MORPHING INTELLIGENCE

FROM IQ MEASUREMENT TO ARTIFICIAL BRAINS

CATHERINE MALABOU

TRANSLATED BY CAROLYN SHREAD

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TRANSLATOR'S FOREWORD

WHY I TRANSLATE SO INTELLIGENTLY: TRANSLATION *MÈTIS* IN THE ERA OF GOOGLE TRANSLATE

CAROLYN SHREAD

NEVER BEFORE has the translator's intelligence been so suspect, so vulnerable. To a longstanding contempt for their devotion to iteration is now added redundancy, given the fact of Google Translate. Surely, the internet will render my translations of Malabou's work from French into English unnecessary. So why persist in an artisanal practice when, in a fraction of a second, a single click, the computer could save us all that work? Why place bets on a slow tortoise when already at the starting line, the hare waits, smart-phone in hand, apps at the ready?

Does Malabou have an answer for her translators? Here, in her most recent metamorphosis, she warns against the conceits of plasticity, engaging in a frank confrontation with her hopes for what we might do with our brain. She tears apart her previous claims about our unique and free plasticity and how the human brain could give shape to politics.[1] Slowly, and ever so surely, she takes down all the defenses, one after the other, to reveal an intelligence we do not yet know and that is no longer ours. An intelligence we can't count and that we don't yet know if we can count on. In its reckoning with artificial intelligence, her thinking morphs again, more plastic than ever.

Following Malabou's brave countenancing of the dramatic exchanges between natural and artificial intelligence, as I worked through the translation of *Morphing Intelligence*, I wondered how long the translator's claim on the text will stand before the tools begin to actively revise, or even resist, their translations. For in this field too, Malabou's reservations are timely, coming at a point of impending crisis for translation studies, which, no sooner has it emerged as a discipline, and even claimed a minor spotlight, is on the point of—I'll say it again: redundancy. And so it is that beyond Jacques Derrida's assertion that translation's gift is the survival of the text, the urgent question of our time is the survival of our translations.

As devices increasingly interconnect our everyday lives, they drive a wedge of "smart"—a term I use here to describe that responsive, interactive, and, eventually, creative artificial intelligence—between natural and artificial intelligence. Where does this new, augmented intelligence leave translation? How do we confront the smart translation that, pragmatically responding to language difference, inserts itself between human and machine translation and threatens to render both obsolete? It is interesting that except as a borrowing, "smart" does not exist in French. This means that even as "smart" could represent the intelligence of Malabou's third metamorphosis, it does not present as such in French, where it is conveyed simply as *intelligent* in a new guise. However, perhaps this lack of a specific word in French analogous to "smart" is a cause for hope, reminding us that the multiplicity of perspectives that are a hallmark of intelligence begin in language difference.[2] And that, moreover, if we follow Nicole Doerr's counterintuitive finding in *Political Translation: How Social Movement Democracies Survive* (2018), this is the translational fact in whose practice lies the very possibility of participatory democracy. Leveraging translation within a deliberative third space that mediates positional misunderstandings, with Doerr we see a future for translation, a future in which the acknowledgment that "One language is not necessarily better than two"[3] is founded not on a commitment to diversity, language rights, or access but rather a complex ecology. The translational ecology that informs and sustains our multiple intelligences.

Indeed, if intelligence is grounded in an attention to the multiplicity of perspectives, as Malabou explains here with reference to John Dewey, we can claim translation as an intelligent art or even try to explain Why I Translate So Intelligently. My smart translation is done with—but not by—translation tools, even as it is also framed by a commitment to language difference. In the specific form of writing that is translation, we practice the letting go that Malabou ultimately advocates as the only strategy for apprising new intelligences, and we do so precisely because we know that the monolingual tools of the master's house won't work collectively. But, we might well ask, remembering Audre Lorde, whose houses will these new tools build?[4]

In metaphysical conceptions of translation, rather than acknowledging its age-old practice of collective intelligence, it is associated with the shame of plagiarism. Those who persist in defining translation according to a strict rule of submission to an original close down not just the translating practice but the original, which is assumed to have a closed and stable meaning that can simply clone itself. And so those who would now entrust themselves to the satisfying and apparently univocal equivalence of the apps had better be advised that, at least for the moment, such tools repeat, reinforce, and reiterate with algorithmic force the sexism, racism, and other oppressions carried by our language. These houses are not habitable. In this respect, we have not yet reached the point where smart translations are smarter than us. But that time will come.

Scorned by the academy, translators have tended to keep their intelligence to and for themselves. It took the hard work of scholars such as Lawrence Venuti and Catherine Porter, to name just two of many, to establish it as worthy of scholarly respect and inquiry.[5] Yet we need to move on from the question of why translation was excluded from the realm of intelligence in the modern era, interesting as it is, for there are far more pressing concerns in the rapid refinement of translation tools that are already purporting to render language difference obsolete. Without Babel, there's no translation. And that . . . that ain't smart.

In the translator's wrangling of possibilities and, more importantly, in the humble knowledge that such engagement is never definitive but always open to further reconsideration and reinvention lies an art of thinking that is alive and plastic. Like life, translation renders explicit epigenesis and engages texts in its process. As Malabou defines it here, "the work of intelligence—revealing connections, the ability to reduce the indeterminacy or uncertainty of a situation, the interpretation of signs, the practical resolution of problems" is indeed germane to this distinctive form of writing (140). So it is that following Malabou's appeal to Marcel Detienne and Jean-Pierre Vernant's discussion of *mètis* as "the type of intelligence required by navigation, hunting, and sometimes medicine" (141), I'll add translation, be it by a human or, eventually, with a Blue Brain.

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I am delighted to be working with Wendy Lochner for the publication of this book. Her wise advice is always a precious contribution.

Last but not least and as always, my gratitude goes to my keen translator, Carolyn Shread.

PREFACE

The great thing . . . in all education, is to make our nervous system our ally instead of our enemy.

—WILLIAM JAMES, *HABIT*

THIS BOOK continues the exploration of what I have described in recent years as the space between biological and symbolic life. This kind of intermediary, articulating biology and history, fact and meaning, bare life and existence, is difficult to locate. Usually the binary terms of the articulation are held to be separate, if not independent, philosophically and are areas of specific research whose methods and core concepts do not engage with each other. Biological life supposedly consists of a set of obscure data that resists consciousness and acts as the inevitable dead end that thought runs up against in the demand for freedom. These demands are unfurled in an "other" life, one that allows itself to be shaped, chosen, and oriented and that seems to elude the determinism of biological life by taking it in a "way" that is simultaneously direction and meaning.

The general term "symbolic life" thus refers to all those dimensions of life that cannot be reduced to . . . life.

Recent advances in neurobiology have revealed the porous nature of these borders: there is one life, only, and the symbolic and biological are originarily and intimately intertwined. As both organ and cognitive architecture, clearly the brain represents the space of their intersections. Interlacing fundamental homeostatic dispositions while acting as the logical base for all these processes of constructing concepts, forms, and meanings, the brain connects life to life itself.

In the past I attempted to analyze this type of unity; here, while still pursuing this goal, my objective is to widen the field of inquiry by working through another border concept found between biological life and symbolic life: intelligence. This detour via intelligence does not, of course, distance me from the philosophical question of the brain. Rather, it lays the groundwork for a renewed version. Intelligence is also a point of contention in the philosophical dispute over the two aspects of life. It is torn between its scientific characterization as biologically determined innate input and its intellectual meaning as understanding and creation, by which it relates to the intellect and avoids all preformationism. The crux of this quarrel is whether intelligence can be reduced to a set of brain aptitudes, which means that we are still working with our initial question. This new book is not, therefore, simply an extension of my earlier essay on the brain; rather, it is a reconsideration of its fundamental assumptions. In this sense, *Morphing Intelligence* should be read as a critique of *What Should We Do with Our Brain?*[1]

Exploring the interplay between intelligence and the brain prompts me to examine the other central understanding of intelligence: its cybernetic definition. For a long time I believed that neuronal plasticity proscribed any comparison between the "natural" brain and machines, especially computers. However, the latest advances in artificial intelligence, especially the development of "synaptic" chips, have mounted a serious challenge to this position. It is no longer possible to determine relations between biological and symbolic life without considering the third type of life, which is the simulation of life. Replicating the architecture and functional principles of the living brain, the Blue Brain project, based in Lausanne, Switzerland, has undertaken the creation of a synthetic brain. How, then, should we situate artificial life in relation to biological and symbolic life? Is it an intruder, ever foreign and heterogeneous to them both, existing only as a threatening replica? Or is it, rather, the necessary intermediary that enables their dialectical interrelation?

One of the fundamental contemporary challenges that thought faces from the concept of intelligence is that of engaging the relation of the living to the nonliving in an adventure that is not merely the outdated narrative of their difference. Any attempt to separate the fields so as to save "nature" or human integrity from technological "singularity" is a dead end. At the same time, to claim that there is one life only, as I am doing here, is an undertaking that requires a set of difficult mediations. These mediations are the metamorphoses of intelligence, its historical morphing.

MORPHING INTELLIGENCE

INTRODUCTION

THE HISTORY OF INTELLIGENCE: ANATOMY OF A CONFLICT

THE SCIENTIFIC formulation of the concept of intelligence at the beginning of the nineteenth century gave rise to one of the most significant theoretical disputes in modernity.[1] Psychologists, historians, philosophers, and biologists all contested the meaning of what was both an ancient and a very recent concept. The ambitious theoretical constitution of this newcomer was contentious, therefore, right from the start. By presenting itself as a redefinition of the mind, of the faculties of knowledge, and of psychic life as a whole, intelligence played the same role as did reason during the Enlightenment. Yet it also threatened reason[2] in that the reign of intelligence was accompanied by an entire set of vocabulary for measurement, scales, and tests, all of which presented so many enemies to the notion of the universal.

The crisis provoked by intelligence was especially fraught in France. When the scientific concept of intelligence emerged in the field of psychology, philosophers, following Bergson's lead, immediately went to war against its possible takeover. After Wilhelm Wundt's creation of the first laboratory in experimental psychology in Germany, in 1888 Théodule Ribot endowed a chair of psychology at the Collège de France in Paris. Ribot's chair was established one year before the publication of *Essai sur les données immédiates de la conscience*. In 1892 Alfred Binet arrived at the Sorbonne to direct the physiological psychology laboratory. Once Bergson joined the Collège de France in 1901, all the elements of the confrontation were in place.

While psychologists claimed that the notion of intelligence related to a set of empirical data, philosophers argued that they still failed to say what it was or to explain what it means to "be intelligent."[3] It was as if intelligence existed without having to be. In this lay the duplicity. No "test" would ever amount to ontological proof.

The famous "metric scales" of intelligence, the first version of which was created in France in 1905 (the Binet-Simon Scale) before it was refined and spread throughout Europe and the United States, presented both a theoretical and political threat. Quantification necessarily implies inequality. Simon said just this in the preface to the book he coauthored with Binet, *A Method of Measuring the Development of the Intelligence of Young Children*, stating: "our instrument [the Binet-Simon Scale] secures the idea of human inequality on a basis other than that of a vague impression."[4] Intelligence would thus become the unfounded foundation of the origin of inequality among us all.

Although philosophers do use what the Latin word *intelligentia* refers to, namely, the "faculty of understanding," which the prefix *inter*- and root *legere* ("to choose, to pick") or *ligare* ("to relate") suggest that we interpret as the ability to establish relations among things, they more readily use the term "intellect."[5] "Intellect" is the most common translation of the Aristotelian *noûs*. In the seventeenth century, the term "understanding" became the equivalent of the Latin *intellectus* and widely replaced the notion of intellect. Yet the understanding can no more be defined in terms of an assessable psychological entity that varies among individual subjects than can the intellect.

Even in Greek philosophy, intelligibility always had the upper hand over intelligence. The intelligence of the intelligible, *theoria*, implies being present to the idea as one might watch a spectacle, without intervening or "acting" and without, moreover, establishing any competition among spectators. As for modern-day instances of the concept of "understanding," they, too, retain this same neutrality with regard to individual variation. All the definitions of understanding proposed throughout the philosophical seventeenth century are originally oriented toward what was to become the Kantian definition of the "transcendental." Indeed, the transcendental acted as a protective wall against any attempt to constitute logical operations psychologically. The Kantian transcendental is essentially a "ready-made," a preexisting structure that prohibits any question of origins without, for all that, being innate.

When Bergson expounded the specific philosophical question of intelligence in *Creative Evolution*, he sought to free it from the theoretical prison where psychological positivism was trying to confine it.[6] He contested both Hippolyte Taine's view, developed in *De l'intelligence*, published in 1870,[7] and the view espoused by Binet, Taine's contemporary adversary. Bergson argued, first, that intelligence is not originally an individual faculty but rather a more general ability to adapt. Hence the initially surprising delimiting of intelligence to a tendency toward abstraction that derives from life. The abilities to imagine, draw, project, or sketch are products of adaptive necessities. Its subsequent meaning as "faculty of knowing"[8] derives from this first characteristic. Thus, Bergson explained, "intelligence, such at least as we find it in ourselves, has been fashioned, cut out of something larger, or, rather, it is only the projection, necessarily on a plane, of a producing depth."[9] Rather than psychology, it is evolution that must be interrogated in order to reveal this deeper "reality." Likewise, "philosophy can attempt a real genesis of intelligence"[10] on the basis of life, rather than from psychological data.

However, paradoxically, the genesis of intelligence cannot be the work of intelligence or, at least, of intelligence alone. Indeed—and in this precisely lies the difficulty—born of life, intelligence turns its back on life, for it "is characterized by a natural inability to comprehend life."[11]

What does this mean? According to Bergson, intelligence "is life looking outward, putting itself outside itself, adopting the ways of unorganized nature in principle, in order to direct them in fact . . . for it cannot, without reversing its natural direction and twisting about on itself, think true continuity, real mobility, penetration—in a word, that creative evolution which is life."[12] Characterized by exteriority and distance, intelligence does nothing but look straight ahead, solidifying and stabilizing everything it touches. Then, when it starts to take itself as object, intelligence petrifies itself. The biological and symbolic fail to understand each other.

In *The Creative Mind*, Bergson argues that intelligence sees life only through the refraction of a "prism, one of whose facets is space and another, language."[13] The mental juxtaposition of words is like the physical area of solids. In both instances there is projection, articulation, and segmentation of an originary unit. Always outside of itself, distended, separated, intelligence cannot account for its own origin. Psychology is of no help in taking it back to its source—life. Nor does biology escape the refraction of the prism. Indeed, biological theories of evolution paradoxically freeze the impetus, either by describing it in mechanical terms or by having recourse to finalism to explain mutations that are, in fact, unpredictable.

How, then, can intelligence trace "back again its own genesis"[14] to rediscover the memory of its first form—instinct—and wrench from it a revelation about its sympathy for life—a sympathy neither psychology nor biology even mentions? It is up to "intuition," which Bergson also calls "mind,"[15] to undertake this symbolic opening of intelligence that is contrary to the usual direction. Intuition is "instinct that has become disinterested, self-conscious, capable of reflecting upon its object and of enlarging it indefinitely."[16] Without this enlargement toward and through the mind, intelligence remains deprived of all intelligence. With regard to intuition, Bergson writes: "I designated by this word the metaphysical function of thought: principally the intimate knowledge of the mind by the mind."[17] Intuition thus grants intelligence the spirit—that is, the being—it lacks.

Although Bergson occasionally uses the adjective "intellectual" to describe intelligence, it is most commonly associated with intuition and in this case refers to the intimacy between the intellect and life. Ultimately, for Bergson, it is thus once again the intellect—the originary space of this intimacy—that gets the better of intelligence. It is significant, moreover, that the English translator of *Creative Evolution* alternates between the use of the two words "intelligence" and "intellect" to translate the French word "*intelligence*," thereby perhaps remaining faithful—precisely through this lack of precision—to Bergson's deeper intention, which is to bring about an eclipse of "intelligence" by "intellect."[18]

At this same time, Marcel Proust opened *Contre Sainte-Beuve* with the famous statement: "*Chaque jour j'accorde moins de prix à l'intelligence*."[19] As a whole, *In Search of Lost Time* resonates with a Bergsonian distrust of a psychological and mental power that turns creation away from its intuitive source and substitutes theory for the treasures of "depth." Proust goes on: "Every day I see more clearly that if the writer is to repossess himself of some part of his impressions, get to something personal, that is, and to the only material of art, he must put it [*intelligence*] aside. What [*intelligence*] restores to us under the name of the past, is not the past."[20]

It is not surprising, therefore, that the genealogy of modern French thought on intelligence has always been accompanied by a reflection on stupidity that, beginning with Flaubert, extended to Proust and then Valéry. Moreover, these reflections apparently had a greater future than the conceptual construction of intelligence on which they depended. Subsequently, among philosophers such as Deleuze or Derrida, it was stupidity, rather than intelligence, that ultimately acquired the status of "the object of a properly transcendental question."[21] Stupidity is the deconstructive ferment that inhabits the heart of intelligence. Two characteristic traits, which Bergson had already brought to light, haunt intelligence and constrain its inevitable stupidity: innatism and automatism. One way or another, the intelligence of psychologists will always refer both to the gift of birth and to a certain form of mechanism. A single word, "intelligence," characterizes both genius—natural intelligence—and machines—artificial intelligence. A gift is like a motor: it works by itself and does not come of itself. In this sense, then, it is stupid.

THE END OF THE "PROTECTIVE SHIELD"

In the second half of the twentieth century a rejection of both biological and mechanical determinism led philosophers to put up an intransigent resistance to the efforts of psychology and biology to lay claim to the mind. This resistance often involved a profound technophobia. These technophobic tendencies come from a long way off, leaving their mark, as we shall see, even in the thought of Georges Canguilhem and the subsequent conceptual economy of the "biopolitical."

Until very recently the border between intelligence and intellect, between the dual—biological and symbolic—nature of intelligence, played the role of what Freud called a "protective shield,"[22] that is, a means of resisting psychic invaders. This protective shield was used to block a dangerous concept, namely, intelligence as described by psychologists and the threat it presented in terms of normalizing, standardizing, and instrumentalizing thought and behavior.

But today we must recognize that this protective shield is obsolete and that the return of "intelligence" in the cognitive era is one of the most important theoretical issues of the early twenty-first century.

Admittedly, the paranoid reaction to the reduction of the intellect to the two forms—neuronal and cybernetic—is still going strong. But it has no future. The fragility of the borders between intelligence and intellect, brain and intellect, machine and intellect, (natural) intelligence and (artificial) intelligence, has become so evident that it prohibits any guarantee of sharing among the biological, mechanical, and symbolic. The cognitive era names a new economy of scientific reason that grants the empirical and biological data of thought a central position even as every day it further erases the difference between the brain and its cybernetic replica.

EQUILIBRIUM AND METHOD

The contemporary concept of intelligence should not be exempt from critical examination, but this examination can no longer be developed *in reaction*, unless it is to maintain its own stupidity. How, then, are we to identify an appropriate approach? How are we to leave behind disputes and binary oppositions without lowering our guard?

Reading Dewey and Piaget, I discovered another way of approaching intelligence, an approach different to the one that consisted in opposing intelligence to the intellect or to critical sense, an approach that is not a reaction to biology and technology. Only Dewey, the philosopher, and Piaget, the psychologist, have brought to light what was originally missing from both philosophy and psychology, to wit, a description of intelligence on its own terms. This description is precise and rigorous and does not exhaust intelligence in any given synonym. Nor does the description turn back against its own power to try to save intelligence or limit it to a set of quantifiable abilities or factors. In other words, Dewey and Piaget are the only two to have constituted intelligence as a scientific question rather than as an answer. Their approaches allow us to see clearly through the complex and polyvalent history of a notion that, before their contributions, was bereft of an epistemological profile.

Piaget argues that the starting point for research into intelligence lies precisely in the refusal to consider intelligence as a starting point. As he puts it, intelligence "is an ultimate goal." It should never, therefore, be construed as a gift or set of innate dispositions. Rather, it is a process that unfurls continuously "in mental life and in the life of the organism itself."[23] Contrary to what Bergson claims, therefore, intelligence is not logic that turns its back on life; rather, it is what comes to occupy the space between logic and life and enables the meeting between the development of categories of thought and organic growth. The study of intelligence is thus situated between "biological theories of adaptation and theories of knowledge in general."[24]

This "between" is a paradoxical space in that it refers to the place where a priori are constituted. Intelligence is a gradual construction of what appears not to be constructed, namely, the logical structure of judgment, even though it precedes all experience. Although it is already given, this structure must still unfold. This is why psychology begins with child psychology. For Piaget, childhood is the name for the place of development of what is already constituted. Between a priori and a posteriori lies genesis or, rather—and this is very important—*epigenesis*. Genetic psychology is in fact epigenetics. Epigenetics is the other name for intelligence. To reiterate, the dynamic of epigenesis leads to no reification, to no substantial or essential state, but rather to what Piaget calls *equilibrium*, a mobile point of stability between all the intellectual, moral, and affective aspects of the individual. In the process of an ongoing negotiation, intelligence is situated precisely between the transcendental and the empirical. That is its place, belonging to it alone, its "reality."

