The artisans form a body, grouped according to production units, situated in an urban sector of their own or sometimes, as in the case of potters, in villages. They are distinct from rural protoartisans who may, within entire villages, dedicate a part of their time to fabrication while leaving the rest for the labors of food acquisition.

—*Industrial*. Individuals are grouped hierarchically within medium- or large-sized companies [*entreprise*], whose [mechanized] means of action are external to their operators [*exécutants*].

It is quite evident that these categories remain mutually permeable, and in a double sense. In a group that has reached the isolated artisanal or even industrial type, some areas of fabrication

still pertain to the masses of individuals, according to sex (dressmaking or basket-weaving in many cases). Similarly, we can observe some transitions between the types, as in the case of those of isolated artisans in a rural community, who nevertheless constitute, on a certain level, a grouping together with other isolated artisans in surrounding communities.

c. First Elements of Technical Evolution (chapter 5)

Reaching the end of this attempt to provide an ethnological framework for the elementary means for action on matter and the techniques of fabrication, it should be possible to trace here some general outlines, without prejudging the results to be obtained in the second volume, where techniques of acquisition and consumption are presented.[26] Since the first edition of this book (1943), almost thirty years have passed, during which ethnology has developed considerably. The publication of numerous monographic studies has contributed [research] material on technical activities; these contributions have enriched and sharpened our knowledge, without, however, considerably modifying the classificatory frameworks used. Ethnology has continued to pay more attention to institutions than to objects and more attention to objects than to the techniques that bring them about. That granted, there are three aspects of technology, unevenly developed, that correspond precisely to the inclinations of ethnologists.

The first aspect is that of the techniques themselves, the [technical] procedures whose [scientific] analysis requires both time and training, which ethnologists generally lack. Despite rather numerous, if scattered, publications, comparative studies of the mechanical properties of tools, animal training and taming, methods and products of preindustrial metallurgy, and techniques of sculpture making or cooking, to give but a few examples, all remain to be undertaken in the future—if indeed there is a future for the observation of facts that vanish day by day. The least disadvantaged domains of pure technology are those of flint working and ceramics, for the easily understood reasons that both knapped stone and pottery are the best chronological aids for the archaeologist. We might also note here that current work focuses much more on morphology than on techniques [as such]; nevertheless, [technology] has undeniably benefited from the attention that the study of the past has drawn to its indispensable [material] evidence.

The second aspect of technology concerns less techniques than their [research] instruments. It is oriented toward taxonomy and museography. At first sight this aspect does not primarily involve a study of techniques, but merely the collecting of objects, albeit chosen, if possible, at different stages of their fabrication. When they are accompanied

26. [This and the following four paragraphs were added to the 1971 edition (313–16). They replace a shorter passage, which, in view of its historical interest, is reproduced below, at the end of text 3.]

by sufficient documentation, these objects represent highly valuable evidence [*témoins*] that will make it possible, to a large extent, to reconstruct techniques, properly speaking. If detailed documentation is lacking, however, these testimonies rejoin the cohorts of archaeological evidence in the realm of conjectural technology. In this present work, I have set out to reconcile the first two aspects of technological research, insofar as objects play a very important role. This role, however, remains subordinate to [considerations of] raw materials and the elementary means deployed to master them.

The third aspect, finally, is that of the place of techniques in society. It is in this domain that the greatest progress has been made since the first edition of this book. While studies of pure technology are few in number, those in which techniques appear in their economic setting are becoming evermore numerous and important. Most standard monographs on specific ethnic groups ritually dedicate one of their first chapters to the enumeration, sometimes quite detailed, of that group's techniques—the rest of the work being oriented to other aspects of existence, especially social and religious ones. Taking as a typical example the blacksmith in African societies, we see that while the equipment of the forge is described, on the basis of objects, its genuinely metallurgical aspects are absent. Much space is reserved for the blacksmith's place in the community, but the concern is mostly not with his role as an important economic agent but in magical-religious contexts. It has been necessary to wait until very recently before research in France (and the situation is not much better abroad) could give to economy its place as an interconnection [*articulation*] between techniques and society. Indeed through its socioeconomic synthesis, economic anthropology (which might be better called economic ethnology, given its primary interest in ethnic groups) brings with it a large part of technological data and thus serves to recover the functional totality of the human group. Since these questions have been addressed in the first volume of *Gesture and Speech* (1964), it only remains here to note the broadening of these perspectives since the first publication of the present work.

What limits are we then to give to technology? A point of view that is gradually losing ground is that of reserving ethnology to the study of "archaic" peoples. What lies this side of modern civilized populations [*le civilisé moderne*] would therefore no longer pertain to the field of ethnology, a field that is specifically concerned with the study of poorly adapted small ethnic groups [*petites ethnies encore inadaptées*] or, among the great nations, with folklore, techniques in decline, or picturesque peasant survivals. Regarding technology and, by extension,

ethnology, my position has remained clear-cut: there is no division, except a verbal one, between this or that side of this mysterious boundary of the civilized.

Technology, a precise term in the modern industrial vocabulary, spans progressively [back] from the television set to the knapped flint. If we appear to respect this conventional divide in this book, this is because research needs to be undertaken thoroughly, drawing on a particularly wide-ranging set of technical data. While I have been able, over the course of a few years, to run through the bulk of technical means employed up to the European nineteenth century, it seems to me that any further expansion [from the nineteenth century onward] will only be possible for specialists. They will all have to address their domains separately, based on a complete assessment of the current industrial state of pottery, smelting, or weaving. In 1936, at the beginning of an unfortunately too-narrow sketch of modern European culture, I could write that "just as we can present the French with a general picture of Polynesian culture . . . it might seem logical to present modern European culture in the same way, to consider the radio[27] as a means of transmission comparable to the drum, the tailored suit as the typical garment of the indigenous male, and the machine gun as a projectile weapon."[28] It seems certain that, even remaining at the level of general ideas, drawing on the means of traditional ethnology to undertake a truly ethnological overview of modern industrial America and Europe is bound to have serious implications for conventional wisdom on matters concerning civilization. It is, after all, quite strange to pretend to study humankind as a whole, while considering that civilized humans [*l'homme civilisé*] themselves are either too well known or somehow of extrahuman essence.

But serious difficulties arise: civilized human beings are able to control the general ideas expressed about them [by others], but they are also to a large extent unconscious. It is difficult for us to have it accepted that, for example, our seated position, with legs crossed and the chin propped up by the hand, is actually an ethnological document—much as is the standing position of the Black east African, on the right leg with his left foot placed on the right knee in the manner of a wading bird.

How, moreover, are we to establish the boundary between what pertains to the domain of ethnology and what lies outside it?

27. ["Radio" replaces "T.S.F" (Télégraphie sans file, 1943, 329).]
28. Leroi-Gourhan 1936, *Encyclopédie française permanente*, vol. 7, fasc. 24, p. 18.

When this book was first written, the axe was still the main tool of our lumberjacks, whereas today it is almost a museum piece—and in ten years from now the chainsaw that replaced it may too have become an outmoded device.[29]

The first generation of curious [explorers] gathered accounts and objects of distant peoples from the seventeenth century onward. Taken over by the first ethnologists in the nineteenth century, these elements progressively formed the basis of subsequent publications and collections. By the end of the nineteenth century in the case of published accounts, and much more recently concerning objects, specifically scientific preoccupations have been added, but the picturesque aspects of ethnology have never really faded, so much so that the most recent man-eaters have met with as much success as their forebears. More than any other science, ethnology has its inner novelistic streak [*une part intime de romanesque*], exacerbated by its very method. Travelers see and report on peoples among whom they have [in fact] rarely spent a substantial number of years and with whose languages they are often barely familiar (if not completely ignorant). The inner reactions of these people all but escape these travelers, at least during the long period of initial familiarization (so much so that these explorers often need to retrospectively project their later understanding onto their observations of the first few months).

Such comments may appear unjust to researchers today. There have been exceptions, and nowadays countries of European culture all have teams trained in linguistics and in the rigorous observation and description of [ethnographic] facts. But it would be even more unjust not to acknowledge the enormous gaps that still mark ethnological research, and the uneven technological value of a scientific literature, whose predominant orientation is toward social phenomena and mythology.

It has nonetheless been necessary to organize the enormous mass of technical documents obtained, the descriptions provided by the authors, and the museum collections. Quite naturally, the starting point has been with objects, the only tangible evidence [available to] investigation. The technical function [of the objects] has often appeared as a secondary element of discrimination, and broad divisions were made: the lighters attesting to fire, iron for metallurgy, baskets for wickerwork. This was a doubly advantageous qualification, since it guaranteed that objects would receive an adequate museographical

29. [Paragraph added in 1971, 317.]

classification, while securing for more theoretical works a satisfactory terminological framework: peoples with pottery and peoples without, with blowpipes and without, with weaving and without, and so on. This classification may well be solid on this general double level, but it nonetheless presents a flaw from the technological point of view.

The first in France to have noticed it seems to have been Charles Frémont, who in 1913 published a book titled *Origine et évolution des outils* [*The Origin and Evolution of Tools*]. While questionable in several respects (after all, an industrial technologist writing fifty years ago could hardly escape the singular views of his own times on "origins"), this work nonetheless includes welcome views regarding drills with alternating circular movement and oblique percussion tools, as well as a real concern with the mechanical effects of various cutting tools. The mere application of Frémont's dynamometry to drills, for one, could have alerted ethnologists to the ambiguous situation occupied by the tool within techniques.[30]

The tool is neither a cause nor an effect, and in the chain "force–tool–matter," it is but a witness to the exteriorization of an efficient gesture. This problem, namely, the situation of the tool in relation to the human who animates it, was taken up in *Gesture and Speech* in 1964. When I first wrote the present book, I was far from having completed the long route leading to my attempted synthesis between humans and the products of their intelligence. The main concern then was to set up the systematic study of techniques on foundations that, better than traditional classifications, would clearly highlight the overall connections, the very unity of human operational behavior [*comportement opératoire*]. It was tempting then to do away with the object, especially the tool, through the formula *force* + *matter* = *tool*, where the exteriorized object resulted from a kind of dialogue, more fecund than the merely morphological classification of some tool sets.[31]

30. [First edition, subsequently omitted: "It [the tool] is neither a cause nor an effect, and in the chain 'force–tool–mechanical action–matter,' it is but an *intermediary* witness. The traveler can easily bring it back to a museum, the ethnologist can insert it in a general classificatory framework, but once put on display it reveals almost nothing of its profound personality. Charles Frémont used disparate examples in his work, but he did not suspect the real importance that the raw material has on the tool, nor has he given structuring elements to comparative technology. To try to organize this work, it was necessary to renounce to the object, in particular tools. The first tendency that led to the plan of the present volume was the formula *force* + *matter* = *tool* (1943, 331).]

31. [Paragraph added 1971, 318–19].

Having abandoned the object, I thought I would find it again at the conjunction of its two causes [force and matter]. It appeared then that, in the vast majority of cases, force served to obtain a percussion effect and that the tool accordingly bore three distinctive marks. These were the marks of percussion that usually impact only a narrow portion of the tool (its cutting edge, tip, or extremity); the marks of the force that conditions its overall shape; and the marks of matter, which makes the extension of similar shapes to other bodies either practicable or impossible.

Percussions for their part were grasped through a terminological web that accounts for all the possible forms of the percussive part [of the tool]. On the application of force to percussions, a series of indices covering most tools was devised and will be applied to all weapons in the next volume [*Milieu et techniques* (1945), 13 ff.]. There remained, however, two domains that fitted less logically into the initial formula: these are the natural elements (fire, water, air) and the mechanical improvements of force and their extension to methods of transport. For reasons of convenience and in order to postpone their discussion, I have inserted them right after the percussions, with the whole topic forming the *elementary means of technical activity*.

There still remained to regain the tool, and this I did by simply projecting the framework of elementary means onto that of raw materials. Here again, it was necessary to innovate. Upon numerous attempts to specify the elementary means, it appeared that some technical extensions were possible: one can hew soft stone, as well as horn, shell, bone, and wood, with the same tools, and there is a perceptible proximity between metallurgy and pottery. But on the other hand, horn can be hewn or modeled; leather can be incised, embossed, or woven; and it therefore seemed necessary to abandon the material itself and only retain its properties when being worked on [*en état de traitement*]. This could lead to some paradoxes, such as apples and wheat becoming "liquids" [in terms of their properties], but overall the classification remains sufficiently homogenous, so that all stones are "stable solids," all metals are "semiplastic," all clays are "plastic," and so on. Using this framework, we have regularly found two types of objects at the intersection of means and matter, namely, tools and products. This corrected the initial formula [force + matter = tool] to a more accurate one:

elementary means / material = tool and product.

Surprisingly, it appears possible to cover so efficiently thousands of objects used by all peoples in their creative activities. The traditional

classification with its twenty or thirty broad divisions leaves at least the illusion of infinite technical wealth, with thousands of shapes within the categories of metallurgy, pottery, or basketry. For our part, the striking impression is rather that of a relative poverty of techniques. Certain general facts seem so natural that they escape attention, yet their very banality is noteworthy. Despite all the possibilities of borrowing, exchange, or influence, it is curious that, to mention only objects of very specific forms, the adze should be the tool of woodworking (across the earth and since the Neolithic), that the forge should everywhere combine the same elements, or that the spinning wheel should be the most perfected [tool] in Europe as well as in the Far East and in India. In the next volume [1945], we will turn to consider the two phenomena of *borrowing* and *technical inertia*, phenomena that explain the diffusion of objects or their indefinite conservation. We will also posit that there is not such a wide gap between the autonomous invention and the straightforward borrowing from one's neighbor, insofar as both factors lead to the creation of the same technical milieu. In other terms, one invents the spinning wheel or one borrows it only if one is in a position to use it: a banal observation, but one that must be placed at the basis of any [re]construction of technical evolution.

On this basis, there are groups that are well placed to have the adze, the spinning wheel, or the forge (and this is a situation from which we may draw useful conclusions). But why is it that we find only very rarely groups that are able to have the *equivalent* of the adze, the forge, or the spinning wheel, that is to say, original technical forms with unpredictable solutions to problems of force and of matter? Are we not led to propose as an answer the exercise of a technical determinism that would be comparable to biological determinism, with as many overlaps and exceptions but also with as much overall clarity?

The problem has never been posed [in these terms] because no classification has rendered it as apparent as the one I follow here. The ultimate question facing all [current] theories is that of knowing whether a given cultural trait has been borrowed or has been created on-site—whether contemporary populations should be regarded as the result of millennia-long blending of material characteristics, or on the contrary as autonomous centers of spontaneous creation. Given that question, we can sense all the importance that the demonstration of a strict technical determinism would have. To show that the adze is the inevitable materialization of a tendency toward woodworking in a certain technical milieu amounts to positing the multiplicity of creative centers for adzes.

For me, the problem cannot present itself in such a simple guise. We have just seen that a given technique can take hold [*se fixer*] (i.e., be invented or adopted) only if it finds itself in a milieu that effectively corresponds to its level: the shotgun will no more take hold among the Australian Aborigines than the spear-thrower will among us. At the most, there might be provisional states of symbiosis where a superior group provides an inferior one with ammunition and already-used weapons. A large share of the facts can thus be understood: certain groups owe to such symbiosis the products they could not fabricate at their technical level, while other groups have a homogeneous material, entirely of local production. This is a significant source of errors of interpretation, from which we will subsequently derive advantage. For the moment, however, let us stay with the case of populations possessing homogenous material. Their technical milieu does not offer the same grasp to all the elements. Bows and arrows, for example, take hold on a wide cultural spectrum because all known groups *can* fabricate bows (which is not to say that they *have to* fabricate them). Technical characteristics all have different affinities. Some, like iron, will not take hold for lack of an adequate general set of tools (through a real inferiority); others will encounter technical inertia or the lack of materials, or again of equivalent means. If determinism there is, it passes through numerous obstacles, allowing for symbiosis (primarily of a commercial nature) and for the technical or natural milieus.

If we place ourselves on the ordinary level (being, all in all, the historical level, insofar as it leads to the demonstration that such and such people have invented or received a given object), any of the solutions proposed could give rise to a range of exceptions, liable to provide opposite demonstrations. This sterile point of view must therefore be abandoned. If on the contrary we take up a position in the chronological and geographical absolute, we observe that the overwhelming majority of peoples who *could* have the adze *do* actually have it, that those who could spin with the spindle have done so, and so on. For the moment it is irrelevant to establish whether they invented or received them, but rather that they *adopted* them [*les ont fixés*]. The fact that for these two examples [adze and spindle] we have six thousand years of documents from literally across the globe strongly argues in favor of determinism.

It remains, however, to establish the inverse proof. Do other possible solutions exist to the problems resolved by the adze, the spindle, and the bellows? The dearth of such original solutions is striking. Some populations, such as the Ainu, hew wood with knives; others, like the Brazilian Indians, spin by rolling fibers on their thighs. Various reasons

explain their condition, all the more unusual that they live surrounded by [populations that use] adzes and spindles. When we go into detail, we see that an apparent technical inertia is often controlled by external factors. The Ainu were not familiar with metal before the Japanese introduced sabers and knives for bartering, so they made use of the only steel objects to have reached them [knives], as both weapons and tools.

It is thus the case that the object normally adopted for working wood is the adze and for spinning, the spindle. Let us look in turn for the reasons that might control the form of each of these two objects. When one sets out to work a piece of raw wood, a trunk, or a branch, the most convenient way is to lift off chips or flakes going with the grain of the wood, from the surface toward the center. The operator, placed before his piece, [may have] no knowledge of the possibility of held percussion with a percussor; he must therefore, to work efficiently, strike the wood and dent it. As he must lift off the chips that follow the grain, the cutting edge he wields needs to be perpendicular to the grain running lengthwise (otherwise he would only be splitting the wood). And as he must set up the flakes with an abrupt (perpendicular) cut, lift them off with very oblique blows, and stop them if need be by means of new perpendicular cuts, the cutting edge must be well cleared for the operator's fingers not to be crushed on the wood by these perpendicular blows and for the cutting edge to penetrate deeply through the oblique blows. We will not be looking for the origin of the tool that responds to these different needs—our example here is and must remain hypothetical—but it is obvious that the conditions I have just described represent the minimum necessary to hew wood by an average human being [*homme moyen*] from the Neolithic onward. Yet to each of these conditions responds some characteristics of the adze: striking the wood (hafted blade) perpendicularly to the grain (cutting edge perpendicular to the axis of the handle) without crushing the fingers (relatively elongated handle and relatively long blade) by lifting off flakes or chips (blade fixed at the very extremity of the handle). Although similar work can be done with a knife, with a machete, or with an axe, only the adze responds harmoniously to all these demands: knives are fragile; machetes are too long and cannot penetrate enough into the piece, while axes would require abnormal wrist positions and movements.

The conditions are no less clear regarding the spindle. Without prejudging their origins, many humans have known for millennia that by spinning a stone at the end of a thread, this thread is twisted in the direction of the gyration. It is thus enough to posit as acquired the

notion that a thread can be twisted by spinning a weight suspended at its extremity. Two conditions appear: making the weight spin and rolling up the thread so as to continue the operation. Both conditions lead to giving the weight used an elongated axis and to its attachment to a shaft. Thus, although the European spindle and the pre-Columbian spindle function in markedly different ways, the two spindles are identical in form simply as a consequence of the association "weight–rotation–reel."

The examples just cited are [admittedly] simple. We could find several dozen other objects with the same universality, such as the bow, the lance, the carrying pole, the raft, or the sandal. A few hundred other examples would show a more local character, like axes, sleighs, bellows, bridges, and sails, their localization being due to the specific conditions of the milieu. The number of tools or of fabricated or transported objects is thus relatively limited, and a few hundred terms can serve to clearly define innumerable particular cases. The ability to say "axe," "sleigh," or "spinning wheel," and immediately to call up thousands of objects from all over the world and from all ages, attests as it were to the higher degree of technical determinism.

Yet each object thus predetermined nevertheless retains a striking personality. To hew wood, one needs a cutting edge perpendicular to a handle, but the handle and the blade can be divided into a mass of details that have to do with the wood worked within a given region, the stone that can serve as the blade, the habits acquired in hafting other tools, the attraction exercised by the adze of a neighboring group, and indeed indefinitely extensible reasons, positive or negative. To apply systematically the notion of determinism to all these details would make the term lose its value. Once we have admitted that the form "adze" is natural and that, through its borrowing or through its invention, every woodworking group can possess it, the determinist explication has reached its limit. It has served as a rough preliminary work, and it is to a more supple and precise explanation that we must turn to account for the details.

This explanation has been suggested on a number of occasions, when I formulated the double aspect of *tendency* and *facts* [above] and *degrees of the fact*. This conception has made it possible to better grasp the material evidence. The example of the spear-thrower has served to evaluate the different degrees that lead from the general technical term (spear-thrower) to a wide range of cultural expressions (European, Oceanian, American spear-throwers), through to evermore specific ethnic data, all the way to the particular spear-thrower of a

given Alaskan island. Technical determinism leads us to consider the spear-thrower as a natural trait, inevitable, born from the combination of a few physical laws and the necessity of launching harpoons. The degrees of the fact [for their part] enable us to take the opposite route, to observe that the southern Alaskan spear-thrower, the last degree of the fact, can lead us back to the impersonal, inexistent [abstract] spear-thrower that is at once the first degree of the fact and the tendency itself.

The notion of tendency covers, in a different way, that of technical determinism.[32] At the onset of my research on the main lines of human technicity, the term seemed to me necessary to express what lies within the technical act materialized in gestures and instruments. This term [*tendency*] was a simple abbreviation, to convey in a single word the sum of virtual possibilities that only become realities under favorable conditions of the milieu—to symbolize too the path followed throughout the living world by the increasingly complex needs of survival. This phenomenon has been taken up and developed in other terms in the subsequent volumes that follow this work.[33] Here, in the present pages, "tendency" is conceived as a means to organize from the onset the exploration of the relations that have prevailed between humanity and the materials it has mastered.

32. [This brief paragraph, added in 1971 (326), replaces a long discussion in the 1943 edition (339–44) that basically anticipates the themes to be developed in the theoretical parts of volume 2 (and is not reproduced here).]
33. *Milieu et techniques*, 1945, chapters 8 and 9. *Le geste et la parole*, vol. 2; *La mémoire et les rythmes*, 1965, chapters 7 and 8.

Material Omitted from "First Elements of Technical Evolution"

We may now draw some general conclusions.[34] Since the origins of our science, technology has interested specialists in each of the great nations. Some aspects such as pottery, textiles, or musicology have found serious comparative bases, but most attention has until now focused on questions more accessible to the researchers' training. The resulting works have mostly been either very general monographs of peoples or very specialized studies of sociology or religion. In France, in the first third of this century, the main proponents of comparative technology have been the detailed works of Charles Frémont (experimental studies of industrial techniques) and Arnold van Gennep. More recently, some works on horses, navigation, fishing, alimentation, and habitation have appeared. Lastly, over the past ten years, André Schaeffner has developed musical organology, taken as a branch of comparative technology, in a way that is perceptible in his department at the *Musée de l'Homme* and in his own publications. In 1936 I presented the outlines of an overarching classification (*Encyclopédie française permanente*, vol. 7 [see text 2]); two years later the *Musée de l'Homme* created a department of comparative technology, whose works have been suspended by the war. These few facts attest to the existence of a well-established current of interest among us, but too small to speak of as a living discipline. In fact, classifications covering techniques have long existed, but they are made by and for ethnological theorists, often with the deliberate aim of philosophical demonstration. Whereas philosophy normally draws consequences from science, it is hazardous to take the inverse route from the onset.

As it is not presented here as a distinct discipline, comparative technology has not been explicitly delimited. We can, however, easily reconstruct an average outline of what is currently covered by the domain of techniques. It [deals with] the ordering of all the material documents of primitive people in order to reach general ideas on the architecture of human societies. Two terms draw our attention: "primitive people" and "general ideas." It is quite obvious that not all ethnologists have dedicated their efforts to the Melanesians or limited their task to the philosophical plane, but it is still the case nowadays that the people being studied are first and foremost savages. It is by an

34. [These two pages, the original opening pages of chapter 5 (1943, 327–29), were omitted and replaced (see above).]

encroachment that some find almost excessive that civilized groups come to occupy a space within ethnology—and some recently would further limit this encroachment to "folklore," techniques in decline, or picturesque peasant survivals.[35]

On this first point, my position has remained clear-cut: there is no division, except a verbal one, between this or that side of this mysterious boundary of the civilized.

35. Our recently created *Musée des arts et traditions populaires* will undoubtedly do much to modify this point of view. Its investigations already reach far beyond the framework of folklore and, at the time of this book going to press, it has asserted this attitude by adding "ethnography" to its scientific program.

Contents of *Evolution et techniques*, vol. 1, *L'Homme et la matière* (1943)

4.

Milieu and Techniques, 1945 (Selection)

Milieu et techniques. Vol. 2 of *Évolution et techniques*. Sciences d'aujourd'hui. Paris: Albin Michel, 1945. 2e éd., revue et corrigée, 1973.

Selections from chapter 9: (1945), 429–32, 450–72; (1973), 402–5, 424–40.

THE EDITORIAL HISTORY of *Milieu et techniques* is straightforward: the first edition (1945) was followed by an identical reprint in 1950. The second edition (1973), besides being designed with a denser layout requiring new pagination, saw only the addition of a brief note to the reader, the rectification of some factual errors, and the inclusion of several footnote references to the 1964–65 *Le Geste et la parole*.

The two volumes of *Évolution et techniques* were conceived together; their publication was probably spaced out because of their growing dimensions and the constrained economic and editorial circumstances of the Second World War. While both volumes relied heavily on the systematic use of descriptive *fiches* and illustrations of technical objects and practices, they differed somewhat in their originality. In the 1943 *L'Homme et la matière*, Leroi-Gourhan's discussions of the "technical structure of human societies," the "elementary means of action on matter," and "techniques of fabrication" (respectively, chapters 1, 2, and 4) were all innovative developments following on his pioneering classification in the 1936 *Encyclopédie française* paper (see text 2). In the 1945 *Milieu et techniques*, the topics addressed in chapters 6 and 7 were rather more traditional, dealing with "techniques of acquisition" (hunting,

fishing, agriculture . . .) and "techniques of consumption" (food, clothing, dwelling). This may account for Leroi-Gourhan's hesitations regarding the long-term relevance of the classificatory and conceptual dimensions of his work. In the 1971 edition of *L'Homme et la matière*, he noted that the systematic framework as a whole remained unchanged, while the theoretical apparatus can and must have evolved.[1] In prefacing the 1973 edition of *Milieu et techniques*, on the contrary, he saw the need to remediate insufficiencies in the empirical contents while granting merit to the theoretical parts, which remained, in his view, quite pertinent.[2] Leroi-Gourhan further remarked in this preface that the book was somewhat irritating for him to (re)read, because it contained in incipient form much of what he would subsequently work on. There was no point in rewriting the book, he granted, so when he felt the need to express himself again on these matters, he simply went on to write *Le Geste et la parole*!

Chapter 8 of *Milieu et techniques*, titled "Problems of Origin and Diffusion," included some wide-ranging discussion on such topics as "civilized and savages," "technical economy," "the technical tendency," "the technical milieu," "borrowing," "invention," and "creative activities." The "internal" and "external" milieu were broached from a temporal perspective in chapter 9 (parts of which are translated here), followed by some traditional "cultural-historical" themes and notions, such as inertia, routine, survival, diffusion, borrowing, adoption, invention, and convergence. The chapter ends with a series of organicist and biological analogies, between the evolution of techniques and life, animal speciation and ethnogenesis, and the rates and patterns of evolution in palaeontology and technology.