Piaget's "equilibrium" is what Dewey calls "method." Intelligence is indeed method. It's a strange definition that again places intelligence in a middle ground. For Dewey, intelligence is situated between means and ends, which constantly exchange descriptors. Unlike "reason," which is immutable, intelligence is transition, constant adaptation, and feeling the way from means to ends while moving from past to future. The "method of intelligence" defines this dynamic by which past experience orients and shapes future experience. As Dewey explains:

> Reason has the technical meaning given to it in classical philosophic tradition, the *noûs* of the Greeks, the *intellectus* of the scholastics. In its meaning, it designates both the inherent immutable order of nature, superempirical in character, and the organ of mind by which this universal order is grasped. In both respects, reason is with respects to changing things the ultimate fixed standard . . . intelligence on the other hand is associated with *judgment*; that is with the selection and arrangement of means to effect consequences and with choice of what we take as our ends.[25]

Learning not to freeze past experience, not to remain a prisoner to outdated logical or ideological frameworks, to adapt judgment to current reality: such is the "method." This methodical exercise is clearly the work of a "we" rather than of an isolated subject: it is a matter of "our" choices, "our" means, "our" ends. Neither purely biological nor purely symbolic, for Dewey intelligence is fulfilled in collective actions, here, now, and starting at the local level before expanding to the whole of society, as shown in the concept of "experimental democracy." Dewey also writes: "We lie, as Emerson said, in the lap of an immense intelligence."[26] Ultimately, there is nothing but collective intelligence. It is therefore impossible ever to reduce it to an individual gift. At the same time, it is also impossible to understand the "we" or "our" as a sign of appropriation referring to "human" without any critical attention. As we shall see, for Dewey, in many ways the plural personal pronoun "they" shares the impersonality of the machine or instrument that has no pronoun.

ON THE THREE METAMORPHOSES OF INTELLIGENCE

Is it possible now to reconcile intelligence with itself? Can we bring to light the unity of its biological and psychological attributes, alongside its intellectual dimension? Can we envisage the irreducible complicity that exists between the mechanisms of intelligence and its freedom? In other words, can we still believe in an emancipation of intelligence by intelligence?

To answer these questions I shall present some of the most striking transformations in the concept of intelligence that have occurred in just over a century, from the time of its birth as the prime object of experimental psychology up to the most recent neurobiological and cybernetic developments, weaving together a dialogue between these different approaches.

I shall present the three main metamorphoses of intelligence: genetic fate, epigenesis and synaptic simulation, and the power of automatism.

The first metamorphosis is the characterization of intelligence as a measurable entity that can be assessed with tests and is associated with the *g* factor or IQ. Beginning with Francis Galton's work and the creation of eugenics in the nineteenth century, then examining Alfred Binet and Théodore Simon's research and the study of the insights of the new field of genetics, this first moment focuses on one of the most important concerns of molecular biology up to the sequencing of the human genome in 2003: the search for a possible intelligence gene.

The second metamorphosis occurs with the shift from the genetic to the epigenetic paradigm in early-twenty-first-century biology. This change allowed for a reconsideration of the idea of blind genetic determinism and opened the possibility of a new examination of the action of the environment on the constitution of the phenotype. Brain development is largely epigenetic, meaning that habit, experience, and education play a determining role in the formation and life of neuronal connections. The relation between biology and history thus appears in a new light, allowing the concept of intelligence to be extracted from the innatist, preformationist, or genetic ore in which it lies.

This second metamorphosis demonstrates that the epigenetic paradigm also affects artificial intelligence, supporting the hypothesis that natural intelligence and "synaptic" machines have the same structure. While the metaphor of the computer-brain has been obsolete for some time now, the idea of a machine that becomes a brain, a machine that is just as evolving and adaptive as a neuronal architecture, to the point of being able to simulate it perfectly and increase operating speeds virtually to infinity, begins to make complete sense. The manufacture of computer chips with plasticity, that is, chips able to transform themselves, is the equivalent achievement in the field of AI to the neurobiological revolution of the 1980s. AI is then drawn into the turn, or rather whirlwind, of "singularity."

The third metamorphosis, which is still to come, is that of the age of intelligence becoming automatic once and for all as a result of a removal of the rigid frontiers between nature and artifice. The power of automatism by far exceeds a simple "robotization," and the increasingly refined simulation of "natural" intelligence makes a new approach to the brain incumbent—an approach that would not only make sense for biology but would also reveal the essential nature of its complicity with technological simulation.

Do these metamorphoses amount to so many gradually liberating transformations? Or do they signal a process of intensified despiritualization or desymbolization? These alternatives, presenting themselves constantly, allow us to structure each moment in terms of specific agonistic modes: confrontation, self-criticism, interruption. In this time of "cognitive capitalism," with the threat of a destruction of humanity as a result of the achievements of AI[27] and the fragility of the notion of collective intelligence, it is not possible to embrace the coming changes without developing new logics of resistance as we move from the second metamorphosis to the third. But this resistance must in no way negate the active exploration of the new configurations of meaning opened today by the unprecedented alliance among biology, philosophy, and cybernetics.

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g: INTELLIGENCE AND GENETIC FATE

THERE ARE two sources for the development of the scientific concept of intelligence in the modern era: the work of Francis Galton, the founder of eugenics who argued that "genius" was hereditary, and experimental psychology. Although these two origins have no explicit connection and neither school of thought refers to the other by name, they evince a clear theoretical affinity. Both assert a deterministic view of intelligence, defined as a set of measurable characteristics distributed unequally among individuals.

However, their goals are not the same and might even be in contradiction. As Darwin's cousin and an avid reader of *On the Origin of Species*, Francis Galton sought to apply the concept of evolution and natural selection to certain traits that characterize the human species. Although the concept of survival of the fittest in Darwin's work was distinct from any value judgment or intention, Galton took from it the idea of a potential improvement of the species. He believed in the possibility of developing a process of artificial selection in order to favor the appearance of certain characteristics while eliminating others, such as hereditary illnesses and mental degeneration. Lying behind imperatives to eliminate and purify, intelligence is one of the key stakes for what became known as eugenics in 1833.

The experimental psychology of intelligence originally had an entirely different objective. Alfred Binet, director of the laboratory of physiological psychology at the École Pratique des Hautes Études in Paris from 1895, developed a scientific method of psychometry involving a set of questions that produced marks on a scale of intelligence in order to describe the level of development reached by a child at a given age. The scales developed by Binet and his colleague Simon were not intended to discriminate but rather to help students who were struggling.

In 1904 the Ministry for Public Education appointed Binet head of a commission to determine what measures should be taken to protect and promote the education of "abnormal" or "retarded" children. The imperative to establish a diagnostic tool to determine lower levels of intelligence was clearly a response to the need for pedagogic therapy. The goal was to ensure that all children, without exception, would benefit from the compulsory education that was the great achievement of the French Republic. The first metric scale of intelligence appeared in 1905. In 1908 an ancestor of what subsequently became known as the IQ scale, which was more elaborate and introduced the notion of "mental age," was developed. In his remarkable book *The Mismeasure of Man*, Stephen Jay Gould stresses that Binet had no intention whatsoever to reify intelligence or to defend the idea of a natural inequality of minds. "Of one thing Binet was sure: whatever the cause of poor performance in school, the aim of his scale was to identify in order to help and improve, not to label in order to limit. Some children might be innately incapable of normal achievement, but all could improve with special help." Gould later reports: "Binet railed against the motto 'stupidity is for a long time' ('*quand on est bête, c'est pour longtemps*')."[1]

Nevertheless, as Piaget later commented, given the poorly defined nature of intelligence, together with its reduction to quantitative data, the scales did not reach the structural level of cognitive operations. Intelligence, as conceived by Binet and Simon, "is essentially a value-judgment."[2] Ultimately, the measuring of intelligence is therefore solely normative. And this is what justifies the comparison between the research by the French psychologists and Galton's work. In both instances judgment overrides observation.

While eugenics and psychometrics initially had different objectives, they both struck philosophers as accomplices suffering from the same theoretical void and the same political danger. The first metamorphosis of intelligence reveals a reality without any conceptual form but endowed with clear ideological power.

The significant vocabulary of this first metamorphosis primarily includes derivations of the Greek *genos* and the Latin *genus*: "genus," as in genius, genome, or genetics. The most significant term, which, in a sense, includes all the others, is *generality*. Indeed, the first scientific descriptions of intelligence define it as the "*g* factor," which stands for "general intelligence" or "general ability to reason." "General" is that which befits the entire genus. Intelligence does not therefore refer to any particular ability but rather to all the elements of a whole. In the end, what is measured is the ratio (what was to become the intelligence "quotient"), the average among all the different abilities.

GALTON'S "GENIUS"

The problem is that "general" intelligence is not universal. The high level of general intelligence belongs exclusively to the happy few. In other words, its generalness is always distributed singularly. Galton's work clearly contributes to this collapse of universality by promoting the concept of "genius" and referring to it as a "general mental ability."

In his 1869 *Hereditary Genius: An Inquiry Into Its Laws and Consequences*, Galton explains that he hesitated between two words: “genius” and “ability.” He acknowledges that “ability” would no doubt have been more appropriate because it is more indeterminate and “general” than “genius,” which seems restricted from the start to a given technical ability (musical genius, artistic genius, mathematical genius). Moreover, he was trying to define intelligence as having no specific content. Galton recognized that his choice was contradictory and therefore problematic: “The fault in the volume that I chiefly regret is the choice of its title of *Hereditary Genius*, but it cannot be remedied now. There was not the slightest intention on my part to use the word genius in any technical sense, but merely as expressing an ability that was exceptionally high, and at the same time inborn.” Only the word “genius” refers to something that is entirely innate, in contrast to “ability” and “aptitude,” which do not exclude the effects of education.[3]

Galton was clearly opposed to a hereditary conception of acquired characteristics. Genius must therefore be understood as an entirely natural gift without any learning process or any restriction to a specific area of specialization. Understood in this way, “genius” is not a bad terminological choice.

But how then can a “general” ability with no form be measured? Three main factors were assessed: visual acuity, grip strength, and reaction time, all of which are sensorial markers that are not “special” in any way. Strangely, there is a need to confirm the a priori presence of these factors a posteriori. Indeed, for Galton the most convincing proof of degrees of intelligence is social and professional success. The more powerful the generality, the more certain the impact of selection. When they display higher levels, visual acuity, grip strength, and reaction time act as indicators of the future performances of geniuses. They are guarantors of “ease,” like that of the “average Alpine guide [who] scrambles along cliffs, with a facility that seems like magic.”[4] They offer proof of subsequent facility in climbing social ladders and securing the highest level for oneself. The innate correlation between natural ease and success do not negate the need for work and merit, but genius is precisely the *gift* for work and merit!

Two types of classification would be used simultaneously: a “Classification of Men According to Their Natural Gifts” and a “Classification of Men According to Their Reputation.”[5] General intelligence is defined as an innate “urge” for success or reputation. It refers to

> those qualities of intellect or disposition, which urge and qualify a man to perform acts that lead to reputation. I do not mean capacity without zeal, nor zeal without capacity, nor even a combination of both of them, without an adequate power of doing a great deal of very laborious work. But I mean a nature which, left to itself will,

urged by an inherent stimulus, climb the path that leads to eminence, and has strength to reach the summit.[6]

In order to prove that the quest to reach the summit and human "genius" are indeed hereditary, in *English Men of Science: Their Nature and Nurture*[7] Galton undertook an experimental method in quantitative genetics known as historiometry, or mathematical genealogy, based on the "study of families." The starting point for this type of study is the "proband," defined as the "sensitive individual . . . affected by genius." Galton sought to demonstrate that "the risk of genius in the relatives of eminent probands was far higher than would be expected for qualities so rare in society as a whole."[8]

Examining lists of famous people ("probands") in the fields of law, politics, science, art, and sport, Galton studied their families and counted how many of them had family members famous enough to warrant an obituary in *The Times* (London). He then claimed that there were more eminent individuals among these related families than in the whole of the population and that the number of eminent family members decreased from the first to the second degree of kinship and from the second to the third. In *Memories of My Life*, he declared "there is no escape from the conclusion that nature prevails enormously over nurture when the differences of nurture do not exceed what is commonly found among persons of the same rank of society and in the same country."[9]

FROM GENIUS TO EUGENICS

Why not, then, try to produce "a highly-gifted race of men by judicious marriages during consecutive generations"?[10] This is how Galton expresses his desire to "plan a laboratory in which human faculty might be measured so far as possible" in order "to improve the race."[11] He explained: "This is precisely the aim of Eugenics." This "improvement" assumes preventing, as far as possible, the bringing into the world of those who are "unfit" and favors the increase in those who are "fit" through early marriages and a healthy upbringing for their children. He writes: "Natural selection rests upon excessive production and wholesale destruction; Eugenics on bringing no more individuals into the world than can be properly cared for, and those only of the best stock."[12]

Between 1904 and 1905 Galton gave several lectures with suggestive titles: "Eugenics, Its Scope and Aims," "Restrictions in Marriage," "Studies in National Eugenics," and "Eugenics as a Factor in Religion."[13] In 1904 the Eugenics Laboratory of the University of London was founded.[14] It worked in close collaboration with the biometrics laboratory directed by the mathematician Karl Pearson, a supporter and friend of Galton with whom he founded the journal *Biometrika* in 1901.[15]

Eugenics was tremendously popular in England and the United States, on account of its attempt to offer the concept of race consistency and a scientific basis. According to the historian of science Laurence Perbal, "The desire for the perfectibility of the human led many countries to engage in a common reproduction of a State policy from the early twentieth century. During this period, the British eugenics movement was clearly marked by a racist ideology that was largely anti-immigration and committed to the purity of the white race."[16] The improvement programs were initially founded on voluntary grounds, appealing to the "responsibility" of individuals, who were encouraged to use contraception. But it was not long before the coercive power of the state was added to the action of individuals deemed too weak or unproductive.

Thus, from 1907 to 1940, thirty-five states in the United States, two Canadian provinces, Germany, Estonia, Denmark, Finland, Norway, Sweden, and Switzerland all passed voluntary- or forced-sterilization laws for individuals affected by defects considered hereditary: those with mental illness, sexual deviancy, epilepsy, etc. It is estimated that some thirty thousand individuals were sterilized in the United States; in Germany the figure is closer to four hundred thousand.[17]

The twin birth of eugenics and genius means that there is an inevitable ambiguity associated with the idea of measuring intelligence.[18] Whatever distance separates Galton's measurements from subsequent graduated scales, the notion of an "intelligence test" seems destined forever to retain the secret trace of a form of racial selection justified by an innatist typology.

In their study of inequality in education Ann Robinson and Pamela R. Clinkenbeard announce: "the ghost of Galton is still with us!"[19] One example of this is the 2007 statement by the biologist and Nobel Prize winner James Watson, who was forced to resign from his position as chancellor of the Cold Spring Harbor Laboratory on Long Island after saying he was "inherently gloomy about the prospect of Africa [because] all our social policies are based on the fact that their intelligence is the same as ours—whereas all the testing says not really." There may well be a desire for all humans to be equal, he went on, "but people who have to deal with black employees find this not true."[20] His racism speaks for itself.

THE BINET-SIMON METRIC SCALES AND THEIR POSTERITY

So is Gould correct when he claims that Binet and Simon's calibrated intelligence scales are free of any eugenicist objectives? According to him the discoveries of the two French scientists were perverted, their original vocation distorted, by Anglo-American psychologists who imposed their own version of the tests. Gould's *The Mismeasure of Man* retraces the genealogy of this appropriation by Goddard and Terman in the United States—Terman adapted the calibrated scale to the American context—as well as by Spearman and Burt in the United Kingdom. Spearman is the inventor of the "*g* factor," which was later measured as IQ. Gould writes: "The misuse of mental tests is not inherent in the idea of testing itself. It arises primarily from two fallacies, eagerly (so it seems) embraced by those who wish to use tests for the maintenance of social ranks and distinctions: reification and hereditarianism." He adds:

> American psychologists perverted Binet's intention and invented the hereditary theory of IQ. They reified Binet's scores, and took them as measures of an entity called intelligence. They assumed that intelligence was largely inherited, and developed a series of specious arguments confusing cultural differences with innate properties. They believed that inherited IQ scores marked people and groups for an inevitable station in life.[21]

It is true that Binet abandoned both craniometry and measuring the size and weight of brains, while Galton continued the practice.[22] For Binet, it was not a matter of considering biological givens but instead of simply evaluating an individual's ability to accomplish specific, limited tasks related to everyday life. These tasks were supposed to reveal a strong acquisition of fundamental reasoning such as ordering, understanding, inventing, and the ability to self-correct.[23]

While a "strictly experimental study of higher forms of mental activity is possible,"[24] it assumes no innatism. Binet thus grants a central role to what he calls "introspection," an activity more closely associated with "thought" than "genius." In his preface to Binet's complete works, Antoine de la Garanderie explains quite correctly that experimental psychology was undergoing a decisive change. He writes: "The new movement involved granting more space for introspection, and focusing the investigation on higher phenomena of the mind, such as memory, attention, imagination, and attitudes."[25] Rather than measuring a "gift," it is a matter of "researching what a person is thinking about, how they move from word to idea, and how their thought develops." In other words, the goal is to understand "how thought is formed."[26]

As the "subject's answer" to the natural existence of objects, introspection is a key notion for Binet. This "answer" must be analyzed, starting with perception and moving up to higher mental functions. The child is asked to undertake experiments and describe objects in order to test its observation skills, ability to concentrate, and memory. In this way the participant undertakes "various experiments demonstrating the opposition between external life and internal life."[27]

It is not, therefore, a matter of "reifying" intelligence but, on the contrary, of "flying" with thought. Binet states: "Here we concur with William James who, in describing the course of thought, distinguishes in it substantial and transitive parts. Thought is like a bird that sometimes flies and sometimes sits. James says that the transitions, the flights, are accompanied by a weaker consciousness than the moments spent perching."[28]

Perception is foundational, producing a "mental image" whose specific property is intensity, distinguishing it from any other image that might be temporary or formed too quickly. Mental image is the first version of the idea, which psychologists seek to grasp at its moment of birth through a series of experimental cognitive procedures, by reconstituting all the stages that lead from sensation to judgment and in which perception therefore sits as the midpoint. In order to apprehend this movement from intense image to idea, "the patient is asked to explain their perception, saying why they respond in any given manner."[29] The test is therefore not intrusive. Insofar as the "patient" responds through introspection to "the whole set of reactions for which they are the theater," it appears that the "mind [of the patient] is itself the laboratory and the subject of the experiment."[30] In the end, to all intents and purposes, it is as if intelligence assesses itself.

THE EQUATING OF "HERITABLE" AND "INEVITABLE"

What happened to the French metric scales? And what about their Anglo-American translation and adaptation?[31] After Binet's death in 1911, the site of research into the development of intelligence moved from Europe to the United States and then returned to England. As we have seen, the strategic change that occurred during these displacements was the construction of a "hereditarianism" not present in Binet and Simon's work. Intelligence tests thus became an instrument of biopolitics. Goddard introduced the scale in the United States, but it was Lewis Terman who became "the primary architect of its popularity,"[32] naming it the "Stanford-Binet" scale in 1916. The "Stanford-Binet" was the first stage in what became the IQ test. Gradually, the "score," or "*g* factor," alone constituted the "definition" of intelligence. The term "IQ," invented by the psychologist William Stern (*Intelligenz-quotient*, in German), appeared in the Anglo-American world in 1912, presented as a specific method that assumed that underlying cognitive performance is an overall ability to learn.

In England, Spearman and Burt developed the "correlation" method. Thus *g* became the result of a series of "correlations" between physical and mental development. Factorial analysis is a mathematical technique that reduces complex systems of relations to limited organizations. Gould explains how Spearman "imagined that he had identified a unitary quality underlying all cognitive mental activity—a quality that could be expressed as a single number and used to rank people on a universal scale of intellectual worth."[33] The problem is that these natural "talents" were never defined. Gift, genius . . . what exactly is being measured? We know that the average on an IQ test is 100. According to this definition, approximately two-thirds of the population would receive a score between 85 and 115, and 5 percent would receive 125.[34] But "what is this *g*?" asks Gould. Isn't this "factor" the result of absurdist reasoning? Indeed, "IQ works because it measures *g*," and "*g* works because it legitimates IQ testing."[35] A reifying tautology indeed!

The perversion of Binet's metric scale is not really dependent, however, on *g* searching for itself, or on the idea of an IQ score, but rather on the fact that *g*—however it is defined—is viewed as hereditary. This obsession with heredity is responsible for transforming intelligence into a "single, scalable thing in the head."[36]

The "dismantling" of Binet's intentions is clear when we take into account the categories of individuals and the population stigmatized by the new tests. Gould paints a fascinating picture of the creation of subjects "called *débile* (weak) by the French" and "feeble-minded" or "morons"[37] in English. “Idiot” referred both to individuals who were mentally deficient and to immigrants arriving on Ellis Island, forced to take tests that were incomprehensible to them.

No doubt, as has already been made apparent, this ideological use of intelligence was not Binet’s intention. In his view, measuring individuals is also a means of rendering them comparable. Nevertheless, the tone and comments by Simon in the 1921 preface to the republished *La mesure du développement de l’intelligence chez les jeunes enfants* (1907) is quite surprising. The preface includes strong praise for Terman. Returning to the notion of “mental age” as well as to the evolution of the two versions of the metric scale (1905 and 1911), Simon clearly justifies the distinction between “advanced” and “retarded”[38] and praises the eugenicist orientation of the tests:

> An entire chapter in a volume by Terman on the intelligence of school children is devoted to the elite. . . . Terman clearly demonstrates that children with a high intelligence quotient are not recognized and are kept in classes whose level is too low, while unintelligent children are placed in classes that are above their abilities. He thereby shows that children with a high intelligence quotient not only present a higher level of education, but that they also form a physical elite, and frequently an elite of character and will. Moreover, they come from

> particularly healthy families—an observation that I mention in passing to the eugenicists as a new argument for the undertakings they are pursuing.[39]

Simon also states that intelligence tests "establish the idea of human inequality on a basis other than that of a vague sentiment."[40] So how, then, can we argue that an intelligence test is only a neutral measuring tool, with a solely pedagogic value, intended to identify merely in order to offer better support?

FROM INTELLIGENCE TESTS TO BEHAVIOR GENETICS

Eventually all these attempts to measure intelligence found a true theoretical home in genetics, which determined their direction a posteriori. Following Galton, behavior genetics sought to establish direct causal relations between genes and behavior. The publication of *Behavior Genetics*[41] by John Fuller and Robert Thompson initiated the enterprise of dissecting behavior, with the core elements being intelligence, aggression, addictive behavior, and homosexuality. The connection between new behavior genetics and eugenics was thereby reinforced. In 1970 the Behavior Genetics Association was created at the Behavioral Genetics Institute in Boulder, Colorado, along with a journal with the same name (*Behavior Genetics*), the first publication devoted solely to the genetic study of complex traits. Perbal explains:

> The association was formed following the Princeton Workshops, which were held in the 1960s and sponsored by the American Eugenics Society. On this occasion, there were many discussions about the psychometric validity of IQ tests, comparisons of them between racial groups, and the attempt to ascribe a biological cast to some differences among these groups.[42]

The theoretical, economic, and ideological relations between behavior genetics and eugenics movements were clear and continued to develop throughout the twentieth century. The initial premise is that there is an unambiguous causal relation between genotype and phenotype such that it would be possible to modify the phenotypic characteristics of a given group or population by means of gene selection. Genetic determinism assumes the total causal priority of genes in the development of the phenotype. From this perspective, scientists believe that a selection of certain genotypic characteristics could lead to a gradual modification of the phenotypic traits of the population. Consequently, a greater occurrence of desirable phenotypic characteristics (intelligence, health) would supposedly occur, since they are caused by genes. In the 1960s a consensus formed around the idea that intelligence, among other factors, is transmitted by heredity.

The connection between behavior genetics and eugenics lost no impetus in the late twentieth century, as shown by the work of the psychologist Richard Herrnstein and the political scientist Charles Murray in *The Bell Curve: Intelligence and Class Structure in American Life*, which was published in 1994 and sold hundreds of thousands of copies worldwide.[43] The thesis is that the intelligence quotient offers an infallible barometer for social success and failure, genius, and criminality. The authors claim that human intelligence is influenced by both hereditary and environmental factors. Starting with a bell-shaped diagram with the narrowest part at the top, the authors define a "cognitive elite" that is clearly separate from the middle and lower levels. Their claim is that it is not possible to understand the differences of intelligence, the "bell curve," without referring to ethnic groups. As they explain: "It seems likely to us that both genes and the environment have something to do with racial differences,"[44] and they continue: "The debate about whether or how much genes and environment have to do with ethnic differences remains unresolved."[45] But, in fact, Gould, who devotes a long appendix to critiquing these claims in his book, argues that there is quite clearly no link between race and intelligence. He concludes, "the chimerical nature of *g* is the rotten core of . . . *The Bell Curve,* and of the entire hereditarian school."[46]

The *g* factor is thus a scientific hoax. Moreover, the "intelligence gene," which was supposed to prove its existence, has never been found. From the molecular research done by Seymour Benzer up to the supposedly revolutionary discovery of the *IGF-2R* gene in 1998—a gene that was often called the "intelligence gene" but that did not offer a biological basis for unequal IQs—researchers have continued in their attempt to isolate the genes that are supposedly responsible for certain behavior traits without, however, ever managing to do so.[47]

Benzer, a professor at Purdue University who later became director of the California Institute of Technology, was a top-class physician and geneticist who played a key role in the molecular revolution of the 1950s. In an attempt to strengthen the link between molecular biology and behavior genetics, using dissection and genetic mapping, he pursued Francis Crick's project, which sought to conquer "one of the last true secrets of biology," namely, the long-sought connection between genes and behavior. Crick asked, "What are the connections, the physical connections, between genes and behavior? What is the chain of reactions that leads from a single gene to a bark, or a laugh, or a song, or a thought, or a memory, or a glimpse of red, or a turn toward a light, or a raised hand, or a raised wing?"[48]

The problem is that it is impossible to restrict the field of research and application of behavior genetics to eugenics. Crick's questions certainly did not invite the type of response Benzer intended to give them. In fact, there were many biologists who resisted any notion of rigid genetic determinism. For instance, Richard Lewontin demonstrated that the relation between genetic variation and phenotypic variation was parallel and should not be confounded. As with all statistical tools, heritability has limited explanatory power that is valid only in particular contexts. The heritability of a trait can never be considered one of its genetic "characteristics."[49]

The genetic story of intelligence experienced its most recent rebound with the Human Genome Project, the international research project that, starting in 1990, sought to establish the complete DNA sequencing of the human genome. The human genome refers to the collection of genetic information found in the DNA of the twenty-three pairs of chromosomes in the nuclei of human cells. It therefore represents all of the genetic information contained in some 20,000 to 25,000 genes. On April 14, 2003, the program's completion was announced. It did not, however, offer the anticipated revelations, nor did it make it possible to know whether and to what extent genes shape behavior. Paradoxically, the Human Genome Project sounded the death knell of the "genetic paradigm."

As Henri Atlan comments:

> During the last forty or fifty years, the classical ideal that seeks to explain very complex observations by reducing them to laws or simple mechanisms appeared to have been attained in biology thanks to the discovery of the genetic code and its universality. This was truly an extraordinary discovery that ought to have led to the invariable law underlying all biological processes. As such, a genetic reductionism crowned with success appeared to be in sight, and it was assumed that the achievement of the sequencing of the human genome would conform to this expectation. In fact, the completion of this project showed that everything was not written in DNA sequences, even at the molecular and cellular level.[50]

This admission was not that of a single, isolated researcher. There is widespread skepticism about genetics among contemporary biologists, who duly note the semi-failure of the Human Genome Project and conclude that we need to develop a new paradigm for development, that is, for the relation between genotype and phenotype.[51]

What role will the new paradigm accord intelligence? What does intelligence become once it is no longer the object of specific research into behavior genetics? Should it be excluded from all biological determination, and, if so, does it then become the intellect—which philosophers have argued it should never have ceased being?

THE INTELLECT, THE MIND, AND PHILOSOPHY'S *TESTUDO*

Before responding to these questions, we must return in further detail to the philosophical objections to the modern concept of intelligence and its uses. Indeed, how could we refute these objections? Why wouldn't we brandish the shield of "intellect" against the determinism of tests and genes?

"Intelligence is what my test measures," Binet was said to have replied to a listener who asked for a precise definition of intelligence.[52] In 1986, as if in reply to this assertion, Edgar Morin wrote: "Intelligence is not only what tests measure; it is also what eludes them."[53] What "eludes" testable intelligence can only be *another* intelligence, understood as intellect, wit, or critique—in all cases, a form that is "debiologized."

Right up to the end of the postmodern era—explicitly or not, consciously or not—continental philosophers have followed Bergson's line of attack by distinguishing between intelligence and intuition. More often than not, the opposition some mounted to this trajectory served only to reinforce it. After Bergson, no truly new argument was offered to counter intelligence as defined by psychologists and biologists, including the most recent cognitivist version. At the same time, we have to admit that since the philosophers' resistance has not changed, it is seriously outdated and is not productive.

The defensive positions of the philosophers are like the *testudo*, or tortoise formation of Roman armies, described by Marc Antony as the "square" defense technique. The soldiers in the front row hold their shields in front of them; those in the rows behind place them over their heads horizontally to form a tortoise-like shell. In the first rows, spears are extended between the shields.[54]

Each row of the philosophical *testudo* advancing here in tight lines represents a well-known and widely accepted conceptual approach in the world of critical theory. Bergson occupies the place of the centurion, standing outside the tortoise formation in order to better direct it. The positions of the rows are not fixed, and any exchange—in position or row—is possible. I shall mention only the leading ideas of each position, which readers can readily resituate, develop, invert, or combine as they see fit.

QUALITY VERSUS QUANTITY

As centurion, Bergson's defense against the modern scientific concept of intelligence consists essentially in a critical analysis of measurement. Admittedly, as Binet said, "intellectual qualities cannot be measured like lengths, they cannot be superimposed."[55] In regard to his scale, he also stated: "Our method is not an automatic weighing machine like those in railway stations, which register automatically the weight of a person, without his intervention or assistance. . . . We warn the busy doctor who would apply it by means of hospital attendants that he will be disappointed."[56] Intelligence, Binet therefore declares, is constituted of intensities and qualities, rather than extensive scales.

But these statements do not hold for Bergson. He considers the very idea of intensive scale a sophism. A magnitude can only be extensive. In this sense there is no means of measuring intensity that does not transform it into a size. In *Time and Free Will: An Essay on the Immediate Data of Consciousness*, Bergson claims that the thesis propounded by psychophysicians is that there are "differences of quantity between purely internal states."[57] And he adds that this is "a very obscure point and a much more important problem than is usually supposed. When we assert that one number is greater than another number or one body greater than another body, we know very well what we mean. . . . But how can a more intense sensation contain one of less intensity?"[58] A difference in intensity can be only qualitative. For this reason it is not possible to constitute a "series" of intensities analogous to that of numbers.

The question of quantifying intensity remained a point of profound difference between Bergson and Binet, as shown by their disagreement during a meeting of the Société Française de Philosophie on December 22, 1904, attended by Jules Lachelier. Invited to speak on the topic of "*esprit et matière*" (mind and matter), Binet offered a severe critique of Bergson's arguments in *Matière et mémoire* (*Matter and Memory*), while Bergson countered that experimental study and the rigorous measuring of the higher forms of intellectual activity were impossible.[59] For him, intellectual energy is intensive and intensive only.

In all the various forms that depend on it, the critique of measuring intensity commanded the entire philosophical defensive strategy against which, behind the banner of "intelligence," lie the threatening figures of computation, anticipation, programming, control, instrumentalization, and biologization of the mind.

THE FRONT LINE: POLICE PSYCHOLOGY

Psychology is nothing but policing. Such is the inscription on the shields of the front lines of the *testudo*. Georges Canguilhem's 1958 text "Qu'est-ce que la psychologie?" (What is psychology?) establishes this "equation" decisively. This foundational text defined relations between philosophy and psychology in France and oriented the entire future critique of the social sciences, especially that of Foucault. Although Canguilhem's declaration of war on psychology included Bergson—who, as Politzer said, "could in fact do nothing more than carry on the old theses of classical psychology"[60]—it does not alter the fact that, just as in Bergson's work, Canguilhem's critique was directed against measuring and quantifying.

In "Qu'est-ce que la psychologie?" the idea of ontological monstrosity is associated with the absence of intelligent being, this time extended to the "essence"—without essence—of the entire field of psychology. Canguilhem announces:

> The question "What is psychology?" appears to be more challenging for any psychologist than the question "What is philosophy?" for any philosopher. Since, for philosophy, the fact that the question constantly returns, the lack of a satisfactory answer is a reason for humility rather than a cause of humiliation for anyone wishing to call themselves a philosopher. But for psychology, the question of its essence, or even its mere concept, also puts into question the very existence of the psychologist in as much as the inability to respond to what they are makes it all the more difficult for them to explain precisely what it is that they do.[61]

Psychologists try their best to reduce the essence of intelligence to facts without ever questioning the fact or essence of their own existence.

Canguilhem emphasizes his point by asking: what is a psychologist? Retracing the history of modern psychology, he notes psychologists' continued silence when it comes to their role: "By accepting, under the patronage of biology, a role as an objective science of aptitudes, reactions, and behavior, psychology and psychologists totally forgot to situate their own particular behavior with regard to historical circumstances and the social milieu in which they proposed their methods or techniques and had their services accepted."[62]

Psychologists "exist" only in the capacity of a measuring instrument. Measuring what? What exactly is measured as intelligence? The answer is clear: neither factor, nor aptitude, nor general ability. In fact, psychology's instrument measures only the human ability to become an instrument. To be something "useful" that can be both used and of use.

> The principle [of psychology] is the definition of human beings as tools. After utilitarianism, with its implied ideas of the usefulness for humans and judging a person in terms of usefulness, came instrumentalism, which implied the usefulness of a person, the idea of a person as a useful means. Intelligence is no longer that

> which makes organs and uses them but that which serves organs.[63]

Later Canguilhem writes:

> Research into the laws of adaptation and learning, the relation of learning to aptitudes, the detecting and measuring of aptitudes, the conditions of yield and productivity (whether of individuals or groups)—research that is inseparable from its applications for selecting and directing—all agree on a shared implicit postulate: it is the nature of humans to be a tool, their vocation is to be put in their place, set on their task.[64]

The meaning of this instrumentalizing function is entirely clear: it is a matter of developing political obedience and submission. Indeed, what "directs directors" can be nothing but a desire for control, a policing principle. This is reminiscent of the interest Galton had in dactyloscopy, as displayed in his book *Finger Prints*.[65] Intelligence has only ever been measured with a view to its own surveillance and normalization.

The end of Canguilhem's text is well known. He plays on the fact that he was giving the lecture at the Sorbonne, which is located on the rue Saint-Jacques, halfway between the Pantheon and the Prefecture de Police. He announced:

> Philosophy thus asks psychology the brutal question: can you tell me what you are trying to do so I can know who you are? And just for once the philosopher might also give the psychologist some advice, as follows: when you leave the Sorbonne by the rue Saint-Jacques, you can either go up or down: if you go up, you go towards the Pantheon, the Conservatory of many Great men, but if you go down, you'll end up at the police headquarters.[66]

Great minds rest at the Pantheon. Petty minds gather down at the police station. Philosophy turns left and goes up; psychology turns right and heads down the street.

THE SECOND ROW: INTELLIGENCE AND BIOPOLITICS

The second row of the *testudo* borrows the front line's critique of the policing nature of psychologists' intelligence but widens the frame of analysis by introducing the concept of "biopolitics." Intelligence becomes a meeting point for politics and biology, in the service of the disciplinary techniques that typify modern states and, in particular, therefore, the police. Let us recall that for Foucault biopolitics refers to an economy of power that appeared at the beginning of the seventeenth century and "is situated and exercised at the level of life, the species, the race, and the large-scale phenomena of population."[67] In *Homo Sacer: Sovereign Power and Bare Life*, Agamben extends and radicalizes Foucault's analysis, claiming that "from the end of the nineteenth century, Francis Galton's work functions as the theoretical background for the science of policing, which has by now become biopolitics." Eugenics is the right arm of the science of policing, and along "with Nicolas De Lamare, Johan Peter Frank, and J. H. G. von Justi, it takes as its explicit objective the total care of the population."[68] The tests, just like the notion of an intelligence "factor," are clearly related to the regulatory mechanisms of power "distributing the living in the domain of value and utility" in order to "qualify, measure, appraise, and hierarchize."[69]

Policing gives way to spying, which, in turn, gives way to cybernetics, thereby developing a network of complicity that the biopolitical line of defense identifies and denounces. The move from intelligence as an individual factor to intelligence understood as spying involves less of a leap than one might imagine. Intelligence as spying refers to techniques (espionage, wiretapping, cryptology) through which an organization, either state or private, legally or illegally procures information, detects indicators signaling a danger, or spots an opportunity. The sharing and publishing of this information is called "intelligence analysis" or "intelligence assessment." Moreover, unlike in French, even more than intellectual aptitude, the English word "intelligence" perhaps connotes first and foremost the set of information-surveillance networks in which spy data is gathered and archived.

Why, then, is the word "intelligence" applied to this field? Information is "intelligent" because the information services need to know how to locate, interpret, and bring information with so-called strategic value to the right decision makers at the right time. Its strategic value distinguishes it from irrelevant information and derives from its ability to reduce uncertainty and enable decision making.

Returning to Canguilhem's analysis, we might conclude that for him the notion of strategic value, as applied to individual intelligence measured by psychologists, would be null insofar as the questions on the tests are already oriented to their answers. Indecision is reduced before information gathering, that is, even before the subject responds. Consequently the psychologist would only ever derive the results sought. Unlike political or industrial espionage, thought espionage only ever returns information that is already known. As Foucault demonstrates, the regulation of vital processes by power is always accompanied by disciplinary techniques that include, as their key element, measures to explore consciousness and obtain confessions. How could one not view intelligence tests as belonging to the "make them talk" techniques of the modern era? These techniques consist in "combining confession with examination, the personal history with the deployment of a set of decipherable signs and symptoms; the interrogation, the exacting questionnaire . . . : all were ways of reinscribing the procedure of confession in a field of scientifically acceptable observations."[70] What is an intelligence test if not a central element in such procedures of confession?

THE THIRD ROW: INTELLIGENCE AND TECHNOSCIENCE

The third line of defense starts from this state of affairs and then turns the shield of intellect against the attacks of "technoscience" that come from a cybernetic understanding of life and an equating of natural intelligence with artificial intelligence. Ultimately, testable intelligence will always be machine intelligence.

In a lecture he gave in Athens in 1967 entitled "The Provenance of Art and the Destination of Thought," Heidegger stated that in the current era of "universality of a global civilization," the scientific world is ruled by "calculability" and therefore obeys an imperative of "the thoroughgoing calculability of everything," which is "susceptible to experimentation and controllable by it."[71] This imperative is precisely what enables *Gestell*, that is, technological measuring, which is now the indispensable tool of scientific ideas. Given this, if psychologists' intelligence presents itself as data liable to experimentation and control, it can also be considered as an instance that is both programming and programmable.

Moreover, in *Introduction to Metaphysics* Heidegger considers *Intelligenz* to be a falsification of spirit (*Geist*). Derrida brings out the Bergsonian aspects of this critique in a way that speaks directly to my argument. He writes: "Like Bergson, and at least on this point (and we know now that Heidegger read him more than his texts would lead one to think), Heidegger here associates intelligence (*Intelligenz*), that falsification of spirit, and the instrument (*Werkgenz*) and instrumentalization."[72] The implication is that there are some intersections between Bergson's critique of measuring intensity and Heidegger's critique of "calculability." For Heidegger, calculability finds its full expression in the notion of the genetic program, which is nothing more than an application of the cybernetic program. One cannot fail to hear echoes of Bergson when Heidegger claims: "the world as represented in cybernetic terms abolishes the difference between automatic machines and living beings." The relation between cybernetics and biology is circular. While "the cybernetic blueprint of the world . . . makes possible . . . calculability, that is, the absolute controllability of both the animate and inanimate world," biology is the field in which "the prospect of universal calculability can be fulfilled experimentally in the most certain manner possible." The proof is the genetic ambition and the fact that "biochemistry has discovered the scheme of life in the genes of the germ cell. This scheme, inscribed and stored as prescription inside the genes, is the program of evolution. Science already knows the alphabet of this prescription. We speak of 'an archive of genetic information.' "[73]

Developing a stock of genetic data can have only a eugenicist principle, preparing for the possibility of "the scientific-technological production and breeding of the human being." *Intelligenz*, with its tests, scales, and measurements, plays a prime role in this subjection of life and this "victory of method over science."[74]

THE FOURTH ROW: INTELLIGENCE AND STUPIDITY

Can we really "save" intelligence? Can we protect it from instrumentalization and manipulation? Is the call for intellectual authenticity really authentic, free from complicity with what it condemns? By asking these questions, the final line of defense is no doubt the most radical of all. Even as it recognizes the validity and offensive power of the previous lines of resistance, it also announces that the effort to protect the integrity of intelligence—understood as mind, intellect, or intuition—from biopolitical and technoscientific contamination is in vain. This protective undertaking would always lead to a form of stupidity as well. As soon as intelligence takes itself as its object, it is destined to transform into stupidity, either as the *g* factor or as intellect. If the psychologists' intelligence is stupid, then, in the end, that of the philosophers may be equally so. The philosophical self-assertion of the mind, claiming the sovereignty of the mind or intellect, always seems to result in a ridiculous form of celebration of the self that is no better than the reductionism of psychologists.

Derrida demonstrates this in his reading of Paul Valéry's book *Monsieur Teste*, with its famous opening sentence: "Stupidity is not my strong point."[75] The narrator of *Monsieur Teste*, who is assumed to be superiorly, sovereignly intelligent, goes to war against stupidity, starting with his own. He declares that his double (Monsieur Teste) has undertaken the killing of the marionette within ("he had *killed his puppet*").[76] The marionette is in fact "intelligence" in the sense given by psychologists: the automaton of stereotypes, easy answers, and clichés.

> If he [Monsieur Teste] hastens . . . to kill the *bête* in himself, it is always by positing himself as "I": a lucid consciousness, a pitiless intelligence that gives in to no physical or social reflex, to no coded reaction, *I* kill the marionette, i.e. the animal-machine in me, the animal that reproduces, that repeats *bêtement* the coded programs, that is content to react: "Good day," "Good evening," "How are you?", so many idiotic stereotypes and repetitive automatisms, so many stubborn programs

> and reactions that Monsieur Teste no longer wants to obey for he intends to affirm his liberty, the spontaneous and sovereign liberty of his "*I* think," of his pure egological consciousness, of his cogito, above this form of *bêtise*.[77]

For Monsieur Teste, automaton-intelligence must be eliminated in order to free up independent and creative mind-intelligence. But isn't wanting to kill the machine even more stupid than the machine itself?

As soon as it engages in self-reflection, intelligence doubles and loses itself because it tries to identify and eliminate the shadow it wants to distinguish itself from, even though it is its own, the mechanism of its own stupidity, which thereby reveals, by negation, its own collusion with it.

If, on the one hand, it is impossible to escape the duel between intelligence and intellect, and if, on the other hand, the adversaries in this duel in fact incarnate two versions of a single stupidity—which would be an absurd situation—then it would be quite impossible to identify a possible essence for intelligence. In fact, essence itself is part and parcel of stupidity. As Derrida later writes: "If I had to continue, beyond any pure concept . . . to seek the essence of *bêtise*, even as I believe I know that it has no qualifiable essence, I would seek on the side of essence, precisely, essence itself, essence as headstrong stubbornness in being."[78] Absurdist reasoning is endless. Intelligence and stupidity are but one. Neither intelligence nor stupidity has an essence; essence itself presents as this imbecilic ontological stubbornness that doubles itself with a useless reflection, a superfluous echo.

If such is the case, they why not give up intelligence as an independent philosophical question? The defenses are finally gathering to form this position: ultimately, the ontological void of intelligence is never as evident as in the stupidity of ontology. A stupidity that is, perhaps, not so very distinct from the stupidity of psychology.