1. Leroi-Gourhan 1971, 7.
2. Leroi-Gourhan 1973, 7.

The image of a certain identity between living tissue and the human masses [*les masses humaines*] was put forward at the very beginning of these chapters on the organization of technical actions. A comparison has often been suggested between the different organs of the social body and those of the living body: in [human] societies as well as among animals, everything is organized toward the specialization of functions. It seems to me that we may strongly adhere to this point of view. Without positing an absolute identity between the behavior of a human society and that of an organized living body, we may admit that these are two aspects of the same phenomenon, on which analyses can proceed using the same categories. It is banal to say that human societies are born, live, and die like individuals, that their functions are comparable to the grasping, locomotive, or digestive functions; but it may be useful to try to represent to ourselves what life is really like in those human units that reach beyond the individual.

The elementary schema of birth, life, and death clearly applies to human beings and to political units [as well]. We may speak of the "life of a people" if by that we mean a certain political duration, like that of the Assyrians or the Hittites: they are organisms conscious of their existence who have known a period of birth, an eventful existence, a decline [*agonie*], and a definitive extinction. Since we have posited that the political unit is both a common standard for historians and the apparent driver of ethnic becoming [*devenir ethnique*], an entire side of human evolution needs to be considered on the scale of the life of political groupings. We reach here an essential preoccupation among historians: a large share of their work aims to establish [*fixer*] the life of peoples, empires, or dynasties. We have seen, from a different angle, that the divisions of history are conventional: they correspond to an average zone of concordance of ethnic characteristics chosen to express the personality of [people such as] Turks, Scythians, or Aztecs. This may broaden the problem, but the fact remains that various groups nonetheless feel or felt themselves to be Turkish, Scythian, or Aztec. This [self-identification] largely justifies the study of these zones, arbitrarily divided into time and space, as [if they were] individuals born, living, or dying. The facts are less clear in the cases when the political unit appears to be linked to ethnic becoming, since the politically constituted group practically never reaches its ideal personality: it dies before having given an equal degree of specialization to its physical type, to its techniques, and to the various bodies of its social-religious

apparatus. These divisions, which are as the organs of the political group—its skeleton, its brain, or its claws—lead a largely autonomous life: some preexist the group, others are tied to its fate, and others yet will survive it. It would be useless to see in them impersonal rubrics such as the "heart" or "lung" that preexist and survive animal species. There is indeed a personal continuity [*continuité personelle*] in the life of a tool that precedes the birth of a people, characterizes it for several centuries, and then dies off before it.

This rather convenient notion of human groups that live the way individuals do is not, however, entirely satisfactory. At most, we may admit as a preliminary hypothesis that societies form something like temporary colonies that are composed of elements that each have their own activity and that act as an effect of a common tendency and react in function of their surroundings—with the political element serving here as a standard for measuring social time. A tighter grasp on the evolution of social units may be secured by a distinction already posited, whereby the specified ensemble of people corresponds to two orders of distinct manifestations: those who appear to be truly alive pertain to the interior milieu [*milieu intérieur*] while the other, perceptible only materially, is expressed in objects or institutions that can be made concrete [*matérialisable*] in some form or another. To achieve a complete demonstration, it would be necessary to work on series of sociological, religious, or aesthetic documents [which would be] comparable to those drawn upon in the domain of the most material techniques—this, however, would reach beyond the framework of this book. It is possible nonetheless to point out that these series contain a split comparable to the one just outlined. When we endow political, religious, or technical forms with an autonomous life, we proceed in fact to describe evidence that represents the materialization of internal phenomena. It has not, for all that, been demonstrated that global evolution actually corresponds to what is suggested by the external examination of so restricted a portion [of the material evidence]. In other words, whether we consider the evolution of silkworm breeding or that of the Manchu political unit, the profound life of a human mass that evolves in East Asia and is conveniently qualified as "Chinese" largely escapes us. We may wonder whether, between the data of material observation and those of the internal milieu, there is no gap comparable to the one that separates histology and quantum physics; we may also wonder whether a certain form of ethnological investigation does not compel us to abandon most currently held values. It is obviously very risky, in a science that does not yet have the resources available

to mathematicians, to reject a framework that allows us to grasp the Chinese, the Fuegians, or the Algonquins, as well as farmers using drag hoes, matriarchies, shamanism, or totemism—all localized, in a time and place, within specific ethnic units. I am convinced that at the end of our research, we will return to these notions, which pertain to some aspects of reality—but that we will do so having gained a singularly enriched background. In our attempt to reach technical objects, we had to take a long detour and, provisionally, renounce the tool: to reach the people, we will have to take a similar path—a path that I can only outline as I bring this book to an end.

b. Time and the Technical Milieu

The state of the technical milieu can only be grasped in the actual objects that emerge from it, and its evolution is perceptible only through isolated and partial experiences that leave a large share to interpretation. In particular, the absence of satisfactory genealogical series for those [human] groups qualified as stationary makes it difficult to generalize our conclusions. Given that all closely observed groups have undergone changes, and given that over the past century primitive populations have changed under the violent action of our civilization, we may posit the incessant deformation or transformation of all human groups to be the norm. In each group, [however], this transformation is unequal, irregular, and each domain of activity presents a certain number of cases that seem to be struck by immobility. Research should focus on these occurrences, which seem to last forever, insofar as they posit an important contradiction to the evolutionary thesis.

Inertia and Survivals [*Inertie et survivance*]

We may posit as a general principle (though not an absolute one) that every normally satisfied need preserves its means [of attaining it]. Such is the case, for one, with the simplest techniques, those that at all times and in all places will require a knife, a hammer, or a rope. Such is also the case of more complicated techniques, like inhumation or circumcision, which reach beyond the strictly material. For a range of reasons, both cases represent relatively stable bases within the technical milieu [*milieu technique*]. That said, even they are not spared completely by evolution. The knife, while it [always] retains a blade and a handle, does follow in its details the general movement of the internal milieu. And much as the group jealously preserves the details of its rituals, it unconsciously brings modifications to the objects considered the most venerable. It suffices to examine a chronological series of European ecclesiastical vestments in order to appreciate how much rituals can attest to considerable aesthetic and technical evolution.[3]

Inertia becomes truly apparent only when a group refuses to assimilate some new techniques—when the milieu, even if it is prone to assimilation, does not create favorable associations. One might see here the very raison d'être of the group's personality: a people is truly itself only through its survivals. If Barbarians have remained

3. See *Le Geste et la parole*, vol. 2, chapter 12 [1973, 425; footnote added].

Barbarians, this is because they were able to meet the flood of Chinese influence with inertia. This is indeed how the question appears for those engaged in historical inquiries around survivals, that is to say, for an entire current of the discipline of ethnology. Among each people can be perceived chains of survivals [*chaînes de survivances*] that are anchored in the past and that express the innumerable reticences of successive generations. This point of view has undoubtedly a measure of exactitude comparable to the one I advocate here, but I have oriented my studies in the opposite direction: not from the present toward the past but rather from successive points in time toward the future. So while in the first view the group *preserves* its past characteristics, in the second it *loses* them, at times slowly but always irreversibly.

This brings us to specify the value we assign to technical traditions. In domains other than techniques, a tradition may be active and conscious, so that the group takes pride in acting in conformity with past custom. Such an attitude is relatively rare, however, except for certain frameworks of social or religious organization where the group feels its own personality with great intensity. In the technical domain, however, despite superficial affirmations, tradition is *almost never an ideal*, nor is it ever a completely conscious practice. Technical traditions are but a precarious base that guarantees for the next generation the possibility of securing [*matérialiser*] most of the objects prevalent in its technical group. In the absence of new associations, these technical associations can successively cover a significant number of generations, but they can also change or alter at the slightest solicitation. The role of traditions, which is to transmit a ready-made technical bloc to the next generation and thereby to spare it pointless experiments, is amply fulfilled when the son possesses all the means of the father. Traditions endow the group's activities with a suitable personality, but the son will not consider it a betrayal to improve upon this heritage. Undoubtedly, significant resistance will remain among the preceding or contemporary generations who claim to uphold to former times; nevertheless, any innovation that might be achieved will actually be included into the basis of traditions that a group leaves to its descendants.

Routine, which expresses the resistance of the older generation or of those who adhere to former times, is actually not a functional obstacle. Even in the most conservative groups, routine exists *in order to yield*. It seems as if the internal milieu of the generation in question, aware of being in equilibrium, expresses its regret at the momentary disruption of its cohesion. Seen from the inside, routine does not differ from those forces indispensable for preserving the ethnic

personality. It simply appears as a fleeting fringe at moments when the internal milieu undergoes some modifications through the interplay of associations.

Following on that, we can highlight the meaning of the notion of "technical survivals" [*survivance technique*]. In order for the ethnic group to express itself in its purity (as commonly understood), it must have a stable technical milieu (and by extension a stable internal milieu as well). In fact, we have no valid examples of such a condition: conservative and arrested [*attardés*] groups, such as the Australian Aborigines, are not known to us over time, while the notion that their technical milieu has been preserved more or less integrally since the beginnings of time is only a hypothesis. In reality, these groups only present the image of a somewhat slower evolution than that undergone by other groups, such that the inheritance of successive generations can seem almost unchanging. But these few cases are in several respects aberrant, and it would be risky to take them as the image of *what must have been* the state of normal ancestral groups. In ordinary circumstances, survivals are merely an economy of technical means; they provide the group with a stock that remains stable from one generation to the next and that normally changes progressively. The role of survivals is in no way passive, and it is by no means comparable to that of the external milieu.[4] In the continuous and permeable internal milieu, constantly revised by the combined inputs of the tendency and external contributions, survivals appear as a conventional abstraction, as a division we make in several successive phases of the same people in order to single out what seems to remain constant. A distinction is, however, to be made between those simple actions that readily converge with the ideal of the tendency [*l'idéal de la tendance*] and those actions that persist in their relative imperfection. The first survives naturally, indefinitely, as a constitutive base for the internal milieu: since it is normal that the same basic formulas should be found among all peoples, it is in these elementary traits that convergences are most frequent. This is why we can find everywhere items such as axes, lances, adzes, or spindles, which all trace long and constant lines back in time, either as the effect of borrowings or of local inventions (an often tricky distinction to make). The second kind of facts, on the contrary, seem to be relatively ephemeral: specialized tools and original institutions

4. Time and technical traditions are the subject of more detailed discussions in the two volumes of *Le Geste et la parole*, especially in chapters 3 to 5 [1973, 427; footnote added].

have a limited existence, their role is to take temporary change of the group's personalizing function, and they do not often span more than a few generations. These unstable survivals, however, have large-scale importance [*une valeur de masse*]: they serve to hold together these great moving units that are the masses of shared civilization. Centuries of the life of the yellow races, for example, evidence a stock of survivals that isolate them from the rest of humankind. The preservation of these survivals in each group is rather precarious, but overall we can single out across time the same range of specialized techniques or institutions from which every group benefits, as the wider masses consolidate.

Such features as survivals or routine no longer appear as lacunae in evolution, or as the antithesis of progress. They are not even properties of the internal milieu, a basis of immobility that would counterbalance the shifting foundations of innovations. Like the notion of a "people," that of "survivals" is based on a conventional view, whereby the surviving object [or elements] simply represents an average point along which certain traits animated by different rhythms concentrate for periods of time. The simple example of the knife can be referred to again. To say that the Siberian bronze knife from the beginning of our era survives in today's Kyrgyz knife is simply to state that among the innumerable evolving traits of the knife—including material, attachment of the handle, ferrule, pommel, decoration, the heel of the blade, sharpening, trimming, sheath, and so on—some have remained more or less in phase [*parallèles*]: the general curving of the blade and of the handle, the sheath that envelops part of the handle, and so forth. If it were possible to run through a film [sequence] of the thousands of knives that have succeeded one another between the two exemplars under discussion, we would see the weapon change in appearance over the course of time, straighten out, curve, become lighter and heavier, take on at each moment the personality of the generation that makes use of it.

This is not to deny the considerable importance of survivals. There are enough astonishing cases to render such a denial absurd. But when we try to identify their workings, the fact remains that we cannot base an explanation of the world on the sole testimony of survivals.

We have seen that the human group is made up of disparate elements, with variable and largely independent paces of evolution, and with equally precarious survivals. It remains for us, in order to provide an objective basis for our research question, to address two antithetical aspects of evolution, namely, [the processes of] diffusion and technical convergence.

Diffusion

The mechanism of diffusion as such is a simple one: it assumes that there is a noticeable but weak discrepancy between two groups. One group is in a position to offer an innovation, the other to receive it. Through the complex interplay of creative associations, the innovative group has obtained some technical element. This often corresponds to the ongoing development of a whole setup [*tout un matériel*] that allows it to gain hold over its neighbors and also of a political apparatus that pushes it outward. This equipment is often military, aimed at conquest, but it is no less frequent to see that trade and trade politics, intellectual culture, and policies of civilizational expansion are all implicated. The innovative group emits a certain number of new themes. As an effect of a very fast evolution, it can literally explode and cover a considerable area in very little time, thereby impressing on its close and more distant entourage the beneficial effects of its expansion.

The receiving groups, as discussed above regarding the theme of borrowings, can only appropriate these innovations if their own state allows for an instantaneous assimilation. In groups already linked in a relatively homogenous mass, such an assimilation is easy. New themes circulate in a continuous chain up to the limits of the mass, and they will cross these limits when groups with a favorable internal milieu are encountered.

Given all this, the uniform distribution of themes, such as the spinning wheel throughout the masses of eastern Asia, is easy to understand. Having emerged at a certain point and at a certain moment that are as yet unspecified, the object and its related technical equipment have spread in a continuous temporal and spatial chain from Indonesia to India, China, and Japan.

The gaps that appear in this diffusion [process] are particularly interesting. They correspond to groups that cannot do anything with the object on offer, either because they have some elements of their own that are just as good or better or because this object does not correspond to anything useful [for them]. Such is the case, in the example just mentioned, with groups that do not have cotton or fine fibers to spin. It is not rare to see that a theme bypasses the groups with an unfavorable milieu and reaches favorable groups farther off; such is the case the world over with sheep breeding or, in Indian America, with metalworking, which jumps over considerable distances and reappears in isolated spots.

It is impossible to give constant values to diffusion. In time and space, it is clear that a homogenous mass of themes springing from a center is not able to spread evenly toward the edges. Each trait of the expanding group acts on its own account in each of the groups it reaches. We see the knife, for example, very quickly reaching all humankind, without ethnic distinctions. The ox-drawn plow, on the contrary, proves to be an instant success only with some groups and a resounding failure with others. Some traits reach distant groups very rapidly but only appear centuries later in groups adjacent to the center of innovation. Other traits remain specific to the group, impervious to any diffusion, and constitute the most profound features of the ethnic personality. Others still do not reach beyond the mass [of groups], such that their enumeration can serve to define civilizations. Some traits, finally, considered to be of universal expansion, will be used by researchers who believe they can thereby establish humankind's original capital.

As a logical consequence of the point of view we have reached, close connections appear between diffusion and survivals. The favorable state of the internal milieu governs the establishment of borrowings; their more or less prolonged preservation depends in turn on the relative stability of the group. Taking the diffusion of a given theme across a wide area, the survival of this theme will be governed not by the ethnic quality of the groups but by the constancy of their internal milieu. *In other words, the object-vestige will not necessarily persist* [*se prolongera*] *among the descendants of its inventor, but rather among groups whose internal formula is compatible with the state of the originating group at the moment of invention*. Thus, the finding among the Chukchi of a dozen objects or institutions that perpetuate prehistoric Chinese themes does not imply that the Chukchi are of Chinese origin, nor even that there existed any direct or ancient contacts between them. Having noted the same theme in first-millennium China and among twentieth-century Chukchi, it would be even less possible to induce the existence of a common ancestry in some fabled past. The survival here is but a testimony of the persistence of the diffusion of themes.

Undoubtedly, there are cases that speak for a distant kinship between certain groups. To neglect them would be to deny any consistency in the material evidence. Yet it takes more than the listing of themes to establish such real relations. This aspect of research is properly speaking historical, it has its arguments, and we will employ them in a work of an entirely different order.[5] We are not, however, concerned at present with historical research. Leaving behind the notion

of persistence, we seek on the contrary that which is unstable in human societies. We must not forget, however, that elements of historical analysis have their place in our framework. If we admit that innovative groups have little reason to hold on to the technical apparatus of their beginnings for long, and if it appears that the survival today of archaic traits is the doing of completely foreign groups, it remains no less true that diffusion is easier and will include more themes the more closely the groups are related.

Diffusion and survival appear thus inseparable. For a tool invented in first-century China (and since surpassed by a better-suited one) to survive, it must circulate. It must have passed, in the first century, from the inventor group to barbarian groups and then made its way from century to century across groups that could integrate such an object, suitable to their needs. The inventor group itself has for its part forgotten about it generations ago, with routine yielding very quickly to the pressure of new inventions, and nowadays there are some savage groups in the outer reaches of Siberia who uphold this vestige, as if it attested to some distant kinship. In order to explain the existence of such survivals within the creative group itself, a set of exceptional conditions must be called upon. These can include the maintenance of the group in question in a state of relative stability due to political events (as was the case of the Barbarians of China), or that the surviving themes were only of minor use and sufficed to satisfy some limited needs, or finally that the objects in question are dedicated to the most basic and immutable actions.

We are still not in a position to distinguish with sufficient certainty between these surviving objects, scattered as they are in space, and the surviving groups, remnants of some archaic units. The difference in evolutionary rhythms is quite perceptible between geographically favored groups (effectively, those along the Eurasian axis) and marginal groups, settled on relatively unproductive soils. For the former groups, the normal state is one of technical instability, with the rapid unfolding of evermore efficient [technical] means. If some of these means go back directly to prehistoric groups, there is little chance that much technical evidence of that has been retained. For the latter, we must admit that their evolution is slowed and also that they have borrowed considerably. If connections had existed in prehistoric times between the central groups and the peripheral ones, there are

5. [Leroi-Gourhan refers here to the *Archéologie du Pacifique-nord*, his thesis defended in June 1944 and published in 1946.]

obviously sound reasons for the latter to have preserved at least some of their [shared] archaic traits. But there seems to be no basis for connecting the survivals of these two masses nowadays. The current peripheral groups, so far as the north of Eurasia is concerned, attest to obvious mutual relationships. While some of these relationships undoubtedly go back to the common prehistoric stock, the circulation of people and techniques since then has been considerable. This makes it challenging for us to untangle today which are the long-established races and which are later emigrants. Likewise, we face difficulties in identifying who were the upholders [*tenants*] of all these techniques that, at all times, came to be diffused across this northern mass, both through the play of circulation among groups of similar levels and through borrowings from groups of the southern masses.

To these already considerable difficulties, we must now add the effect of convergences.

Convergence

"Convergence" is a burden from which ethnologists are never completely freed, a trap from which no theory escapes unscathed. With the exception of a very few cases in which the act of invention or borrowing is firmly dated, it is difficult to assert whether two identical items of evidence are of the same origin or of independent creation. This indecision has given rise to the two groups of theories that have been sparring throughout the history of ethnology: those for whom everything is in contact and those for whom everything appears spontaneously. We have not had to take sides, since we have dealt here with phenomena of borrowing and diffusion as part of the normal functioning of the internal milieu. What remains for us to examine is what these same internal properties allow for, in terms of invention and convergence.

It appears to us that, in the internal milieu, borrowing and invention pertain to the same sources. When the milieu is favorable, the same needs lead to borrowing and inventing—that is to say, for evolving groups to manifest either the effects of diffusion or those of convergence. For [the discipline of] technology, the result is not open to discussion: a certain technical level—rustic, semi-industrial, or otherwise—can be reached via two different paths in groups that may be very remote. To endow the phenomenon with its significance at a general evolutionary level, it suffices to note that this evolution is not related to a massive movement of peoples, nor does it imply any [physical] anthropological shift at a geographical level.

The play of technical associations, ongoing in the internal milieu, necessarily leads groups toward convergence. The external milieu, in view of the limited quantity of materials it offers, necessarily imposes a narrow margin for innovation. To suspend an ornament [on the body] can only be done by piercing the nose or the ears, to spin fibers is possible only by twisting them, to attach an axe to its handle only can be done following a dozen or so combinations of handle and blade. When a neighbor proposes a ready-made solution, it is borrowed, and we can thus trace, from spot to spot, the spread of diffusion. When the solution does not exist in the vicinity, one innovates, thereby creating a center of future diffusion. When the spots are clearly delimited, it is easy to affirm relationships with precise centers: when they extend to the point of overlapping, we may arbitrarily fix the location of the original center. Finally, when sterile zones are found between the points where the theme is attested, we may well suppose the existence of ancient connections or, with equal likelihood, that of convergence.

c. Technical Progress

Naturally social, human beings find in groups of different sizes the equilibrium that enables them to act efficiently on their surrounding milieu. The dimensions of the group—ranging from the isolated family (which sociologists consider to be the initial unit) to the tribe, the federation, the state, or federations of states—are governed by laws of proportion that are still little known but are nonetheless perceptible to all who have attempted to establish the historical progression of societies. Without exception, groups are all the more important the more extended are their material means [*moyens matériels*], such that a relation can be posited between technical progress and the extension of the group: to the Fuegians, barely assembled into tribes and poor in material means, we can oppose the United States. These are elementary notions of human evolution.[6]

Technical acquisitions tend to spread from one group to another, to cover, area by area, evermore extended zones in successive layers, until we see them endow with a halo all those centers where progress has materialized into inventions.

From this double notion of the progressive extension of the group and the extension of techniques has emerged the idea of the progressive diffusion of ethnic characteristics—a point of view that is, moreover, confirmed by anthropology, the history of religions, and the history of art. As the implications of the present work have become clearer, it has seemed to me that such notions, while undoubtedly accurate, might lead to the irreversible dilution of the groups. Such notions represent but one aspect of evolution, only imperfectly accounted for by the most banal observation that perfectly circumscribed ethnic units have always been in existence.

It cannot be denied that one side of evolution tends to disperse both humans (through migrations) and techniques, together with intellectual and moral values (through borrowings) by constantly breaking up established groups. But this trend is inseparable from another side of evolution, whereby human materials [*les matériaux humains*] are permanently animated by a movement of concentration into blocks of viable proportions. In order to exploit this latter aspect of the documents [the human materials], I have deliberately reduced the first, so as to temper the theoretical exaggerations that a single

6. This subject was taken up in more concrete terms in chapter 5 of the first volume of *Le Geste et la parole* [1973, 435; footnote added].

path might have encouraged. But it is indispensable to recognize that human evolution is at the same time this and that, that it is singular, and that our own inability to express unity in antitheses has led us to put forward alternatively the light and dark sides of the problem. I had believed it possible to free myself from several common conceptions and the greater part of the usual vocabulary employed. This did not come without sacrifice. It would have been fruitful to draw on a century of research bearing on the evidence I have marshaled. The almost complete absence of written work on comparative technology and its philosophical foundations has, however, largely justified my attitude. It is of no use to ignore that the same facts I have drawn upon can sometimes lend themselves to a precisely opposite interpretation. Someday I might have occasion, in taking up the same material, to contradict the propositions of the present work. Reality can only be grasped in parts, and it is superfluous to keep trying to secure a complete and animated representation of it from a two-dimensional image [of the kind we produce]. That is why, rather than incorporating theoretical considerations into the wealth of materials, I have opted here to give first the facts, independently of the philosophical apparatus: facts that will remain usable whatever the fate of the theory may be.

In the domain of technical evolution, we have come across facts that can be expressed through biological images. That is not to say that they are of the same order, but simply that the same reality can be found here and there in the manifestations of life. To the progressive diffusion of techniques can be offered the parallel example of animal species that are born, live, and die out in a movement of irresistible extension. As for the concentration that follows the specification [*personnalisation*] of the ethnic group, it corresponds to the image of living bodies, who bring together the experience of their species to secure an evermore efficient hold on their natural milieu. The term *horse* expresses the changing personality of a group of equids that has tended to specify itself since the Tertiary, much as the term Chinese is the unstable label given to a group of the yellow [populations] that has been progressively singularizing for barely forty centuries or so.

Just as modifications are almost imperceptible in palaeontology, such that we do not see annelids sprout pincers or wings ex nihilo, so technical progress has appeared harmoniously linked to the proportions of the internal milieu. It is thanks to tiny increments [*dépassements*] in the potential polyvalence of tools—so that, for example, one can file with a knife and hammer with a pair of tongs—that groups acquire new technical elements. On the whole, the evolution of techniques has

shown the same attitude as that of living beings, the same moderation, the same incapacity to create out of nothing or instantaneously, or to borrow outside any set proportions.

There is a point on which we have been more fortunate than biology: for us, no abyss separates evolution and mutation. The hereditary transmission of acquired characteristics is indeed quite normal in technology. The spinning wheel, once created, is from the onset reproduced with all its characteristics and is enriched with more adequate details, generation after generation. But mutations too appear just as normal. In one generation, by the assimilation of borrowings, a group can change its state quite radically and, without discernible transition, pass, for example, from the Neolithic to the Metal Age, from stockbreeding to agriculture, from a nomadic to a sedentary life, and from Buddhism to Christianity. The fact that the [ethnographic] documents provide such good examples relating to the two great problems of biology [evolution and mutation] should not deceive us, but this fact remains invaluable both because it unveils the fundamental identity between these disciplines (or at least their extremes) and also because its very facility can serve as a warning against hasty generalizations.

The phenomenon of invention, resulting from unexpected associations between preexisting technical elements, appears as one of the essential functions of the internal milieu. It is counterbalanced by the phenomenon of inertia, which ensures the preservation and transmission of the acquired personality. The group is embedded in its own internal milieu and more broadly in the internal milieu of the [civilizational] mass to which it belongs. Invention is forcefully oriented by these momentary values, so that it occurs in the direction of the group's personality, as a step toward increased specialization. The group is thus pushed forward toward its technical progress: thanks to personalized discoveries or to integrated borrowings, it clears the various stages of general evolution, each identified by their similar objects. These facts of technical convergence, independent as they are of time and space, give us a measure of technical determinism, comparable to biological determinism. As it enriches itself, the internal milieu continues to engage in evermore numerous and fruitful associations, and the general rhythm of evolution seems to accelerate: the very rustic Australian Aborigines [for example] appear to be stagnant, when compared to industrial Europe.

These various rhythms in the global progress of technical groups are made more complicated by the independence of each element's rhythm. Just as in the ethnic groups we can see the racial type,

language, techniques, or the arts all progressing independently of each other (with, however, a convergence toward the peak of the group), so do we see in the technical group each element evolve on its own account, while undergoing, during certain periods, the otherwise profound influence of general progress.

All this can coalesce to create an image of collective progress: technical advance [*l'acquis technique*] is not lost, and its transmission is assured regardless of political adventures. Its role, which is fundamentally to provide the group with its identity and isolate it from the corrosive influence of contacts, is prolonged in time after the death of the group in new units that arise from its debris. This survival, from which humanity draws its present state, sets technical activity in distinction to all the other domains of human activity. For the technical actors [*le technician*], infinitely more so than for others, the past adds up fruitfully to the present. Moralities, religions, and social organizations acquired in periods of political upheaval can often survive through long stretches of decadence. Innate social aptitudes suffice to re-create a framework for the groups, often reborn out of the collapse of some given civilizations. This is absolutely not the same for technical aptitudes: all their value comes from the millennia that add, one after the other, their capital of inventions. Moral, religious, and social progress [in contrast] is perpetually thrown into question: we cannot say that we have improved much on the moral heritage of the early Christians, but technical progress imposes itself without any possible doubt.

The continuity of technical efforts among humans makes of technology a discipline where the values shared with the rest of ethnology apply only in part. If we are to look for real affinities with technology, we must look to palaeontology, to biology in the widest sense. At every instant, we see that technical elements succeed and organize themselves the way living organisms do and that human creation, in its continuity, copies [*calque*] universal creation.

Similarity does not mean identity, however, and we must not forget that technology and biology are sciences that can lead to rather diverging results. Biology may hesitate to assign predetermined plans to life, but we [technologists] can attribute tendencies, intentions, indeed a goal to the thin material layer that stands [*s'interpose*] between the human and the milieu: this is because this material layer is a human creation and because humans are capable of desiring. If we propose here to juxtapose *invention* and *mutation*, *tradition* and *transmission of acquired characteristics*, this is not to take sides or to extend technological values to biological values. The complexity of biological problems is

sufficiently familiar for us to proceed with extreme caution. Biology is going through its phase of puberty, and technology is still in its infancy, but we may predict that, in the future, the proximity of the two disciplines will become increasingly clear. By confronting together the two series, the creations of nature and the creations of human industry, we will secure a more profound understanding of the general phenomena of evolution.

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Note on the Relations between Technology and Sociology, 1949

"Note sur les rapports de la technologie et de la sociologie." *L'Année sociologique*, 3e série, 2 (1949): 766–72.

Republished in *Marcel Mauss: Techniques, technologie et civilisation*, édition et présentation par Nathan Schlanger, 431–39. Paris: Presses universitaires de France, 2012.

THE THIRD SERIES of *L'Année sociologique* (dated to 1940–48 and published in 1949) was "resurrected" at the initiative of Henri Lévy-Bruhl and other scholars. As if echoing the journal's former revival after World War I, another round of homages to those tragically disappeared colleagues (Céléstin Bouglé, Marcel Granet, and of course Maurice Halbwachs, murdered in Buchenwald in May 1945) opened the way for a new generation of researchers and collaborators to the journal. The rubric "Technology," inaugurated in 1901, was now entrusted to philosopher and sociologist of work Georges Friedmann, who called for research focusing on the links between techniques, industrial progress, labor, and social and economic history.

Leroi-Gourhan wrote this contribution around 1947 or 1948, when he was a lecturer in colonial ethnology at the University of Lyon. Mauss's *Manuel d'ethnographie* had just been published, and indeed Leroi-Gourhan included some comments on this book, drawn from a review he had wisely kept unpublished. The publication of this *Année sociologique* paper also coincided with Leroi-Gourhan's first attempt to gain election to the *Collège de France* and with the revision of *L'Homme et la matière*, both in 1949. Be this as it may, this was the only piece

Leroi-Gourhan ever wrote for *L'Année sociologique*. It stands out for its seemingly "secessionist" position vis-à-vis sociology, including a fairly blunt critique of Mauss's limitations, and a manifest reluctance regarding the new turn toward "applied sociology" in the study of techniques, as promoted in the very same issue of the journal. Instead, Leroi-Gourhan asserted that technical phenomena have a primarily critical-epistemological usage, serving to assess the value of the available material evidence. As for the discipline of technology, its tasks were rather to explore possible affinities with biology and palaeontology. Regarding the "critique of documents," this text represents something of a swan song or closure for his initial "material-civilization" diffusionist and museological concerns, which he effectively left behind thereafter. In contrast, the opening up toward biology advocated here—building on his concluding comments in *Milieu et techniques* (see text 4)—announces and reorients his main research program for the two decades to come.

Note on the Relations between Technology and Sociology, 1949

It is difficult to take stock of a discipline that has no past and to situate comparative technology within the human sciences. The recent publication of Marcel Mauss's *Manuel d'ethnographie*,[1] whose first part is wholly dedicated to techniques, takes me back to those years when, reading through a text that was far from error-free, I sought the technological thought of the man who has been a guide to most of us.

What Mauss thought on technology is simple and remains valid. He sensed the absolute necessity for the ethnologist (who, for Mauss, was implicitly a sociologist) to observe the facts of material activity as rigorously and scientifically as possible. He sensed that a science of [material] evidence [*science des témoins*] ought to exist. He foresaw for this science a rigorous classificatory framework, Linnean as it were. He did not himself provide this framework, but he was able to suggest it, drawing on the already accepted divisions of human industry. We need only compare [my] *L'Homme et la matière*[2] and his *Manuel* to realize that in fifteen years of revisions, the main divisions have been retained in today's technology. This framework, already hinted at by old [Friedrich] Ratzel, is too logical not to be still usable. Mauss improved it, then handed it on so that it could be adapted to current research.

In the form in which it is preserved in the *Manuel*, the text of Mauss's lecture course on technology strikingly illustrates the persistent need for ethnology to open itself to the critique of material evidence [*témoins matériels*]: in its forty-five pages, sixty-five major errors remain; if more was needed to bring out the usefulness of technology [as a discipline], this example would suffice.

How are we then to consider technology? It cannot be as a minor complement to the study of humankind or a collection of technical curiosities duly classified. Just as history cannot be conceived without textual criticism, so ethnology is inconceivable without a critique of the material evidence. It might be possible, in some parts of the human sciences concerned with more universally human values, to prize some truth out of false documents, but it is impossible to base human history on approximate data.

Technology seems to have a primary and capital role: that of unmasking false evidence, objects whose universality does not mean

1. [Mauss 1947.]
2. [Leroi-Gourhan 1943. See text 3.]

anything, mechanical discoveries that lead to convergent types, techniques that seem comparable only to those whose naivety recalls that of ancient travelers. Palaeontology is learning to distinguish its good fossils from the bad ones—ethnology still has a long road to go.

The critique of materials demands that efforts unfold simultaneously along three paths: [classificatory] systematics, the internal critique of documents [*critique interne des documents*], and the study of historical evolution. Each of these three paths progresses to the extent that the way is cleared for the other two; taken together, they are largely sufficient for the specialist's explorations, thus ensuring that technology is destined to become a discipline in its own right, and not a mere auxiliary technique [*technique d'appoint*].

The *systematic dimension*, as in all sciences, undergoes periodic revisions. Mauss's own framework sufficed for organizing what this sociologist could glimpse of the material domain, thirty years ago. The framework that I suggested in 1936[3] attempted to introduce an understanding of the technical fact [*fait technique*] in function of the technique itself. This framework represented a break with tradition, and this may perhaps excuse its all too evident shortcomings. The classification I proposed ten years later in *Évolution et techniques* had, for me, a quite definite sense: to orient the systematics of techniques through the critique of documents.[4] Nevertheless, this classification remains far from satisfactory; to advance, two other paths will need to be sufficiently cleared.

The critique of technical documents amounts to an internal understanding of our evidence. To Mauss, such a critique could only appear as an abstraction, whose means can only be incompletely grasped. It implies a considerable scientific apparatus designed for the objective description of objects, in their form and function. Put in these theoretical terms, the problem appears easily resolved; in actual fact, it proves as difficult to describe the morphology and physiology of an object as it is to describe those of an animal species. This requires an immense and precise terminology, based on a systematics that brings out the fundamental traits of description and eliminates superfluous aspects. To describe the pottery of a certain people, or a certain type of pottery, requires specific training, of whose necessity ethnologists are not always aware. Specialists of technology are called to form an independent body of experts oriented toward the sciences; likewise, the

3. [Leroi-Gourhan 1936c. See text 2.]
4. [Leroi-Gourhan 1943, 1945. See texts 3 and 4.]

literary and philosophical branches of our discipline will increasingly have to take the material document and its interpretation into account.

This is particularly true for archaeology and prehistory, which form part of ethnology in the strictest sense and which require, more than any other discipline, the critique of their materials. One example will illustrate the risks of an insufficient critique: in a recent article concerning Merovingian tombs, an otherwise highly competent author describes the enigmatic contents of certain "purses" found near the bodies: small iron plates, fragments of flint or hard siliceous rock, and a Neolithic arrowhead whose presence is quite unexpected. This is in fact the contents of any fire-making kit as found in Black Africa today or in Europe two centuries ago; the form of one of the iron platelets was actually still in use in eastern Europe fifty years ago.

To ignore the exact nature of the evidence represents here a loss for the history of fire, but when the author suggests a "phylacteric" character to these objects, he introduces a serious error into the domain of the history of religion.

This brings us to the third path of *the history of technology*, that of an extensive critique of techniques that leads directly to history. It is repeatedly forgotten that ethnology is a historical science, much as the natural sciences are. In formal terms, ethnology does not aim at a history of states and humankind writ large, but rather at placing the human complex within its successive situations. No ethnologist has ever seriously tackled a contemporary problem without addressing or at least considering its history. Through a healthy reaction against those who, during the discipline's heroic times, saw "origins" everywhere, we are now engaging in the separate study of humanity's successive stages [*plans successifs*], so that each of us has become somewhat confined in his [chosen] century, not without developing, at times, a minor myopia. As the document is consolidated by its internal critique, we need to return to a truly historical conception of the human sciences. This may seem more difficult for the sociologist, whose material vanishes with each generation. Yet the human sciences constitute a single bloc, and, even if in a very indirect way, sociology benefits from the progress of each discipline. Suffice to recall the richness of the anthropological and technological images evoked by some facts of Australian sociology to appreciate how much the sociologist stands to gain from a better knowledge, through specialist work, of the potentialities of the bodies and of the techniques of the Aboriginal Australians.

Historical critique appears as one of technology's most fertile grounds; it requires the full implementation of its means of scientific

investigation. Barring fortunate exceptions, the oral context is lost beyond the third generation, and since written sources remain the exception, the history of humankind rests essentially on the critique of its recovered [material] remains. If we leave aside the critique of figurations, which pertains to the art historian, everything else hinges on technological interpretation. This is valid not only for tools but for all objects, given that their signification is shared between their technical usage and the social meaning they have or have had in the past.

We should not, however, fall prey to the illusion whereby comparative technology is some sophisticated passe-partout: the history of ceramics will never emerge in all its clarity from a physico-chemical analysis alone. The laboratory is a first necessary stage for [material] characterization, but we must avoid creating false evidence [*faux témoins*] in the process. Two formulas that appear similar are not necessarily comparable; it is their good fit in time and space that will attest to actual kinship. Resin-based varnish can be found in Brazil, Melanesia, and North Africa, but the identity of the procedure does not necessarily indicate their affinities. On the other hand, continuities can be evidenced between two dissimilar formulas, when the substitutions of materials are taken into account. Early in my attempts at historical research, I was mainly struck by the similarities between the bone- and ivory-working peoples around the Arctic Circle. Since then, I have come to perceive more discrete but also more secure connections, concealed by the transposition of raw materials between certain Arctic groups and their neighboring groups to the temperate south. The case of mutations in the form and materials of adzes in the Pacific has enabled me to perceive how short the distance actually is between the procedures of philology, which works on phonetically unstable words, and the procedures of technology, which needs to prize out rules of mutation. One such fundamental rule concerns axe hafting, whereby a stone axe will be sheathed, a bronze axe will be socketed, and an iron axe will be collared, with various transitions and exceptions justified by contacts [between groups]. This rule is confirmed by historical progression and also controlled through instances of regression, such as when socketed hafting becomes sheathed as bronze is downgraded to stone (see my *Archéologie du Pacifique-nord* [1946]).

These rules [of mutation] are only broadly defined, their formulation implies a lengthy prior critical experience, and the evidence is often lacking at crucial moments. But technology can already confirm how important the laws of convergence are, laws that rather seem to have escaped the theoreticians of historical evolution, at a time when

"migrations" could explain coincidences of all kinds. Technology thus also confirms that it cannot by itself explain humankind as a whole, without running that same risk of using a mere few laws to shed light on everything. It transpires then that comparative technology must proceed on other bases than those foreseen by the first ethnologists: it does not abide by the same principles as sociology does, because the technical and the social are not rooted in the same soil, because objects by and large work for their own evolution, and because techniques may always have a national style, but rarely a nationality. One of the consequences of *Milieu et techniques* was precisely to reach this conception of techniques as inevitably surpassing their inventors, through the progressive addition of improvements.[5]

If indeed the evolution of techniques has laws of its own, all the more reason for us to confront them with the religious and social sciences. Technology [as a discipline] will gain all the more significance for the sociologist as it demarcates its investigative procedures from those of sociology. Of what purpose would technology be, if it were merely to return to the sociologist a passive reflection of what they themselves have invested in it?

Thus, there is scope for some confrontation between sociology and general technology, which tends to structure [*ordonner*] the world of material activity according to its own principles. But the indispensable connection between the two does occur, when technology tackles the particular domain of the ethnic unit: an axe is an axe the world over, and yet there are as many "races of axes" as there are peoples. Here, the social personality brings all its weight to bear on techniques. Few examples attain the magnificent proportions of Iranian weaponry: dirks, knives, daggers, and sabers, whose blades are made of steel ingots from the Indies and whose handles are worked in walrus ivory from Arctic Russia. An entire continent with its technical traditions and commercial pathways is mobilized in the production of objects that in their manufacture and style are unarguably Persian. The first stage of technological analysis does not deliver anything: knife in the Asian tradition, Indian steel blade, handle in walrus ivory from the Arctic Ocean. In the second stage, the technological investigation aimed at piercing the "Why Iranian?" of the object is directly adjacent to the concerns of the sociologist. This investigation ends by linking data on military technique and general aesthetics to an exact diagnosis of the object. Rather curiously, this diagnosis makes no use of technological terminology;

5. [Leroi-Gourhan 1945. See text 4.]

it bears on the economic conditions and manual traditions related to combat habits that have favored a particular kind of steel cutting edge, and also on the aesthetic principles that govern the curvature of the handle, the winding of the blade, the soft tone of iridescent steel joined to a polished ivory handle. We would be wrong to think that this is no longer a matter of technology; it is simply the circle closing itself. It is as indispensable for those who study tools [technologists] to reach toward the men who use them as it is necessary for those concerned with individuals in society [sociologists] to securely grasp the material evidence that surrounds them.

6.

Material Civilization and Spiritual Life, 1950

"Civilisation matérielle et vie spirituelle." *Rythmes du monde* 3 (1950): 38–45.

LEROI-GOURHAN'S YEARS in Lyon were notably marked by the renewal or confirmation of his Catholic faith, which expanded from strictly personal convictions to public and scientific positions. As part of this reaffirmation, he began to participate in various Christian scholarly meetings: first, those involving Catholic missionary initiatives in the field and, later on, more official gatherings of like-minded intellectuals keen to address questions of science and society.

In this vein, Leroi-Gourhan attended the 1949–50 yearly cycle of "national study days" organized by the *Rerum Ecclesiae* circle, set up following Pope Pius XI's call in his 1926 encyclical to strengthen the Church's missionary activities both materially and morally. The study day of July 5, 1950, was dedicated to "ethnography and missions," and Leroi-Gourhan was invited to lecture there (as the event's organizer, Père de Menasce, put it) as an innovator in the study of "la culture matérielle"—as distinct from and complementary to "la culture spirituelle." The proceedings of this conference appeared in print that same year in *Rythmes du monde*, a missionary review published in Belgium. Leroi-Gourhan had already published two articles on more ethnographic matters in this review, and another was to follow in 1954.

Through the "missionary" rapprochement it makes between exotic situations and modern circumstances, this text presents yet another facet of Leroi-Gourhan's technology, quite distinct from its "civilizational" or evolutionary dimensions. His lectureship in Lyon was, after all, dedicated to colonial ethnology, as notably evidenced by the 1953 publication, with Jean Poirier, of the two-volume *Ethnologie de l'Union française*. Likewise, his creation of the *Centre de recherches et de formation à l'éthnologie* (CFRE) brought him closer to "applied" or "developmental" concerns in anthropology and technology, in France and worldwide.

The text published in 1950 differs very slightly from the typescript of the conference preserved in the Leroi-Gourhan archives. The only changes of significance I have recorded here are the typescript's introductory paragraphs (omitted from the publication), which expand on the notion of "technical behavior," and a short paragraph later in the text, placed in a footnote.

P. de Manasce.
I have the honor to present M. Leroi-Gourhan, deputy director of the *Musée de l'Homme* which, as you know, is one of the most interesting and best furnished museums in Paris.[1] M. Leroi-Gourhan is also a lecturer at the Faculty of Letters of the University of Lyon, and one of the most listened-to specialists, an innovator, in the field of the history of material culture [*l'histoire de la culture matérielle*]. I leave him the floor, thanking him for having agreed to come, not only today but throughout the year, to our meetings of the circle *Rerum Ecclesiae*.

M. Leroi-Gourhan.
It might appear at first sight unusual to address you as a representative of the study of material culture [*l'étude de la culture matérielle*], in a series of conferences that are dedicated, rather, to spiritual culture. I admit to having been somewhat embarrassed when Father Bernard-Maître asked for my topic. In fact, I will deliver some reflections which touch on the links between material civilization and moral life, and then try to prize out some of the ways in which it seems that material civilization might contribute to the goal you pursue.

Material life, techniques, belong to a discipline of ethnology which has taken the name of *technology*, and more precisely *comparative technology*. Technology has arrived very recently in our disciplines, in fact a dozen or so years ago. Previously, the ethnologist was interested in techniques from the point of view of picturesque and primitive techniques. Then, gradually, from the point of view of the documents that these techniques could provide for the history of humanity. All the broad theories concerning human migrations, population movements, or the origins of such and such civilizations have been partially or wholly based on documents drawn from material life.

In reality, all this constituted a sort of preface to technology, for in itself technology has as its first and foremost goal the study and the description of human technical behavior [*comportement technique de l'homme*]. Its goal is to identify general laws of technical behavior, those strands that may be common to humanity in its broadest sense, and those that are particular to such and such human group or civilization.

1. [Omitted from the publication itself, these five introductory paragraphs are translated here from the typescript of Leroi-Gourhan's conference presentation, as preserved in his archives at Nanterre (Arch.MSH.M-ALG 90-1-16).]

And finally [the goal of technology] is to make all that pertains to material behavior enter within the mental ensemble of humans; that is to say, the social ensemble.

As a consequence, you can see that from the outset the position of technology appears well established, both regarding the social sciences, and—a subject I will not touch on today—regarding the scientific disciplines, the exact sciences.

In sum, the study of material life, of material civilization, completes [our] knowledge of the human personality, in its broadest sense. This evolution of [the discipline of] technology is akin to that followed by ethnology as a whole over the past fifty years. In effect, the first step of our science has been the study of primitive people, and very often, when people speak of ethnology, they have in mind works on Australian Aborigines, Papuan peoples, or Eskimos.

Very often, when people speak of ethnology, they have in mind works done on Australian Aborigines, Papuan peoples, or Eskimos.[2] Such studies of primitive peoples, still conducted quite actively, are of essentially scientific interest. They have made it possible to highlight a number of social or technical traits that, it must be said, have at times been addressed in a rather superficial and picturesque way. But, as we have gradually come to realize, such studies do not in fact represent the essential goals of ethnology.

Attention has in fact shifted rapidly from these most curious peoples to the study of the semiprimitive, to the study of numerically very significant masses such as the Black Africans, and then to the study of more evolved groups and great civilizations, such as India or China. And, finally, ethnology has reached the study of modern Western peoples, be it the United States or western Europe.

As a result, we have witnessed over the past few years a progression of ethnological studies toward those facts most directly connected with the development of civilizations. It is easy to foresee that such an attitude should lead to much more fruitful works and above all to much more practical applications—applications that are far more directly useful from a social point of view than the achievements of a science still completely focused on the study of rare populations.

Ethnology is thus rapidly transforming itself into the study of humankind as a whole. In truth, while the usefulness of ethnology for the study of society and for its practical applications has been

2. [This is the opening line of the 1950 publication.]

understood in the United States for a good number of years, and especially since the last war, France has come to this realization only very recently. For some years now—especially since 1946—the French administration has turned to ethnologists to ask them for preparatory studies regarding the social and material situation of such and such group within the *Union française*. I have in mind, for example, an investigation conducted in Fouta-Djallon [in French West Africa, today's Guinea] two years ago by one of my students on the economic situation of the Fula people there. I am above all thinking of the truly innovative character of an investigation conducted last year by another student in the Landes of Gascony, during the great wildfires. The Ministry of Agriculture took the initiative of sending an ethnologist into the field to undertake a technical and economic monographic study of the population of the Landes, prior to a general development project for the Gascony moors. It is thus, at the dawn, as it were, of an ethnology where some specialists will turn to social action in its widest sense, that I wish today to talk to you about technology.[3]

Sociology, conventionally understood, grants the existence of barriers between peoples, be they religious or social. In technology, we do not have such barriers to separate peoples from one another. We realize that on the path toward material progress, a path traversing both time and space, peoples are spread out across its different stages, which they clear one after the other—and inevitably so, given that this is one of the ways by which general evolution proceeds. It is impossible to imagine material structures that might be inaccessible, at least in theory, to such and such human group. In fact, if a sufficient length of time is granted, we see that any given group, when the occasion arises, will inevitably clear the stages of material progress.

I will take this point up again later, when the question of a possible conservatism in the technical domain is addressed.

In reality, the successive technical stages that range from the primitive to the most perfected are, in each civilization, nested [*s'emboitent*] into each other. If we take our own example, we realize as we travel the French countryside that, in the same village, five or six stages of technical development can often be found superimposed. Between the hoe, still in use in some agricultural practices, and the tractor there is a distance that, from a material point of view, is the

3. This discipline [part] of ethnology has as its goal the study and description of human technical behavior [*l'étude et la description du comportement technique des hommes*].

same as the one that separates the Fula people of Sudan from ourselves. I am also thinking of the technical imbroglio I had to face during a recent investigation among Brittany peasants. Some had reached the stage of motorization while others, within the very same village, were still grinding buckwheat using a millstone whose prototype predates the Roman conquest—a millstone, incidentally, of the kind I have often observed in the Far East.

We should not therefore understand technology as the strict and narrow study of the techniques of material life. To be sure, the study of the material forms of human activity lies at the basis of our work: the fabrication of tools, pottery, basketry, weaving, food production and processing, and so on. But once this basis, which is above all a nomenclature, is established, once our materials become classified documents (exactly as in zoology, for example, the study and designation of animals provides elements to construct the whole biological edifice), once the technologist has these materials in hand, technology quickly expands in the social and the economic directions.

In reality, the study of any civilization leads us to establish indissoluble links between techniques, social structures, and the economy.

A first example I have in mind is that of a population among whom I worked in the years 1936–38, the Ainu people of the far north of Japan. Studying the Ainu as a technologist, one notices their striking technical poverty. They have practically no agriculture, no pottery, no metalworking, and hardly any weaving, living as they do in an apparent technical destitution. However, when we study the archaeology of the Ainu and their material life through the documents left to us by Japanese authors, we realize that a progressive impoverishment has taken place and that, as recently as the eighteenth century, some groups were in possession of pottery techniques that they have since lost. Studying the Ainu, at least as they were before they were entirely crushed by Japanese colonization, we realize that despite this technical dearth, they were not poor and even enjoyed quite a favorable economic situation. Thus it appears that the Ainu's technical impoverishment is due to the progressive development of commercial exchanges with the Japanese, a commerce that has been ongoing for almost two thousand years. The economic symbiosis that prevailed between Japanese and Ainu is manifest from the beginnings of the Christian era and leads to sustained commerce by the seventh and eighth centuries. Imported Japanese ceramics have progressively suffocated indigenous pottery, and likewise the Ainu had no metallurgy because Japanese steels were a particularly convenient currency for exchange.

The moment we seek to understand the technical developments of the Ainu people, we realize that this can only be done through a close study of their economic relations with Japan.

To give another example from a domain closer to us, I began last year a study on cow breeding in a small village in Ille-et-Vilaine, chosen for its location on the borderline between [the distribution areas of] Norman and Breton cattle. The study is thus of a strictly technological character. When the map of the canton's bovids was drawn—with each animal taken individually—I realized that we had been working toward a veritable bovine sociology: there were poor cows and rich cows, and the Breton cows were actually the rich ones, which is paradoxical since the Breton cow was expected to be that of bad pastures and the Norman cow that of rich farmers.

From that moment on, we have fully entered into sociology, and it has become clear that there were precise reasons for the recent implantation of Breton cattle. These reasons were firstly of a sentimental order. The lord of the manor [in the village under study], feeling himself to be profoundly Breton, wanted to introduce the Morbihan cow to the village, where it had never existed. He progressively imposed on his farmers this small black cow, which to him seemed better suited to the soil. As he did so, he had the cowsheds renovated and the manure pit concreted anew, gradually leading to a more hygienic setup. As a consequence, the Breton cattle's mortality rate diminished noticeably. The strictly statistical expression of this work quickly became a fabric of paradoxes. The moment I realized this fact, I found myself entering into a closely knit network of political, social, economic, and religious considerations.

This investigation, launched from the strict perspective of the study of material culture [*stricte étude de la culture matérielle*], has finally led me, as a last development of the questions regarding the cow distribution map, to an in-depth study regarding attendance to either free [i.e., religious] or secular schools in the local area.

I have taken two examples, one unfolding in the islands of northern Japan, the other in Brittany, precisely to show that technological problems are of immediate relevance not only when we are talking about far-flung countries but also when we are dealing with our own terrain, our own soil.

One reason pleading in favor of a conscientious study of material culture is that, when we appear before foreign peoples, our own civilization is taken, whether we want it or not, as a single bloc. When we pretend to instill a new moral or social order [among foreign people]

we are, whether we want it or not, the representatives of the automobile, the tractor, and all the achievements of our material civilization. It suffices to take the example of Roman civilization, and follow our own history through the Gallo-Roman period, to appreciate the behavior of the Gauls toward what the Romans brought materially, and toward Christianity. We need only the remains of a Roman villa or of one of those Gallo-Roman shelters, the *maquis* [as it were] during the barbarian invasions of France, to make us realize that Roman civilization and Roman Christianity, too, were taken as a bloc, with all they could bring to the improvement of material life, with vines, new agricultural practices, techniques of all kinds—so that, even if we seek to set material problems aside, they have to be put up with.

Let us now address the problem of the contact between very different civilizations, a problem conveyed by this Gallo-Roman example. When a civilization such as ours finds itself confronting a foreign civilization, the latter may adopt one of three attitudes: that of *deculturation*, that of *acculturation*, or that of *conservatism* pure and simple.

Deculturation is the inevitable result of actions taken in ignorance of locally existing structures in the social or the technical domains. When the administration claims to impose our law, or our plows, on indigenous minorities, and if it proceeds to do so without sufficient prior familiarity with the indigenous substrate, deculturation will ensue—that is to say, the creation of an incoherent state of affairs, of social and technical awkwardness, and of maladjustments, that unfortunately lead to conditions all too frequently found, not only in French overseas possessions but more generally across the world. Deculturation is the substitution of an order seen as bad [by the administrators] with an even worse disorder. When we think of the technical malaise into which certain parts of the Black African world have been thrown, it is obvious that any conscientious study of social phenomena must confront this problem of deculturation. This is an important question for you, because it is one of the reproaches sometimes leveled at missionary work. Even if the administration has sometimes gone too far, even if the accidents of deculturation seem to be inevitable, we cannot avoid considering this question very closely indeed.