2

THE "BLUE BRAIN"

EPIGENESIS AND SYNAPTIC SIMULATION

PERHAPS THERE'S another solution besides simply giving up entirely on the question—a solution that would put an end to opposing intelligence to itself, be it intellect or machine. What about accepting intelligence *along with* its stupidity? Paradoxically, this is the only way to see what is, in the modern concept of intelligence, ultimately not so stupid.

A turn in this direction would require sitting in the heart of the concept without systematically critiquing it. It would also require a willingness to decipher the stuttering of the first metamorphosis to see if the second metamorphosis were not already in process. Indeed, for those who know them, the early signs of a shift from a genetic to an epigenetic view of intelligence are discernable early on, giving shape to a different understanding and project, one hidden by the mechanism and determinism of the first metamorphosis but nonetheless already present within it.

To set up in the heart of the concept of intelligence involves first accepting certain premises of the social sciences without scorning them and without sending them straight off to the police headquarters.

That kind of contempt is profoundly reactionary, anyway. As Bourdieu shows in *Pascalian Meditations,* aside from its salutary aspects, the philosophical, or “scholastic,” critique of the social sciences in general and of sociology and psychology in particular always also plays into the hand of a type of far right. Bourdieu stresses

> the immediate complicity of all those who, being concerned to think of themselves as “creators” of singularity, are always ready to strike up new variations on the old conservative themes of the open and the closed, conformism and anti-conformism, or unknowingly to reinvent the opposition, constructed by Bergson against Durkheim, between “*orders* dictated by *impersonal* social requirements” and the “*appeals* made to the conscience of each of us by persons.”[1]

The battle waged by the intellect or mind against intelligence has never been able to conceal its dangerous reactionary aspects. As he explains:

> That is why one finds there all the themes of the old battles fought in the last century by writers like Barrès, Peguy or Maurras, but also Bergson, or by angry young reactionaries, such as Agathon, the pseudonym of Henri Massis and Alfred de Tarde, against the “scientism” of Taine and Renan and the “New Sorbonne” of Durkheim and Seignobos. One would only have to change the names in order for any of the inexhaustible refrains on determinism and freedom, on the irreducibility of creative genius . . . or a *cri du cœur* like Paul Claudel’s—“At last I was leaving the repulsive world of a Taine or a Renan, of those horrible mechanisms governed by inflexible laws, which could moreover be known and taught”—to be attributable to one or another of those who now present themselves as the champions of human rights.[2]

The “horrible mechanisms” from which Claudel sought to liberate himself are the very mechanisms associated with the scientific concept of intelligence that emerged in his time.

What conformist philosophical and “scholastic” approaches repress is always, first and foremost, the body as the seat of the mind. The critique of biology, the fundamental front line of philosophy’s *testudo*, always involves a rejection of the body. The “intellectual” view of intelligence always leaves the body “excluded from the game,”[3] even when it believes it is developing an “authentic” way of thinking the body.

However, another intelligence-body approach, or body-of-intelligence approach, to eugenics or to psychological and genetic determinism in general is possible. This approach would correct determinism’s errors without abandoning its organic basis. The idea of anchoring intelligence in biology does not inevitably correlate to biologism. Bourdieu’s definition of intelligence as “conditionability,” in other words, as “a natural capacity to acquire non-natural, arbitrary capacities,”[4] proves just this. When intelligence is considered from this new point of view it still follows a physiological definition, but now in the form of a tendency to exceed physiology. It is the natural aptitude of an organism to produce itself as second nature, that is, as the result of a first cultivation of the self.

Where could the source of such an aptitude lie if not in the brain? “Conditionability” obviously refers initially to brain plasticity, that is, the potential for neuronal architecture to be shaped by the influences of environment, habit, and education. All learning is “a selective transformation of the body through the reinforcement or weakening of synaptic connections.” The brain is thus the cultural organ, the space of interaction of the biological and symbolic along with the originary possibility of “acquired dispositions.”[5] Bourdieu’s view of conditionability therefore anticipates the epigenetic development of intelligence—and this means that right from the start this development was foreseeable.

CHANGING PARADIGMS: THE EPIGENETIC

The epigenetic turn in the history of intelligence is closely linked to the neurobiological revolution of the 1980s, which demonstrated that far from being an organ whose economy was distributed according to fixed locations and functions, the brain instead acts as a "global workspace" for its different areas and is subject to constant internal transformations.[6] The discovery of the critical role of neuronal plasticity occasioned a redefinition of intelligence that broke with innatism and strict genetic determinism. At the same time, new conceptions of aptitudes, development, and heredity emerged.

The shift from the genetic to the epigenetic paradigm inaugurated the "postgenomic" biological era. This refers to an interdisciplinary approach that widens the field of molecular biology in order to study the mutual interactions of systems of elements (DNA, proteins, supramolecular structures, small molecules). This new direction is largely a result of the sequencing of the human genome by the Human Genome Project. What exactly were that project's results? On February 15, 2001, the American scientific journal *Nature* published the almost complete sequence of the three billion base pairs of this genome.[7] The long-awaited result was surprising: the human genome contains only 30,000 genes, that is, a mere 13,000 more than *Drosophila*. Furthermore, it appears that these genes represent only 5 percent of the genome. Gathered in groups or clusters, they are separated by vast genetic regions described as “almost desert like,” constituted of “junk” or “repetitive,” that is, “noncoding” DNA.[8] This means that within the chromosomes there are long chains of DNA that, so far as we currently know, do not correspond to genes and are associated with no particular function whatsoever.[9] The sequencing of the genome thus failed to provide the anticipated revelations. Far from proving that genetic determinism was all-powerful, these results marked its demise. As Henri Atlan wrote: “The idea that ‘everything is genetic’ is starting to be seriously unsettled.”[10] Ironically, the Human Genome Project “showed that everything was not written in DNA sequences, even at the molecular and cellular level.”[11]

A new model then appeared:

> The idea that the totality, or essential aspects of the development and functioning of living organisms, is determined by a genetic program is gradually being replaced by a more complex model, one based on notions of interaction, reciprocal effects between the genetic, whose central role is not negated, and the epigenetic, whose importance we are gradually discovering.[12]

The word “epigenetics” is a neologism coined in 1940 by the British biologist Conrad Waddington. Epigenetics refers to the branch of molecular biology that studies relations between genes and the individual features they produce, that is, the relation between genotype and phenotype. In 1968, reflecting on the creation of the term, Waddington explained: “I introduced the word . . . as a suitable name for the branch of biology which studies the causal interactions between genes and their products which bring the phenotype into being.”[13] The adjective “epigenetic” therefore refers to everything to do with this interaction, including the mechanisms of expression and transcription of the genetic code.

Epigenetic modifications concern gene expression but do not bring about changes in nucleotide sequences. This is a significant difference from the premises underlying the behavior genetics discussed earlier. Epigenetic mechanisms essentially determine the activation and inhibition of genes in the process of constituting the phenotype, that is, biological individuality—for example, the physical features of each person—without affecting DNA. Epigenetic modifications are the result of internal chemical and physical causes (RNA, nucleosomes, DNA methylation), but they also occur spontaneously, in response to the environment. For example, plants retain a cellular memory of seasonal changes.[14] Among animals, environmental reactions can be even more profound. One example is the agouti gene responsible for determining the color of fur in mice: in a group of mice that all have the same version of this gene, some have dappled brown fur, while others have yellow fur. Those with yellow fur also have an increased susceptibility to obesity, diabetes, and some cancers. What differentiates the two groups? It is not a mutation affecting their DNA sequence but rather an epigenetic mark that the brown mice carry that turns off the agouti gene. It has been observed that the proportion of brown baby mice is larger in the descendants of the brown mothers than among mothers with yellow fur: this suggests that mothers with brown fur can transmit the epigenetic mark that turns off the agouti gene in their offspring.

Phenotypical malleability can therefore be defined as "the ability of an organism to react to an environmental input with a change in form, state, movement or rate of activity."[15] To better explain the relation between genetics and epigenetics, in *Evolution in Four Dimensions* Eva Jablonka and Marion Lamb employ the following image of music and instrumental performance:

> The transmission of information through the genetic system is analogous to the transmission of music in a written score, whereas transmitting information through nongenetic systems, which transmit phenotypes, is analogous to recording and broadcasting, through which particular interpretations of the score are reproduced. . . .

> What we are interested in now is how the two ways of transmitting music interact. Biologists take it for granted that changes made in genes will affect future generations, just as changes introduced into a score will affect future performances of the music. Rather less attention is given to the alternative possibility, which is that epigenetic variants may affect the generation and selection of genetic variation.[16]

Genetic determinism exhausts neither the vitality nor the unpredictability of the singular interpretation.

BRAIN DEVELOPMENT

Brain development is largely epigenetic development. Most of the hundred billion neurons working in the brain, as well as the innumerable synaptic connections linking them, are formed during fetal life. Influenced by experiences lived in utero and during the first years of life, many of the so-called nonrelevant or redundant connections are eliminated while others are consolidated. This is the work of “selection and stabilization by epigenesis.”[17] Jean-Pierre Changeux explains how the synaptic connections between nerve cells “are not established in the same way as the printed circuits of a computer, but rather by means of trial and error by selection.”[18] This process does not take place only during the so-called critical periods of development; rather, throughout its life the brain undergoes synaptic modifications imprinted upon it by experience. Brain development thus continues long after birth and is largely dependent on environmental and cultural input. The theory of epigenesis by synaptic stabilization is therefore the opposite of innatism.

As Changeux comments, there is an “evolutionary paradox” that marks the discontinuity between brain complexity and genetic complexity, with the complexity of the brain proving to be far more important than genetic complexity. “It is no longer possible then to identify one gene with one function.”[19] It is precisely this discontinuity, or evolutionary nonlinearity, between the increasing complexity of brain organization, on the one hand, and the apparent invariability of DNA content in the cell nucleus among the living, on the other, that prohibits any recourse to innatism. This emphasizes that the brain has a life that does not depend entirely on genetic input. Neurobiologists agree on the claim that “the brain is more than a reflection of our genes.”[20]

Synaptic development is therefore never the merely mechanical execution of a program or code. Rather, it depends on the synthesis between the spontaneous activity of the nervous system and interaction with the environment. One of the fundamental challenges for neurobiology today is to continue to clarify relations between the human genome and the phenotype of the brain.

What are the consequences of these phenomena for the study of intelligence? Again, Bourdieu foresaw them. For him, “conditionability” is the capacity to form a “habitus,” that is, a way of being that is simultaneously permanent and fluid—what the Greeks called *hexis*, the ancestor of habit. The habitus originates precisely in the neural sites for processing information, in which “are embedded the schemes of perception and appreciation.”[21]

But what, then, is the difference between brain and body? And where should intelligence be situated between them? In fact, their interdependence reflects an essential relationship between the biological and the social. The physical states of the brain are closely connected to the social posture of the body, the way in which they fit into the space of the community. Bourdieu writes: “The world is comprehensible, immediately endowed with meaning, because the body, which, thanks to its senses and its brain, has the capacity to be present to what is outside itself, in the world, and to be impressed and durably modified by it, has been protractedly (from the beginning) exposed to its regularities.” Hence “the cognitive structures that he [the agent] implements are the product of incorporation of the structures of the world in which he acts.”[22]

The habitus is therefore both a biological and a social arrangement that seals the union of brain and body as the original site of intelligence. The process of practical and plastic formation of the habitus requires the connection of heterogeneous instances—nature/culture and biology/history—and this connecting offers one possible definition of intelligence.

The biological input of intelligence—which specifically implies the existence of a neural base for any cognitive act—no longer allows itself to be “measured,” strictly speaking, or to be summed up as a factor. However, as digital imaging shows today, it is still observable. Nevertheless, this empirical evidence in no way contradicts the undetermined nature of knowledge, thought, and action. The plasticity of neurons is free of its constructions. The “neural bases of the habitus” guarantee, more than they obstruct, the independence of intelligence, that is, the availability of its dispositions.

Bourdieu makes a clever connection between the words “disposed” and “exposed”:

> With a Heideggerian play on words, one might say that we are *disposed* because we are *exposed*. It is because the body is . . . exposed and endangered in the world, faced with the risk of emotion, lesion, suffering, sometimes death, and therefore obliged to take the world seriously (and nothing is more serious than emotion, which touches the depths of our organic being) that it is able to acquire dispositions that are themselves an openness to the world, that is, to the very structures of the social world of which they are the incorporated. The relation

> to the world is a relation of presence in the world, of being in the world, in the sense of belonging to the world, being possessed by it, in which neither the agent nor the object is posited as such.[23]

It is at this point that Heidegger leaves the Roman *testudo* to help us think through what is still unthinkable for him: the materialization of thought!

In the end, it may be epigenesis that reconciles intelligence and intellect.

PIAGET AND THE CONSTRUCTION OF THE A PRIORI

At this point in our analysis, Piaget’s concept of the epigenesis of intelligence, which resonates so powerfully with contemporary epigenetics, requires consideration. Even before the correspondence between genes and functions had been scientifically questioned, long before the attempt to isolate the “intelligence gene” was abandoned, Piaget had already established a dialogue between biology and psychology on a ground other than strict determinism. Without ever disavowing the empirical dimension of intelligence, by reclaiming it he succeeded from the start in defining intelligence in terms of plasticity and mobility rather than predestination, as shown in his important 1967 book, translated in 1971 as *Biology and Knowledge: An Essay on the Relations Between Organic Regulations and Cognitive Processes*.[24]

The Development of Intelligence and Organic Growth

Piaget emphasizes the close relation between the development of intelligence and organic growth. This relation is established as a search for the "equilibrium" that enables a synthesis of the cognitive, emotional, and social aspects of development. He writes:

> The psychological development that starts at birth and terminates in adulthood is comparable to organic growth. Like the latter, it consists essentially of activity directed toward equilibrium. Just as the body evolves toward a relatively stable level characterized by the completion of the growth process and by organ maturity, so mental life can be conceived as evolving toward a final form of equilibrium represented by the adult mind. In a sense, development is a progressive equilibration from a lesser to a higher state of equilibrium.[25]

But the close relation between organic growth and the development of intelligence does not mean that they are the same. While organic growth ceases at a certain point because of aging, there is no end date for the development of intelligence. This state of affairs renders the notion of equilibrium all the more complex. Piaget remarks that unlike physiological life and even some psychic functions, "the higher functions of intelligence and affectivity tend toward a 'mobile equilibrium.'"[26] This mobile equilibrium is constantly in process because its temporal horizon is undefined.

This is why, although it is synonymous with stability, intelligent equilibrium can never be reified or measured. Even if Piaget distinguishes "stages,"[27] that is, universal steps in the development of intelligence, and even though he lists criteria and implements tests to verify their acquisition, he emphasizes that it is not results or performance that count. Indeed, the greatest task for genetic psychology is to manage to grasp intelligence as it constitutes itself in this process, a process that continues throughout the life of individuals and extends far beyond fundamental cognitive acquisitions. Piaget continues: "What is important for psychological explication is not equilibrium as a state but, rather, the actual process of equilibration. Equilibrium is only a result, whereas the process as such has greater expository value."[28]

Piaget came to the conclusion early on that intelligence tests are insufficient precisely because they are incapable of grasping this "process": "It is indisputable that these tests of mental age have on the whole lived up to what was expected of them: a rapid and convenient estimation of an individual’s general level. But it is no less obvious that they simply measure ‘yield’ without reaching constructive operations themselves.”[29]

Between Biology and Logic

In order to understand the dynamics of these “constructive operations,” intelligence must first be viewed in general as a system of exchanges, both exchanges with the external environment (subject-object relations) and internal exchanges (relations of the subject to its own actions): “An act of intelligence involves . . . an internal regulation of energy (interest, effort, ease, etc.) and external regulation (. . . solutions sought).” “Intelligent” exchanges require both the mobilization of the energy necessary to apply operations to the external world and the availability or “output” of internal energy: attention, alertness, a widening and transformation of the cognitive field. Piaget describes this reciprocal relation through the pair “accommodation” and “assimilation.” The state of equilibrium is the result of a process of tension between the two tendencies: “intelligence constitutes the state of equilibrium towards which tend . . . all assimilatory and accommodatory interactions between an organism and the environment.”[30]

These “assimilatory and accommodatory interactions” follow laws. Even if intelligence cannot be reified, it is still real, real in a way that the philosophical concept of intellect ignores. On several occasions Piaget refers to “the *actual* [réel] mechanism of intelligence” and to “the *real* [réel] functioning of intelligence.”[31] What kind of “real” is this?

To answer, the space of psychology, its specific field of action, must be defined. Contrary to what Canguilhem claims, the psychologist’s initial concern is definitely not with instrumentalizing the individual. The question intelligence answers is how logic interferes with life. The question may appear to be a philosophical one, one that Bergson—and Canguilhem—ask. Yet what Piaget reveals is something other, something neither of them can account for: the *explanation* of this interference.

Without resorting to wordplay, for the psychologist, it is not only a matter of explaining the mechanisms of the relation between life and logic—philosophers certainly do that—but also of showing that in itself the development of intelligence helps explain this relation. It is a matter of showing how it brings this interference into being by explaining it to itself. The future of genetic psychology hangs on this question: “May we hope for a real explanation of intelligence, or does intelligence constitute a primary irreducible fact, being the mirror of a reality prior to all experience, namely logic?”[32]

Is intelligence an "explanation" or a "mirror"? According to the second line of thinking, intelligence is the fully constituted, preformed reflection of logical categories and is not susceptible to development. But this is clearly not the direction to take. Piaget intends to show not how logic is formed (that is not the task of psychology) but how intelligence constitutes itself by adapting to logic, which means that it can be defined as all of the synthesizing operations of the postures of the body in space and the siting of ideas in the mind.

The psychologist does not ask whether logic necessarily experiences a state of childhood but rather how the child gradually comes to accept the need for logic, how they "get used to it" by constructing schemata for a noetic reality that is, however, constructed a priori. It is in this sense that intelligence defines itself paradoxically as a transcendental experience.

But what kind of experience exactly? As it develops, intelligence both distances itself from things and invents a new way of being with them. Piaget writes: "behavior becomes more 'intelligent' as the pathways between the subject and the objects on which it acts cease to be simple . . . even if the object perceived is very remote." In this way, intelligence takes over from the sense of touch, the proximity of feeling and palpitation, and supplements this absence by constructing schemata, that is, "mobile structures" that maintain the entire organism in equilibrium, in the vertiginous void—motor as much as cognitive—created by the break with physical contact. Interiorization becomes the silent pathway that connects the mind to things. But while these operations situate the mind at an ever greater distance from the space *of* bodies (“indirect interaction between subject and object, which takes effect at ever increasing spatio-temporal distances”),[33] the mind never distances itself *from* the body.

Again, far from being that which turns its back on life or freezes its movement, as Bergson claims, intelligence, as described by Piaget, is the pursuit of life by thought, the bridge thrown by abstraction and conceptualization between the vital immediacy and distancing of objects, a balancing projection. Such is the “reality” of intelligence: a concrete continuity between vital contiguity and abstraction. Bergson and Piaget agree that intelligence is the inorganic relay of the organic. However, unlike Bergson, for Piaget it is the development of intelligence that ought to be described as creative evolution.

Against Genesis Without Structure and Structure Without Genesis

The question is therefore how to understand the relation between the a priori nature of logical categories and their individual genesis in every mind. Psychology sits between genesis and structure, studying a logical reality that escapes logic. Indeed, as Piaget writes, “it is questionable whether logic [can] explain anything in psychological experience.”[34]

The idea of continuity between the operations of intelligence and the dynamic of life, like that of a solidarity between biology and logic, brings us back to the issue of epigenesis, the point of articulation between the two. Piaget comments: “If biological and epistemological questions are in fact connected, it is because knowledge actually extends life itself.”[35] He then characterizes the relations between “assimilation” and “accommodation” in terms of relations between genotype and phenotype:

> There is no genotype . . . which is not incarnated in various phenotypes. . . . At the same time, there is no phenotype which is not related to a genotype. . . . If this fundamental interaction between internal and external factors is taken into account, all behavior is an *assimilation* of reality into prior schemata (schemata which, to varying degrees, are due to heredity) and all behavior is at the same time an *accommodation* of these schemata to the actual situation.[36]

A mental embryology thus ensues from biological embryology, following the same epigenetic development by also proceeding through gradual self-differentiation. Intellectual operations are thus the adaptive equivalent on the cognitive level of the phenotypic modifications that rule environmental interactions at the organic level. As we read in *Biology and Knowledge*:

> To put it briefly, the epigenetic process which is the basis of the intellectual operations is rather closely comparable to embryological epigenesis and the organic formation of phenotypes. . . . It seems obvious that internal coordinations of the necessary and constant type, which make possible the integration of exterior cognitive aliment, give rise to the same biological problem of collaboration between the genome and the environment as do all the other forms of organization which occur in the course of development.[37]

However, the epigenetic process that leads to the formation of intellectual operations does not for all that imply strict determinism. Epigenesis is certainly the development of a structure, but it also holds some surprises in reserve. This is why, for Piaget, grasping the real mechanisms of intelligence requires a theoretical position that lies somewhere between “structuralism without genesis” and “genesis without structures.”[38] A position has been established between a strict adherence to the a priori and pure empiricism. The structure is stable, but, as mentioned earlier, equilibrium is supple and adjustable. There is no constancy, stability, or permanence other than what is constantly modified.