In fact, such a deculturation may be a poorly understood or incomplete *acculturation*. All modern states (the United States as well as we ourselves) are gradually turning to address this problem of acculturation, which appears of capital importance at a time when social and technical tensions across the world lead to a state of malaise that increases year by year. One of the essential tasks of U.N.E.S.C.O [*sic*]

over the past few years has been to seek the causes of such tensions within societies and also to identify the pathways by which primitive or more evolved groups might be brought, through a series of conscious transitions, toward a new social, religious, or economic structure, while sparing them precisely this awkwardness that arises when one proceeds without caution and without prior knowledge of the milieu.

Over the past two years, U.N.E.S.C.O has been engaged in a very extensive worldwide investigation on the causes of tensions in the social milieu. This survey has been extended to the civilized countries, including France, where last year ethnologists teamed up with psychologists in two French *départements* to study a sizable town in the southeast and a village in Picardy. This study was specifically aimed at addressing the phenomena of social, economic, or technical malaise that can occur in a human milieu subjected to the constraints of contemporary civilization.

Let us return to the role of the ethnologist and in particular to that of the technologist. It now appears that one of the ethnologist's roles is to be an agent of acculturation, an agent of transmission, between different states of civilization. From the moment we are compelled to admit that progress in techniques is inevitable, we have to take stock of this and envisage a technology able to ensure the transitions between the [different] technical states. Here the ethnologist can play his role to the full only if he is thoroughly knowledgeable about the society he is studying. The times of travelers and their tales have long gone. Rather, years of contact with a group of people—and here you find yourselves by your very vocation [as missionaries] in a most favorable position—are necessary in order to attain sufficient knowledge of this group, in both the material and the moral domains, to be able to speak in full awareness of acculturation, to touch on the essential problems, and to avoid errors such as the state of deculturation, mentioned earlier.

Sometimes, we have been too quick. Attempts have been made to instill technical progress and social action, among the Black Africans, for example, by offering them, free of charge, plows of a more perfected type than their wretched hoe for digging up peanuts. It so happened that the new plows tore up the light and arable soil and left in its place a completely uncultivable earth.

Mistakes in the agronomic domain have been quite numerous. I am thinking again of the survey among the Fula people, two years ago, where it was shown that the agricultural methods of these Black Africans, for want of anything better, actually contributed more to the

conservation of the soil than the plows it was attempted to impose on them. This survey has also shown that, in mechanically cultivatable soils, the introduction of the plow would be desirable only if the economic status of the indigenes concerned could enable them to actually acquire these plows. In fact, among the Fula, the goal was not to introduce the plows quickly, but rather to have them acquired at a relatively modest price—without however realizing that in the region under study, the price of a plow actually amounted to a family's entire capital.

The errors made concerning cattle rearing, the long-held illusions concerning beef production among the Fula or in Madagascar, whose stockbreeders were supposed to furnish the industry with tons of corned beef, have been costly. We now see that while the Malagasy and the Fula are excellent stockbreeders, it is necessary to adapt for them an entire series of transitions to enable them to reach the [level of] economic returns that would justify the industrialization of their stockbreeding. The material transformation of a society is very often a factor leading to family dislocation. And here again—especially here, I would say, insofar as this has to do directly with the goal you [missionaries] pursue—the study of material civilization must precede any transformation in the technical domain.

There are societies whose artisanal production is based materially on a given form of family structure. During a two-year period in Japan, I was able to follow the effects of the dislocation produced by progressive industrialization in some districts. It is certain—as it has been made apparent rather painfully on several occasions—that in the parts of Japan where a proletariat of workers has emerged, this emergence was due to changes in family structure and the very profound economic and social modifications brought about by the construction of factories.

The same goes here at home, when we turn to the problem of rural exodus. That is why we consider it necessary to carry out specific research on technical structures, including a sustained study of their repercussions in the social domain.

The third attitude [in the contacts of civilizations] would be that of *conservatism*, that is to say, an immobilism that is practically indefensible. To change the moral life of a people is inevitably to impact on its material life. It is impossible to ignore that part of our role, as the French administration, for example, and your own role too [as missionaries], is the study and survey of the material domain. We have seen, through several examples, where immobilism in this domain actually leads us: it quite simply opens the door to integral materialism [*au matérialisme intégral*]. A people whose material culture is artificially

conserved (gradually appearing as outdated even to the indigenes themselves) are likely to readily succumb to the first proposition to improve their material civilization. Thus also on the most practical level, we can no longer ignore the necessity of studying technical structures.[4]

As a result, some of us think that the ethnologist, beside his strictly scientific activity, has a social role to fulfil, a role that converges at numerous points with the one you yourselves fulfil.

Technology reaches beyond material culture [*La technologie dépasse la culture matérielle*]. If we take your own case, we can see that while the missionary is the representative of a moral order, he is nonetheless addressing human beings. He may to a certain extent refuse to represent current Western civilization, but he can in no way avoid its consequences. We [ethnologists] are also in the same situation. The missionary cannot, any more than the ethnologist, refuse to play the role of link between the current civilization and the populations of whom he is, in some ways, the interpreter.

The ethnologist shares with the missionary this role of being an interpreter of the primitive [*interprète du primitif*]. To a certain extent, we can both of us understand people at once on the intellectual, the moral, and the technical planes. We can also express their thoughts and their needs, for the usage of the administration or of Westerners generally.

For some years now, we are, for our part, becoming conscious of the importance of those who have chosen to study humankind in order to lead it toward more elevated forms of civilization. You and I may remain attached on sentimental grounds to the past, to the picturesque beauty of some now-perishing civilizations. The mistake, for all of us, would be to misjudge the movement of life and, perhaps by imprudence, to let what is beautiful and viable outside Europe be blindly crushed. [In fact,] knowledge of humankind is accessible only to those who have been able beforehand to provide a solid and correct basis to the material facts of existence [*faits matériels de l'existence*].

4. ["As a consequence, we have established more or less the general tendencies and some of the aims of comparative technology. We have seen the state at which the ethnological sciences were found a hundred years ago, a state in which the study of techniques played a role either of *pittoresque*, or of contributor of documents to support some theory on the evolution of humanity, or on the migrations of people. Between these times and nowadays, the road traveled is quite long, and some of some of us think that the ethnologist, besides his strictly scientific activity, has a social role to fulfil, a role that converges at numerous points with the one you yourselves fulfil" (Arch.MSH.M-ALG 90-1-16, 18–19; omitted from publication).]

7.

Homo faber . . . Homo sapiens, 1952

"*Homo faber . . . Homo sapiens*." *Revue de synthèse*, nouvelle série, 30 (janvier–juin 1952): 79–102.
Also published as "L'*Homo faber*: La Main." In *À la recherche de la mentalité préhistorique*, 75–98. Actes de la 16ème semaine de synthèse du *Centre international de synthèse*, Paris, 1950. Paris: Albin Michel, 1953.

UNDER THE BANNER of "seeking the prehistoric mentality" (with its simultaneous allusion to Proust and to Lévy-Bruhl), this sixteenth *semaine de synthèse*, organized by Henri Berr and the *Centre international de synthèse*, took place October 30–November 7, 1950, in Paris. The first of these daily lectures, by Annette Laming of the *Musée de l'Homme* and Georges Granai from the University of Lyon, was titled "L'Histoire militante: Ses moyens"; the authors reviewed a range of science-based methods (site detection, environmental reconstruction, archaeometric studies) for the making of archaeological "documents." The next paper, "De l'animal à l'homme: Les Origines du psychisme," was an unfortunately rather rambling survey by veteran psychologist Henri Piéron. Leroi-Gourhan's own contribution, "L'*Homo faber*: La main" (translated here) was followed by "L'*Homo sapiens*: Language et sociabilité," by Belgian linguist Éric Buyssens; "L'*Homo religiosus*," by historian Paul Chalus, Berr's successor at the *Centre international de synthèse*; and "L'*Homo estheticus*," by Strasburg prehistorian and palaeontologist Paul Wernert.

This succession of "*Homo*" appraisals was no doubt prompted by Henri Berr, who had himself been toying with the notion of *Homo faber*

since the 1920s. The setting of this *semaine de synthèse* provided Leroi-Gourhan with a welcome opportunity to reconsider, and to overcome, the *faber/sapiens* dualism he had himself brazenly championed seven years before in *L'Homme et la matière* (see text 3). A key role in this conceptual turnaround was played by the flintknapping experiments of Léon Coutier and François Bordes. For their authors, these experiments served to characterize various knapping techniques and then address their distribution in time and space. For Leroi-Gourhan, however, these experiments initiated a veritable revelation with regard to the technological and indeed psychological intelligibility of lithic remains—he drew on them to foreshadow what has since come to be known as "cognitive archaeology."

The distinction between *Homo faber* and *Homo sapiens* only makes sense if we can demonstrate through prehistoric studies that, at some point in the evolution of the higher primates, a threshold was crossed beyond which beings who had been only makers gained the prerogatives of thinkers. The goal I set myself here is not so much to demonstrate this point as to establish the convincing value [*valeur probante*] of the material we have at our disposal, in order to confront this philosophical hypothesis with the evidence of history.

Whatever name we give to research on humankind's distant past—prehistory, history, or palaeoethnology—this research is historical by the mere fact that we arrange documents on a temporal scale to retrace an evolution. History here is taken in the sense of geologists or palaeontologists when they speak of the "history of the Earth" or the "history of fossil mammals." Whether or not this history is events based [*événementielle*] is a matter of terminology: the appearance of the first real horses in North America during the Pliocene is a historical fact whose event value is as precise and real as that of the first meeting of the Estates-General [prior to the French Revolution]. No one would demand from palaeontology a duly signed birth certificate for the first horse, any more than a historian would consider the date of the first meeting of the Estates-General to be the actual temporal and spatial starting point of the revolutionary movement.

Quaternary sediments can thus be taken as archives. The position of glacial moraines or loess in these sediments corresponds to dates, and the first attested occurrence of different types of knapped flints would indeed represent events. Prehistory is therefore quite simply history, a history that makes use of its own distinctive palaeographic research techniques [*techniques d'étude paléographique*].

Serious confusion can result, however, when the study of humankind *before* writing is approached from the point of view of the historian working *after* the development of writing. To belong to our civilization implies, for each individual, the acquisition since childhood of a "historical fold" [*pli historique*] in the most common acceptance of [the notion of] "history," a fold that we can rid ourselves of only with great difficulty. A well-put formulation in one of the preceding presentations [at this *semaine de synthèse*] noted that historians need all the more imagination the further they are removed from our times. This remark is correct, insofar as it refers to the scarcity of texts and to a prevailing aspiration to reconstruct a history that would resemble one obtained

from written archives. Prehistorians have at times followed that path, but their failure reflects their desire to pass for historians at all costs, [merely] by satisfying the lazy curiosity of those focused on dates and on names of tribes. This failure, moreover, bears almost entirely on the recent margins of prehistoric times, during what has quite revealingly been called "the twilight of proto-history."

On Prehistory

There is not a single prehistory but several [*préhistoires*] that progressively unfold out of each other, the further we move back from our own times, and from the criteria familiar to the traditional historian.

There is [closer to us] the prehistory of metals that abandons writing halfway through and the prehistory of the Neolithic that forges a path between historical extrapolation and the first concerns of the geologist. These two prehistories are situated in a material and social climate so similar to ours that we will not seek there any demonstrative elements of a separation between *Homo sapiens* and *Homo faber*.

The preceding prehistory is that of the Reindeer Age, from the Aurignacian to the Magdalenian. The materials it offers are still abundant and explicit: its works of art and Cro-Magnon skeletal remains would suffice to show that we are still fully implicated, insofar as we are still dealing with a humanity that is physically and mentally *sapiens*.

Then there is, finally, the prehistory that extends across the immensity of anterior times, times that are counted no longer in millennia but in geological periods. This [earliest] prehistory, on which I will focus here, is populated by human beings whom we prefer to recognize only as distant cousin relations: Neanderthaloids, Sinanthropus, Pithecanthropus, and such fossils that, beginning with the Neanthropoids to which we belong, form part of the long chain of Paleoanthropoids and Archanthropoids. Prudently, palaeontologists have given them names that evoke biological stages; less cautiously, philosophers have set up somewhere a barrier between them and us: *Homo sapiens–Homo faber* . . .

Let us therefore abandon this distinction, perhaps for good, and rather try to follow the chain of documents.

Anthropological Documents

Prior to the Reindeer Age, the paucity of human skeletal remains is striking. For human history before our own species, there are

throughout the old continent [Europe] about one hundred specimens [*témoins*] of variable value, ranging from complete skeletons to single teeth. Moreover, this material appears in two sets: nine-tenths of it concern Neanderthals (or the Palaeoanthropic stage), while the remaining tenth (which includes at best some skull fragments or jawbones) concerns a duration that must be at least a hundred times that which has followed since. When we consider what a Latinist, for example, can actually do with a mere fragment of an inscription, we should not feel too discouraged by these anatomical bits and pieces. Set within their palaeontological context, they show with a reasonable degree of certainty that human physical forms have progressed, with advances and delays from one branch to another, in a logical and regular manner, from the types closest to animality to the current [human] types.

Moreover, regarding the distinction that concerns us [between *faber* and *sapiens*], there is practically nothing to be gained from these anatomical remains, even had they been complete. Skeletons can attest to the mental personality of their deceased bearers only if they are accompanied by evidence of their material productions [*industrie*]. Human palaeontology would be a fruitless science in this respect, without the aid of prehistoric technology [*technologie préhistorique*]. It is, actually, a pleasant surprise every time it proves possible to associate products with their makers: overall, the brain of Archanthropes and Paleoanthropes appears in much better light than might be concluded from the study of their crania alone.

The evidence of material productions [*oeuvres*] is therefore of capital importance and will form the basis of the observations that follow.

Technical Evidence

The volume of technical documents [*documents techniques*] available on the distant past is considerable indeed. Barring geological perturbations, each and every flintknapped in the course of time has preserved its testimony to this day. Collected in museums, such documents run into the hundreds of thousands, while their total numbers still in the ground worldwide is literally beyond measure.

What are these documents worth? Despite debates on matters of detail, their chronological order has been satisfactorily established. The very existence of such debates is actually a good sign: when the discussion focuses on whether a group of flint artifacts belongs to "Upper Protomagdalenian 2b" or to Acheulean IV, the philosophical margin of security seems to be adequate. What these materials represent,

however, appears very limited. Barring a few exceptions, the evidence consists of cutting tools. Given that all perishable matter has long disappeared, our historical documentation is by necessity based solely on cutlery equipment and related techniques. Trivial evidence, one might think, until we recall that, in an entirely different register, historical chronicles are also documents of a limited scope. The culture of a human group leaves its mark on all its productions, and it is therefore possible to perceive this culture in the outlines of a flint knife as much as between the lines of a text. But in either case, we are only dealing with a reflection; we are free to conjecture that Java Men burst into song while working, or that they accompanied the final stumble of a wounded rhinoceros with rude exclamations of thanksgiving, just as we can imagine that the people's piety or sufferings somehow come to light through dynastic lists. In all these examples, the thread of history is extremely fragile, and imagination remains at once a resource and a risk for both these forms of history.

But the interpretation of the document itself, of the flint tool, is as rigorous as the reading of a word: over the past twenty years, experimental technology has made it possible to untangle the series of gestures [*démêler les series de gestes*] that lead to such and such form of tool. We know that the possible ways leading from the raw flint nodule to the handaxe or the arrowhead are not numerous. Give or take a gloss, we know how the Paleoanthropians fabricated their scrapers. This immediately enriches our materials of study: to follow the gestures, flake by flake, is to reconstruct with certainty an important part of the mental structure of the maker; to observe the technique become more rational from epoch to epoch is, without forsaking the strict objectivity of the historian, to give this tenuous chain of technical evidence a significance that reaches far beyond the arid chronological disposition of minerals struck by some vague anthropoids.

The Elementary or Clacton-Abbevillian Stage

It is likely that the Archanthropes, or even their predecessors, used for cutting some rocks broken up by frost or other natural forces—tools that will never be recognizable as such. As soon as the making of a cutting edge was at stake, however, the effort of their fabrication left distinctive traces. Without seeking to determine too precisely the starting point, we obviously possess thousands of pieces attesting to a very primitive phase of industry. This phase corresponds to the Clacton-Abbevillian period of the early Quaternary. Found in many sites across

the Old World and apparently associated with the Pithecanthropus of Java, this industry belongs, in any case, to Anthropoids that are still very different from contemporary humans. Making this Clacton-Abbevillian industry our point of departure thus guarantees a sufficiently wide margin of speculation. Seeking *Homo faber* earlier than the Pithecanthropes would make no sense, as this would extend the meaning of the term *Homo* beyond anatomical likelihood and takes us into a field for which we have no documentation whatsoever.

Using the criterion of the cutting stone is reasonable because its appearance implies a mental procedure [*demarche mentale*], a sequence of actions [*enchaînement d'actes*] that unquestionably establishes a boundary between conditioned reflexes and conscious technical operation. We may imagine intelligent primates that had no need for cutting and simply picked up fruits or knocked each other about with sticks. That would make it difficult to pin down the boundary between them and Anthropoids—whereas knapped stones, with their indefinite conservation, anchor research in a strictly objective point of departure.

Any mass of stone liable to provide a cutting tool, be it directly or via the flakes detached from it, is called a *nucleus* (English *core*). The basic technical procedure for exploiting this mass consists in applying, with a percussor or hammer stone, a blow that hits the striking platform at an angle perpendicular to its surface. This thrown perpendicular percussion [*percussion perpendiculaire lancée*] is, barring accidents, the only one practiced at this elementary Clacton-Abbevillian stage. The delivered blow yields from the mass of the core a thick flake with a smooth striking platform called *Clactonian flake*. This flake can be used directly as a cutting tool or discarded.

The nodule may then, after initial shaping, be transformed into three different types of tools:

1. The removal of some flakes from one of its edges gives it a basic cutting edge; this is called a *chopper*.

2. If one continues on the opposite edge and removes flakes from both sides, one shapes the point to obtain an elementary bifacial handaxe.

3. If the core is sufficiently voluminous, one can detach usable Clactonian flakes from all or part of its circumference, then turn it around and remove a new series of flakes, by striking on the ridges left by the previous removals. The striking platforms of these flakes are of a dihedral shape. The core thus acquires a particular shape and constitutes a *bipyramidal tool* that can be used on its own.

Clactonian flakes, flakes with dihedral platforms, basic handaxe choppers, and bipyramidal tools—all represent the simplest forms of technical activity known to us. While handaxes and bipyramidal tools already display considerable technical complexity, all these tools remain based on the same elementary type of percussion, and likewise their shapes abide by the physical laws that constrain them: heavy and irregular flakes, with sinuous cutting edges.

Flakes and choppers are closely linked to the shape of the core used, but the two other tool types already represent a deliberately imposed shape [*forme volontairement acquise*]. Even if still incipient, this systematic search for shapes through matter actually represents an indisputable criterion of humanity. Just as it remains difficult to separate the intention to create shapes from the constraints posed by matter, it is probably impossible to establish, in the behavior of the tool maker, a distinction between two attitudes: that of fabrication and that due to the anticipation of efficient shapes. At this elementary Clacton-Abbevillian stage, then, humans are as originally *sapiens* as they are *faber*, since they can foresee the shape of the tool in the block and they can obtain it. It therefore makes sense to abandon this vain distinction and rather examine what the humans of the following stage [of evolution] knew to draw from this first stock [*capital*] of inseparable gestures and shapes.

The Acheulean Stage

Acheulean industries can be found over a considerable part of the Old World, including Europe, Africa, and half of Asia. Their center of origin is not known, but western Europe provides a particularly coherent evolving series: while the origins of Acheulean industries might not be found there, this series seems to faithfully reflect their sources.

The nature of the material has not changed. We find large cores used for flake *débitage* and smaller ones that have been transformed into handaxes. It is nonetheless possible to observe, from the Abbevillian to the end of the Acheulean, a lightening and standardization of the shapes, as well as a diversification of the flake tools.

Most important, however, is the discovery of a new type of percussion, which is applied not perpendicularly to the mass but parallel to its surface. This percussion entails the formation of long, thin flakes, much lighter and more efficient than Clactonian flakes. When further retouched, these flakes yield a range of tools, including the triangular points that will lead to the development of the next stage.

Handaxes too benefit from these improvements in percussion techniques. When the wooden percussor is added to the stone hammer, the flintknapper progressively manages to obtain long and thin flint *limandes* [oval-shaped handaxes] with straight double cutting edges.

From the point of view of fabrication, the interlinking [*enchaînement*] with the preceding period is perfect: flakes continue to be extracted from the circumference of their cores, which thereby tend to become bipyramidal. For their part, the handaxes produced on cores are exact continuations of the elementary handaxes, except that long-flaking percussion has completely changed the appearance of the products, so much so that by the Middle Acheulean period it becomes possible to raise the issue of aesthetics.

There is, to be sure, no proof that particular shapes were being sought beyond the immediate utility of the cutting tool, nor of any search for decoration, which, incidentally, would be difficult to express in flint. Still, there are numerous indications that the natural shape of flint nodules was ingeniously used to fabricate atypical tools. Together with that, the balanced proportions and extreme care in the finish of certain pieces seem to open up a margin between the strict utility of the cutting edge and the shape obtained.

Efficient technical forms are always aesthetically satisfying solutions: this is absolutely true in present-day technology and for the Acheulean as well. It is certainly not by stressing the natural links between matter, usage, and shape that we will better distinguish the *sapiens* from the *faber*. Several hundred millennia before the attested appearance of the first humans judged worthy of being called *sapiens*, the crude Acheuleans already possessed a technical sagacity that differs from ours not in essence but only in degree.

The Moustero-Levalloisian Stage

We know very little of the physical appearance of humans in Acheulean times; that of their successors, the Neanderthals, is somewhat better known. With their eyes and muzzle sheltered by enormous orbital ridges, with their low foreheads, these beings preserved something of the stooped posture of the great anthropoids. It is largely to them that we owe the idea of a *Homo* that is strictly *faber*. If I attempt here to rehabilitate these Neanderthals, this is not to make of them bucolic creatures, somehow channeling their artistic impulse into an evermore refined lithic *débitage*. Indeed, they have left sufficient evidence of their realism: we know that they could easily resort to cannibalism and that

they lived surrounded by trash and rotting carcasses in their untidy shelters. But we will appreciate that it was really the Neanderthals who accomplished the technical revolution that was to oversee the development of our own material evolution.

We know that the rise of contemporary industrial civilizations became possible when bronze, the alloy of two rare metals, was replaced by iron, a metal that exists in mineral form almost everywhere, and in large quantities. This substitution entailed two crucial consequences: an indefinite multiplication of tools and a certain degree of autonomy of civilizations with regard to raw material sources. While the importance of the widespread dispersal of iron for recent civilizations is clear to us, we are less aware that a comparable phenomenon has already occurred and that the Palaeanthropes had to resolve a problem exactly comparable to ours.

The handaxe, while relatively useful as a cutting tool, also has some technical drawbacks. During the first part of the Acheulean, it took about one kilogram of flint to shape twenty centimeters of usable cutting edge. In the course of the Acheulean, a judicious use of elongated flaking gradually lowered this quantity to about five hundred grams (forty centimeters equals one thousand grams). It was, however, impossible to go any further, while still remaining within the handaxe mode of fabrication.

Additionally, being an all-purpose tool, the handaxe also presents the drawbacks of multiple tools, including a lack of convenience for usages that demand great precision. As a costly and no longer really perfectible tool, the handaxe would gradually make way for new forms.

The modes of evolution occurring during that period are not known to us in detail. The available documents give the impression that humans undertook the synthesis of all prior acquisitions in order to arrive at a new formula. This included striking the core in parallel to its external plane, the use of ridge reduction on the second series of flakes, leading to the Clactonian bipyramidal tool, and the use of truncations by thin retouches resulting in the more slender handaxes. The coordination of these diverse procedures has led to the systematic *débitage* of the Mousterian triangular point and of the Levallois flake.

The analysis of these preexisting elements—Clactonian, Abbevillian, or Acheulian—is exactly of the same kind as what we might undertake today with airplane technology. Taken and studied in isolation, the airplane appears as the almost miraculous coordination of four thousand years of metallurgical advances. Such an analysis does not help us to grasp the details of the individual procedures that

govern evolution, but it does show that, at this Acheulean-Mousterian level, there are no differences in global technical behavior with the modern level.

Let us then examine how the average Mousterian of the Riss-Würm interglacial, contemporary of the straight-tusked elephant, has learned to produce all-purpose knives in a series. To obtain the standard model, it is necessary to select in a quarry a nodule of flint, several kilograms in weight, while taking account of any holes and cracks that might appear in the core to be shaped. This mass is then peeled off with heavy blows to remove the cortex and remaining irregularities, to the stage where a series of parallel removals will make it possible to extract a first series of triangular flakes. For each flake, a precise preparation is needed, including the following:

a. striking off two short and deep flakes on the striking platform, one on each side of the future point of impact;

b. preparing a series of removals on the striking platform, both for ensuring that the blow will impact on a narrow and precise point and for giving the platform of the future point a "*chapeau de gendarme*"–like convex shape that can provide a short tab for grip or fixation;

c. striking off, with a well-measured blow, the crest of the median ridge to lighten the future point and narrow it at the platform by giving it a surface perfectly suited for gripping;

d. finally, striking and detaching with a single blow the tool in its definitive form.

That makes six or seven successive operations, performed in a rigorous order, by calculating several strikes in advance the result to be obtained in a precise area of the core, with all the irregularities of a raw material that each time prompts new reflection.

Such fabrication cannot be compared with the technical behavior of insects or beavers, nor with the stereotypical acts of a present-day machine operator [*actes stéréotypés d'un maneuvre actuel*], but rather, for example, with the work of a good wood craftsman who calculates, prior to each application of his tool, the extent to which the grain, the knots, or the desiccation of the material will influence the final result. Mousterians too fashion [*compose*] with flint and pour their gestures into the mold of matter [*coule ses gestes dans le moule de la matière*], exactly like artisans of all times. They are in full possession of the art of their period, and it is not for nothing that we *Homo sapiens* have given such varied meanings to the word *art*: art and craft [*art et métier*], aesthetics, and techniques are inseparable and constitute precisely the primary attribute of humankind.

The triangular point is an incomparably preferable tool to the handaxe, in two different domains.

1. The *débitage* of triangular flakes (generally regular and flat) ensures the possibility of a considerable diversification of technical objects whose production was previously impossible: knives, pike heads, spearheads, *racloirs* [side scrapers], *grattoirs* [end scrapers], burins, and so on. This *débitage* furthermore creates elements preexisting the invention of blades.

2. Once the core has been prepared, the extraction of points proceeds quickly and allows for considerable economy in raw materials: the average ratio of usable cutting edge per one kilogram of material has moved from twenty centimeters to two meters. This makes it possible either to transport a relatively light reserve of raw material whose *débitage* can serve to fabricate makeshift tools or to knap at the quarry and carry away a substantial length of usable cutting edge in the form of finished points. In both cases, the result is a considerable emancipation [*affranchissement*] regarding the sources of raw materials and, as a consequence, the possibility of choosing settlement sites in function of their overall convenience and no longer [solely] in view of their proximity to quarries.

The evolution of triangular points did not take place in a single step, and it combined with the evolution of another important product: the Levallois flake. The handaxe had several advantages, and its flat and wide shape could accommodate certain technical habits that the triangular point could not. In the course of extracting a triangular point from the core, there comes a moment when the latter acquires the general shape of a tortoise shell: bulging on one side, lightly convex on the other. It appeared one day that a blow delivered to an appropriate point on the edge would detach a large leaflike flint flake, with cutting edges. First noticed [by late nineteenth-century researchers] at the site at Levallois-Perret [near Paris], this characteristically shaped flake has been given the name *Levallois flake*. It proved suitable for multiple uses, either directly, or retouched, or when transformed into a very thin bifacial handaxe. The extraction of such Levallois flakes made it possible to use already exploited cores and also to obtain flakes of considerable surface area from small nodules or pebbles from which regular points could not otherwise be extracted.

The study of Levallois *débitage* can shed at least as much light as that of the triangular points on the technical behavior of Paleanthropes and shows that this behavior cannot be distinguished from that of present-day humans. The cores for points could maintain

an irregular shape: if the material were abundant, the cores could be exploited, then discarded. The Levallois flake, on the other hand, requires a core on which each preparatory removal is judiciously placed. In the regions where the technical need for Levallois flakes was significant, or where flint existed only as small nodules, such preparation became the main operation, as each core could yield only a very limited number of large flakes. The surface of the future removal is thus meticulously prepared: by centripetal removals to obtain a typical Levallois flake; by elongated and convergent removals to obtain a large triangular point; and, finally, by long parallel removals when the first blades begin to appear.

These two types of removal—the triangular point and the Levallois flake—open up several perspectives. The triangular point, as we saw, results from the lateral *débitage* of the core. On small cores, however, the operations previously listed serve to shape, on the upper side, ridges that reproduce the lateral aspect of the larger cores and yield a single large point. We are indeed far removed here from apes [haphazardly] bashing rocks together! In addition, we witness in the course of the Moustero-Levalloisian period the appearance of the first parallel-edge blades, and this appearance concludes the evolution of the major technical operations on flint. Until the Bronze Age, indeed, no other procedure would be available to obtain blanks for fashioning different tool types. Likewise, the Upper Palaeolithic cores, as well as the Grand-Pressigny nuclei belonging to the first copper daggers, would take up with minor variations the chain of preparatory gestures [*chaîne des gestes préparatoires*] we have just examined.

Thus, thousands of years before the effective presence of anatomical *Homo sapiens* has been recorded, the treatment of flint reached its apogee, and the last economic revolution, that of blade production, had been accomplished. Blade *débitage* represents in effect a new stage in the emancipation [*affranchissement*] with regard to [raw material] sources. The numbers provided here correspond to an average magnitude, but they are sufficient for expressing this progressive autonomy. From one kilogram of raw flint, Abbevillians obtained a heavy handaxe with twenty centimeters of cutting edge; Acheulians progressively increased the usable length to forty centimeters (two handaxes); Moustero-Levalloisians brought the length to two meters (ten flakes); and the discovery of the blade core makes it possible to reach five meters (twenty-five blades). We also observe, as this evolution unfolds, that settlement sites are distributed farther and farther from areas in which flint is common.

To complete this presentation of Moustero-Levalloisian techniques, it remains to specify that progress in systematic flintknapping has been accompanied by an enrichment and diversification of tool types. At the Clacton-Abbevillian stage, the existing tool types correspond to the following associations of raw flakes: with bipyramidal tools (Clactonian); with basic handaxes (Abbevillian); or with choppers (chopper industry). At the Acheulean stage, tool types continue to develop: handaxes, thin and elongated flakes, tools on pointed flakes, scrapers (cf. Kelley, *Acheulian Flake-Tools*).[1] At the Moustero-Levalloisian stage, the list has considerably expanded: alongside the handaxes that survive in limited usages or in certain regions, we find toward the end of this stage also typical tools—points, scrapers, Levallois flakes—to which are progressively added disks, small cores worked into planes or graving points, end scrapers, the first true burins, the first *raclettes* [side scrapers], the first knives, both naturally backed and backed by ventral retouches (so-called abri Audi points), notched pieces, and a host of occasional tools. With the transition to the Upper Palaeolithic and the first discoveries of Aurignacian *Homo sapiens* skeletons, blades acquire an overwhelming importance, and the flintknapping industry takes on a new aspect—yet almost all flint tool types have long been in existence.

Thus, when we follow the paths of technology, nothing entitles us to distinguish a *Homo* who would be *faber* from a *Homo* who would be *sapiens*. So far as forms are concerned, nothing allows us to mark boundaries using aesthetic considerations; in fact, the search for beautiful forms has its apogee somewhere between the final Acheulean and the early Moustero-Levalloisian. If we try to understand the complex relations between the search for efficient tools and the constraints of matter, we cannot in fact place a limit at the point where current humankind appears, and furthermore we notice that the evolution of flint working was already completed in Palaeanthropian times. The only perceptible criterion [for this distinction] would be the appearance of art, but we now know that even full-fledged Mousterians did actually collect curious fossils. Moreover, we shall never know whether the Sinanthropus might not have had lyrical inclinations. It therefore seems that the separation [*dissociation*] of *faber* and *sapiens* is fallacious one and actually of very little help in understanding the origins of humankind.[2]

1. [Kelley 1937.]
2. 1952: I first outlined the subject matter of this communication in 1948–49

at the *École [pratique] des Hautes Études* and again, in the same year, in two courses at the University of Lyon, before presenting it here at the *semaine de synthèse*.

The study of flintknapping [*débitage du silex*] is based both on my own experiments and on the research of [Léon] Coutier and [François] Bordes. Bordes has recently published several studies that shed remarkable light on the typology and distribution of Mousterian industries and that confirm evermore clearly the technical development of that period.

I would also like to highlight the importance of my exchanges with Harper Kelley, who has assembled at the *Musée de l'Homme* a unique sum of specific evidence regarding the technique and products of the entire Lower Palaeolithic. Lastly, in discussing the last part of the evolution of the Mousterian and its consequences for the early Upper Palaeolithic, I have drawn on the materials provided by our own excavations at Arcy-sur-Cure.

8.

Techniques and Society among Animals and Humans, 1957

"Technique et société chez l'animal et chez l'homme." In *Originalité biologique de l'homme*, 11–27. Recherches et débats du *Centre catholique des intellectuels français* 18. Paris: Fayard, 1957.

Republished in *Le Fil du temps: Ethnologie et préhistoire, 1945–1970*, 110–23. Paris: Fayard, 1983.

FROM THE MID-1950s to the early 1960s, Leroi-Gourhan regularly attended the activities and debates of the *Centre catholique des intellectuels français*. These participations resulted in five articles in the CCIF's publications, as well as some debates that were left unpublished. In addition to the spiritual and religious affinities he felt toward the center and its objectives, his welcome presence there as a "lay scholar" provided him with an opportunity (he would have been hard pressed to find elsewhere) to theorize and generalize on questions of human evolution and technology. While Leroi-Gourhan's first intervention, "What Is Human?" (1955), had a decidedly theological tenor, his subsequent ones were more oriented toward questions of science than of faith: "Where Is Ethnology" (1955), "Techniques and Society among Animals and Humans" (1957; text 8), "Animal and Man" (1957), "The Technological Illusion" (1960; text 10), and "Materialism and Human Sciences" (1962).

Leroi-Gourhan's contribution presented here, with its key developments on technicity, anatomy, memory, and language, prefigured in several key respects *Le Geste et la parole*, published a decade later. This contribution formed part of a debate (held on October 27 and 28,

1956) on the "biological originality of humankind," proceeding under the premise, as set forth in the volume's preface, that modern biology could provide elements of synthesis toward a humanistic "totalizing wisdom," as perceived by the "twin geniuses Bergson and Teilhard de Chardin." Alongside Leroi-Gourhan's, other contributions to this debate included "Human Psychism and Animal Psychim," by ethologist and parapsychologist Rémy Chauvin; "Toward a Bio-psychological Definition of Man," by Piagetian psychologist and primatologist Michel Goustard; and "The Biological Limits of Humanism," by neo-finalist philosopher Raymond Ruyer.

Techniques and Society among Animals and Humans, 1957

To address the problem of the biological originality of humankind amounts, for the [physical] anthropologist, to a return to the very foundations of their discipline: it is to revive the old human and monkey phantoms and to pursue a debate that has lost none of its topicality and urgency over the past two centuries. Yet it has long been well established that forms spread out in progressive order [*les formes s'échelonnent en ordre progressif*] across all the realms of the living world and that it is difficult to demonstrate the presence of an abyss that would separate the zoological human being from the rest of the vertebrates. While the hypothesis of mutations that at some point marked the boundary of the human can still be maintained with some plausibility, the scope of the transformations implied diminishes a little with each new discovery. The biological originality of humankind lies perhaps less in its zoological dissimilarity [from other species] than in the fact that humans are human without having thereby lost any of their continuity with the living world.

Among the philosophical commonplaces that come up insistently where humanity is concerned, the distinction between *Homo faber* and *Homo sapiens* quite conveniently ensures a retreat toward the imprecision of general values. Some consider *Homo faber* and *Homo sapiens* to be two stages that allow for distinguishing humanity proper from some vague infrahumanity. Others take these notions to mark a juxtaposition, in each human being, of two humanities that are more contradictory than complementary. The distinction *sapiens–faber* reflects the polarization of human undertakings between the life of speech [*vie de la parole*] and the life of acts of material existence, between the humanities [*les humanités*] and techniques, between speculation and manual work. This dualism has progressively intensified as societies evolved, projecting back to the origin of humankind a recent outcome whereby the orator insulates himself from the worker. The distinction between the maker and the sage [*le fabricant et le sage*] would be futile to anthropologists if they did not perceive the intimate relationships that have linked speech and techniques from the very roots of human societies.

In a sense, it is pointless to place all our stakes on prehistoric humanity, as it were, and to demand from the Pithecanthropian the solution to "our" enigma. We would deserve our disillusion when, reaching back from the human to the prehuman to the monkey, we

would not find waiting a milestone on which a prescient hand had engraved: "Look no further!" On the contrary, everything leads us to think that the perfect continuity of the providential economy in all the manifestations of the sensible world suffers no break at the precise moment when those beings appear who confer signification onto this world. Therefore (and even though it is essential to gain evermore detailed knowledge of the forms that immediately precede our own), the biological originality of the human being has to be established beyond the imprecise zone of transitions. It is to be sought in the significant value of a continuity with the living world, rather than in a hypothetical negation.

To discuss the biological originality of humankind starting with technicity [*technicité*] and with organization into social groups might seem inappropriate, for two reasons: first, because techniques and social structuring are, at first sight, original [to humankind] and, second, because both seem to be only very indirectly connected to the anatomical or physiological domains implied in the formulation of the problem. In fact, we might contest the value of a postulate that implies that, since the mental originality [*originalité psychique*] of humankind goes without saying, the anatomist is left with the accessory task of seeking out supposed proofs of their material originality [*originalité matérielle*]. Human palaeontology, which, as noted above, needs to be bypassed so as to escape the dilemma of humans and monkeys, does, however, contribute invaluable testimony: the only biologically irrefutable criterion of humanity is the presence of tools. In undecided cases, when palaeontologists search for the boundary milestone, the only testimony judged to be decisive, the ultimate proof that archaeological excavations will eventually be continued for years, is the stone flaked by hand—by a hand that, by this very fact, becomes human. If anatomists necessarily resort to technological evidence [*témoin technologique*] to distinguish the hand bones of a monkey and those of a supposed human, this is because there exists, within their own [disciplinary] field of action, a fundamental challenge regarding the technicity of living beings—a technicity that implicates at the same time organic structures, the neuromotor equipment, and the manifestations of the mind.

Organic Technicity

Over the past hundred years, palaeontology has made the most important contribution, since antiquity, to the means by which humankind thinks its existence. From the invertebrates of the early Palaeozoic

period to the Neanderthals, this immense chronological picture has served as a frame for an ongoing intellectual revolution. Like history, palaeontology has invested much effort in establishing the event-based [*événementiel*] framework of its materials. Its long rows of fossils have only little by little begun to come alive, illuminated by the methodical confrontation between fossils and living beings, between the anatomical traits of the vestige and the behavior of its nearest survivor. It is within this inexhaustible stock that we ought to find some food for thought on technicity.

Since the origin of animated beings, functional organization implies a highly harmonized coordination between the organs of relation [*organes de relation*] that inform the living being, the organs of prehension [grasping; *préhension*] that ensure their acquisition of food, and the locomotive apparatus [*dispositif locomoteur*] that enables them to explore the external milieu. Relations, prehension, and locomotion, with the neuromotor and neurosensory systems they imply, are so closely connected since the earliest forms of animal life that any modification of one of the terms presupposes the modification of the two others. More precisely, the functional ensemble corresponds to a rigorously synergetic whole. At the very beginnings of palaeontology, [Georges] Cuvier formulated the law of correlations that made perfectly clear the synergetic character of animal organization. Since then, however, the analysis of organs has usually prevailed over the study of functional ensembles. This way of proceeding [admittedly] corresponded to the indispensable advancement of knowledge and to the need to ensure the value of the palaeontological material. Yet it could be of considerable interest to take up again the confrontation between function and organ, from the particular angle of technicity.

When we consider the animal world as a whole, we find walking mammals: in each [animal] order, certain families became specialized in rapid walking, losing the technical use of the hand. This is, for example, what distinguishes hares from beavers, the former using their hands only very little for purposes of grasping, while the latter do so intensively; this is also what distinguishes dogs from raccoons or felines; and this is how, even among primates, we perceive clear differences between monkeys such as the colobines and the anthropoid apes. The technical use of the hand corresponds therefore to functional typology and not to zoological systematics: this is because among the features offered by each systematic group, there are some privileged forms as regards the possibilities of technical action. It is worth noting that these forms are not the most evolved ones, in an anatomical sense, but

rather those that have preserved the five-finger hand of the primitive reptiles and bear witness to the initial indetermination of the front limbs, between locomotion and technical operations.

Another very consequential observation needs to be made. For all the animals considered, the technical use of the hand entails a significant evolution of their posture, namely, the acquisition of the seated position that liberates the front limbs. Rodents or carnivores who practice well-developed grasping share their life activities between locomotion, when they are quadrupeds, and the seated position, when one or both hands are freed. In these forms, the link between the anterior part of the head and the hands is very close, and the anterior field, in squirrels, for example, is equally divided between the facial pole and the manual pole.

The primates confirm the definitive importance of manual technicity, for reasons that bring out the synergic value of the links relation–prehension–locomotion. Monkeys represent the largest set of tree-dwelling mammals, where arboreal locomotion seems inseparable from the very origins of this species: locomotion in their case is a sequence of graspings involving all four limbs. Like the other grasping mammals, they divide their existence between quadruped locomotion and the seated position with freed arms, yet prehension, and manual grasping in particular, remains the dominant action in these two moments of their active life. Monkeys are thus the first in the zoological series to present a field of relation clearly polarized toward manual action. What their study teaches us regarding the variations of manual technicity [*technicité manuelle*] and of facial technicity [*technicité faciale*] is thus of primary importance for our understanding of human technicity.

The facial technicity of primates involves the lips, the front teeth (incisors and canines), the tongue, and the entire apparatus behind the face that governs the interplay of these organs. Manual technicity for its part involves the hand and forearm as well as the entire apparatus that governs the seated position, that is to say, the musculature and skeleton of the entire body from the neck to the feet. Studying the behavior of living animals makes it easy to establish for various species the relative importance of the locomotive role of the hand, the proportions of the vertebral straightening in the seated position, the manual or buccal participation in the transport and peeling of food, or the intervention of the teeth in manifestations of aggression. It is then apparent that monkeys form a set of surprising variety. Not more here than in inferior zoological groups, this variety does not correspond

to the classification of zoological families, but rather to the particular behavior of each species. This variability transpires very clearly in the relative proportions of the thumb (which materializes manual aptitudes) and of the roots of the canines (which express the mechanical importance of the anterior facial apparatus).

Within the framework of this overview, I cannot go into much detail,[1] but the following could be noted. While the form of the hand stands in direct relation with the importance of the seated position, and consequently with the form of the vertebral system, the canines, which structure the face, stand in direct relation with the cerebral part of the skull and its insertion onto the vertebrae. The two criteria chosen thus implicate the totality of the bodily apparatus [*dispositif corporel*]. Their respective variations are highly significant regarding the vertebral straightening [of the body] and the mechanical liberation [*libération mécanique*] of the osseous brain case. Yet we observe that the development of the thumb and of the dental roots are inversely proportional: the species with developed thumbs are also those whose seated positions are the least constrained by suspension on the front limbs and whose canines have the most reduced roots, leading to the "least bestial" faces. We may add that they are also the ones whose skull base is most comparable to that of humans (even though the distance remains great) and whose cranial cavity is proportionally the most developed.

It thus appears in a very precise way that, from species with little-developed technicity all the way to monkeys, the organic apparatus of mammals with manual technicity is oriented toward the development of the thumb, the vertebral straightening of the seated position, the mechanical reduction of the facial organs, and the creation of a cerebral space freed from a structural link between the dental apparatus and the spinal cord.

From this point, it is possible to envisage the transition from monkeys to human beings. This, however, can only be done by somewhat fiddling, as it were, documentation that, up to now, has not yielded forms that ensure a certain transitional form between living monkeys and even the most primitive forms of the human group.[2] Indeed, whether we are talking about the Australopithecus of southern Africa, Pithecanthropians, Sinanthropians, or Atlanthropians, not to mention the multiple forms of Neanderthals that are already very close

1. See my article "Du quadrupède à l'homme: Station, face, denture," *Revue française d'odonto-stomatologie* 2, no. 8 (1955): 1021–33.
2. See my "L'Origine des hommes," in *Qu'est-ce que l'homme? Semaine des Intellectuels Catholiques, 7 au 13 novembre 1954* (Paris: Horay, 1955), 50–60.

to the current human being, the organic originality of anthropoids translates into a functional apparatus [*dispositif fonctionnel*] most of whose elements can be found in the animal world but whose synergetic grouping is uniquely human. The essential trait has to do with locomotion. Humans have feet that we can imagine to have been arboreal in a very distant past but that appear, starting with the Australopithecus, as adapted to walking on the ground. In other words, the human foot has undergone evolution in the same direction as the walking mammals' feet, while the human hand has undergone the maximal possible evolution in the direction of prehension. This anatomical paradox reflects the complete separation between the front limbs and the organs of locomotion, the vertical position during walking and the vertebral straightening—all characteristics that are originally human. From a functional point of view, this anatomical situation results in an almost total preponderance of the hand in technical actions; the facial organs intervene only occasionally. Due to this fact, the facial structure finds itself considerably lightened, even in relation to the most gifted monkeys, and the mechanic link between the front and the back parts of the skull only creates accessory constraints on the cranial cavity.

On the strictly organic level, then, it would seem that the human apparatus, for all its links with the animal world all the way to the depths of its origins, responds to an absolutely original functional formula. Let me add that, to the extent that we are considering functional characteristics alone, the differences between the most primitive forms of fossil anthropoids and *Homo sapiens* are only a matter of proportion.

Technicity and Neuromotricity

The progressive increase in brain volume is a phenomenon shared by all vertebrates. The wealth and complexity of motor associations increase in synchrony with the various directions taken by functional evolution. So much so that, since the beginning of the Tertiary era to the present, improvements in the neuromotor equipment have followed those of the organic apparatus. It is not necessary here to follow those tendencies [*tendances*] that have led to the elimination of the hand as an organ of the anterior field, nor to consider the grasping animals for whom manual technicity remains tributary to facial technicity. In the case of the latter [grasping animals], it is noteworthy that neurology has been able to show, at the level of the cerebral cortex, aspects that correspond to an already very precise motor differentiation for the frontal facial region. It is only with the primates, when manual

technicity becomes preponderant, that the study of the cortex, which progressively extends over the cerebral hemisphere of the superior species, becomes of direct interest for our discussion here.

Those cells that ensure the most highly differentiated motricity of the body's parts are located in the area of the cerebral cortex between the frontal and the parietal regions, on either side of the Rolandic fissure. The size and density of the cells and their extensions are proportionate to the importance of the precise motricity of the organs most frequently engaged in technical operations. For a monkey, these privileged organs are the thumb of the foot, that of the hand, the tongue, the lips, and the guttural organs; for the human, the thumb of the hand, the index and little fingers, the tongue, the lips, and the organs of phonation. Differences between the privileged organs of the monkey and those of the human are negligible, apart from the foot (which only confirms what I said earlier about the human foot). But there is no comparison between the extension and density of the cells in the two instances. This seems at first sight to be a purely quantitative difference, which would hardly reflect the cerebral originality of the human. Once again, the human situation is not established beyond some [would-be] fracture, but rather in the development of a vocation in which specific features never go against general ones.

The development of the areas of finely coordinated motricity is not a matter of chance. It takes place in the first region of the brain to be freed from the mechanical constraints imposed by the facial complex and by the insertion of the back of the skull onto the spinal cord. This region is comprised within a frontal-parietal triangle whose summit is directed toward the base of the skull. Among humans, the possibilities of extending this triangle are greatly enhanced. The first strip, situated along the Rolandic fissure, is enriched by associated areas that little by little establish an extraordinarily complex network of connections. Organized around the summit of the triangle (where the cells pertaining to the motricity of the frontal facial complex are located) are the different regions where auditory and visual representations coordinate, to ensure that the facial organs' motricity is oriented toward the production of the organized sounds of language.

The functional situation specific to the anthropoids (hands independent from locomotion and the vertical position) appears then to be closely linked, in the cerebral domain, to the possibility of a highly organized phonetic expression. This explains why, despite the apparent regression of facial technicity, the motor centers of the

face have maintained an importance at least equal to those of the hand. The human field of relation thus preserves a technicity that, like animal technicity, is shared between hand and face: however, this technicity takes on a specifically original aspect, in that the facial pole is cerebrally adapted to the emission of organized sounds. We may note, moreover, that there occurred a surge back onto the manual field when language extended to plastic representations and to writing. This observation is of great importance when we consider the evolution of anthropians themselves, from Australopithecus to *Homo sapiens*, since it establishes a close link between the emergence of language and that of genuinely human manual technicity, as indicated by the first fabricated tools.

If we remain with the facts established by palaeontology and physiological anatomy, the organic originality of the human appears with great clarity under two guises that are complementary rather than contradictory. Under the first aspect, the technicity situated in the frontal field of relation turns out to be an absolutely general fact, attested very early in the development of animal life and present in insects as much as in vertebrates. The modalities vary from one group to another, yet it is possible to say of humans—as it is of bees, beavers, or macaques—that their technicity, centered on the frontal field, is shared between the extremity of the front limbs (which in the human has become the upper limbs) and the frontal facial organs. The other aspect on the contrary confirms the original character of each functional formula. The human formula is in no way identical to that of the superior primates or to that of the best-organized invertebrates. Even if we grant that certain social insects possess a system of communication comparable to a language, this language bears no organic relation with the conscious phonicity of the human being.

Mental Originality

Conscious phonicity and manual technicity raise one last problem, that of the mental originality [*originalité psychique*] of the human technician. Complex technical operations are as surprising in animals as they are in humans. Beyond an organic analysis, which accounts only for possibilities of execution, there remains the mystery of the transmission of chains of gestures [*chaînes de gestes*] leading to similar results from one individual to the next and across generations. Palaeontology and anatomy have here an auxiliary role, and comparative psychology becomes the discipline of choice.

The execution of chains of gestures whose gathering [*assemblage*] constitutes a technique assumes the existence of some memory, of whatever nature, be it that of a freshly hatched insect, a mammal tending its young for the first time, a human being, or indeed a weaving machine whose behavior is inscribed on perforated tape. Several centuries of studies have multiplied our perspectives on the nature of animal memory, usually qualified as instinct. While we are no further advanced today regarding the nature of instinctive memory than we were in the early days of research, we at least possess precise indications concerning the form of its relationships with technicity. We are perhaps even less enlightened about human memory, given that the mind [*psyche*] is frequently considered as an imprecise whole, called "intelligence," and that particular aspects of technical behavior have rarely been analyzed.

On a strictly technical level, the behavior of an isolated invertebrate, proceeding instinctively with operations of food acquisition or with (often very complex) operations of construction, appears to be underlain by a memory of hereditary character. This *hereditary memory* [*mémoire héréditaire*][3] belongs to the species and not to the individual, whatever its mode of fixation in the species. Moreover, this memory seems largely to escape the individual's control, insofar as individuals can be led, in experimental conditions, to pursue an unfolding chain of operations under perfectly absurd conditions. The hereditary technical memory is rational on the level of the species, yet in the individual it takes the form of an automatism. While we will encounter some exceptions below, animal technical memory is thus hereditary, specific, and automatic, and all the more clearly so among lower zoological groups.

When we rise through the zoological ladder, along the parallel series of invertebrates and vertebrates, individual exceptions to the automatic unfolding of operational chains [*chaînes opératoires*] become more numerous. An increasing number of learned things manifest themselves among the still-dominant hereditary stock of knowledge [*choses sues héréditairement*]. The importance of this *learning memory* [*mémoire d'éducation*] is marked in the higher vertebrates, birds and mammals, and takes a very noticeable place among the most evolved of them, carnivores and primates. This learning memory is of a completely different character from species [or hereditary] memory, as it cannot be transmitted via genetic paths, while the processes of

3. [This memory is variously referred to here by Leroi-Gourhan as "species," "genetic," or "instinctive" memory.]

cerebral integration it involves differ from those of species memory. Neurophysiological experiments have shown that in monkeys, experimental lesions of the frontal part of the triangle of the cerebral cortex (discussed above) provoke the disappearance of learned operations, while instinctive behavior subsists. This underlines the importance, with regard to technicity, of the cerebral areas whose development is linked to the evolution of the primates' posture.

The fact that the learning memory is not hereditary implies that its fixation no longer occurs on the level of the species but rather on that of individuals, who acquire it through personal experience or through transmission from other individuals of their species. This consideration, valid for all forms of conditioning, is all the more important for the higher species. The capital of knowledge that is transmissible through education forms a significant part of technical behavior and rests on a group of individuals that in certain specific cases may not necessarily belong to the same species. Thus, for different reasons, the two forms of technical memory find their preservation guaranteed outside the individual itself, with instinctive memory providing the individual with behavior inherited from the species and learning memory offering it a sum of knowledge possessed by the social group.

When we move from the level of the higher animals to the human level, we find again two forms of technical memory, but in proportions that give their association a profoundly different character than it has among animals. Instinctive memory is reduced to feeble vestiges, or rather, it is buried as the substructure of operational processes and totally eclipsed by the learning memory. Regarding memory, much as with the organic and neuromotor aspects of technicity, the human situation is neither a compromise nor a divorce; it is no more a hypertrophied animality than it is the negation of the laws of the living world.

Human memory, for its part, is molded into language; it is totally socialized and constitutes a capital of practices transmissible from one generation to the next. Its transmission does not occur through series of gestures dynamically incorporated within the limbs, but rather as a series of symbols, objects, and values. Speech is a verbal tool that can be isolated from the mouth that emits it, in the same way the manual tool can be isolated from the hand. Speech and tool thus appear, at the two poles of the field of relation, as the solidary consequences of the specifically human version of a process whose development can be traced back to the origins of the living world.