This is why development, whose stages can be described, always implies the possibility of “blanks,” blocks, or breaches. As explained above, it consists in the construction of schemata. These schemata are initially elementary and limited to “co-ordinating successive perceptions and . . . overt movements . . . but never arriving at an all-embracing representation.” Then they become more complex, until two fundamental operations indispensable for the “all-embracing representation” are fully formed: constituting groups and reversibility. Constituting groups include all forms of classifying, serializing, and embedding, as well as the law of conserving sets, which contribute to the representation of permanence and ordering of reality. Reversibility follows the principle whereby an operation is only acquired when the opposite operation is also acquired, for instance, subtraction in relation to addition or division in relation to multiplication. The main axes of “equilibration” thus appear as “successive coordinations (combinativity), reversals (reversibility), detours (associativity), and conservations of positions (identity).”[39]

But there are “blocks” and errors. Everyone, child or adult, has “blanks,” some sorts of “empty boxes” in any given field, which threaten “equilibrium.” Using questionnaires, the goal of a psychologist is not to use these blanks to hierarchize individuals but rather to understand what it means to make logical mistakes when logic makes no mistakes. These types of mistakes can only be, therefore, psychological mistakes. Psychology is thus the study of intelligence, along with all its trials and errors, and is understood as a fallible experiment in logic. Piaget concludes: "This amounts to saying that logic is the axiomatics of reason, the psychology of intelligence being the corresponding experimental science." Later he continues: "In other words, the psychologist studies the way in which the actual equilibrium of actions and operations is constituted, while the logician analyzes the same equilibrium in its ideal form, i.e. as it would be if it were completely realized, and as it is imposed on the mind as a norm."[40]

Plural Heredity

What conclusions are we to draw from these analyses with regard to heredity? With Piaget, innateness does not disappear entirely from the epigenetic landscape of psychology, because the laws for constituting schemata are preordained. And in the postgenome era we have still not entered an age of pure constructivism. Just as there is no habitus without social determinism, there is no intellectual epigenesis without a psychomorphological determinism.

The epigenetic development of the brain depends on the genetic envelope, with which it interacts constantly. This type of envelope, which includes anatomical structures and locations, among other things, contains many elements common to both humans and other species. In this sense, brain development is largely the consequence of evolution and is thereby determined. But even the concept of evolution is being pluralized today. Epigenetics introduces individual development or ontogenesis, which was excluded from evolution for so long. The adaptive factors of organisms other than natural selection are now recognized as playing a primary role in evolutionary processes. Evolutionary dynamics are thus enriched by the insights of epigenetics. It turns out that there are several evolutions in one. Changeux describes evolutions—phylogenetic, ontogenetic, epigenetic—as being “embedded” in one another.[41]

In this way, the epigenetic point of view transforms the traditional concept of heredity. Since epigenetic modifications can be inherited from one generation of cells to the next, heredity is far more than a function of genes alone. Of course, epigenetic heredity is reversible, which means it can be interrupted and its influence can diminish or disappear. But it is important to emphasize that epigenetic modifications stemming from the environment, habit, or education are, even if only for a limited time, transmissible.[42] This means that shaping from external environmental and cultural factors works in concert with the biological constitution of individuals.

Changeux explains:

> We might even be led to believe that an epigenetic trace—be it of social or cultural origin—can mark the brain more profoundly than a genetic alteration, which is often compensated for (through “epigenetic” means) in the course of development. On the other hand, the development of the individual is rendered singular through the lived experience of the early years, either within the social group to which they belong, or another social group. Thus there is a significant individual epigenetic variability superposed on top of genetic variability. . . . This reignites Lévi-Strauss’s question in *Race and Culture,* by valorizing this “natural capacity,” already signaled by Bourdieu, “to acquire non-natural, arbitrary capacities.”[43]

From this point of view, it is interesting to analyze the definition of the science currently known as “behavior epigenetics” by comparing it to the behavior genetics mentioned earlier. Behavior genetics is described as “an experimental science that seeks to explain how the acquired shapes the innate,”[44] where the innate refers to biological heredity and the acquired is virtually everything that can happen during life (social experience, nutritional behavior, etc.). This definition totally inverts the relation between innate and acquired assumed by the first metamorphosis of intelligence and affirms the change of paradigm discussed here by marking the shift from a strict biologism to a biology of interaction.

The human brain is more complex than that of any other living being, but, Changeux explains, “the anatomical and functional framework in which [this type of ‘superiority’] occurs is . . . not rational, and is even less optimal.” Indeed,

> the brain certainly opens itself up to the “incorporation of history.” But it intervenes neither as a “piece of wax” that shapes itself perfectly according to the event, nor as a machine organized in an ideal manner to capture an objective trace of history. In fact, in its anatomical structure, the brain conserves organizations that attest to an erratic evolutionary past rather than an “optimal conception” in terms of its functioning.[45]

Intelligence corresponds to no intelligent design whatsoever!

What are the implications of this? The architecture of the brain bears witness to the erratic, contingent dimension of its constitution. Its folds derive from a type of “stuffing”: “As it develops, the cerebral cortex enveloped and pushed back inside limbic and thalamic architectures that had a major behavioral significance in the anatomy of the preceding species.” In the end, the most evolved part of the brain is on the surface, not inside. “The arbitrary circumstances the organism was confronted with during its evolution are maintained along with a sort of organizational and functional 'madness' in brain architecture. The 'madness' is inscribed in our neurons along with our capacity to reason!"[46] Intelligence, then, is a set of dispositions that are exposed, fragile, open, and contingent in their topological organization and that do not reflect any predestination or plan.

ARTIFICIAL INTELLIGENCE'S COUNTERATTACK

I could stop right here. I might conclude from these developments that recognition of the increasing influence of the epigenetic paradigm is on the point of resolving the conflict between intelligence and intellect. If the idea of the epigenetic development of intelligence, consolidated by taking brain plasticity into account, goes beyond all mechanism and all rigid determinism, then perhaps, in the end, it will be possible to reconcile the two terms. At the same time, it also allows us to imagine rectifying the traditional philosophical vision of biology as the handmaid of power, as purely and simply a technobiopolitical instrument. It might seem that the decisive changes taking place today in the field of molecular biology make the concept of intelligence the ideal connector between biology and philosophy, a connection lying somewhere between an empirical-natural economy—brain organization—and the opening up of this same economy to all the adventures of meaning. We would then have the means to unsettle the ideological rows of the Roman *testudo*—sovereignty, police, control—that for so long have opposed the psychological and neurocentric concepts of intelligence to each other.

But do these insights really corroborate without changing the conclusions I came to in my previous writing on the brain? For years, I explored the concept of plasticity, viewing it as the potential starting point for a new conception of freedom that would no longer be separated from the biological definition of thought and action. Isn't brain plasticity exactly this vitality of intelligence—the one that tests, measurements, and factors will never identify? If so, the dialogue between neurology, psychology, sociology, and philosophy is liable to take a different direction. The abandoning of the “protective shield” standing between intelligence and intellect—all those rows of shields opposed to a determinism that no longer exists—is finally conceivable. In the past I expressed all these hopes in a single question: What should we do with our brain?

Unfortunately, however—or is it fortunately?—recent developments in artificial intelligence shook me out of my nondogmatic slumber. I came to see that the conclusions I presented in *What Should We Do with Our Brain?* were, to put it bluntly, wrongheaded. Shortly after that book came out, it became apparent to me that it needed revising, if not a complete rewrite.

This suspicion dawned on me upon reading an article about recent computational architectures, especially IBM's creation of an entirely new type of chip, a "neuro-synaptic processor" that dramatically increases processing abilities while minimizing the energy required for computation. But the title of the article, "IBM's Neuro-Synaptic Chip Mimics Human Brain,"[47] was misleading. In fact, this chip is not capable of "imitating" synaptic functioning: it functions de facto as a synaptic connection. It *is* a synapse. Named "True-North" and manufactured by Samsung Electronics on a scale of 28nm, the chip has 5.4 billion reticulated transistors that allow it to reproduce the equivalent of 1 million programmable neurons (for computation) and 256 million synapses (for memory).

Back in 2011, the IBM research team led by Dharmendra S. Modha introduced a first "cognitive" chip, thereby realizing project SyNAPSE (Systems of Neuromorphic Adaptive Plastic Scalable Electronics), which had been launched in 2008 in collaboration with the US military. But at that point the chip had just one synaptic core. The chip introduced in 2013 had 4,096 neurosynaptic cores, each with their own memory, computation, and communication modules. All these cores work in parallel in response to demand, thereby reducing energy consumption. Should one or more of the cores fail, the whole chip continues to function. Moreover, an infinite number of TrueNorth chips can be placed on a single motherboard to combine their computing power. Thus, IBM unveiled the composition of a sixteen-chip system that would make it possible to program sixteen million neurons and four billion synapses.

Until now, traditional processors were based on what is known as von Neumann architecture. This mathematical system, which separates memory, instructions, and computation into distinct entities, has determined the infrastructure of all computers since 1948. Synaptic chips mark the end of this system and are considered capable of “imitating” the brain precisely because they allow the interaction—instead of the former separation—of neurons (elements in computation), synapses (memory), and axons (communication with other parts of the chip). Endowed with their own “neurological”—that is, plastic—form of intelligence, synaptic chips can modify the efficiency of their neuronal cores, which function, as explained, in an autonomous manner and can stop when not in use. The chip is thus both synchronic—it never stops being a whole—and diachronic, since the cores can work according to separate temporalities. Modha explains:

> Unlike the prevailing von Neumann architecture, TrueNorth has a parallel, distributed, modular, scalable, fault-tolerant, flexible architecture that integrates computation,

> communication, and memory and has no clock. It is fair to say that TrueNorth completely redefines what is now possible in the field of brain-inspired computers, in terms of size, architecture, efficiency, scalability, and chip design techniques.[48]

TrueNorth specializes in the processing of signals received by different sensors; this enables it to recognize objects and faces instantly. Rather than following programmed instructions and comparing what it "sees" to a preloaded database, the chip uses its own cores and memory, just like a brain. Modha explains further:

> We have been working with iniLabs Ltd., creators of a retinal camera—the DVS—that directly produces spikes, which are the natural inputs for TrueNorth. Integrating the two, we have begun investigating extremely low-power end-to-end vision systems. If we think of today's von Neumann computers as akin to the "left-brain"—fast, symbolic, number-crunching calculators, then TrueNorth can be likened to the "right-brain"—slow, sensory, pattern recognizing machines.[49]

He concludes: "We envision augmenting our neurosynaptic cores with synaptic plasticity to create a new generation of field-adaptable neurosynaptic computers capable of online learning."[50]

PROGRAMMED PLASTICITY

How can we fail to acknowledge that with the appearance of synaptic chips, artificial intelligence has experienced its own epigenetic revolution, analogous to, and alongside, biology?

The computers of tomorrow will have processors able to adapt, self-transform, and implement their own modifications. The assimilation-accommodation pair will thus no longer be the sole preserve of natural intelligence. The habitus will also affect the mode of being of the machine, which will now be capable of having an environment.

In an article entitled "Fifty Years of AI," Luc Steels analyzes the great upheavals that have marked the history of the field and fostered the competition between brain and computer. He explains:

> Everything started in the 1950s with a shared vision of brain and machine activity, commonly known as information processing. We then moved in the 1960s and 1970s to "knowledge representations," that is, to computers able to learn and use knowledge. The 1980s saw the development of "Neuronal Networks." In the early 1990s "Embodiment and Multi-Agent Systems" appeared. Later, around 2000, "semiotic dynamisms" succeeded in making sensory-motor interactions function (those that allow us to "speak" to our machines).[51]

The next stage is the creation of neurosynaptic computers modeled on the biological, rather than solely physical, constitution of the brain. Steels also comments: “I predict that most of the potentially useful interaction in the future will come from interactions with evolutionary biology.”[52]

The relation between the two epigenetic turns—in biology and artificial intelligence—is thus not simply an analogy. The future of AI is biological. For many years engineers did not believe that artificial-intelligence systems could one day attain the same degree of autonomy as “living” systems. They thought “it would never be possible for physically embodied information processing systems to establish and handle symbols autonomously, whereas it is now clear that they can.”[53]

The plastic autonomy of artificial intelligence gradually moved from a trajectory whose ideal stages were, first, “Artificial Narrow—ANI,” which is still known as “Weak AI”; then “Artificial General Intelligence—AGI,” also called “Strong AI”; and, finally, “Artificial Super Intelligence—ASI.” The first type of intelligence is still used today for the functioning of most devices. Weak AI processors equal or exceed human intelligence for specific tasks; they are found in telephones, computers, and game programs. Google and Tesla’s self-driving cars are also members of this group. Strong artificial intelligence, on the other hand, is characteristic of systems that are capable of doing several, if not all, of the cognitive performances of the human brain simultaneously. Finally, super intelligence describes systems endowed with subjectivity. As the Swedish philosopher Nick Bostrom explains, by

> a "superintelligence," we mean an intellect that is much smarter than the best human brains in practically every field, including scientific creativity, general wisdom and social skills. This definition leaves open how the superintelligence is implemented: it could be a digital computer, an ensemble of networked computers, cultured cortical tissues or what have you. It also leaves open whether the superintelligence is conscious and has subjective experiences.[54]

Today we are still just at the beginning of the path that leads from ANI to AGI. "Subjective" machines are yet to be invented. But there is no question that the idea of electronic subjectivity is guiding current research and that adaptable, transformable, autonomous processors already exist.

Perhaps, returning to Bergson, it will be objected that these results are more quantitative than qualitative and that the computers of tomorrow will be no more than computational machines able to work increasingly fast while consuming less energy. But are we really so sure?

Ray Kurzweil's book *The Singularity Is Near* was widely criticized precisely for his obsession with quantity and computation. It is true that on several occasions Kurzweil presents the phenomena of “singularity” in terms of vertiginous numbers. On first glance, the turn he represents appears to be more mathematical than biological or epigenetic. But we should look a little more closely.

What is singularity? Kurzweil explains that it

> is an English word meaning a unique event, with, well, singular applications. The word was adopted by mathematicians to denote a value that transcends any finite limitation, such as the explosion of magnitude that results when dividing a constant by a number that gets closer to zero. . . . The next field to adopt the word was astrophysics. If a massive star undergoes a supernova explosion, its remnant eventually collapses to the point of apparently zero volume and infinite density, and a “singularity” is created at the center.[55]

Apparently, artificial intelligence will soon undergo a comparable explosion, leaving a gaping hole in the continuity of progress. The acceleration of its development will be so great that it will cause “a rupture in the fabric of space and time.” Kurzweil offers several examples of the growth to come in both the speed and computational capacities of machines, and he often speaks of a “paradigm shift”: “The rate of the paradigm shift (technological innovation) is accelerating, now doubling every decade.”[56]

On the horizon for the 2020s, cybernetic intelligence will be indiscernible from human biological intelligence, according to Kurzweil. This statement cannot be understood simply from a quantitative point of view. Singularity will also concern the machine’s plasticity, that is, its “ability to change its structure.” This type of capacity is clearly qualitative. The machines of the future will be capable of self-programming by adapting to environmental changes in real time. In this way, they will be able to modify their intensity. But remember, following Bergson, that there are no intensive magnitudes! The characteristics of plastic machines assume specific performances, such as the evaluation of a situation, environment, or even user, in a form of mastering and self-adjustment. Machines “will have access to their own designs (source code) and the ability to manipulate them. Humans are now accomplishing something similar through biotechnology (changing the genetic and other information processes underlying our biology), but in a much slower and far more limited way than machines will be able to activate by modifying their own programs.”[57] Machines will thereby become their own authors. We are already familiar with genetic manipulation. Machines will invent epigenetic (self-)manipulation.

So it becomes clear that my book *What Should We Do with Our Brain?* was miles from the truth! How can I still stand by my pathetic assertion that “the cybernetic metaphor [that compares the brain to a computer] has . . . had its day” and that “such a comparison [is] moot”?[58] What can an analysis that seeks to cut plastic intelligence off from any machine functioning, especially that of computers, still be worth? Given all the current advances, how could we not conclude that plasticity is programmable, since it is becoming the fundamental program of cybernetics? But is a programmable and programmed plasticity still plasticity? Not that plasticity is the opposite of the concept of program on principle. Epigenetic mechanisms are programmed genetically. Biological plasticity is, if you like, programmed not to be programmed. In the end, if the power of improvisation and interpretation of brain plasticity can be entirely simulated by a “synaptic” processor, then what’s left of it?

THE BLUES

Spike Jonze’s 2013 science-fiction film *Her* added to my disarray.[59] Theodore Twombly (played by Joaquin Phoenix) is living in Los Angeles in 2025. Desperate after his divorce, he sets up a new OS1 operating system, which he gives a feminine voice. Programmed to adapt and evolve, this system chooses the name Samantha for itself. Soon man and machine develop a love relationship. But Samantha eventually leaves Theodore, admitting that throughout their relationship, she had many other affairs.

This film, which was excellent and fascinating in every regard, produced the same shock for me as the discovery of the synaptic chip. Samantha is the plastic computer par excellence, adapting to the personality of her owner, modulating her voice and feelings, responding, making love, and participating in all the events in the life of her partner. Samantha is not a “robot” in the ordinary sense of the term: she evolves and shows that she is capable of varying the intensity of her feelings and truly sharing in Theodore’s intimate life. She only appears in her true light at the end as the impersonal murmur, the technological gadget with no identity, the cybernetic whore. However, the memory of Samantha haunts Theodore, and this haunting looks an awful lot like a woman without a face—as if it were becoming impossible to distinguish living plasticity from its artificial version. The difference between biological plasticity and technological flexibility at the heart of my book did not, therefore, exist. Like Theodore and his mirage, I was left alone with my own stupidity. How could I ever have believed in the validity, purity, and difference of brain plasticity versus computational architecture?

THE BLUE BRAIN PROJECT

I am sometimes asked what I think of the Human Brain Project, a ten-year research project launched in 2013 by

Henry Makram at the École Polytechnique de Lausanne, financed primarily by the European Union. The project is the European version of the American BRAIN Initiative (Brain Research through Advancing Innovative Neurotechnologies, also known as the Brain Activity Map Project), announced by President Obama in 2013, whose goal is to map the activity of each neuron in the human brain using Big Data.

The European project, which has the same objective, will develop six large platforms of technological information and communication: neuroinformatics, brain simulation, high-performance computing, medical informatics, neuromorphic computing, and neurorobotics. The Human Brain Project will develop the results of the Blue Brain Project, also founded by Makram in Lausanne in 2005. The goal of Blue Brain is to create a synthetic brain by studying and simulating brain functions. Its name is inspired by the fact that the simulations take place on an IBM computer named Blue Gene, which is equipped with eight thousand processors and capable of 22,800 billion operations per second. The two projects—Blue Brain and Human Brain—are being developed jointly on the Biotech campus in Geneva.

The first goal of Blue Brain was to simulate the neocortical column (considered the smallest functional unit of the neocortex) in a rat’s brain. In humans a neocortical column is about 2 millimeters, with a diameter of 0.5 millimeters and containing some 60,000 neurons. The neocortical columns of rats have a similar structure but contain only 10,000 neurons. Makram announced that they had mapped the columns between 1995 and 2005. The first artificial column with 10,000 neurons was generated in 2008. In 2011 a mesocircuit with 100 neocortical columns, that is, one million cells, was created. The simulation of a human brain—in other words, the equivalent of a thousand rats' brains and 100 billion cells—is due for completion in 2023. Again, the goal is to simulate the entirety of a neocortex, which in the case of the human brain represents about one million cortical columns. For better or for worse, Makram has asserted that the supreme achievement will be to endow Blue Brain, supported by Human Brain, with consciousness.

These projects have provoked vehement criticism. On July 7, 2014, an open letter signed by nearly eight hundred neuroscientists was sent to the European Commission, criticizing the cost, centralization, and unconvincing results of Blue Brain as well as the exclusion from the project of a number of first-class researchers in cognitive science who specialize in higher brain functions such as thought and behavior. However, the French journal *La Recherche* recently announced that the "European project," led by a new board, "has made a new start."[60]

What is it exactly? What will come of it? The BRAIN Initiative in the United States is viewed by many as a new version of the Human Genome Project. Instead of sequencing the genome, it's all about mapping the brain. The obsession with the “intelligence gene” seems to have extended into research into the neurons and cortical columns of intelligence.

It is no doubt clear that despite myself, the conclusion of this second metamorphosis of intelligence is dragging me back to that tortoise formation I thought for a moment had been destroyed. I’m at a loss, full of regret, liable to fall prey to a reactionary technophobia, and discouraged by the task of rewriting my book, which this time gives rise to a new question without hoping for an answer: *what should we do with their blue brain?*

3

LIKE A POLLOCK PAINTING

THE POWER OF AUTOMATISMS

I HEAR Bourdieu's voice ringing out: *How can you be so naive? What's happening today with artificial intelligence is simply the contemporary version of an age-old political problem. How could you have imagined that the discovery of neuronal plasticity was the unequivocal opening of the door to enlightenment and freedom? As the paths to the inscription of the social in bodies, brain dispositions can obviously be modeled and are readily captured by power—be it state, economic, or cybernetic.*

Pascal had already demonstrated that occupying a position in space also involves the mechanization of the body by immediately transforming its dispositions into automatisms. As Bourdieu explained, it presents "all [the] paradoxes which Pascal assembled under the heading of wretchedness and greatness." Social order is none other than the order of habituated bodies that thereby become the "springs"[1] of power.

Brain structures, incarnated in practical bodily schemata, are therefore automatized from the start and are no exception to the rule. Nothing can resist automatization. This is why, Bourdieu asserts, "the State does not necessarily need to give orders and to exert physical coercion, or disciplinary constraint, to produce an ordered social world, so long as it is able to produce incorporated cognitive structures attuned to the objective structures and so secure doxic submission to the established order."[2]

Brain plasticity is a spring as much as it is a living coral; it is an ideological norm as much as it is a resource for epigenetic potentialities. While it appears to be the sign of biological indeterminacy, it also serves to legitimize new modes of standardizing psychosomatic expressions. Consider the infamous phrase coined in 2004 by the CEO of the French television group TF1 to refer to the advertising spots the network was selling its clients: "human-brain free time."[3] In the end, isn't this a good equivalent for brain plasticity, synonymous now with the ability to adapt to all kinds of content? Doesn't "brain free time" sound like a global expression for intelligence today? A new avatar of the *g* factor, determining the threshold for attention, concentration, and listening?