The most obvious consequence of the total replacement of instinctive memory by learning memory is the individual's dependence

in relation to the social group. The technical behavior of individuals becomes inconceivable outside the collective apparatus in which language is, strictly speaking, the seat of memory. Individuals finding themselves isolated at birth, as in the case of wolf children, would have to start from a human point zero and would be, socially speaking, individuals without technical memory. The nature of the relationships between human beings is thus fundamentally different from that prevailing between animals, who are grouped according to species and for whom social memory is at best an additional support [*appoint*]. The distinctions between groups of humans lose all zoological value insofar as there is currently only one human species. On the other hand, grouping by categories [*des groupements catégoriques*] as clear cut as those between species does exist at the level of society and of language. The transition from zoological to ethnic values is specifically human and is expressed in the transgenerational permanence of systems of reference common to individuals sharing the same language.

Another specifically human consequence of the substitution of genetic memory by social memory is the cumulative character of technical achievements. Being exterior to individuals, the social memory cumulates [*totalise*] individual innovations from one generation to the next, which is not the case for any form of animal memory. This setup contains within itself the means of its own progress. The inextricable link between language and technique, present in the thought [*pensée*] that uses the hands to act and the face to speak, appears even more clearly at the moment language reaches the hand via drawing and writing. The sum [*totalisation*] of technical acquisitions takes an astonishing rhythm, when there are no longer any physiological limits to the accumulation of knowledge, when the memory of all the technicians of all times and all places becomes available to any individual in a library. The accelerating enrichment of technicity increases even further with the apparition of mechanical memories that extend individual memory through the programs of automatic machines or calculating machines.

The study of technical behavior is certainly one field where it seems most difficult to isolate humankind from the animal world. Psychology, by multiplying examples of animal species that build, cultivate, and stock-breed, that speak and use tools, seems to condemn the search for human originality to ineluctable failure. Palaeontology has long accustomed us to the existence of ever more ancestral forms, whose origins can be traced to the common trunk of all living beings. The physiology of the nervous system increasingly specifies the functioning of a cerebral organ whose competencies progressively reach

those of thought. So much so that the notion of a humanity without a common measure with the rest of the living world, when confronted with the irrefutable character of scientific achievements, has become less compelling than it has been for many centuries. But it has never been denied that human beings are, in their materiality, in total continuity with the material world [*monde matériel*]. This makes it difficult to understand the fear that some might feel when we pass from the implicit perception of this materiality to the [actual] demonstration of its reality across time.

It would be even more difficult to understand if this demonstration were thought to exhaust the problem of the nature of the human. The topic addressed here is precisely the one best suited to showing how behavioral originality [*originalité de comportement*] fits with the common evolutionary current of all living beings. It also shows how, while one side of the problem excludes human biological originality, the other shows nothing but originality in human behavior—and that, without resorting to dialectics or to demonstrations of unity within complementary antitheses. To retain a strictly scientific grasp on the facts, it suffices to realize that on the biological level, human originality does not reside in a dualism that would oppose the zoological human being and the spiritual one. That would be purely and simply to deny the validity of the biological evidence. This negation would be all the more serious since we have seen the very close integration of specifically biological evidence, such as bodily form or neuromotor organization, with the evidence of techniques and language. The borders of the biological are thus deeply implicated [*engagées*] in the intellectual domain. Would this amount to integrating the greater part of the human, including techniques and language, into the shared animal stock [*fonds animal commun*]? The immediate consequence would be to create a new abyss, this time no longer between humanity and animality but within the human itself, generating a new contradiction. It might be that this contradiction is defensible, since it is couched in the traditional distinction between *Homo faber* and *Homo sapiens*, but I have refrained from situating the problem on a level that, at least for the moment, escapes biologically founded observations.

It is, on the contrary, by taking on board a necessary link between human thought and the language that expresses it that we have been able here to prize out the biological originality of humankind—an originality that is to be found in their body and their technical behavior, in their means of verbal expression, and in their social organization that ensures the transmission and the progress of their achievements.

9.

Technical Behavior among Animals and Humans, 1957

"Le Comportement technique chez l'animal et chez l'homme." In *L'Évolution humaine: Spéciation et relation*, 55–79. Bibliothèque de philosophie scientifique, *Institut d'études des relations humaines*. Paris: Flammarion, 1957.

THE VOLUME *L'Évolution humaine: Spéciation et relation* is the outcome of a study day held in 1957 (date unspecified) around the notions of human "speciation" and "relation," in conjunction with the *Institut d'études des relations humaines*. The volume appeared in the collection Bibliothèque de philosophie scientifique at Flammarion, an editorial undertaking somewhat comparable to (and probably competing with) Henri Berr's historic synthesis collection. The topic of "speciation and relations," set up by the collection's editor, Paul Gaultier, was found to be rather enigmatic by most authors. First among them was palaeontologist Jean Piveteau, the director of Leroi-Gourhan's 1954 science thesis (*Mécanique vivante*). In his text, Piveteau linked the origins of human speciation to "the liberation of the hand, and the development of the brain, in both absolute and relative sizes." Anatomist Jean Anthony from the *Muséum national d'histoire naturelle* followed with a substantial comparative study of the human brain, including a range of references and illustrations (e.g., the homunculus) that would be reproduced by Leroi-Gourhan in *Le Geste et la parole*.

Leroi-Gourhan's own text was also a substantial one, developing a range of important concepts, from the *chaîne opératoire* to different

technical behaviors and memories. Interestingly, its first couple of pages provide the kind of disciplinary background and systematics he often dispensed with elsewhere. The paper by ethologist Jacques Nouvel from the *Muséum national d'histoire naturelle*, on "the animal sources of human behavior," was rather anecdotal. That by psychologist Jean Piaget, on the other hand, focused on the "epistemology of relations," including its logical and analytical dimensions ("relations of modification" and "relations of conservation"). Piaget's paper also mentioned some general principles of Gestalt psychology, with references to Wolfgang Koehler and Max Wertheimer. In Piaget's view, "a scientific epistemology is necessarily genetic: the epistemological study of any intellectual instrument supposes the prior assessment of its psychogenesis, for only the examination of the laws of formation of this instrument of knowledge will make it possible to highlight its real epistemological signification."[1] There are indeed several analogies to draw between Piaget's "genetic epistemology" and what may be called by extension the "genetic technology" of Leroi-Gourhan. Be this as it may, this 1957 study day provided a rare (attested) opportunity for these two scholars, apparently colleagues for several years at the Sorbonne, to exchange views or at least listen to each other.

1. Piaget 1957, 145.

Technical Behavior among Animals and Humans, 1957

Given the time limits allocated in this colloquium, I will not undertake here the history of research already conducted, be it from psychological or physiological points of view, on the technical behavior of humans and animals. The technical behavior of animals has been the subject of a very large number of studies, some geared to the neurophysiological understanding of tropisms and others to a psychological appraisal of behavior, an appraisal that encounters some difficulties in avoiding anthropomorphism. The technical behavior of humans has also been widely studied, though less perhaps than that of animals, but as much from the physiological and mechanical points of view as from the psychological one. Likewise, research has been undertaken on relations within the human–animal ensemble, taken in palaeontological (that is, historical) terms. This, however, was carried out either from the anatomical angle, which reflects only a very limited share of physiological behavior, or through the prehistoric products of human industry, where only a limited sector of the psychological problem can be addressed. This present colloquium will provide an opportunity to outline the totality of the relations that underlie technical behavior, both human and animal, both psychological and physiological, both present and past.

Although it is impossible to dissociate the technical operation and the technical gesture that implements it, we are bound—if only by the necessities of language—to address these two phenomena of technical behavior in succession and to consider in turn the psychological and the physiological sides of the problem. In its widest sense, *technical behavior* [*le comportement technique*] refers to the ensemble of psychosomatic attitudes that, for a given organism, result in a material action on the external milieu. Technical behavior is thus expressed in a material contact that extends the predatory impulses or the protective reflexes. It is oriented toward activities that for the most part ensure the acquisition and consumption of food. For certain species, moreover, it includes specific acts of creation, namely, techniques of fabrication.[2]

2. This elementary division, valid for all technical activities throughout the living world [*monde animé*], constitutes the very basis of the division of human techniques into techniques of acquisition, consumption, and fabrication. Understandably, we will only consider in this current overview the techniques of vital subsistence and leave aside the techniques of the figurative or social domains.

In this very broad sense, the notion of technical behavior is equally applicable to all animated beings. Even where techniques of fabrication are concerned, there are numerous spectacular parallels between animals and humans that have been so exhaustively examined as to become classic. It is enough to mention, at random, bees and wasps that build, ants that garden, ants that stock-breed lycaenid larvae, sticklebacks' nuptial constructs, the burrows of tundra voles, the nests, shelters, burrows, lairs of a very large number of species [and so forth], to appreciate the extent to which the technical operation is not determined by the taxonomic status of the technician [organism].

In the technical operation, behavior manifests itself by a chain of gestures, the operational chain [*la chaîne opératoire*] whose unfolding involves, among both animals and humans, complex reactions that may be qualified for the sake of convenience as *operational memory* [*mémoire opératoire*]. This operational memory, which is identical in its object at all degrees of the series that links invertebrates to humans, appears in its essence in two different guises at each extremity of the scale, that is, aspects traditionally associated with instinct and with intelligence.

On the strict level of operational memory, and taking into account the extremes represented by insects and humans, these essential differences can be characterized by reference to the transition from species-specific memory to socialized memory. At the level of the insect, the operational memory (which governs the chain's technical gestures) is fundamentally hereditary and species specific and results from a genetically transmitted neurophysiological setup. This means that at the individual [insect] level, memory manifests itself by an automatic reaction to the stimuli of the external milieu, in a state of perfect relation between matter, tool, and the neuromotor circuit.

At the human level, operational memory is independent of hereditary structures. It relies on the individuals' neurophysiological virtualities, but it is in itself a pedagogical phenomenon, and thus a social one. Having considered these extremes, we see thus two forms of operational memory emerge: that of insects, which, taken in the egg and isolated, possess a [species-]specific complete operational memory, and that of humans, who are almost completely devoid of any specific operational memory, but who rather draw together elements of the collective memory they acquire in the course of their extrauterine existence.

The technical behavior of humans is thus fundamentally collective: the sum of operational knowledge is included in the social organism, and its use is a function of the means of preservation and transmission available to this organism. Hence, the development of human technical

activities and the development of language appear closely linked from the very beginning. Throughout the evolution of human societies, this close relationship between techniques and language manifests itself in the parallelism between, on the one hand, the growing efficiency of techniques and, on the other, the development of means for securing and transmitting knowledge—through speech and, later on, through writing and mathematical symbols. With the emergence of metallurgy, collective operational memory surpasses the limits of the memory of isolated individuals. This provokes the emergence of specialists, and subsequently the apparition of technical literature, leading nowadays to procedures of recording and of mechanical or electronic elaboration that overtake the neuroassociative possibilities of the human brain.

This essential aspect of human operational memory, at once historical and social, has as a neurological corollary the emergence of a high degree of technical consciousness. While individuals at all times and in all societies have no other starting point than collective knowledge, they also have, as individuals, the possibility of exercising their judgment on collective memory, of comparing or associating its elements, and of personally giving rise to new technical forms. Such that, in the unfolding of the technical progress, inventors, as individuals, are the exact complement of operational memory as a social phenomenon.

I

Between the two extremes represented by the insect and the present-day human, the analysis of the chain of gestures characteristic of technical operations reveals categories of operations that reflect the progressive overtaking [*franchissement*] of species-specific memory by socialized memory. This overcoming can be regrouped into three levels: (i) inferior animal operations, (ii) superior animal operations, and (iii) human operations.

i. *Inferior Animal Operations*

On the inferior animal level, the triggering of operational memory is linked to the automatism of reflexes. The operational chains are immutable (at least in the range of historical observation) insofar as the external causes that trigger them remain identical. Gesture and tool are merged within one and the same organ, without transpositions or overtaking [*dépassements*] such that the operational series appears to represent the maximum of specialization.

ii. *Superior Animal Operations*

On the superior animal level, among the canidaes or the monkeys, automatic memory is still of preponderant importance, but there are clear possibilities for exceeding it. There is, consequently, an incipient individual technical consciousness, which, incidentally, differs significantly in canidaes and monkeys. Among the leading individuals of very superior forms, such as chimpanzees, we can even see the elementary control of operational chains and a serialization of gestures [*mise en série de gestes*] invented for nonhabitual technical actions.

The first traces of sociocultural speciation also appear together with the first signs of technical consciousness at this superior animal level. To the acquisitions of hereditary operational memory is added a collective memory that intervenes in the training of the young by the adults. The contents of this collective memory can vary from one population to the next as a function of the characteristics of the milieu, and it is therefore prone to evolution at a rapid pace. Acquisitions through education have very different characteristics from those that are inherited. Even if the repetition of series of gestures may lead an isolated subject to acquire reactions comparable to those of hereditary memory, these series remain likely to degrade over time and to require the presence of an at least crepuscular technical consciousness. That is why it seems to me necessary to distinguish the *automatic* behavior [*comportement automatique*] associated with hereditary memory from the *machinal behavior* [*comportement machinal*] that pertains to acquired memory. The notion of *machinal* knowledge is of considerable importance when seeking to reach the palaeontological development of human technical behavior. From the moment when the liberation of the hand and of the parietal-occipital region of the brain ensures the physical virtualities of technical behavior, mental evolution needs to be understood alongside the functions that make possible the surpassing of a specific mental level. These functions imply the collective totalization of knowledge in socialized memory and the individual totalization of knowledge in machinal behavior. In order to detail this point of view, let us consider three possible states of technical behavior of a chimpanzee of average mental aptitude.

1. Adults that were isolated at youth and held in captivity without any attempt at oriented education remain below the average aptitudes of their species. Their behavior hardly differs from that of most monkeys, inferiors from the cerebral point of view, placed in the same conditions.

2. When left free among their group, individual chimpanzees acquire a relatively considerable sum of knowledge in the technical and social domains. This knowledge, acquired and integrated at a young age, corresponds to the normal proportions of collective memory within a society of chimpanzees.

3. Several experiments teach us that young chimpanzees, when placed in situations of human education, largely exceed the technical level of their groups and can acquire a relatively high number of operational chains. These operational chains allow them to surpass their specific mental level by the machinal incorporation, within their zoological limits, of elements that belong to the socialized memory of the human species.[3]

These considerations show that there is no strict relation between the cerebral structure of the species under consideration and the technical level to which it can accede. Rather, there exist some possibilities of interspecific training [*dressage interspécifique*] between forms placed on neighboring taxonomic rungs, which, for the mentally inferior species, amount to a veritable surpassing [*dépassement*]. Let us grant that for a long part of their palaeontological development, the anthropoids must have unfolded alongside forms at different degrees of evolution. This makes rather less surprising the apparent contradiction between the dissimilarity of skeletal vestiges and the perceptible uniformity of [stone] industries.

iii. *Human Operations*

Specifically human operations are characterized by the overriding importance of machinal operational chains [*chaînes opératoires machinales*], acquired through education. Most material operations are made up of chains that unfold in a crepuscular state of consciousness—and this consciousness intervenes with lucidity only at the essential points of these operations. This machinal state of behavior is not, however, to be confused with automatism, since it remains at every moment

3. The point here is not to suppose some modification of acquired neurophysiological structures, but rather the bringing into play of all specific virtualities. At their maximum use, these virtualities lead to a functional equivalence between two neighboring taxonomic rungs, with the lower rung acting at the upper limit of its virtuality, while the upper rung preserves an important margin of surpassing [*marge de dépassement*] (as in the supposed case of a technique shared between Neanderthals and *Homo sapiens*, living contemporaneously in neighborly relations).

liable to be oriented, but it does constitute a considerable economy in terms of technical consciousness. In parallel with the deployment of mechanic acquisitions that mark the transition from quadrupedal locomotion to the biped whose hands are totally freed, we can observe the progressive deployment of thresholds [*paliers*] of operational behavior.

These thresholds, whose separation in the unfolding of technical operations can only be theoretical, are as follows:

—the level of primitive *automatic memory* [*mémoire automatique primitive*], limited among humans to true reflexes or physiological impulses;

—the level of *machinal memory* [*mémoire machinale*], acquired during childhood and adolescence through training [*dressage*] on the basis of socialized memory, especially through visual and verbal education—and which oversees the majority of technical acts;

—the level of technical lucidity [*lucidité technique*], which regulates or innovates operations and whose associating elements are to a large extent acquired through education, starting from the superior forms, verbal or written, of socialized memory.

Thus [the domains of] operational motricity, verbal or written symbolism, and associative consciousness all appear to be deeply embedded [*engrenées*] in human technical behavior. It will not come as a surprise to observe, later on, that these three domains are precisely those most clearly marked in the progressive spread of the cerebral neopallium, as the brain develops from primate to human.

To undertake the study of technical behavior would seem to imply the specific study of the tool, which, by all appearances, is the prime evidence of the technical operation. In fact, while the tool is a necessary element in the unfolding of the operational cycle, it exists only through this cycle and within this cycle, and it is inseparable from the gestures that render it technically efficient. That is why the study of the tool is in itself only of museographical or functional-morphological significance. Between humans and animals, there exists a profound difference regarding tools. Animal tools, which, with very rare exceptions, are irremovable, are species-specific, whereas human tools, which are normally mobile, are not [species-]specific but rather ethnic. They present the same characteristics of socialization as does human operational memory. This brings up a very fruitful point in the talk of Mr. [Jean] Piveteau, namely, the substitution, on the human level, of strictly psychosomatic values by sociocultural values—in other words, the preponderance, in the human being, of ethnic speciation.

Yet the tool cannot be considered as the support of operational memory. Techniques are a gestural chain within which the tool is strictly speaking an "instrument," participating, that is, in the setting up [*agencement*] of a structure. Hence the fact that the tool loses its technical meaning as soon as it finds itself cut off from the gestural context: prehistory and archaeology abound with technical objects whose meaning was lost as soon as the memory of their usage had faded.

II

The technical operation is a gestural complex [*complexe gestural*], and it is therefore indispensable to complete the psychological study of the technical gesture with its phylogenetic study. On the human level and within a strictly historical framework, the development of technical activities is closely correlated with the evolution of language and writing. We can thus suppose some phylogenetic relation between the development of gestural complexes and that of articulate expression. Here we connect with what Jean Anthony brought out in an earlier talk, particularly regarding [C. U. Ariëns] Kappers's interpretation of the equal importance of the cerebral motor centers that govern the groups tongue–glottis–lips and thumb–ring finger–little finger. We have seen in this talk that in the progressive development of the cerebral neopallium, from monkeys to humans, the three territories of the cortex whose evolution is most striking are Brodmann area 44, associated with language; area 4, which is that of motricity; and the neighboring areas with neuromotor associations. It is important to note, moreover, that the distribution within the motor area 4, in relationship to the whole of the body, gives equal importance to the motor innervation of the hand and that of the phonetic organs. As it happens, the phonetic organs are anatomically situated in an area of essential technical importance: the frontal facial region.

Among both humans and animals, technical gestures involve a wide range of organs, of which the most commonly used are the hands and the front teeth or lips. From a mechanical point of view, all mammals show a clear-cut morphological distinction between the front teeth, which are tools of acquisition, fabrication, or predation, and the cheek teeth, which effectively form the entrance of the digestive tract. The high number of animal species where the frontal mouthparts and the extremities of the front limbs contribute to technical actions should make us consider a possible phylogenetic relation between these two groups of organs and a possible balancing out of their proportions.

Throughout the mammal series we can envisage a specific relation between the liberation of the front limbs, the grasping ability of the hands, and the regression of the front teeth (or their specialization for joint action with the hands). We know as well that among humans there is a close relationship between the acquisition of the upright posture and the liberation of the hands, such that the triple relation hands–posture–frontal facial area deserves to be assessed.

Palaeontologists have been struck by the relation hands–posture, but I do not think that the subject has been addressed from a sufficiently comparative point of view. The animals for whom the extremities of the front limbs ensure functions other than locomotion can temporarily free their hands, and they do so in ways that differ according to the orientation presented by the axis of the body when the front limbs are free.

The vast majority of cases consists of animals that free their frontal limbs in a horizontal or subhorizontal position. Three groups can be distinguished:

—those where support is ensured by the other limbs. This is the case of insects, for example, where the interplay of the front legs and the mouthparts is made possible by support on the other limbs.[4]

—those that have, at least when at rest, a very oblique bipedal attitude. Equilibrium is then ensured by the tail, which constitutes a counterweight to the body inclined forward. This is how kangaroos, jerboas, and certain dinosaurians ensure the liberation of their hands.

—those that dispose of their hands when in a recumbent position, or with one hand placed on the other limbs in alternation, as felines or bears do.

Insects apart, all these animals are grasping animals who possess relatively complete and flexible hands. In the case of the walkers, whose anterior limb disposition does not allow an efficient liberation of the hand, the area of technical activity is concentrated in the buccal extremity. Those walkers that have a complex activity can complete their dental apparatus with particular organs, such as the trunk of elephants or tapirs or the upper lip of sea cows.

The second group is that of animals where the freeing of the hands takes place in the seated position. There we find some rodents such as rats or squirrels and the majority of monkeys and anthropoids. These animals' existence is characteristically divided between two

4. It is important to note that in many arthropods the front legs tend to be incorporated with the mouthparts.

modes of posture, walking in a horizontal quadrupedal position and at rest in a seated vertical position. Curiously, human palaeontology has paid little attention to the seated position among primates, even though a good number of them pass the larger share of their existence with their spinal cord upright. There is furthermore a direct relationship between the greater or lesser importance of the seated position, the more or less advanced position of the occipital hole,[5] and the degree of complexity of manual actions. Leaving aside the rodents, which have no immediate bearing on our theme, we note that cynomorphous monkeys have two vertebral positions, that of walking, in which the vertebral axis presents the curving characteristic of upright quadrupeds, and that of the seated position, in which the vertebrae form an arch with an anterior concavity to ensure that the head has a posture that conforms to the position. The great anthropoids present a different setup, which is not necessarily a transition toward the bipedal position. The proportions of the limbs are such that, in both quadrupedal locomotion and in the seated position, the spinal cord preserves the same anterior concavity. Chimpanzees or gorillas thus are not divided, as the cynomorphs are, between the horizontal and the vertical position. They are perfectly adapted to the seated position, since this position determines (also in humans) the anterior concavity of the vertebral axis, as well as an inclination of the head. This gives the cone of manual activity the radius that the hand of a squatting subject can reach on the ground.

The third group is that of mammals in an upright position, to which belong, in part, the gibbons and, completely, the Australopithecenes and the anthropoids. Gibbons need to be considered apart, as they are in fact associated with the vertebrates who use bipedal locomotion with a balancer, while their hand is technically active only in the seated position. Australopithecenes and anthropoids can, on the contrary, make technical use of their hands during locomotion, and this brings the technical activity to a totally new dimension.

5. In all vertebrates, the position of the occipital hole is closely related to posture. Different mechanical formulae are present in animals with aquatic locomotion and the terrestrial animals with crawling quadrupedal locomotion (sauromorphs), erect quadrupeds (theromorphs), semiquadrupeds, and vertical bipeds. The position of the occipital hole (and of the basion in particular) is taken into account here in order to express clearly and succinctly the characteristics of an anatomical complex that involves at once the skull, the vertebral axis, and the limbs—an anatomical complex that is directly linked to the modes of posture and locomotion.

Up to then, in effect, the essential acts of predation or defense implied either the exclusive use of the front teeth or the combined use of dentition and hands, with the hands only serving to maintain or to push aside the adversary.

With the acquisition of upright locomotion, it is no longer anterior dentition that takes on the main role as weapon and tool, but rather the hand. Suffice to consider the dentition of the anthropoids, not yet totally freed, and that of the Australopithecenes and the subsequent anthropoids, to posit with reasonable certainty the existence of a proportional balancing between the hands and the front teeth.

This first outline proposed here on the relation hand–posture shows that, among the groups where the liberation [of the hand] is more or less secured, the mammals with seated and upright positions are those that offer the widest examples of manual technicity. It suffices to consider beavers, rats, hamsters, monkeys, and anthropoids in order to realize not only the importance of the relation hand–posture but, as we shall see, that of the relation hand–posture with anterior dentition.[6] We should note, finally, that rodents, primates, and anthropoids are the mammals that possess the most complete digitary formula. The opposability of the thumb, partial with rats or total with humans, stands in a proportional relationship with the characteristics we just examined.

The link "hand–posture" can be expressed, among both primates and anthropoids, by the relationship prevailing between the diversity of operational chains and the position of the occipital hole. While it may seem paradoxical to link together traits of technical psychology [*pyschologie technique*] and an anatomical characteristic, it is evident that technicity stands in direct relationship with the means potentially provided to it by the equilibrium of the body in upright position. Australopithecenes seem to contradict this view, since they are perfectly bipedal and certainly much below humans in their technical achievements. Yet despite their indisputable superiority over monkeys, Australopithecenes are rather small-brained bipeds. Until their discovery, human palaeontologists clearly favored the "brain–upright

6. In basing this discussion on anterior dentition, we simply take advantage here of the osteological documentation, given that the skeleton alone is accessible from the past. In fact, we should consider anterior dentition and the mobile parts of the face, lips, tongue, and nostrils in their totality. This will help us understand the nature of the relations between the face (where olfaction, touch, taste, technicity, and phonetics are concentrated) and the hand (which is at once touch, technicity, and gestural expression in support of phonetics and writing).

position–hand" triad, whereas now it seems that cerebral expansion cannot really be considered the driving motor of human evolution.

The situation of the occipital hole provides a convenient expression of the vertebral apparatus and, consequently, of posture. Importantly, there is a direct relationship between the position of the occipital hole and the proportions of the facial bloc (figures 9.1–9.6). This relationship, posited by numerous authors for nearly a century, has been given in the classic works an explanation to which we obviously cannot subscribe. In effect, if we posit that upright posture was acquired as an effect of the expansion of the brain, it becomes impossible to give the same explanation for equivalent anatomical facts (reduced face, upright position, free hands) for the Australopithecines with their 700 cm^3 brains and for contemporary humans with their 1,500 cm^3 brains. On the contrary, there has been a constant and certain relationship between the locomotive apparatus (expressed here by the position of the occipital hole) and anterior dentition, from the first terrestrial amphibians up to and including humans. Among primates and anthropoids, it is actually possible to follow with precision the modalities of this relationship, which is mechanically independent of the relative volume of the brain. It is possible to establish relations between the development of manual possibilities and the specific position of the occipital hole and of facial regression. Moreover, this morphological evolution can be followed through the different stages presented by almost purely quadrupedal monkeys like colobines, monkeys sharing quadrupedal and seated positions (like baboons), monkeys possessing a predominant seated position like lutungs, anthropoids walking in a semiquadrupedal way, and anthropoids.

The regression of the front teeth can be expressed by the straightening of the mandibular symphysis, which in humans leads to the acquisition of the chin. This straightening is mechanically linked to the migration of the occipital hole toward the lower side of the skull, and there is a constant parallelism between the inclination of the symphysical axis and that of the floor of the base of the skull (clivus) in all mammals. Yet the clivial portion of the skull is linked to the occipital hole, that is to say, ultimately to the vertebral axis and to posture, and not to a cerebral surge that would here paradoxically take place in the most structured part of the cranial apparatus (figures 9.1–9.6).