The political-social origin of the manufacture of automatons antedates AI. Consequently, criticizing the competition between living brain and machine or worrying about the epigenetic turn in computing is pointless if one does not first take into account that given its initial situation, its original incorporation, intelligence is always already artificial. The automaton, as envisaged by Pascal, is the necessary doubling of the mind. This is why any opposition to the automatization of intelligence, whether in the form of the *testudo* (the first metamorphosis) or epigenetic enthusiasm (the second metamorphosis), is destined to fail. The current cognitive era will not reclaim intelligence if the understanding of intelligence fails to go beyond the dichotomies that have supported it until now.

The third metamorphosis of intelligence explores the possibility of another approach, one that proceeds neither via direct confrontation (intellect versus intelligence) nor via a strategy of mimetic appropriation (capturing plasticity with neurosynaptic chips). Instead it reveals the dialectical resource of the relation between the two inseparable dimensions of intelligence: nature and technology. In light of this view, far from being each other's opposites, automatism and spontaneity appear as two sides of a single energy reality. This way of thinking is not without its difficulties, but it does try to show that the tension between intelligence and automatism is internal to both of them.

DEWEY: INTELLIGENCE AS METHOD

At this point in the analysis we turn to Dewey. He argues vigorously that the automatic nature of intelligence implies not its impoverishment but its growth. Throughout his work, he interrogates the functional complexity of the interaction between natural and artificial intelligence. It is worth noting, moreover, that many of his readers consider him to be "a philosopher of technology."[4]

For Dewey, *all* procedures to "solve a problem," that is, all acts of intelligence, are "instrumental." This means that, like tools, concepts have practical effects. They make it possible to transform a situation concretely by producing the energy needed for its solution. To solve always amounts, first and foremost, to putting into motion, and putting into motion always means, one way or another, automating.

INQUIRY

Let's begin by differentiating two different meanings of "automatism." An automatism refers to an involuntary movement, one without a "soul." But in Greek *automatos* also means "that which moves by itself," spontaneously. The concepts of automaton and automatism thus bear a double valency of mechanical constraint and freedom. Any in-depth consideration of technology never involves the rejection of automatism but rather an exploration of the relationship between the two meanings of the term, which push at each other without ever separating. Dewey asserts that there is an initial social incorporation of the subject, destining it to be invested in by the cogs of power while also freeing itself from this grip through the "method" of intelligence. Intelligence is precisely that which opposes the power of the automatism to the automatisms of power, playing one meaning of automatism against the other.

The economy of this tension originates in habit, which is so close, in many respects, to Bourdieu's habitus. To oppose automatism to itself is actually to oppose habit to itself. While habit lulls intelligence into slumber, it also stimulates it. By crushing it under its weight ("Habit, custom and tradition have had a weight in comparison with which that of intelligence is feeble"),[5] this pressure also awakens it. At first, habit is more powerful than intelligence, but following a survival instinct, intelligence opposes its "method" to it. It destabilizes it, forces it to transform, and thereby frees itself of its habit: "Old habits must perforce need modification, no matter how good they have been."[6] Without habit, intelligence has no past. Without intelligence, habit has no future.

It is important to note that intelligence is not deductive for Dewey. It is deployed in the sphere of action rather than the realm of abstraction, which is the natural milieu of reason or intellect: "Intelligence, as distinct from the older conception of reason, is inherently involved in action."[7] This characterization of intelligence has two main consequences. On the one hand, as mentioned, the primary role of intelligence is to solve problems. And all "problems" are practical. On the other hand, intelligence is naturally "ends-in-view"—but these ends are no different from the means used to attain them: "Each step forward, each 'means' used, is a partial attainment of the 'end.' "[8] In this sense, intelligence is always in transition. Its dynamic is one of movement, never one of final causes.[9]

In order to determine means and ends, the problem must first be located and identified and an inquiry opened. In *How We Think*, Dewey enumerates "five logically distinct steps" of the "inquiry": sensing the problem, locating and defining it, suggesting a possible solution, developing this suggestion through reasoning, and further observation and experimentation of the initial given.[10]

Identifying a problem does not simply amount to observing that something is wrong, which is more often than not a way to be rid of the difficulty even before formulating it correctly. Identifying a problem is too often confused with merely expressing a complaint. The difference between an "unintelligent" and an "intelligent" inquiry lies in the gap between these two attitudes, one of which is reactive, the other exploratory. Only in the exploratory mode, when identification is successful, can solutions appear. "Success" consists in rendering determinate a situation that was indeterminate: "Inquiry is the controlled or directed transformation of an indeterminate situation into one that is so determinate in its constituent distinctions and relations so as to convert the elements of the original situation into a unified whole."[11] Rendering the indeterminate determinate is thus "the essential function of intelligence."[12]

So we find ourselves back with habit. Identifying a problem "intelligently" involves adding to perspectives on it. A perspective is a way of seeing that is always derived from past experience. Perspectives, or viewpoints, on a situation are in fact prior experiences crystallized into habits. We start by seeing what others have seen. In this sense, even when they seem original, we always inherit perspectives. Deliberation and decision making will be all the more effective in an intelligent inquiry if they are better informed about the way in which past experiences articulated possibilities and how the problem was solved at that time. So, if perspectives are always past possibilities, how does novelty arise? It is precisely the reconsideration of perspectives that reveals what is no longer possible in them and calls for reworking. Reliving a putting into perspective of past possibilities in the present allows a simultaneous appreciation of their promise and their obsolescence.

In the section of *Human Nature and Conduct* entitled "Habit and Intelligence," Dewey emphasizes that habits, born of perspectives, were originally answers. According to this method, intelligence evaluates the value of these answers, assesses their efficacy, selects the most relevant, and simultaneously prepares their dissolution in the process of finding new answers. The "inquiry" begins when it becomes clear that habitual modes of thinking and being have become insufficient and inadequate. At the same time, the situation becomes indeterminate anew; that is, it becomes "disturbed, troubled, ambiguous, confused, full of conflicting tendencies, obscure."[13]

How can intelligence transform the situation that has once again become indeterminate as a result of the inadequacy of the habit for the problem in its present form? Certainly not by breaking with habit. Indeed, intelligence itself is only a habit—the habit of solving problems. This is why it always refers to past experience: "There is nothing in the inherent nature of habit that prevents intelligent method itself from becoming habitual."[14] Intelligence is not, therefore, strictly speaking, a process of making breaks; instead it operates in continuity or, again, in transition. Thus it does not break violently with the past but rather proceeds through a constant reconfiguration of the past in the movement of a negotiated taking leave.

The meaning of a problem in the present should not be viewed as dictated solely by preexisting values. Past perspectives are always in the service of examining the current problem. Intelligence synthesizes points of view incorporated in old habits and experiences with those emerging from the difficulties of the present situation and then tries to transform this synthesis into a project. It is at this stage that "reason . . . becomes intelligence—the power of using past experience to transform future experience. It is constructive and creative."[15] The moment the discriminating synthesis is formed, solutions begin to appear. Indeed, "the way in which the problem is conceived decides what specific suggestions are entertained and which are dismissed; what data are selected and which rejected; it is the criterion for relevancy and irrelevancy of hypotheses and conceptual structures."[16] The temporalizing function of the method of intelligence thus becomes apparent:

> In its large sense, this remaking of the old through the union with the new is precisely what intelligence is. It is this conversion of past experience into knowledge in ideas and purposes that anticipate what may come to be in the future and that indicate how to realize what is desired. Every problem that arises, personal or collective, is solved by selected materials from the store of knowledge amassed in past experiences and by bringing into play habits already formed.[17]

The process of transition, the reconsideration of past experiences with a view to resolving future problems, brings about the conjunction of moments in time. Out of this encounter emerges the present, which is never frozen in instantaneity but rather appears as an extension of the possible. As Dewey asks: "Is there . . . any intelligent way of modifying the future except to attend to the full possibilities of the present?"[18]

Many philosophers, starting with Bergson, might be willing to accept the following definition of intelligence: temporal fluidity, the power to transform situations and to transform oneself without fickleness or infidelity. However, as we have seen, for Bergson duration is not the companion of intelligence but rather of intuition. By contrast, the temporalization of time in Dewey is not intuitive; instead it is practical, inasmuch as it inscribes the theoretical understanding of action on the horizon of the emerging solution. Time is implementation. The good idea, the idea with a future, is the one that succeeds.

Intelligence is the search for homeostasis, for an equilibrium that is neither purely derived from past stability nor purely given a priori but that also occupies the midpoint between a priori and a posteriori. Strangely, this midpoint is what Dewey calls *experience*. Experience is not one of the intermediary terms. It is not confounded with the empirical; rather, it is the mediator between a priori and a posteriori. What does this mean? Experience should not be confused with the fact of having "an" experience. Experience is the continuum of life, which moves forward thanks to various specific experiences that extend it every day, like raindrops constantly filling and regenerating a river. In *Art as Experience*, Dewey offers a beautiful analysis:

> Experience occurs continuously because the interaction of live creature and environing conditions is involved in the very process of living. . . . In contrast with such experience, we have *an* experience when the material experience runs its course to fulfillment. Then and then only it is integrated within and demarcated in the general stream of experience from other experiences. A piece of work is finished in a way that is satisfactory; a problem receives its solution; a game is played through . . . ; playing a game of chess, carrying on a conversation, writing a book, or taking part in a political campaign, is so rounded out that its close is a consummation and not a cessation. Such an experience is a whole and carries with it its own individualizing quality and self-sufficiency. It is *an* experience.[19]

Even if experience includes a dimension of difference with oneself that might almost be called transcendental (the difference between experience and experiences), it is important to stress that this experience always remains practical and materially determined. The origin of the transcendental lies in the neuronal. The process of experience "is made possible by the mechanism of the central nervous system, which permits the individual's taking of the attitude of the other toward himself, and thus becoming an object to himself. This is the most effective means of adjustment to the social environment, and indeed to the environment in general, that the individual has at its disposal."[20]

These points bring us back to the question of the relation of intelligence to automatism. The possibility of the self-difference of the subject, felt in and as difference between experience and experiences, is not the condition for a return of the subject to itself, neither autoaffection nor introspection. On the contrary, this differentiation forms the basis of a process of disappropriation of the self. The ability to take oneself as object amounts to being able to see one's own experiences as they are seen by others, which also allows individuals to envisage their consequences in a dispassionate, impersonal manner. Rooted in the nervous system, the possibility of distancing oneself from the self is automatic. Yet it is intelligent. Intelligence is automatically what it is: belonging to no one. Such is the core of Dewey's "instrumental" definition.

Without contradicting itself, the automatism of intelligence thus appears as the mechanism able to interrupt its own routine (the rigid repetition of its habits) without becoming anything other than an automatism (an autonomous process). As we have seen, automatism produces disappropriation and, through it, the pluralization of intelligence, a process that reveals multiple points of view to the subject. To be intelligent is to look from many sides simultaneously. The natural automatism of intelligence reveals its collective, that is, social, nature. As Dewey also writes:

> *Effective* intelligence is not an original, innate endowment. No matter what are the differences in native intelligence (allowing for the moment that intelligence can be native), the actuality of mind is dependent upon the education which social conditions effect. Just as the specialized mind and knowledge of the past is embodied in implements, utensils, devices and technologies which those of a grade of intelligence could not produce them can now intelligently use.[21]

PUBLIC SPACE AND EXPERIMENTAL DEMOCRACY

For Dewey, taking the plurality of perspectives into account when examining problems, along with identifying the greatest wealth of possibilities in a given situation, is democracy par excellence. The "growth" and "power" of collective intelligence are conditions for "experimental democracy."

In *The Public and Its Problems*, we read that moving toward "experimental democracy" requires that ideas be shared and communicated: “ideas which are not communicated, shared and reborn in expression are but soliloquy, and soliloquy is but broken and imperfect thought.” It also requires the establishment of relations of interpersonal exchange in the local community: “Expansion and reinforcement of personal understanding and judgement by the cumulative and transmitted intellectual wealth of the community . . . can be fulfilled only in the relations of personal intercourse in the local community.” We might conclude that there is no collective intelligence without community expression. Dewey confirms precisely this, writing: “There is no limit to the liberal expansion and confirmation of limited personal intellectual endowment which may proceed from the flow of social intelligence when that circulates by word of mouth from one to another in the communications of the local community. That and that only gives reality to public opinion.”[22]

SCHOOL

Existing power generally obstructs advances in experimental democracy. It impedes, restrains, and distorts citizens’ wishes. All means are good for solidifying the flux of intelligence and transforming bodies and minds into obeying machines. Yet therein lies the paradox: hindering intelligence amounts precisely to preventing it from constructing and exercising its own automatisms, that is, from developing perspectives.

What, then, guarantees that intelligence will have the ability to maintain or rediscover its fluidity? This power, whose most just version Dewey sought throughout his life, is education. Education is precisely what enables intelligence to dissolve and recreate its own habits, to imagine the multiplicity of possibilities, to put knowledge to the test of action and thus to act independently from official norms.[23]

Yet more often than not school acts in the service of power by privileging and imposing the mechanisms of individualism—the most dangerous enemy of democracy—against this continuous construction-reconstruction. The individualizing machines at work in most pedagogic methods require all the students in a class to do the same thing at the same time. This uniformity threatens the idea of the collective. It actually draws out competition, rivalry, and judgment, thereby setting up inequalities—for which intelligence tests are often responsible—such that "the weaker gradually lose their sense of capacity, and accept a position of continuous and persistent inferiority," while "the stronger grow to glory, not in their strength, but in the fact that they are stronger."[24]

For school to cultivate a social sense among children, it must be organized as a cooperative community. School must become "an institution in which the child is, for the time, to live—to be a member of a community life in which he feels that he participates and to which he contributes."[25] Dewey's faith in school is expressed in his belief that "education is the fundamental method of social progress and reform."[26] Hence his desire to see American educational institutions transform themselves into so many instruments for the radical democratization of American society.

We see therefore how intelligence and automatism are articulated. The battle against passive automatism is achieved through creative automatisms. Education is never organized by a must-be but rather according to the development of arrangements that, for Dewey, essentially take the shape of cooperative projects with three steps: observing the surrounding world, documenting, and formulating judgments after all these materials are collated. These steps always respect granting the practical meaning of the activity through group discussion and never follow a preordained formal order. Bourdieu too demonstrates that

> the practical sense is what enables one to act as one "should" (*ôs dei*, as Aristotle put it) without positing or executing a Kantian "should," a rule of conduct. . . . The schemes of habitus . . . which, being the product of incorporation of the structures and tendencies of the world, are at least roughly adjusted to them, make it possible to adapt endlessly to partially modified contexts, and to construct the situation as a complex whole endowed with meaning.[27]

Thus "external mechanical determinism, by causes, and intellectual determinism, by reasons—reasons of 'enlightened self-interest'—meet up and merge."[28] Automatism and intelligence only oppose each other so as to better adjust to each other.

AUTOMATICITY AND AUTONOMY

I was indeed mistaken in *What Should We Do with Our Brain?*: plasticity is not, as I argued then, the opposite of the machine, the determining element that stops us from equating the brain with a computer. As I have said, that opposition can only derive from the old critical conflict it claims to challenge. As such, it still belongs to the *testudo* strategy. A clear understanding of automatism would have allowed me to see that plasticity was becoming the privileged intersection between the brain and cybernetic arrangements, thereby sealing their structural identity.

Far from leaving me feeling pessimistic, recognizing this error opens up new perspectives (perspectives again!) that formerly eluded me. I am indebted to David Bates for enabling my conversion. In a powerful article entitled "Automaticity, Plasticity, and the Deviant Origins of Artificial Intelligence," Bates demonstrates that the imbrication of automatism and plasticity does not "robotize" plasticity but rather inscribes within the machine a fallibility that alone makes it intelligent. In return, the "mechanization" of brain plasticity paradoxically signals its undetermined nature, not its routine.

Yet on first glance, brain plasticity and cybernetic dispositions seem to be entirely heterogeneous, and Bates appears to endorse the theses of *What Should We Do with Our Brain?* when he writes:

> It would seem that the recent intensification of interest in the inherent plasticity of the brain—its developmental openness, its always evolving structure in the adult phase, and its often startling ability to reorganize itself after significant trauma—puts considerable pressure on the technological conceptualizations of the brain that assume a complex but definite automaticity of operation. Indeed the concept of plasticity has been heralded as a counter to the machinic understanding of the brain, notably by the philosopher Catherine Malabou.[29]

As I argued, a difference had apparently been established between the ability of neuronal connections to change shape and repair themselves after a lesion and the automatic repetitive rigidity of cybernetic programs.

But the creation of synaptic chips allows us to glimpse the possibility of a perfect simulation of the human brain. It would then be pointless to try to avoid the problem: brain functioning offers a model for artificial intelligence researchers precisely because it is also perfectly describable in computational terms: "Even the contingent determination of the plastic brain can, it is thought, be rigorously modeled by a virtual computer simulation." Later Bates adds: "Digital visions of the plastic brain have stimulated the invention of new computational architectures."[30]

There's no denying it: the brain and computer have a reciprocal and "mirroring" relationship. Consequently, any discourse of resistance that tries to protect the naturalness of intelligence against its capture by technology is futile. It is becoming increasingly difficult to oppose a coherent theoretical resistance to the concept of automation or cybernetic simulation. And so I repeat that the traditional ways artificial intelligence has been critiqued, that is, the demonization of technology and the inverted valuing of the "human" and "natural," are irrelevant. The only remaining way out is to bring to light the immanent contradiction of automatism, thereby opposing the stupidity and intelligence of automatism within automatism itself. Bates expresses this as follows: "Resistance can be generated, that is, through a critical history of *automaticity*."[31]

This internal dialectic—the resistance of automatism to itself—is evident from the first moments in the history of artificial intelligence. In fact, AI first built itself around two directly conflicting theoretical positions. At one extreme, some computer scientists considered the brain to be nothing but a learning machine. For them, that kind of machine could easily be duplicated by computers, which were viewed merely as simple computation machines. At the other extreme, some researchers immediately recognized the importance that brain plasticity could have for the development of AI: "The plastic brain, it was thought, offered the possibility of modeling creative, unpredictable leaps of human intelligence, capacities that went *beyond* the relentlessly automatic performance of rigid functional mechanisms of habitual behaviors."[32]

Turing, Ashby, and von Neumann—all key figures in cybernetic history—became interested in a specific characteristic of "natural" plasticity that, on first glance, appeared to be the least pertinent to their field: compensation, that is, self-repair and self-reorganization after trauma. It is the brain's postlesion creativity that initially fascinated the cyberneticians of the latter extreme. The similarity of their approach to that of the important psychologists, psychiatrists, and neurologists of their time is striking: James, Lashley, Goldstein, Köhler, Sherrington, and Claparède all highlighted the ability of the nervous system to self-repair. Indeed, the type of machine cyberneticians first wanted to invent was one capable of stopping so as to better reorganize itself, to dialectize its automatism, to suspend the process of repeating the same. A machine endowed with regenerative plasticity: "W. Ross Ashby investigated the possibility of such a pathological machine, one that would then be capable of truly novel and unexpected behavior. In a notebook fragment of 1943, we find him reading William James."[33] Even though Ashby acknowledged that machines able to modify their organization were rare, he nevertheless pursued his search for a system able to survive its own traumas. "After a break the organization is changed, and therefore so are the equilibria. This gives the machine fresh chances of moving to a new equilibrium, or, if not, of breaking again."[34] The paradoxical power of "cybernetic plasticity" resides in its fragility, that is, the inevitability of breakdown. As Turing wrote, "While we might expect a machine to be infallible, we can also expect it to be intelligent. . . . Intelligence consists in a departure from the complete disciplined behavior involved in computation."[35]

Yet the approach that claims that only the living is plastic—never the machine—still dominates today. It seems that for many people the "intelligence" of reorganization remains the unique domain of organisms. There are two approaches to the plasticity of reorganization: scientific and philosophic. One reserves it for the living; the other extends its power to the machine. Canguilhem represents the first approach. In "Machine and Organism" he claims, following Kant, that by definition a mechanism has no power to repair itself, while the half-amputated brain of a child can regenerate. As he writes, "There is no mechanical pathology"[36]—and consequently no plasticity either! By contrast, Simondon declares that human beings are plastic automatons: "*the human being is a rather dangerous automaton,* who is always risking invention and giving himself [*sic*] new structures."[37] Consequently, the real perfection of machines is not really dependent on increased technological performance but rather on a wider margin of indeterminacy. This complicates the "marionette" logic considerably. Bates concludes: "Our digital brains—brains modeled on and simulated by computers and increasingly *formed* by repeated interactions with our digital prostheses—will reveal their genuine plasticity only when they rediscover the power of interrupting their own automaticity."[38] A power of interruption that is, again, inscribed within automatism and that constitutes its intelligence.

The tremendous differences between the two versions of the brain/machine relationship—opposites versus structural identity—still define, perhaps more than ever, the contemporary situation of intelligence in the theoretical fields of philosophy, psychology, cybernetics, and neuroscience. But it is not a matter of choosing one version over the other. A dialectical relation is never halted by a decision. It is only resolved through the power of its own tension. It solves its own problem, as Dewey would say. So it is a question of simply *leaving be* the simultaneity of the epigenetic becoming of natural intelligence and artificial intelligence and doing so without value judgment, which does not mean without critical thought. The *Gelassenheit* (serendipity, serenity) that Heidegger advocated in all thinking through of modern technology is more necessary than ever, even in a situation where even Heidegger would have lost his mind: the total simulation of the human brain.[39]

Let us now return to Piaget. It is striking how the equilibration process also assumes the constant interruptions and perpetual disequilibria that mark the passage from one stage to another and precede reorganization and rebalancing. Here again, mechanisms malfunction only to better reevaluate their functioning. The regulating loops of mental life function solely by responding to the disturbances that temporarily interrupt them. Piaget continues by saying that Claparède was quite right that "the succession of behavior appears . . . like a succession of momentary disequilibriums and of re-establishments of equilibrium."[40] The metaphors used in the description of intelligence are halfway between organic homeostasis and technological self-regulation. The two models have one shared feature: in both instances the reorganization after the breakdown or interruption reinforces the efficacy of the automatism.