The mechanical liberation of the back of the skull takes place in the course of the phylogenetic evolution of primates through the straightening up of the spinal cord. When this happens, cerebral pressure is exerted not on the base but precisely on the areas of the vault

that are mechanically freed, that is to say, on the parietal-occipital region. The demonstration is clear when we look at a dog such as a Pomeranian (figure 9.2), whose skull base remains identical to that of the other canids (figure 9.1) because it is bound, as they all are, by quadrupedal locomotion. However, the dog's intense cerebral expansion results in the development of the brain in the only area that is mechanically free: that of the forehead and the nasal-frontal sinuses. In primates and humans (figures 9.4–9.6), the liberation of the cranial vault appears as soon as the advancing occipital hole transports the vectors of temporal-masseter tractions to the front part of the petrous bone. As [Antoine] Delattre has indicated, the free sector develops between the frontal-parietal region and the base of the squamous part of the occipital bone. This territory, Jean Anthony has shown, corresponds to the progressive expansion of the neopallium and to the development of the areas of motricity and of associative sensibility. It is thus evident that the relation brain–posture does exist but appears as a subsequent development.

To sum up these observations on the physiological aspect of technical behavior, we may say that there is a close relationship between the liberation of the hand and the degree of technicity of animals and of humans. For the higher forms of operational behavior (among rodents and primates), there prevails a relation between manual technicity and the upright seated position.

Concerning the forms where machinal behavior begins to overlay automatic behavior, the evolution of the hand–anterior dentition–upright posture complex brings out, through the mechanical freeing of the back of the skull, an additional relation with the expansion of the cerebral neopallium. The constancy of the hand–anterior dentition–upright posture relation and the coherent phylogenetic unfolding of this relation do indeed present the expansion of the brain as a consequence of human evolution toward the vertical posture, and not as its cause. On the contrary, once the liberation of the cerebral cavity has been secured, it appears, from species to species, to be preadaptive to each of the stages of the mechanical structures that come into play in technical behavior and the cerebral structures that make use of their virtualities.

This leads us to the following conclusions:

For the ensemble of arthropods and vertebrate animals, technicity is linked to a gestural behavior whose most elaborate forms consistently involve the front limbs, associated with the front part of the face.

Mammals consistently present a relation hand–dentition that begins with the absence of manual technicity combined with a very specialized anterior dentition and spans all the way to the frontal dental regression combined with manual technicity that ultimately involves a movable set of tools.

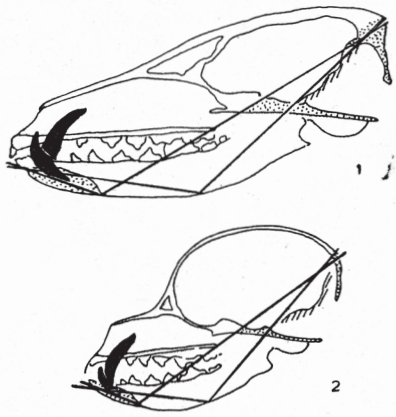
For the higher forms of technicity, the liberation of the hand is secured by an upright posture whose first term is the seated position. It is in the course of evolution toward the complete vertical equilibrium of the torso that a reflected technicity [*technicité réflechie*] appears, marking the transition from species-specific memory to socialized memory. This passage could only occur through a correlated increase in the cortical centers that control the movement of the hand and the centers of articulate language.

Finally, the relation between manual technicity and the [increased size of the] brain seems conceivable only in conditions where the cerebral layout does not appear as the motor of physiological evolution, but rather as one of its immediate consequences.

Figures

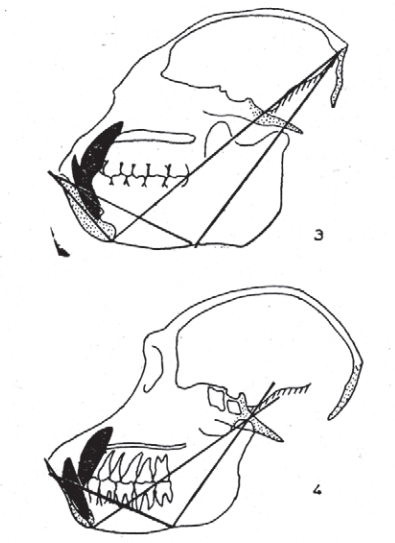
Longitudinal sections of the crania of canidae, primates, and humans. The filled lines represent the respective vectors of the tractions by the temporal masseter muscle on the anterior teeth (incisors and canines) and on the buccal teeth. Canines are figures in black. The dotted lines indicate the mandibular symphysis, the clivus ocularis part of the basilar floor, and the basis of the occipital from the external inion to the opisthion. Hatched lines show the upper edge of the petrous bone.

Section longitudinales de crânes de canidés, primates et homme. Les traits pleins figurent les vecteurs respectifs des tractions temporomassétériennes sur les dents antérieures (incisives et canines) et sur les dents jugales. Les canines sont figurées en noir. En pointillé la symphise mandibulaire, la portion clivienne du plancher basilaire et la base de l'occipital de l'inion externe à l'opisthion. En hachures le bord supérieur du rocher.



1. — Renard. Les vecteurs vont à l'inion externe en suivant le rocher et la tente ossifiée du cervelet. Racine de la canine inférieure parallèle au sommet du clivus, le plancher est horizontal et le trou occipital ouvert en arrière.

2. — Chien loulou. La construction mandibule-arrière-crâne est semblable à celle du renard. La poussée du cerveau dans les régions libres provoque une avancée frontale considérable et l'enfouissement de la face sous le front.



3. — Colobe. Le tracé mandibulo-occipital est celui d'un quadrupède (liaison directe à l'inion externe après la traversée complète du rocher).

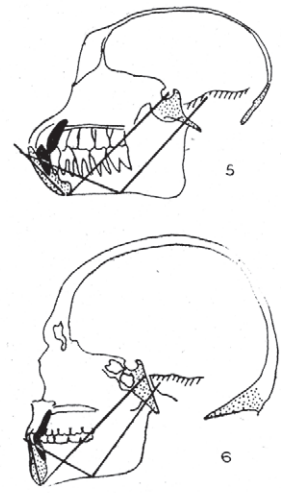
4. — Chimpanzé. L'évolution de l'ensemble station-denture provoque l'aboutissement des vecteurs dans la pointe du rocher. Racine de la canine inférieure parallèle au sommet du clivus. La base du clivus est entraînée vers le bas avec le trou occipital.

Fig. 9.1 Fox. The vectors run along the petrous bone and the ossified cerebellar tentorium to the external inion. The root of the inferior canine is parallel with the top of the clivus, the floor is horizontal, and the occipital hole opens to the back.

Fig. 9.2 Pomeranian. The construction mandible–back of the skull resembles that of the fox. The brain's push into the free spaces provokes a considerable frontal advance and the nestling of the face underneath the forehead.

Fig. 9.3 Colobine. The mandible-occipital layout is that of a quadruped (direct link to the external inion after a complete crossing of the petrous bone).

Fig. 9.4 Chimpanzee. The evolution of the position–dentition ensemble leads to the vectors crossing in the tip of the petrous bone. The root of the inferior canine is parallel with the top of the clivus. The base of the clivus has shifted toward the bottom along with the occipital hole.



5. — Semnopithèque. Tracé semblable mais plus accusé. Le trou occipital est fortement orienté vers le bas, le redressement du sommet du clivus est considérable et les canines fortement réduites. La base du clivus est encore en position semi-quadrupède.

6. — Homme (néo-calédonien). Le trou occipital tend à s'orienter vers l'avant. Les deux plans cliviens (sommet et base) sont sensiblement dans le prolongement l'un de l'autre et les vecteurs aboutissent dans la pointe du rocher qui contre-butte perpendiculairement la mandibule.

Fig. 9.5 Lutung. Similar layout, but more accentuated. The occipital hole is strongly oriented toward the bottom, the straightening of the top of the clivus is considerable, and the canines are strongly reduced. The base of the clivus is still in a semiquadrupedal position.

Fig. 9.6 Human (New Caledonian). The occipital hole tends to be oriented toward the front. The two levels of the clivus (top and base) are in noticeable continuity with each other, and the vectors lead to the tip of the petrous bone, which is set perpendicularly against the mandible.

10.

The Technological Illusion, 1960

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WHEN LEROI-GOURHAN took part in the debate regarding "la technique et l'homme," he was already an habitué of the *Centre catholique des intellectuels français*. This particular debate was coordinated by the Jesuit epistemologist and historian of science François Russo. As a contributor to the more mature and modern reflections of the Church regarding the "challenge" of techniques, Russo was well aware that the human and spiritual implications of techniques had already given rise to diverse and even contradictory opinions. This CCIF debate was organized in two parts, with "Technicians and Scientists Ponder" followed by "Philosophical and Theological Considerations."

The first part began with a report by the *Union catholique des scientifiques français* (UCSF), surveying its members on their attitudes to techniques, the impact of their technical activities on their spiritual life, and indeed the place they reserved for techniques in their religious conceptions of humankind and the world. Subsequent papers followed the same orientation: a report by Louis Chevalier on the works of the international secretariat of Catholic engineers, agronomists, and managers; a discussion of the crisis of the technical world and psychology by Igor Caruso; Leroi-Gourhan's paper on

the technological illusion; and a reflection on the cultural value of techniques by Jean-Louis Kahn.

Although Pierre Teilhard de Chardin's position was implicitly criticized for its overoptimistic determinism, as Russo granted in his introduction, the participants in the debate overall shared the belief that techniques, for all the increased mastery of the world they bring, "do not dehumanize us or weaken the feeling of God, but rather give us a better opportunity to sense our true vocation."

So much has been said about the perils that techniques pose for humanity, at least since the distant times when the Holy See condemned the use of the crossbow as inhuman. So much has been written these past few years on the threats that the monster of techniques brings to bear on our future. So often it has been repeated that our techniques overtake us [*nous dépassent*] little by little and risk swallowing us up. So much indeed has been said that prehistorians or historians of dead techniques [*techniques mortes*] may well wonder whether this is really a new problem or whether we are not simply prisoners of the illusion affecting those who, just because they are taking a turn on the road, imagine they are moving toward some previously unseen horizons.

In the preparation of the present publication were already noted "the perils posed by the usual statements regarding techniques, which, not belonging to any defined genre, give free rein to confusionism, imprecision, sentimentality, and impressionism." It was also said that "techniques are a subject that merits as much respect as pure metaphysics or positive sociology." These wise observations tend to confirm the separation between techniques as the philosophers talk about them, often without any deep knowledge of the topic, and such respected and familiar values as philosophy or sociology. Techniques and the threats they pose are set up as antagonists, seemingly minor dangers on which we might be advised to revise our judgments. I do not know whether the problem is well put in this way, but it is certainly posed in a manner that highlights the constant relevance of the dialogue between *Homo sapiens* and *Homo faber*.

Let us take the problem sufficiently close to its roots: prehistory knows of human creatures through their skeletons, and it knows of the products of human techniques in the form of stone tools—both skeletons and tools recede into obscurity several hundred thousand years back from us. Yet what is perhaps not emphasized enough is that anatomical science cannot recognize humans by their skeleton alone: it was only when they were discovered together with tools that Australopithecenes or Pithecanthropians became humans in the eyes of science. Without tools, they would have been condemned to remain in limbo between monkeys and us. For a long time, it was denied that Pithecanthropians could make tools at all, until more and more Sinanthropes, Atlanthropes, and other "anthropes" that multiply from year to year were found with such tools, whose ingenuity represents a challenge for the primitive brain of their makers. The latest victory of

techniques over the human is the recent discovery in Tanganyika of the tools of the Australopithecenes, the most primitive of all candidates for humanity, which we will now probably no longer dare call "Pithecus" but rather "Australanthropian." They were certainly "humans," insofar as what genuinely characterizes us in comparison with animals is conscious technical activity [*activité technique réfléchie*]. But is it then possible to preserve a monolithic image of humanity? In our discussions of the specifically human [*la qualité humaine*], there is certainly linguistic confusion—for which techniques are responsible.

Though anatomists are always belied by tools in their predictions concerning fossils, they certainly have an image of humanity that is philosophically valid. They start with our skull, which shelters a thought acknowledged to be human, and, by subtraction, they reach a point where it legitimately appears to them that the fossilized skulls cannot really contain human thought. In other terms, the tools count for more than the skulls of those who fabricated them, and the oldest "anthropes" were already overtaken [*dépassés*] by their techniques. While it may seem a facile and little-called-upon paradox, this observation is actually based on the broadest experience. Both the "technical overtaking [*dépassement technique*]" and the dialogue between human intelligence and tools were born very near the "point zero" of technicity. Of all human activities, techniques alone have never returned to their point of departure. Every generation rethinks Plato, but we do not rethink techniques—we learn them. The millions of encounters between workers and tools are such that techniques progress, cumulatively, by insensible improvements, just like living beings evolve. In this way techniques, the product of human thought, have a life that escapes human individuals—each individual takes them at the state they are in, and they run ahead of him until the next generation.

To talk of our current-day overtaking by techniques thus raises a false problem: techniques are quite normally "overtaking [*dépassantes*]," and this is probably not where the main anxiety lies. For those who travel the length and breadth of the dusty space of the millennia, the problem resides rather in the link that binds techniques to the human brain. The issue is to know whether we are "human" because we make tools, or whether we can, as the philosophers do, conceive of two kinds of humanity, first existing in succession and then combined in everyone's life: *Homo faber* and *Homo sapiens*. Furthermore, our challenge is to find out whether we think as *faber* and *sapiens* using the same parts of our brain; whether the earliest humans did not start with a brain in which sapient thought occupied a limited number of slots; whether, initially, the

technical brain [*le cerveau technique*] did not surpass the "cerebral" brain [*le cerveau "cérébral"*]. In more orthodox terms we may wonder whether, in the generally acknowledged extension of the cerebral neopallium, the cortical centers of manual motor functions and related zones of association did not have some precedence over the development of the complex apparatus whereby language mobilizes the elements of intellectual thought. On the first point, palaeontology can provide a clear answer: upright posture, a short face, hands freed from [participating in] walking are all aspects that we share in common with the first tool makers. Of all these criteria, upright posture is the most important, because it entails a cranial rearrangement whose most immediate consequence is the expansion of the middle part of the brain, the one that precisely corresponds to the cortical zones involved in both manual and facial motor functions. Accordingly, the earliest anthropoids have hands, a face, a brain equipped for technical acts, and also premises of the remaining features, probably in the form of a language already distinct from animal signals. These remaining features are actually what, over a few hundred thousand years, would little by little come to form *Homo sapiens*. The anatomically and historically infrastructural role of techniques is thus obvious. The problem is therefore shifted toward the modalities that would mark, on the one hand, the evolution of an intellectual brain [*cerveau intellectuel*] slowly surpassing a technical brain [*cerveau technique*] already acquired from the origins and, on the other hand, the evolution of techniques themselves, which rapidly surpass the possibilities of any individual brain. Nonetheless, this technical surpassing [*dépassement*] has not been totally free. It is to the extent that the activity of the intellectual brain (ever better equipped) came to be reflected throughout the creative apparatus that techniques have reached the successive stages of their evolution, including this constant margin of overtaking [*marge de dépassement*] that is in their nature.

We can therefore understand that the relationships between human and techniques have varied relatively little since the origins and that the *Homo faber* that is contained within us is the barely elder brother of [that within] the Australopithecene. We may perhaps also understand the ambiguity of techniques, which have long been overshadowed [*surplombée*] within ourselves by genuinely human thought, and which overshadow us, outside ourselves, following their own dynamism.

For long millennia, the relationships between the intellectual and the technical [dimensions] not did appear as a dilemma. Technicity worked painstakingly at mastering an external world, whose supply of mystery seemed inexhaustible. This mystery of the natural world, which

techniques would progressively erode, enveloped intellectual thought, which worked at explaining it in supernatural ways, with a link created by magic, a hybrid of the technical and the religious. The dilemma arose as techniques lost their role as protagonists in this cosmogonic drama. Intellectual rationality set humankind on a course in which the two poles of their activity have appeared to be competing with each other: from Archimedes to Diderot, the dialogue between religious philosophy on the one hand and scientific technicity on the other has progressively become an altercation.

The critical point has now been reached, and it is probably here that the real problem lies. Our technical means have overtaken the limits of resistance of the natural world. What little remains of the mystery of matter is very slight indeed. In material terms, techniques have broken through the limits of the earthly globe. Automation has transported the *faber* value outside the human body, and it has also reconstructed its network of motor associations that transpose the technical centers of the human nervous system. Electronics even crosses the sacred limits of intellectual thought, and it has become possible to speak, quite literally, with machines—thinking machines that, with their total mastery of the instructions impressed on them, can think more quickly and more accurately than the human brain. It is thus only natural that a certain feeling of anxiety slips into the dialogue between robots and humans, completely stripped as they are of all their mysteries. Through a brutal transposition, the beast of the Apocalypse has become the hydra of Technology.

What is happening to us is undoubtedly serious, but we should draw some comfort from our privilege in belonging to the generation chosen to live at the moment when humans find themselves naked, as it were, before their machines. Science is the product of a long dialogue between the *Homo sapiens* and the *Homo faber*, and we cannot really envisage that techniques may have a culture of their own [*culture technique*]. The day that machines ever write symphonies, humans will still be needed to listen to them; their symphonies will no doubt be perfect, [yet] they will only add by degree to the scale that runs from slapping one's thighs through to the pipe organ. One day, thinking machines will beat the philosophers, able in a fraction of a second to think through all possible intellectual and moral situations; and yet there will need to be a philosopher standing by the solution-distributing machine in order to set up the program that integrates the solutions of the solutions. How is that anything else than a methodical stripping away of the mystery of nature?

Thinking humans [*l'homme spirituel*] will be glad to see their false problems disappear one after the other: there are no little demons presiding over the melting of metals; the earth is turning on its axis; humans do not descend from monkeys but arise from a being that may have resembled them long ago; the brain is an extraordinary machine that can be enhanced by even more extraordinary machines. This sweeping appraisal may very well leave us with a feeling of comfort, insofar as it consecrates a stage of the human in its totality [*l'homme total*], and not just a victory of the lower half of the brain. There is, assuredly, a danger of a void, of a rigorously pure technical civilization [*civilisation technique rigoureusment pure*]. In any case, it is certainly not for us to refuse the departure of mysteries on the grounds that we risk finding our spiritual life desperately empty.

Attachment to facile mysteries has its source in the very origin of humankind, from which we are not yet very far removed. It is normal that many would hang on to the fringes of the magical, at a time when it is quickly dissolving. Occultism and, at its opposite, a pure materialist "mystique" [*une pure "mystique" matérialiste*] both reproduce at will some infantile forms of consolation—consolations that are no better and no worse than part of what orthodox religiosity has known in other times and throughout the globe. Neither curses nor the refusal to participate without limitations can ensure the conversion on offer. This is why we should be the first to rejoice at reaching the moment when it will be necessary for us to live religiously, in a life bereft of mystery.

Might it be that we fear direct dialogue and the difficult transition to contemplation? Withdrawal from the material world and its illusions has always been the first move of the mystic. Could it be that technical progress ultimately leads to creating an analogous, but ever more generalized, situation? It is evident that the world of past centuries and millennia was on the whole more "religious" than the present world; it is less certain, however, that it was more "spiritual." Indeed, a large share of [human] religious activity was satisfied by operations that are in some ways complementary to techniques, such as in rites to ensure the success of hunting, fishing, cultivation, and acts of material life. In the world that now awaits us, it is by no means certain that the sum of truly spiritual human impulses [*la somme humaine des véritables élans spirituels*] is condemned to decrease.

One comfort to come from the palaeontological scrutiny of human societies is undoubtedly that techniques have [in reality] always been external to the human and that ultimately they leave him free at the physiological level. The veritable catastrophe would have been the

integration of technical perfectibility within the brain, [leading to] the development of living entities with an evermore voluminous and complicated technical brain [*cerveau technique*], with evermore precise and efficient gestures, and with techniques actually inscribed within heredity. On this point, we may be completely serene: the fate of ants does not threaten us, and the human technical brain is of a relative imperfection that is in fact wholly reassuring. This technical brain has improved from stage to stage, albeit to a very limited extent, until the emergence of the current human species. Neanderthals could already coordinate their creative gestures with finesse, as evidenced in their tools, in a way that was not inferior to our own. Since the forty thousand years that we [modern humans] have taken center stage, millions of vestiges found the world over show that while the intellect has explored an ever broader technical domain, the brain's technical equipment [*l'équipement technique du cerveau*] has practically not varied. The gestures are no more confident, no more precise, no more hereditary now than they were at the beginning. We are thus led to consider that humans would not be the humans they are had techniques not escaped them since the beginning, had techniques not left the cerebral fields available to be developed for all the [nontechnical] rest.

The triumph of techniques is therefore not that of the *Homo faber*, who would threaten to devour, as it were, the *Homo sapiens*—it is rather the current state of an evolutionary process on which our existence as humans is based. The human ant has from the onset been exorcized. There are even no problems in the dialogue between *Homo sapiens* and his machine, insofar as the electronic brain [*cerveau éléctronique*] appears as the solution to the only real danger facing the human species: this electronic brain can extend infinitely, outside the human body, the means of integration of the human nervous system, without obstructing the freedom of the higher [nontechnical] brain areas.

Finally, there remain these higher activities, intellectual or affective, that are reflected throughout the nervous, and nowadays also the mechanical, infrastructure. These are indeed such higher activities that make or undo ideologies, and it is from them that we may one day fear the imposition of a rigorously technical culture, as an irrationality founded on the rational. Here again, a return to the roots can advance our reflection. Palaeontological knowledge remains partial because the neurology of the living does not yet provide satisfactory explanations of the higher manifestations of cerebral activity. All that palaeontologists can provide is reduced to a limited, but certain, set of answers. We have seen that the fundamental data on humans (upright

posture, short face, free hands, tools) do not allow us to place the Australopithecene in a different category from our own. The "minimum base of humanity" [*base d'humanité minimum*] is indisputably established, and it corresponds from the onset to a state of the middle regions of the cerebral cortex—a context that will from then on vary only very slowly and very little. The stage *faber* was reached from the outset, and we have just outlined [in the preceding paragraphs] the consequences this precociousness has for the relationships between humans and their technical activity. What do we know of the access to the *sapiens* stage?

So far as anatomy is concerned, the evolution of the skull was by no means finished when the minimum base of humanity had been reached, when humans, now upright, rearranged their entire cranial edifice. The vault of the Australopithecene's skull is still encircled with a longitudinal crest, comparable to that of gorillas. Pithecanthropians shed it, and the upper parietal space has enlarged from stage to stage. Among the Australopithecene, the frontal part is mechanically linked to a wide face; a vast orbital ridge has taken root there, and the dental arc with its giant premolars comes there to rest. From palaeontological form to form, all the way to Neanderthals, the facial bloc recedes little by little in favor of the frontal mass of the brain. When we reach the point where the fossil skulls come to resemble our own, we note that the ridge has melted away, that the face has transferred its supports onto the first molars, thus freeing more and more the frontal territories of the brain that end up overhanging it. While the technical human [*l'homme technique*] is already practically completed with the Australopithecene, another human begins his evolution and pursues it until today by enriching a brain that is not strictly technical. What role are we to assign to these frontal territories, constantly being perfected, in which the future of the human species, its true vocation, is inscribed? What neurology contributes, with its still rather fragmentary experience, does not go against the idea that the [cerebral] enrichment had to do with affective qualities and intelligence, strictly speaking. The contribution of prehistory is fully concordant. The progressive unlocking [*déverouillage*] of the frontal part of the cranial box allows for the precocious possibility of a language of sorts, whose centers are topographically intermediary between the frontal territories and those of technical neuromotricity. The proximity of the centers of verbal association with those of manual and facial motricity points to the double role played by verbal symbolism, between material expression and abstract expression. It also points to the role of

language (simultaneously sound, facial expression, and gesticulation) as a necessary stage between the technically creative activity of the hand and abstract reflection.

Humankind, since the beginning or soon thereafter, had two instruments at their disposal: tools and language. The former would unfold all its evolution [history] outside the human body, while the latter would ever more closely link up, within the human, with higher thought [*pensée supérieure*]. What do the manifestations of higher thought that have come down to us consist of, and when do they appear? These are the combined manifestations of religious thought and of artistic thought, and they appear at the moment we recognize our skull [shape] in those of human fossils. Truth be told, they appear a little earlier, issuing forth from the brain of the last Neanderthals, but they erupt the moment that anthropologists recognize the osseous vestiges of *Homo sapiens*, some thirty thousand to forty thousand years before our era. From that moment, the relationships between higher thought and technical thought are established, in terms that remain unchanged to the present day.

The very first body of evidence, contemporaneous with the late Neanderthals, is that of intentional burials with deposits of tools, obvious indication of a belief in the afterlife [*un au-delà*]. Later on, evidence of magical-religious activity comes in the form of amulets and in the decoration of everyday objects. Symbolic thought is expressed in a complex system of representations of animals and signs, still poorly understood, but that seems to go far beyond the simple level of magic alone and to attest to a very organized body of mythological traditions. Between fifteen thousand and ten thousand years ago, this system leads to an extraordinary flourishing of decorated caves. The existence of a theology in the broad sense, the perception of a world of the dead and of magic, gives a depth of more than thirty thousand years to the world in which we are still steeped.

From the strict point of view of evolution, there is nothing to indicate a possible reversal of the relationship, established in humans' mental activity, between their technical works [*oeuvres techniques*] and their symbolizing thought [*pensée symbolisante*], related to both religion and to art. As indicated earlier, it is magic that is sacrificed here, forming as it does a temporary transition between the technical and the religious in the face of a still-incomprehensible world. If we simply keep to the order in which the [mental] faculties emerge, it is indeed the higher activity, the search for a contact beyond materiality [*substance matérielle*], that is the most recent, almost still-nascent faculty of the

human species. An ideology of material triumph might appear to gain hold in the successes of modern techniques, but is this success a new, biologically significant fact, or is it not that the Promethean illusion is perpetually resurgent in the dialogue between humans and their technician double [*double technicien*]?

What is actually perceptible for us is not the threat of a world governed by technicity so much as the promise of an emancipation [*affranchissment*]. Steeped as we are in the chaos of transformation, we cannot perceive the modalities of this emancipation, but we can be certain of it. The loss of the secrets of the natural world does not alter the fundamental situation of the human in front of supernatural mystery. This situation inevitably leads parts of humankind to the solution of technical materialism [*matérialisme technique*], but this is actually a door that leads nowhere. Our freedom of choice could have been undermined [*aliénée*] only if technocracy had been the outcome of some physical modifications of the human brain; yet, according to all we know of humankind past and present, such a freedom remains intact.

Could the place occupied by techniques in religious life [today] be more cumbersome than that which, among primitives and others, was held by innumerable operations destined to contain the unknown of the natural world? If techniques and science stand in opposition to religion, this occurred already in the past, precisely at the time when the liquidation of mythologies began. Christianity was in a less fortunate position from the sixteenth to the nineteenth century, when everything it had inherited in terms of explanations of the natural world was collapsing under the repeated blows of rational knowledge. Yet what has Christianity lost of its fundamental values in this fight, from which it has actually emerged with greater clarity? What would Christianity lose the day when humans, having gone through yet another crisis, come to fabricate machines for understanding better [*des machines à mieux comprendre*]?