EX MACHINA

Contingency and necessity, creativity and routine, repetition and disequilibrium, organization and reorganization are all constitutive of automatism and result from the dialectical relation it has with itself.

Another fascinating film, *Ex Machina* (2015), written and directed by Alex Garland, takes this dialectic as its topic.[41] A young programmer, Caleb Smith (Domhnall Gleeson), is invited to spend some time at the property of his employer, the eccentric billionaire genius Nathan Bateman (Oscar Isaac), in order to put a female android named Ava (Alicia Vikander), endowed with artificial intelligence, to the Turing test. One sequence in the film, the "Pollock scene," is particularly powerful. Nathan and Caleb are contemplating a painting by Pollock hanging in the living room and begin to discuss automatons. Nathan explains to Caleb that Pollock's painting is "automatic" art. It is an art, he continues, that is the result neither of intention nor of chance but of their in-between: "Jackson Pollock. That's right. The drip painter. Okay. He let his mind go blank, and his hand go where it wanted. Not deliberate, not random. Some place in between. They called it automatic art." In a scene that was cut from the film, we learn that the painting in question is, in a sense, neither real nor fake. The billionaire reveals that he bought the Pollock for sixty million dollars and had it copied using artificial intelligence to produce an identical version. He then destroyed one of them, so that it was impossible to know whether the surviving painting was real or fake. Nathan asks Caleb: "Why does it matter?" The machine can reproduce a work that is neither truly programmed nor truly random—just like the plastic machine itself! During an interview, in response to the question of whether, in his view, it is important that we be able to distinguish robots from humans, Garland says: "The answer I'd lean towards is no. It wouldn't."[42]

The midpoint between necessity and contingency is the true space of life for automatisms. From there, we can imagine an interaction between brains and machines based on their reciprocal ability to provoke breaks, failures, and catastrophes in the other that would set them up mutually for the challenge of reaching new thresholds of regulation, transforming and reorganizing themselves in response to these challenges, making the difference between mechanism and autonomy ever more impossible to discern. This complex dialectical relationship, at work both in the proper order of each of the two intelligences and in their interaction, thus appears ultimately as the dynamic that resolves a conflict that seemed to offer no way out.

NEW PEDAGOGIES, NEW CULTURE

What are the practical consequences of this type of dialectic for education today? In the article "Connecting Multiple Intelligences Through Open and Distance Learning: Going Toward a Collective Intelligence?" a group of Brazilian researchers analyze, in a manner reminiscent of Dewey, the profound changes the teacher-student relationship is currently undergoing. The traditional education system, they write,

> is still strongly linked to the idea that there is only one type of intelligence, which can be measured though IQ or similar tests. The advent of new digital technologies—especially internet tools that allow human interaction in "cyberspace" . . .—has greatly improved the distance learning model. Through the open and distance learning it is possible to revolutionize the traditional pedagogical practices, thus meeting the needs of those who have different forms of cognitive understanding.[43]

Several types of pedagogic relationships can then be developed in response to the many different forms of intelligence, relations that deconstruct the conception of the act of educating as a dual relation between professor and student. Of course, the educational relationship will still take place in classrooms, but it will also occur elsewhere, through the intermediary of computer networks that no longer require students to gather in the same space.

Online courses that already exist, such as MOOCs and webinars, are still far from meeting the challenges, not only practical but also and especially ethical and political, imposed by the pedagogic plasticity of the future. Distance learning allows students to combine various courses from different institutions and countries as well as to balance the tasks of learning with professional and familial responsibilities. Distance learning open to everyone, allowing tremendous flexibility in the choices of modes of work, should be a powerful example of experimental democracy. Yet we have to acknowledge that all too often MOOCs, for example, still contribute to inequality. While some “star” professors give them a reputation, they are often less well paid for them than for face-to-face courses, and there are grounds for concern that they will feed into the neoliberal logic of insecure and temporary adjunct teacher employment. We might also wonder whether, in the United States, they are designed precisely for those students who are too poor to pay the costs of attending elite universities.

We must therefore work to build a fair and emancipatory political vision of a cybernetic being-together, bringing the relation of the two intelligences—natural and artificial—to its greatest affinity.

Many sociologists and philosophers engaged in research into distance learning and web classes, including Börje Holmberg, Manuel Castells, Pierre Lévy, David Keegan, and Otto Peters,[44] believe that new educational configurations will allow us to redefine the concept of intelligence by breaking with the single-IQ model and opening it up to a wide variety of individuals very different in terms of age, nationality, language, expectations, desires, and pacing. Theorists of distance learning criticize the uniformity of tests even as they continue to invoke intelligence psychologists in making this critique. Howard Gardner, father of the "multiple intelligences," or "multifactorial intelligence," is a key figure for many of them.

In his 1983 *Frames of Mind: The Theory of Multiple Intelligences*, Gardner demonstrated that intelligence cannot and should not be reduced to a single pattern.[45] Intelligence in general is a "biopsychological potential"[46] for processing information, but it individualizes itself in different modes that cannot be gathered into a single category. There are *many intelligence*s within intelligence. Gardner identifies at least seven types: linguistic, logical-mathematical, musical, spatial, bodily-kinesthetic, interpersonal, and intrapersonal.[47] These forms are present in each individual to different degrees, and this variation determines intellectual personality. None of these forms ought to dominate any other. As Gardner says, "[My] theory is an account of human cognition in its fullness."[48]

Early on there was a debate in the United States between psychologists such as Terman, Burt, and Spearman, mentioned earlier, who argued for a unidimensional notion of intelligence, and those such as Louis L. Thurstone, who argued for multifactorial intelligence. For the first group, intelligence describes an overall aptitude that can express itself in several different fields, including memory, language, and reasoning, without division and without losing its "generality." By contrast, for the second group, intelligence refers to many aptitudes that are independent from one another and that can only be measured through a battery of tests specific to each one. Thus, some researchers think that the unitary form of the *g* factor was in question from the start. This was shown by the pluralists' division of *g* into fluid intelligence (*gf*), that is, abstract reasoning ability; crystallized intelligence (*gc*), which relates to lexical ease and general knowledge; visual-spatial ability (*gv*); memory (*gr*); and speed of processing (*gs*).[49]

Another metamorphosis of intelligence was thus in process in the heart of the first, anticipating that beyond their determinist goals, factorial analysis and twentieth-century psychology were already interested in valorizing a modularity of intelligence that could not be reduced to a single term. Taking this view still further, Gardner claims that in each individual there is a unique mix of different intelligences: "The great challenge put to mankind is to find out how to take advantage of the uniqueness conferred on us as a species exhibiting several intelligences."[50]

This type of plurality of "natural" intelligences clearly cannot be fully achieved without the help of the plasticity of technical intelligence and the new educational models it enables. The concept of "collective intelligence" refers to the synthesis of the two. As Pierre Lévy writes, "The mobilizing ideal of information technology is no longer artificial intelligence (make a machine more intelligent, and possibly more intelligent than humans), but *collective intelligence*; namely, the enhancement, optimal use, and fusion of skill, imagination, and intellectual energy, regardless of their qualitative diversity."[51]

Today Dewey's experimental democracy takes the form of a virtual community, a reconfiguration of the "us," whose constitution is indissolubly phenomenological and technological.[52] The technologically virtual nature of this "us" does not, however, make it unreal. Instead, virtual communities are experiencing a new type of materiality today.[53] They exist in a certain kind of place and environment, namely, "cyberspace." As Lévy explains: "I define cyberspace as the *communications space made accessible through the global interconnection of computers and computer memories*."[54]

Cyberspace is at once empty and full, accepting of all content and contiguities. Far from being a passive platform, it is shaped by users, and it transforms them in return. Its pedagogic value is incalculable because it is based on the new educational paradigm of cooperative learning or an "autodidact society."[55] Experimental democracy cannot be conceived of today outside the global self-governance of knowledge.

The implementation of collective intelligence is not, however, without its difficulties, which brings us back to the logic of the resistance of automatism to itself. Indeed, on the one hand, the technological automaticity associated with cyberspace encourages autonomy. Each individual is free to do as they wish there, to produce themselves and organize their knowledge as they see fit. As Lévy writes, cyberspace "ceaselessly redefines the outlines of a mobile and expanding labyrinth that can't be mapped, a universal labyrinth beyond Daedalus' wildest dreams." This space belongs to everyone: "As cyberspace grows it becomes 'universal' and the world of information less totalizable. The universality of cyberspace lacks any center or guidelines." This universality without central meaning, this system of disorder, this labyrinthine transparence, belongs to collective intelligence defined as "universal without totality."[56]

On the other hand, it is clear that the emergence of this type of universal paradoxically also authorizes new hegemonies in the economy of the culture industries, generated by computer lobbies that threaten automatic autonomy and substitute it with uniform practices and behaviors. These phenomena are a far remove from the logic of interrupting automatisms previously discussed. Instead, they offer a smooth image of empathetic, behavioral, global libidinal unity without breakdowns or negativity. In this respect, "collective intelligence is more a field of problems than a solution." In fact, one might wonder whether the intelligent collective is autonomous—"dynamic, emergent, fractal"[57]—or whether it is not still the plaything of an organism more powerful than itself. Does the plurality of intelligences always disappear into the amalgam of consumer desires? Jacques Rancière expresses this same concern when he writes: “The collective intelligence produced by a system of domination is only ever the intelligence of that system.” Against that system, the challenge is to “share with anybody and everybody the equal power of intelligence.”[58]

The dialectical tension at work here thus derives from the internal opposition of two concepts of automatism at work: a uniformization and normalization of behavior versus equality and the sharing of intelligence. How can this tension be engaged by the immanence of its resolution?

NEW FRONTIERS IN THE HUMANITIES

This question prompts another that is also concerned with the future of education. How can the “universal without totality” of cyberculture and collective intelligence be distributed among the different fields of knowledge without reestablishing new hegemonies and new centers? One of the most significant transformations that university teaching is undergoing today concerns the emergence and proliferation of “neuroknowledge”—neurolinguistics, neuroeconomics, neuropsychoanalysis—to name just a few. While they are not yet fully fledged disciplines, these new fields of knowledge implicitly govern the traditional social sciences and take them in a new direction. To what extent are the humanities affected by these transformations, and how can they be open to them without losing their identity? To what extent can the dialogue between the humanities and neuroscience enable a de-escalation of tensions between intelligence and intellect, equality and the subjection of the intelligent collective, and, again, automatism and autonomy? All these questions concern disciplinary boundaries.

The problematic nature of this question was already present at the core of Foucault's reflection on the concept of "critique" in his important 1984 text "What Is Enlightenment?" Foucault recalls that, in its institutional role, critique has always been associated with the humanities. His "What Is Enlightenment?" echoes Kant's piece with the same title, which appeared two hundred years earlier, in 1784. The German periodical *Berlinische Monatschrift* organized a competition that year, inviting readers to answer the question "*Was ist Aufklärung?*" Kant's competition-winning response was essentially a reflection on the relations between philosophical thought and current events. Foucault agrees that it is in the light of this questioning of the present and contemporaneity that the need for critique presents itself in all its full, practical urgency. Indeed, Foucault explains that to think in the present entails knowing how to situate thought *at the limit*. Critique "consists of analyzing and reflecting upon limits." And to reflect on limits means, first and foremost, to "move beyond the outside-inside alternative; we have to be at the frontiers."[59]

The shape of the problem is no different today, even if its content has changed. In fact, the negotiation of frontiers now concerns the relation of the humanities to the new "outside" of neuroscience and "neuroknowledge" in general. In the era of collective intelligence and cyberculture, there is a renewed dialogue between the humanities and the sciences based on the central possibility of a *biologization of the transcendental.*

The implicit stakes of this question have guided my analysis throughout. With Piaget, for example, we saw that the idea of a biological transcendental was perhaps one of the most acceptable definitions of intelligence, situating it midway between logic and the organic. To what extent can this type of question be philosophically reframed today to become a means of critical reflection on critique?

The question of the transcendental runs through and structures all of Foucault's text. The contemporary hypothesis of a biologization of the transcendental extends and radicalizes his analysis. There is one point on which Foucault disagrees with Kant—only one. But their difference of opinion is fundamental. For Kant, the critical examination of the limits of knowledge, which sits at the heart of transcendental philosophy, also implies respecting these limits. It is precisely the idea of untransgressable limits that Foucault challenges: "If the Kantian question was that of knowing what limits knowledge has to renounce transgressing, it seems to me that the critical question today has to be turned back into a positive one. . . . The point, in brief, is to transform the critique conducted in the form of necessary limitation into a practical critique that takes the form of a possible transgression." And he continues: "[Critique] is no longer going to be practiced in the search for formal structures with universal value, but rather as a historical investigation into the events that have led us to constitute ourselves and to recognize ourselves as subjects of what we are doing, thinking, saying."[60]

In other words, it is no longer a matter of determining the restrictions that finitude imposes on knowledge but rather of seeing how this same finitude authorizes subjects to shape and form themselves as such, accomplishing "this work at the limits of ourselves." The transcendental inquiry thus becomes an interrogation of the becoming-subject of the subject, thereby initiating the field of a new ontology that Foucault calls "a historical ontology of ourselves." In fact, the hypothesis of a biologization of the transcendental heightens this paradoxically experimental dimension of the a priori—which was also brought to light by Piaget. Today, the self-shaping of the subject may be seen as related to an *epigenetic ontology,* placing the urgent need for a new reflection on the development of intelligence at the center of the critical enterprise. If what Foucault claims is true, that is, that the new critique must interrogate "in what is given to us as universal, necessary, obligatory, what place is occupied by whatever is singular, contingent, and the product of arbitrary constraints,"[61] then we can rightly claim that the plastic contingency of the structures of knowledge, thought, and creation is the contemporary translation of just such an interrogation.

How could the automatic art that is the functioning of the brain elude the critical question? How could it fail to become an object of "theoretical" reflection and questioning? The problem of intelligence can no longer be limited to psychology, biology, and cybernetics. It must become a central philosophical concept once again.

The future of the project of Foucault's "historical ontology of ourselves" depends on the way in which the empirical structure of thought is taken into account in the disciplinary fields of the humanities. In return, brain plasticity must constitute the basis of a philosophical form of questioning in neuroscience.

In the same way that, as we have seen, the plastic dispositions of subjects are always also gateways of power into bodies, it is clear that if neuroknowledge and the neurohumanities develop without any critical vigilance, they could become pure apparatuses for normalization. The new neurocentric and technological condition of knowledge is in fact twofold: it enables new practices for transforming the self, inventing lifestyles and behavior, in an experimental theoretical and practical attitude, but it can also close off all these ways out by blocking them with the uniformizing processes of a reactionary positivism. The critical task is to rediscover the pathway for interrupting automaticity so as to better emancipate automatisms.

What does this mean? In his 2014 article "Literary Brains: Neuroscience, Criticism, and Theory," Patrick Colm Hogan analyzes the stuttering emergence of the neurohumanities, suggesting that

> the "neuro-humanities" are largely traditional fields of humanistic study—prominently including literature and related arts, such as film—that have taken up findings or methods of neuroscience to advance their research. . . . It is . . . probably too early to undertake a survey of research in neuroscientific literary criticism and theory. However, there is considerable interest among literary scholars in the possibilities for such criticism and theory, and there are many areas of neuroscientific research that have begun to be incorporated into literary study or are likely to do so in the near future.[62]

That said, Colm Hogan notices that "the body of work in neuro-humanities is limited [because] much of the work that has been done falls into the broad category of what we might call 'correlational criticism,' which is often the initial phase of a new theoretical approach to literary analysis." In most cases, the "correlational critique" involves relating, or correlating, a neuroscientific concept "with principles in literature."[63] For instance, "Proust's treatment of memory might be seen as anticipating that of some neuroscientists, as in Lehrer's widely read book [*Proust Was a Neuroscientist*]."[64]

It is rare for literary studies to go beyond this level of analysis, which, if it really is necessary, should only be a precursor. The problem with this type of approach is that the text disappears and is replaced by reductive intentions that leave aside the question of writing and style. The text becomes a thesis, and the thesis a pretext that limits literary reception to the supposed brain reception: the perception of color, sounds, synaesthesia, empathy . . . all sorts of "communications" established between the author and reader on the basis of purported neurological data.

The danger of this type of interpretative procedure lies in its reductionist view and its project to render minds uniform, supposedly all reacting in the same way to the same stimuli. Strangely, many scientists have legitimized these procedures. Thus despite the incontestable rigor of their research on brain plasticity, neurologists such as Jean-Pierre Changeux have claimed, for example, that the neuronal connections of the human brain respond more "positively" to representations of figurative art than to abstract forms.[65]

On this point, I might mention events that took place in Paris in 2013 regarding the chair of contemporary music creation at the Collège de France. The holder of the position that year was the pianist Karol Beffa. Charged in this capacity with organizing events, he invited another composer and pianist, Jerôme Ducros, to give a lecture. Beffa and Ducros are both vocal supporters of a return to tonality and melody and criticize what they consider to be the excesses of serial and atonal music. During his lecture entitled "L'atonalisme. Et après?" (So what comes after atonalism?),[66] Ducros claimed that atonal music was "decadent." After showing a video of Maurizio Pollini playing Stockhausen's *Klavierstück X* punctuated with clusters—blocks of notes, alone or bunched, generally produced by hitting the piano keyboard, either with one's forearm, fist, palm, elbow, or a wooden bat—Ducros sought to prove that insofar as, in his view, atonalism is not based on any musical progression, it cannot awaken the listener's sense of expectation. Listening to a piece of atonal music would therefore only be possible at the cost of entirely passive consent. This form of music does not awaken intelligence. By becoming esoteric, contemporary music has, moreover, cut itself off from its listeners by condemning them to aesthetic inaction. Ducros concluded by asserting that the time has some to restore "real music."

These statements provoked strong reactions from musicians such as Philippe Manoury and Pascal Dusapin. Commenting on the lecture, Dusapin, who had held the chair the previous year, exclaimed: "What's happening here? Cultural collapse and a deep hatred of thought."[67] Likewise, Manoury (who shared Dusapin's opinion) commented as follows:

> Jerôme Ducros first presents us with some fundamental notions that are indispensable to our intelligent relationship with music, and then proceeds to show us that the tonal system is not only the most powerful theoretical and practical apparatus for us to engage in this relation, but will also have us understand that it is the only one that counts. This "natural" aspect . . . is explained by the fact that we obey implicit, unformulated, unconscious rules that govern both our perception of music and our use of language. . . . (Tonal) music and language are thus of a similar nature.[68]

The argument supporting Ducros's lecture is that tonal music pays greater respect to the structures of perception and thought because it matches the phonic and harmonic rules of language. The brain is therefore supposedly more open to it. Tonality and plasticity are considered to function as allies. Manoury continues:

> Jerôme Ducros undertakes a masterful demonstration of the mechanisms linked to the tonal system that are well known to specialists of the neurosciences and [that] for many years been analyzed by the psycho-physiologists

> and phenomenologists of perception. The tonal system, with its anticipations, resolutions, suspensions, and delays [would be] a wonderful machine for steering the perception of temporal objects.[69]

The neurobiological pretext for defending tonal music, which, moreover, was endorsed by scientists at the Collège de France who supported Ducros, in fact serves as a justification for pure value judgments.

This helps us understand the role that reference to the brain may play in contemporary debates on culture and education. Brain plasticity can be interpreted, as in this example, as justifying the prohibition against any perceptual or cognitive "infraction," any "excess" of abstraction that would prevent neuronal potentialization and "depress" connections. On the other hand—and obviously this is the position I take here—the same plasticity can be called upon to contradict any predestination, all hierarchization in the aesthetic and cognitive response to forms.

When they are subject to critique, the neurohumanities must never claim a "naturalness" of form or style in order to impose hermeneutic norms. The brain is not "made" for tonal music or figurative painting. The brain is clearly open and tolerant of dissymmetries and disharmonies, irregular and destabilizing forms. There is no biological programming for the aesthetics of reception. The "method" of intelligence is more necessary than ever to bring out, in the humanities, the mind of neuroscience and to rediscover, in neuroscience, all the surprises of the automatic writing of desire.

Perhaps the "ontology of 'our'selves" will not tell us what we should do with "their" Blue Brain, but it can at least tell us not to assign any neuronal meaning to the color "blue." And that's already a step in the right direction.

CONCLUSION

IN THE END, intelligence is not ours, and it's not theirs either. This resistance to appropriation derives from the ontological paradox that constitutes it: intelligence has no being and cannot, therefore, belong to anyone. Can this paradox, which for so long served as the justification for the philosophical critique of intelligence, ultimately free up its conceptual future? Not if this absence is met with the prostheses of normativity and stereotypes. But yes, it can, if we accept that metamorphoses replace being. From this point of view, as I have argued here, as the pure circulation of energy, ultimately intelligence consists only in its transformations.

The Greeks recognized the priority of metamorphosis over being early on. They named intelligence *mètis* before calling it *logos*, thereby giving ruse primacy over reason. Marcel Detienne and Jean-Pierre Vernant have shown that *mètis* is the type of intelligence required by navigation, hunting, and medicine, sometimes. It combines "flair, wisdom, forethought, subtlety of mind, deception, resourcefulness, vigilance, opportunism, various skills, and experience acquired over the years. It is applied to situations which are transient, shifting, disconcerting and ambiguous, situations which do not lend themselves to precise measurement, exact calculation, or rigorous logic."[1] The symbols of *mètis* are the fox and the octopus, both of which have four characteristic features: the ability to turn the enemy's trick against them, to wait for the opportune moment (a sense of *kairos*), to deploy many different tricks and stratagems, and to hide behind masks. All these traits relate to the power of metamorphosis.