11.

Ethnology and the Making of a New Humanism, 1962

"L'Ethnologie et l'élaboration d'un nouvel humanisme." In *Les Grands Courants de la pensée contemporaine et l'avenir de la liberté* [. . .], 31–47. Paris: Cahiers du Centre économique et social de perfectionnement des cadres de la Fédération nationale des syndicats d'ingénieurs et cadres supérieurs, 1962.

LEROI-GOURHAN'S INTELLECTUAL ENGAGEMENTS coincided in part with state-encouraged initiatives, following World War II, to provide the political and the technocratic classes with some "humanizing" insights into social governance and administration. In this vein, the *Fédération nationale des syndicats d'ingénieurs et cadres supérieurs* (the National federation of trade unions of engineering and senior executives) set up an Economic and Social Center for training senior managers in 1952. Meetings organized by the center were published in a series revealingly titled Elites and Responsibility, and some conferences were also recorded and distributed on LP, in order to ensure their broader impact.

The tenth session, in 1962, was dedicated to "the broad current of contemporary thought and the future of liberty" and included papers on such topics as "the drama of contemporary humanism" by Denis Huisman, philosopher of aesthetics and administrator; "from mass psychology to emotional propaganda," by Gaston Bouthoul, sociologist specializing in war studies; and "technocracy and spiritual life," by René Poirier, philosopher and mathematician. By coincidence, the paper following Leroi-Gourhan's, titled "The Successive Forms of

Energy and Their Influence on Social Structure," was by an author who had published alongside him back in 1936 (see text 1), namely, André Varagnac, by now the director of the *Musée des antiquités nationales*.

The targeted audience and the format of presentation gave Leroi-Gourhan the opportunity to produce a tight and yet wide-ranging text, reaching from the depths of prehistory to futuristic speculations, with brief but evocative mentions of electronic brains, ecological catastrophes, multidimensional symbols, and artisanal nostalgia. In the process, he made several references to recent archaeological discoveries and interpretations. These include the deployment of radiometric dating in East African palaeoanthropology, as well as several developments in Near Eastern archaeology. Alongside the "oasis" hypothesis advanced for the origins of domestication by Marxist archaeologist Vere Gordon Childe, he mentioned the challenges stemming from the Mesopotamian irrigation systems, and the explorations of early urban life in Jericho, southern Turkey, and northern Iraq. Furthermore, Leroi-Gourhan brought up again the finding of several fossils and strangely shaped stones, identified as "the first objects of curiosity," in his excavations in Arcy-sur-Cure. This was part of his "rehabilitation" of the Neanderthals and beyond them, we may argue, the "rehabilitation" of *Homo faber* itself.

The title of this talk might seem somewhat ambitious, insofar it would task ethnology with providing the key to a new humanism. I shall be more modest and limit myself to briefly telling the history of humankind as it appears to someone who, thanks to the vagaries of university life, has found himself throughout his career to be at once a prehistorian and an ethnologist of the present. This position enables me perhaps to perceive aspects of the general evolution of humankind that might escape the attention of specialists of the very distant past, or of specialists of the present, who lack the necessary distance to formulate judgments on this issue.

I. What Prehistoric Ethnology Teaches Us

As we know, over the last years discoveries have been made in South Africa of creatures that have been named the *Australopithecines*, which represent the most distant stage we can reach of human origins.

What Australopithecines show us is the existence of bipedal beings, using their hands to fabricate tools and possessing a brain almost three times smaller than ours, about a million years ago—and perhaps a lot more, since the dates, obtained from radioactive materials, are still tentative and can as much as double in age.

In sum, it now seems that humanity began with its feet—whereas, even a few years ago, the available data would have us begin with the brain instead. We imagined large-brained monkeys rising little by little from the ground to reach the dignity of *Homo sapiens*. It rather seems that the opposite has taken place; we were *technicians* before we were *philosophers*.

In any case, if we consider technicity [*technicité*], that is to say, the possibility of creating tools and of using one's hands for offensive or defensive ends, as the characteristic of the human, then Australopithecines are humans.

If we refer now, not to about a million years ago, but rather to five hundred thousand years before us, we have the cohort of the *Pithecanthropians*, the "monkey-men," so named at a time when nothing was known of Australopithecus and when they were seen as the ideal intermediary between monkeys and humans.

In fact, Pithecanthropians are humans, who have a brain smaller than ours but who already possess a rather developed [stone] industry. Pithecanthropians are surprising to look at, with their low, brutal

face, their very salient orbits and supraorbital ridges, but they are humans who populated the greater part of the old warm and temperate world, from western Europe all the way to Java via China, and to South Africa.

That is the second page in the history of humanity.

We are beginning to think that Australopithecines and Pithecanthropians could have had a language, which must have been both very simple and very concrete, remaining tied to the operations of the most material life.

The third page is that of the group characterized by *Neanderthals*. This is, incidentally, an unsatisfactory label since on the larger scale, they are the latecomers of a great family of anthropoids called Palaeoanthropians, a family whose development is dated to around three hundred thousand to fifty thousand years before our era. They constitute the penultimate stage of our development.

Neanderthals already had a brain as big as ours, and when we represent them in popular images as semianthropoids, with their low forehead and developed muscles, we do them an injustice. Exactly like the Australopithecines and Pithecanthropians, they walked as upright as we do. They must have had more or less the same bodily proportions as ours, but a brain nonetheless less developed in the frontal domain, that is to say, in that part where abstract thought is localized, according to today's neurophysiologists.

The Neanderthal [stone] industry is considerably more developed than that of the Pithecanthropians. Some of the technical discoveries made by [Neanderthal] Palaeoanthropians are reflected in our present today, insofar as they were directly inherited by Stone Age *Homo sapiens* and furthermore that, in the thirty or forty thousand years of our [*Homo sapiens*] past, this fundamental basis, due to the Neanderthals, has ensured the launch of all our subsequent developments.

There are other reasons to rehabilitate them: their brain was certainly very close to ours and it was they—and not us [modern *Homo sapiens*]—who provide the first manifestations of religious thought. They were the first to bury their dead. They were the first to make use of coloring materials. It is among them that we find the first objects of curiosity, strange-looking stones gathered from nature that excited something other than the instinct of simply material acquisition. Here then is a second reason for us to consider the Neanderthal phase as the preface to our own history, and not as some distant episode in an almost apelike past.

The Beginnings of *Homo sapiens*

Around forty thousand years ago, we begin to recover the first evidence of ourselves, I mean *Homo sapiens*, people who resembled us to the point that, if there were a Cro-Magnon man among us [in the audience], dressed in the latest fashion, we would not recognize him: he would be a little taller than most of us, that is all.

These Cro-Magnon humans, who serve as torchbearers of sorts for the entire legion of the first *Homo sapiens* fossils (much as the Neanderthals did for the Palaeoanthropians), these humans were already ourselves. Their bodily aspect was ours, so that, in comparison with the Neanderthals, their most noticeable acquisition is that of the frontal part of their brain, a development of the prefrontal lobe that caused the disappearance of this vizor-like protuberance above their orbits.

From the point of view of techniques, Cro-Magnon humans tell us nothing very revolutionary when compared with the Neanderthals. Their techniques diversify considerably, but the great contribution they make to our history is that of abstract thought. Obviously, buds of such abstract thinking existed among the Neanderthals, but there can be no comparison with this extraordinary explosion that takes place when we reach the oldest evidence of our own species.

Within some ten thousand years, we see the birth of figurative art, which is much more than what might have been perceived at its beginnings, that is to say, the mere reaction of humans playfully copying their natural surroundings. In reality, this figurative art reveals to us the earliest evidence of an already very elaborate metaphysical thought. We have here a play of very complicated symbols, comparable to those that we observe among all peoples without writing, such as the Australian Aborigines or the Eskimo, whose symbolic elaboration is beyond all comparison with ours, we who have been linearized, as it were, by the development of writing [*nous qui sommes, en quelque sorte, linéarisés par le development de l'écriture*]. Their multidimensional thought expresses itself through very supple symbols.

Yet Palaeolithic art—that of Cro-Magnon—is just that [a multidimensional expression], and the extraordinary sanctuaries of Lascaux or Altamira, the hundred or so decorated caves we now know spanning from the Atlantic coast to the Urals, provide us with the most spectacular evidence.

When we turn to examine the technical productions of fossil *Homo sapiens*, we also note something rather striking: the material evidence of the Australopithecines, the flint tools, constitute a uniform

layer throughout their known territorial extension. Whether we go to the north or the south of Africa, a tool made by an Australopithecus is immediately recognizable; it is identical to a tool found thousands of kilometers away.

When we broach the industry of the Pithecanthropians, we have the same impression, possibly a little nuanced. The tools we find are all veritable twins, from India all the way to the sediments of the Thames, a bit as if this industry were linked to the zoological species, rather than to the individual [maker].

When we study the industries of Neanderthal man, or of the Palaeoanthropians as a whole, from China all the way to South Africa via the entire Eurasian world, with its large continental province, we still observe a very great unity.

But the moment we reach our domain, that of *Homo sapiens*, we witness the fragmentation, the parceling out, the *regional specification of types of tools, of industrial ensembles, of artistic schools.*

Preeminence of Social Characteristics over the Characteristics of the Species

This, succinctly put, marks a key moment of human evolution: the moment when we move away from what I would call "zoological speciation" [*spéciation zoologique*]—that is to say, from the link between humans' mental and physical activities, from the immediate, close, and peremptory link with their body—toward "technical speciation" [*spéciation téchnique*]—the state when social groups are what characterize the human species and when these are peoples, and no longer zoological variations, that characterize humankind.

It is thus from the moment we are among ourselves [as *Homo sapiens*] that the characteristic appears that will dominate our entire history: *the preeminence of social characteristics over the characteristics of the species.*

We know now quite enough about the chronology of prehistoric humans since the Australopithecus to roughly establish the rhythm, in tens of thousands of years, of the development of the human brain, from Australopithecus (with 500 to 600 cm^3 of brain matter) to Neanderthals (with 1,500 to 1,600 cm^3).

We also realize that if we had to wait for our *zoological moment* [*moment zoologique*] to bring us to where we are now, if we had remained tied to zoological speciation, we would have had to wait another eighty or a hundred thousand years. Thus, for human societies, the emergence of ethnic speciation has corresponded to a veritable overtaking

[*dépassement*] of the zoological species by social organization that allows the diversity of intellectual manifestations.

This first stage brings us to the very heart of our subject.

Between thirty thousand and around eight or seven thousand years before our era, the Palaeolithic societies of *Homo sapiens* progressively matured and diversified up to that moment when, in the Near East, in a region we can now localize between Iraq and the Mediterranean, an extremely important mutation takes place: the transition to agriculture and husbandry. The transition, in other words, from an economy based entirely on utilizing the products of nature to one based on artificial food production.

The extraordinary perspective opened up by the latest works in Near Eastern archaeology on the origin of our societies and economy show us that this transition could only take place in regions that are geographically preconditioned, as it were, for its two nearly simultaneous techniques, agriculture and husbandry. These are mountainous regions with narrow valleys, like those in Iraq and southern Turkey, where herds of wild animals, goats in particular (for it seems that husbandry began with goats), migrated along altitude and not latitude, as do the great American reindeer or the bison. Within its valley each ethnic group lived in a sort of symbiosis with its wild herd, going up and down the mountain, while in the valley's lower [naturally] irrigated parts grew the cereals that are at the origin of wheat and the principal cereal species cultivated today.

A series of coincidences, at an already high degree of maturity of the hunting and fishing economy, thus contributed to the simultaneous appearance of agriculture and husbandry. It is from this Near Eastern core that, over the course of twenty or thirty centuries, current societies in the strict sense emerged. The cradle of civilization—and we will appreciate the full weight conveyed by this notion of "civilization"—is thus to be found somewhere between the Caspian and Mediterranean Seas. Within twenty, thirty, or forty centuries at the most—and what do two, three, or four thousand years represent, on the scale of human evolution?—Near Eastern societies suddenly and successively discovered pottery, metallurgy, and writing. By about five or four thousand years before our era, we are already situated in our current [stage of] evolution or, more exactly, in a stage that is possibly already past, but in which most of us lived at least our childhood and youth.

Indeed, between the emergence of writing and the development of electronics, humankind has progressively matured, just as the

Palaeolithic populations matured during their twenty-five or thirty thousand years of development.

What are the immediate consequences of the adaptation to writing and husbandry? There is, first, the adoption of a sedentary lifestyle, the attachment of groups to localized vegetal food resources. With the arrival of agriculture, the first villages also appear and, soon after, the first towns. And if I have insisted above on the word "civilization," it is because etymologically, it signifies "to settle in a town." Indeed what has characterized our societies over the past six or seven millennia is precisely the adoption of a sedentary lifestyle at progressively extending scales.

Put otherwise, once cereals are cultivated, one needs a granary to preserve them and people around to defend it.

Another consequence of agricultural development is the existence of a surplus, that is, the possibility of storing resources harvested during a relatively short time of the year. Individual life is no longer entirely tied to the immediate quest for food, as it is in primitive societies.

It is this *economic fact* that allows us to understand the emergence of fire-using techniques such as ceramics and metallurgy. It is also this phenomenon of the possible emergence of specialists, who are not dedicated to the procurement of foodstuff alone, that explains the development of writing. Moreover, the link between these elements is a close one because, all in all, there is complete cohesion between the granary, the weapons to defend it, metallurgy, and writing, which in its first forms is primarily related to account keeping.

The emergence of writing, practically contemporaneous with that of husbandry and agriculture, had another consequence that amplified the maturation that took place in the economic world to such a degree that the impulse [*élan*] has persevered from the beginning to the point at which we now find ourselves. In effect, before writing, the memory of the social group is of an essentially oral character. Societies without writing can transmit knowledge entrusted to a certain number of individuals over centuries (albeit for shorter periods than is often imagined). But the moment that writing appears, the memory of the community becomes infinitely extensible. In written texts, in libraries, documentation can be accumulated such that, from the Greeks onward, collective memory surpasses in scale the memory of individuals.

We are thus approaching the conditions of development of today's societies. Before addressing them head-on, let me first summarize the rapid overview of the centuries I've just provided.

The first stage was the one of humans who, primates of a higher kind, possessing tools, matured their personality for hundreds of thousands of years, at the general biological rhythm, until the moment they emerged into *Homo sapiens*. Starting with the *Homo sapiens* era, primitive societies, that is to say, societies of hunters and fishermen, lived on their impulse for a few more thousand years. The characteristic trait of primitive societies, from the point of view of knowledge—and this still holds for the Australian Aborigines, the Eskimo, or the pygmy peoples of equatorial Africa—is that each individual possesses within himself, in his individual memory, the ensemble of the group's knowledge. There may well be some sorcerers or chieftains who know somewhat more than the others, and who are specialized in memory, but in order to survive, individuals must know how to do everything. These are societies that have no specialists and moreover that cannot spare any individuals [for specialization], given their economy.

The second stage is the one in which the natural economy is mastered, when the ethnic group is organized through agriculture and husbandry.

The third stage, which stems from the development of agriculture and husbandry, is when writing makes it possible for societies to add and accumulate knowledge in an indefinite manner.

Throughout these different stages, the density of human groups was able to increase considerably. We do not have precise evidence [*documents*] regarding primitive societies prior to *Homo sapiens*, but we cannot conceive of group sizes of more than a few individuals, or a few dozen individuals at most. The same holds for the primitive preagricultural societies of *Homo sapiens*, although some indications tend to show that occasionally, groups of several dozen individuals could live together in favored regions.

Starting with the agricultural economy, numerical density becomes a necessity for the group. Whereas the dispersal of small primitive units was an immediate consequence of their economic system, the concentration of humans around granaries and the multiplication of the workforce become the dominant feature of agricultural societies. Between four or five thousand years before our era and now, we

see the progressive development of this setup, put in motion with the appearance of metallurgy and writing.

One of the fundamental traits of our current societies is the development of urbanization. The town is the core of our civilizations and has been so since the beginnings. In the Near East, ever-older towns have been discovered. There are certain urban gatherings, like Jericho, for example, or like those discovered just this year in southern Turkey and also northern Iraq, that correspond to an epoch when pottery had not yet appeared, that is to say, the very beginning of what we call the Neolithic.

It seems that once the economy latches on to cereals, a system is necessarily set in place whereby cultivated areas are controlled by villages, while a set of villages is controlled by an urban center, in which chieftains, troops, artisans, and scribes would soon gather. This process appears as inevitable and natural.

II. The Characteristics of Our Age

Between five thousand years before our era and nowadays, what differences can we observe?

Until the middle of the nineteenth century, we may say that the peasantry did not change in comparison to what it had been in Neolithic times. We can also say that until around 1850, human societies remained closely linked to the rhythm of the human footstep, so that consequently their liberation with regard to distances is a very recent phenomenon. Yet distance conditions not only the relationships of societies within themselves, but especially the scale of groups, and in particular the scale of urban groups. Until barely a hundred years ago, all territorial divisions remained based on distances that humans could cover on foot, those on horseback really not being faster.

If we want to single out a new mutation occurring in human societies, if we try to understand the state in which find ourselves now—which we perceive to be very different from the one our great-grandparents knew—if we now feel ourselves cut off from the Neolithic, we must first of all invoke the *liberation from distance* [*libération de la distance*]. This is much like the Australopithecines could have invoked the liberation of their hands or the first *Homo sapiens* the liberation of their brain. In the twentieth century, we are becoming aware of this liberation from distance, and the limits of the terrestrial world have already been shattered.

This liberation corresponds to a complete transformation of the scale of human societies and the rhythm of communication. With the material developments [*développement matériel*] that have been both its origin and one of its consequences, this liberation also corresponds to an ever-tighter conditioning of the individual by the collective means of action.

What has above all else marked the last hundred years of the evolution of human societies is the *progressive ascendency over each individual of the social apparatus* [*l'emprise progressive du dispositif social sur les individus*]. The relative freedom [*affranchissement*] that prevailed between humans and society until around the middle of the nineteenth century disappears little by little. What also disappears is the relative freedom that societies had from one another on the economic level. The entire apparatus scaled to human walking distance, which guaranteed alimentary autarky to the different groups, often even at the scale of the village itself, has completely melted away. What has also melted away are the artisanal techniques that were at the source of the initial thrust [*élan*] toward technical progress—and this is a fading away we can still observe today.

The liberation from distance thus translates—and this is where the contrast is the starkest for archaeologists when they consider the developments of societies in succession—into another phenomenon, namely, the passage to an economy of universal type.

There is another equally crucial fact of social evolution, connected with scientific development: the liberation from [population] numbers. We have seen that the most primitive societies could only consist of a very small number of individuals. Upon the transition to an agricultural economy, they necessarily had to increase their numerical density. A certain equilibrium remained, however, within the group, conditioned both by epidemics and by the availability of food resources. However, the most important biological fact to have occurred over the past fifty years has been the disruption of this demographic equilibrium and the disappearance of the situation that had been steadying human societies with their natural milieu since their origins. In consequence, we really are different [kinds of] human beings from those who existed between forty thousand years before our era and 1850. We find ourselves in a situation that no other human society has ever known. In effect, the rhythm of transformations has accelerated to such a degree that an individual can witness in his or her lifetime the transition from one stage to another. No one before us, in the Neolithic, for example, ever saw the transition to agriculture, which occurred over the course of two or three thousand years in

imperceptible gradations, through the evermore rationalized use of the capital of natural cereal products that people were harvesting on the riverbanks of the Near East.

There is, finally, another fact that marks our societies in a unique way, in addition to the liberation from distance and the liberation from population numbers: it is the exteriorization of thought [*l'extériorisation de la pensée*]. The Australopithecines were the first—or at least they provide the earliest evidence—to project their technical organs outside themselves, that is to say, to fabricate tools that could be detached from claws or teeth. The Cro-Magnons (which, incidentally, is an abstraction since there were other humans in Upper Palaeolithic times) were the first to be able to project part of their thought outside themselves, thanks to figurative art. In all human history, they inaugurated the exteriorization of what was occurring in their brains. But nowadays, something completely different is taking place: for some thirty years now, we have managed to create artificial nervous systems, such that mechanisms of thought are being reproduced and amplified by electronic or mechanical devices. In the space of half a generation, we have shifted part of our nervous system outside ourselves, so that the traditional equilibrium that involved a nearly equal relationship between individuals and their society is increasingly being severed. With its indefinite cumulative memory, resting on ever more perfected mechanical procedures of memorization, society can now use machines to draw upon resources that were hitherto considered a prerogative of human thought. The individual increasingly becomes something of an organ within a super-organ that mimics the biological apparatus in surprising ways.

But at this point, can we project these data and their ineluctable development onto what we are able to perceive of the future? Can we return to the subject indicated in the title of this talk and dwell on the *conception* of a new humanism?

III. The Options in This Second Half of the Twentieth Century

The material sources we possess can be considered in two different ways.

We may admit that the ongoing evolution of human societies is something of a fatality and that we are prisoners of a biological state that has been transformed by our techniques into a social state, dragging us into the increasing complexity of its organs.

Are we, as quite a few people already think, determined by this long sequence that we triggered seven or eight thousand years ago?

And if so, what might the result be in the future? To be sure, regarding specifically the material results of technical life, we can expect in the decades to come the disappearance of all those techniques that cannot be industrialized or automated—that is to say, the gradual elimination of everything that has pertained to the personal thoughts of the artisan.

Regarding the external world in which we live, we may also imagine that the traditional natural world is in the process of disappearing, especially the vegetal and the animal worlds, rapidly devoured by the human species. In the course of one century, we have outrageously reduced not so much the numerical density of animals on the globe as their species variety. It is no exaggeration to conceive of a future humanity that will only be familiar with a few animal species, effectively those that are indefinitely reproducible on an industrial scale, until such time as there will only remain livestock and a few vegetal species, highly edible and in any case prone to be industrially produced ad infinitum. This vision is not mere utopia, because when we follow the botanical and zoological adventures of the civilized world over the last fifty years, we perceive that this is actually the path we are on.

In the social domain, we can extrapolate and try to gain an idea of what society might become. Without denying the positive aspects of class phenomena—it is intellectually dishonest to insist only on the negative ones—we may imagine, starting from a system in which all individuals would theoretically be equivalent, a hierarchization based on consideration of pure material efficiency [*pure efficacité matérielle*]. Such a hierarchization could equally well extend to intellectual values, with individuals [ending up] industrialized, specialized, and standardized, as [if they were] organs in the functioning of the collective apparatus. This, too, is no utopian vision!

On the intellectual plane, our great achievement, as *Homo sapiens,* has been our abstract intellect [*intélligence abstraite*]. However, where does this intellect lead to, in our current pattern of development? Starting with writing, we have already embarked on a process in which we have lost something when compared to Cro-Magnon humans and their cousins, some of whom are still living in the solitude of the Australian plains or toward the poles. What we have lost is that abovementioned multidimensional conception of symbols. It is evident that from the moment we began to align letters on lines, our rational thought became more efficient, but at the expense of the possibility of symbolizing phenomena of multiple dimensions, such as certain impressions incompatible with scientific thought.

On this very point, then, we can expect an even greater reduction of symbolic thought. The kind of startled reaction [*sursaut*] of our current societies when they escape into abstract art is a symptom of an unconscious concern at the dangers facing some of our means of [symbolic] expression.

The electronic brain is called to make constant progress in the coming decades. It is, however, inconceivable that it will ever replace the human brain; the machine will always remain machine. It will nonetheless increasingly serve to economize mental operations, and everything that is transferable to artificial brains will be transferred. This process has already begun, such that, for better or for worse (we do not know), we are moving toward such a reduction of our own intellectual and manual operations that we may well envisage a society where machines operate by themselves and where the only technical operation left to humans, apart from constructing machines to conceive self-operating machines, is that of pushing a button. Having kept five fingers over a million years to end up with an evolution that requires only one—that would really be tiresome!

The possibility of a second path has been hinted at. The one we have hitherto considered is that of fatality, and actually I do not think I have pushed it all the way to its most pessimistic nuances. I have simply tried to extend a trajectory we have been following for a very long time. But the question now is whether there is another path for us to take.

Personally, I am very pessimistic regarding the coming two centuries. I do not believe that our great-grandchildren will emerge from the crisis we are living through. On the other hand, I am very optimistic about the millennia that will follow. Some may be disappointed, but as I have begun with the Australopithecenes, it costs me little to extrapolate ten or fifteen thousand years into the future . . . And this may actually become a reality sooner than that, since we can sense quite well what it is that we are beginning to miss. Individuals are lucid enough to foresee the catastrophe, due to the failure of an evolution that we endure more than we direct. Societies have no consciousness, and because we have mechanized them since the invention of writing, we can also hope to be able to control and orient them, instead of following them.

The achievements of science allow us to consider a world without distances. We must, however, avoid a world without space, where we would have at our disposal a surface reduced to the minimal requirements of a strictly vegetative life. I am not the first to raise this problem, whose solution requires of us a kind of "demographic sang-froid" in

order to preserve a minimum of living space [*espace vital*] and to set us on a path of *conscious humanization* [*une humanisation consciente*].

The societies evoked here, spanning from Cro-Magnons to our great-grandfathers, secured a human equilibrium. It therefore seems, if we wish to remain human, that we have to recuperate one by one the techniques liberated by the automatic processes [of industrialization]. Individual *bricolage*—a larval form of this [liberating] tendency—as well as craftsmanship recovered [*artisanat reconstitué*] through the arts and through conscious technical activity, should enable us [Westerners] to use the time freed by the machine to mobilize all our means of expression.

If contemporary humanity has a duty to fulfill, it is to grasp consciousness of the natural capital and to do its utmost to conserve it. By *natural capital* [*capital naturel*], I refer to the most varied domains, zoological, mineralogical, botanical . . .

When speaking of the theoretical leveling [*égalisation théorique*] that marks our contemporary society, I have voiced my dread of a hierarchization based solely on the criteria of social and technical efficiency. I consider that we can remedy this tendency by the reconstitution of what we might call "social microclimates," which would enable individuals to live with a framework scaled to their dimension.

The creation of ethnic values is an achievement of *Homo sapiens*, which we are now in the process of losing. It is extraordinary to see that people from China or from Gabon can dress like us [Westerners] and imitate all our habits, the good as well as the worst. But when the whole world sees things in the same way, such a uniformity risks engendering the sclerosis of a society that has suppressed the nuances and diversities that are indispensable to its progress and its necessary renewals.

The loss of ethnic affiliation corresponds to a real state of intellectual malaise. The Russians had a premonition of this, and they based a large part of their political behavior on the preservation of the ethnic minimum necessary to communities [*collectivités*]. The fact that the peoples of the USSR have been maintained in the form of ethnic minorities, sometimes constrained to preserve a minimum of national dress, popular songs, popular art—when all they were asking for was often to abandon their national particularities—corresponds within Marxism to the perception of a fundamental human reality. Yet our Western societies blissfully equalize and level habits and customs, without awareness of the disequilibria that they thereby engender.

Finally, on a higher level, we need to make use of our material liberation in order to perfect our thought and elaborate a human philosophy.

Of these two paths, the first, that of fatality, is the one we are currently on, and its extension does not lead us to a brighter future [*ses prolongements ne nous conduisent pas à des lendemains qui chantent*]. The second path is that of courage and of faith, and it may seem wildly utopian. But is not hope the overcoming of great despair, is it not a virtue, a heroic determination of the soul?

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