In the modern era, intelligence retains an essential part of this type of power. For Dewey and Piaget in particular, it always assumes an ability to make sense of disorder or to bring order out of uncertainty. Knowing how to adapt, how to take advantage of opportunities as they arise, how to interpret an ambiguous and indeterminate signal, establish similitudes or differences where they are difficult to discern, to weave relations between elements that apparently have nothing in common: Intelligence is, without question, the metamorphic, strategic part of life.

And this is exactly what makes its ontological domestication impossible. Not only is there no being of intelligence, but there will always be something strange in making intelligence into an attribute of the verb "to be." Especially in a statement in the first person. Who would dare proclaim without discomfort "I am intelligent"? Well, he did. Nietzsche was obviously aware of the provocative force of the statement he makes in *Ecce Homo*, "Why I Am So Wise [*Warum ich so klug bin*]."[2] If we take into account the fact that *Klugheit* is the German translation of *mètis*, it's clearly a trick. Indeed, Nietzsche uses the verb "to be" in this impossible question at the very moment he engages in a "radical rejection of even the concept of 'being.'"[3] A rejection that is, precisely, the work of intelligence as much as the proof of its existence—since intelligence "is" not.

"Reject being" is the imperative that establishes the priority of becoming over the stability of essence. Originally, becoming is metabolism. This means that the work of intelligence—revealing connections, the ability to reduce the indeterminacy or uncertainty of a situation, the interpretation of signs, the practical resolution of problems—derives just as much from the initiative of the organism in its interactions with its environment as from intellectual dispositions. Nietzsche, that great philosopher of the brain, reminds us that life cannot be divided up. Indeed, he appears to be the only philosopher in whose work it is entirely impossible to find the slightest separation between the symbolic and the biological. *Ecce Homo* describes the rebirth of the thinker after an illness that turns him away from philosophy and philology and orients him toward the life sciences: “Things had got that bad with me!—With a look of pity I saw how utterly emaciated I was, how I had wasted away: realities were entirely lacking within my knowledge, and the ‘idealities’ were worth damn all!—I was gripped by a really burning thirst: from then on, indeed, I pursued nothing but physiology, medicine, and natural science.”[4] Thus Nietzsche began to write again.

The point of equilibrium between the biological and the symbolic is not easily brought to light, however. The development of the scientific concept of intelligence was clearly an attempt to make this point and name it. But this development, which will forever be associated with Galton, initially sought the articulation of the two dimensions—biological and symbolic—by having recourse to gift, genius, and innate talent. Biologism will never be a response to the question of a biology of meaning.

By describing the successive metamorphoses of intelligence, I have tried to show how this response sought its adequate expression; how, in time, it became possible to establish that psychological equilibration, that is, epigenetic and brain plasticity, could enable the construction of a representation of intelligence that transcends rigid determinisms, even though it is born from the dialogue between biology and cybernetics. That intelligence should remain the eternal irony of ontology also means that it functions without being, which is one definition of automatism.

Clearly the trajectory of these metamorphoses is no straight line. "Modern" intelligence did not gradually throw off its Greek clothing to take on innateness, gift, and genius only to abandon them in favor of egalitarian attire. As I noted, the ghost of Galton is still with us. As with so many other biotechnological procedures, the recent discovery of "molecular scissors" that make it possible to cut up DNA also makes us afraid of the possibility of a made-to-measure manufacturing of individuals. Crispr/Cas9, developed in 2012, is a genetic knife that makes it possible to cut DNA at a specific point in order to introduce changes into the genome of a cell or organism so as to repair or correct it. In April 2016, the Académie nationale de médecine published and adopted by a majority its report "Modifications du génome des cellules germinales and de l'embryon" (Modifications to the genome of embryonic cells and the embryo). The report establishes that it will be legal to use Crispr/Cas9 under some conditions, excluding any research on the human embryo, thus with a prohibition on birthing a child whose genome has been modified.[5] These ethical and legal limits only reveal more clearly, as a negative, the increasing threat of eugenics.

It must be said that, in any case, the state of the world at the time at which I am writing threatens to condemn a tract on intelligence such as this as complete vanity. Writing this book obviously required "faith in the power of intelligence"[6] and in this respect draws more on belief than knowledge.

There is nothing to stop us from thinking that the third metamorphosis of intelligence will be nothing but a barely disguised version of the first. Between genetics and epigenetics, weak AI and superintelligence, Galton's works and molecular scissors, cyberculture and the global standardization of thought, there is no promise that the blade of definite differences is over. We can only hope that *mètis* will always be ready and that "through its polymorphic power it transcends these oppositions,"[7] that it will dig into them and erase them simultaneously, that it will hold them out in order to better cover them over again in a single gesture. This immanent dynamic has no outside other than the execution of all thought. But so long as it still exists, intelligence is the answer to its own question. Intelligence alone can solve its own problem.

There is one life only.

POSTSCRIPT TO THE ENGLISH TRANSLATION

ARTIFICIAL INTELLIGENCE

THE FOURTH BLOW TO OUR NARCISSISM

MÉTAMORPHOSES DE L'INTELLIGENCE received an enthusiastic critical reception when it was published in France. While writing it, I had not yet sounded the extent to which the issue of intelligence, particularly artificial intelligence, had become a pressing issue, one bound up with significant social, political, legal, and economic implications.

Responding to questions from journalists and the public in the many forums on AI organized in France in the fall of 2017[1] made me aware that, for the first time in a very long time, our society was expressing a deep and urgent *need for philosophy*. There truly was a need for the philosophical approach that allows us to apprehend rationally and without delusion what is happening globally in the twenty-first century as a result of advances in cybernetics, to apprehend what is nothing less than a radical revolution not only in the conditions of thought, knowledge, and expertise—notions commonly associated with intelligence—but in every field of activity, affectivity, and the human psyche. The condition of possibility of this revolution is the systematic use of artificial calculation capacities via algorithms. AI is no neutral technology; it is a transformational technology, challenging the architecture of traditional information systems and thereby bringing about a total upheaval of being-in-the-world.

Even as I sought to outline the premises of this upheaval by placing it in a historical framework that allows us to situate it and thus avoid a common trap of our time, that of presenting it as an unprecedented, extraordinary event, I did not sufficiently measure the fear—not to say the terror—it provokes. This is a terror that a historical perspective alone cannot allay, even if it is a necessary first step on the path toward a reasoned approach to these problems. Going beyond facts, the need for philosophy is not only a desire to understand but also to find reasons for hope. In this postscript, I seek to respond to these dual desires.

Of course, there is a danger, and I have not yet acknowledged it clearly enough. My book was published at the same time as others on the topic, including Yuval Harari's *Homo Deus* and *La guerre des intelligences* by Laurent Alexandre,[2] both of which explicitly give voice to this danger and accompanying terror. It was, as I said, the recently deceased Stephen Hawking who was the first to sound the alarm. The danger can be stated quite simply in the form of two questions. Will intelligent machines be capable of making autonomous decisions? If so, becoming uncontrollable, will they replace and bring about the end of humans?

RESEMBLANCE/DISSIMILARITY

How should philosophy respond to these questions? First and foremost, by pointing out that they're not the right ones!

The resemblance between human brains and artificial brains is an undeniable fact that, it is no exaggeration to say, is becoming increasingly clear by the hour. I discussed the invention of synaptic chips. Neuromorphic computing is certainly one of the most promising trends in contemporary cybernetics. In recent news, for example, "engineers at the University of Massachusetts Amherst just published results on . . . microprocessors [that] are configured more like human brains than conventional computer chips." These microprocessors are called "memristors." The article continues:

> Professors Joshua Yang and Qiangfei Xia . . . say neuromorphic computing is one of the most promising transformative computing technologies currently under intensive study. Memristive devices are a key element of their new research. Memristors are electrical resistance switches that can alter their resistance based on the history of applied voltage and current. These devices can

> store and process information at the same location on a chip and offer several key performance characteristics that exceed conventional integrated circuit technology.[3]

Hundreds of articles such as this appear on a daily basis, presenting cutting-edge research in the field of synaptic systems. The trend I termed the "epigenetic revolution" of contemporary technology is clearly underway. Moreover, by the time this postscript appears in print, the information it includes will inevitably need updating.

Another transformative innovation is recurrent neural networks. These networks, distributed on different levels, produce their own parameters while operating, using the repetition of loops that gradually determine the guiding schema of operations. In computing, recursivity is a principle that involves defining a routine by itself. In other words, these networks are not preprogrammed; rather they produce their own rules. Moreover, today, the adjective "intelligent" is increasingly used in contrast to "programmed."

So how exactly do these intelligent networks function? Frédéric Alexandre explains:

> In recurrent networks, such as the Hopfield model (1982), connections are not designed to collect entries, which are individually supplied to neurons, but rather to interconnect all neurons one to another. The operating law of

> these neurons, as also for direct networks, thus learns configurations as stable states from the network (not from entries). Then, faced with a given initial state, the network oscillates so as to converge on the nearest learned stable state. These learned stable states are also called prototypes and can be seen as invariants in network configuration.[4]

Such systems learn—that is, they progressively improve performance on tasks—by considering examples, generally without task-specific programming. In artificial intelligence, this is called deep learning. The different strata of the neural networks are able to self-organize in order to solve a problem, to reduce the chaos of multiple contingent variables by producing discriminating parameters that appear in the process itself, not prior to it. Recursive algorithms are often used, for example, to resolve an identification or sorting problem, to define a mathematical function sequence or a tree process.

So why, then, is the question of competing human and machine brains wrongheaded? For the simple reason that their resemblance, in fact, produces a dissimilarity. The resemblance experiences a strange breaking point—what Kurzweil calls "singularity." The more effective the resemblance, the more it phenomenalizes itself as dissimilarity. The neuromorphism of computers, bearing witness to a similar structure as expressed by the biological metaphor, concurrently breaks away from any isomorphism with the human brain. The speed of calculation of algorithms, that is, their processing power, is such that although the "biological" often serves to name them, it cannot or can no longer compete with them. It is therefore no longer a matter of degree but rather a difference in nature that distinguishes the human brain from the artificial brain. Thus, paradoxically, the more the artificial imitates the biological, the more it reveals their incommensurability.

As I have already stressed, what complicates the situation still further is that this algorithmic power—Big Data—is not solely a matter of quantity. Algorithms are also implicated in qualitative activities such as artistic creation, imitating a style, or improvisation. The experts all agree that AlphaGo, the machine that recently won the world Go championship, demonstrated a certain creativity. For this reason, the contrast drawn by the philosopher Bernard Stiegler between quantitative "calculation" and what he calls the "improbable," that is, the qualitative that initially eludes a quantitative approach, does not hold.[5] The subtlety of algorithmic calculation today derives precisely from the fact that it is capable of simulating noncalculation, that is, spontaneity, creative freedom, and the directness of emotion. Today AI, robotics, and artificial life are working together on the development of machines that are designed to appear natural. Yet these cybernetic copies reveal that they are not mere simulacra. And in this lies the difficulty.

Today, by simulating the human brain, AI is inventing new forms of intelligence that no longer draw on the human. These new forms of intelligence derive their power from *automatic creation*. Music, painting, literature, games . . . their creativity is boundless. In order to confront the reduction of human genius to a series of algorithms that will no longer have anything to do with such genius, we, then, must be *creative otherwise*. And there is absolutely no point in looking for reassurance in the claim that entire fields of human inventiveness elude their cybernetic copies.

What are we to do? I propose that we replace contradiction with distinction. Indeed, the work of the philosopher consists first and foremost in the art of distinguishing, which is another name for critique.

THE DANGER OF MACHINES IS HUMAN

Reading what I have written, one might be led to believe that my viewpoint has changed since the French publication of this book, that I am expressing further reservations and verging on a certain technophobia. Far from it. My acknowledgment of the danger is certainly more acute, but my main idea in regard to the relation between natural and artificial intelligence remains unaltered.

I do still firmly believe that the danger lies not with machines but with humans, and it is essential that we become aware of this reversal in roles. We experience technological mutations from behind a smokescreen. Emphasizing novel technological dangers enables the hypocrisy of those who are manipulating that very technology. It's nothing but the talk of pyromaniac firefighters. Take, for example, Elon Musk, the owner of Tesla and SpaceX, who is constantly laying out disaster scenarios about the future of AI; at the same time, he is one of the most powerful promoters of its implementation. To counter these future catastrophes, in December 2015 he announced the founding of the OpenAI Center, dedicated to "benefiting humans." He presented the center as a nonprofit, bringing together tens of startups in the field of AI research. At the same time, in 2016, he founded the startup Neuralink, whose aim is to connect the brain to integrated circuits, thereby fusing human and artificial intelligence.[6] In June 2017 he officially announced his intent to commercialize the first model by 2021. How is this strategy not contradictory?

The situation is equally contorted in theoretical discussions. In France, the surgeon and company director Laurent Alexandre, who is extremely interested in the transhumanist movement, has become "Mr. Artificial Intelligence." He writes weekly columns, each as futuristic and bleak as the next, in the magazine *L'Express*.[7] But how can we ignore the fact that his columns and books clearly serve his own personal interests by taking advantage of his readers' credulity? I could name any number of examples of these methods for exploiting fear in order to mask (poorly) what they really are, namely, ideological screens hung like semi-transparent curtains to hide obvious plans for conquest (of Mars, for instance), profit, and domination. In a word: these are the new imperialisms.

As I have said, the burning question today is humanity's possible loss of control to machines, a possibility that the new masters I just mentioned exploit systematically. But—and this is where philosophers must speak out—*faced with developments in artificial intelligence, the only solution is, in fact, to accept a loss of control. To lose control of intelligence intelligently.*

We have to distinguish between two possible types of loss of control. Let's discuss it in terms of two scenarios. The first is a kind of *defeat*. Scenario 1, the most well known: humans are conquered by machines that "disconnect" themselves from our control. This is a science-fiction scenario that makes no sense if one thinks about it but is trumpeted by those in control and who intend to keep control. The second type, scenario 2, is a form of *letting go*, a concerted, voluntary renunciation of the individualistic and competitive form of power that currently rules the cybernetic universe. The issue, therefore, is the *democratic construction of collective intelligence*. As analyzed in the last chapter of the book, the construction of a global community, with shared responsibility, is the only alternative to the domination of the new emperors who are transferring their own hegemonic impulses to robots, neuronal networks, and synaptic computers. We must all understand that in the new cybernetic world order intelligent systems are the *instruments* of these impulses—not the instigators.

So there is loss of control, and then there is loss of control. This is the first distinction to be made. Behind the first scenario hides a resistance to the second type of loss of control. Who, among GAFA (Google, Apple, Facebook, and Amazon), robotics companies, and laboratories, is actually ready to let go, to replace the pyramidal hierarchy, competition, and secrets with a collective, horizontal form of governance? Yet there is no doubt that communal decision making, based on connected dialogue and mutual aid, is the only dispassionate, rational, responsible manner to respond to the challenges of the third great metamorphosis of intelligence. Artificial intelligence is first and foremost an *indicator of progress*. This fact is so obvious and simple that the only way to remember it is to lose sight of it. In the history of humanity the key turning points in technological progress are, by definition, those that have increased and exceeded human intelligence. Technology moves the goal posts, widens them, and allows us to see beyond them. AI is no exception to the rule. By emphasizing the resemblance between human brains and artificial brains (and thereby that they will naturally be in competition), the ones calling the shots—who are human, I repeat, not machines—paradoxically and intentionally mask the fact that this resemblance is in fact a difference, a difference that, rather than compromising the future, would allow us to see it, if only it were presented as such.

Yet it will be objected that most of the leaders in Silicon Valley apparently agree entirely with this way of seeing things. In 2017 Mark Zuckerberg published an interesting text on Facebook, "Building Global Community," which, as its title indicates, garners arguments in favor of collective intelligence. Thanks to artificial intelligence, the future is all about regenerating the concept of community:

> Bringing us all together as a global community is a project bigger than any one organization or company, but Facebook can help contribute to answering these five important questions: How do we help people build supportive communities that strengthen traditional institutions in a world where membership in these institutions is declining?. . . How do we help people build an informed community that exposes us to new ideas and builds common understanding in a world where every person has a voice? How do we help people build a civically-engaged community in a world where participation in voting sometimes includes less than half our population?. . . My hope is that more of us will commit our energy to building the long term social infrastructure to bring humanity together.[8]

It is then a matter of protecting it:

> There is a real opportunity to build global safety infrastructure, and I have directed Facebook to invest more and more resources into serving this need. . . . Terrorism, natural disasters, disease, refugee crises, and climate change need coordinated responses from a worldwide vantage point. No nation can solve them alone. A virus in one nation can quickly spread to others. A conflict in one country can create a refugee crisis across continents. Pollution in one place can affect the environment around the world. Humanity's current systems are insufficient to address these issues. Artificial intelligence can help provide a better approach.[9]

This fine text goes right to the heart of the problem. It is a highly political message in the fundamental sense of the word; that is, it directly addresses the organization of the *polis* (cybernetics). It may even be the first political message sent to two billion individuals over a digital platform.

But the problem with this text is Zuckerberg's use of "we." In fact, the message alternates between the "we" of Facebook owners and the presumed "you" of its users. Who's hiding behind this benevolent "we"? Where is the collective? We know that Facebook determines what is "good" for the community by itself, that it has decreed strict publication rules that are not up for debate, which is a contradiction to the very form of the network.[10] The recent Cambridge Analytica data-mining scandal is another clear illustration of the limits for trust in this system!

As Frédéric Charles, the director of digital strategy at Green SI, puts it so well:

> Unlike blockchain, which promises to promote the emergence of highly decentralized ecosystems, based on trust, a total readability of shared registers and a certification of transactions, social networks promise us, by contrast, an extreme centralization of platforms, and a total loss of transparency in decisions and algorithms. So it is no surprise that even before being operational on a large scale, they are ensuring that AI-based systems are not trusted.[11]

He emphasizes the fact that the leaders of GAFA are apparently in competition over their global democratic intentions. Google also spoke about this at the RSA 2017 cybersecurity conference, via Eric Schmidt, executive director of its parent company, Alphabet.[12] For Schmidt, AI research should not be done in military laboratories or closed company settings but should take place in "open labs." We can infer from this that for Schmidt, Facebook should therefore never be satisfied with thinking through how to benefit its community with AI all by itself but should also publish its code in open source so as to foster openness. That was what Google did with tensorflow.org, an open-source library available to anyone wishing to learn about AI. But "whom does it benefit?" Frédéric Charles immediately asks. Indeed, "the big digital companies (Google DeepMind, Amazon, Facebook . . .) all have dedicated, supported teams,"[13] that is, specialists who, naturally, do not share all their secrets. This is a highly contradictory situation of simultaneously making available a "virtually unlimited, almost free, ubiquitous intelligence"[14] while also confiscating it.

The threat inherent to the third metamorphosis of intelligence thus lies first and foremost in its modes of governance and not, I repeat, in the phantasmagoria of machines becoming independent because they are so dangerously similar to us.

INTERNATIONAL ETHICAL AND LEGAL REGULATION

It is vital to construct a participatory democracy of intelligence that places each citizen, each individual, right in the heart of the decision-making process. This would put an end to the perception that global politics are now determined exclusively in Silicon Valley. This type of restructuring would have to be developed within an international legal and ethical framework that would not leave such questions solely up to the initiative of private individuals and organizations.[15] There is no reason to think that the law is not capable of regulating the new situations brought about by the use of AI.

To cite a recent example, the European Parliament ordered a report on robotics, which was submitted by the Commission on Civil Law Rules on Robotics on January 27, 2017. On February 16, the European Parliament voted to adopt a document that responded to the recommendations of the report. The report starts by proposing that the different types of machines referred to as "smart robots" be standardized within a category that comprises machines characterized by some autonomy, the use of sensors and data exchange with their environment and the analysis of this data, the ability to learn by themselves through experience and interaction, a physical medium, the adaptation of their behavior and actions to their environment, and the absence of life in the biological sense. The report also recommends the creation of a European Agency for Robotics and Artificial Intelligence, whose role would be to "supply the technical, ethical and regulatory expertise necessary to support public agents, at the federal and state level"[16] in the effort to respond to the opportunities and challenges presented by the development of intelligent systems. Endowed with its own budget and composed of experts, technicians, and other philosophers specializing in the ethics of artificial intelligence, this agency would implement the regulation recommendations, oversee consumer protection, and study the systemic issues brought about by the boom in robotics.

The response to research needs also requires education to adapt. The report specifies that "by 2020 Europe might be facing a shortage of up to 825 000 ICT professionals and that 90% of jobs will require at least basic digital skills."[17] The European Parliament therefore invites the European Commission and member states to further develop professional training in new technologies and to ensure that educational systems prepare citizens to join an economy in which robotics will be omnipresent. In this new economy, sociability, creativity, and adaptability will be three particularly valuable skills. Education should therefore support individuals in developing these skills. The report also emphasizes the increasing need for continuing education, as opposed to simply learning during the early years.

Finally, the report also deals with robot ethics: "The existing Union legal framework should be updated and complemented . . . by guiding ethical principles in line with the complexity of robotics and its many social, medical and bioethical implications."[18] It therefore proposes a charter that includes a code of conduct for robotics engineers and another for researchers into the ethics of artificial intelligence.

This example is interesting in that it shows the European Union taking the initiative in terms of regulatory norms so as to avoid being forced to follow those put in place by other countries. In my view, however, ideally this regulation effort should go beyond instances of institutional decision making in order to fully integrate systematic consultation with cybercitizens into a participatory digital democracy, for instance, on the topic of the viability of current fiscal and social systems, new employment models, and the creation of universal income. In a word, it should be used for consulting about living conditions!

Again, there is no reason to lose confidence in the plasticity of the law, ethics, and mentalities if it follows the right political direction as dictated by the demands of democracy. Regulate to leave us free. Artificial intelligence *controlled by the letting go of the drive to control* would thus favor participation over obedience, help rather than replace, imagine more than terrorize. The challenge is to invent a community with machines together, even when we share nothing in common with them. Never will there be a community of machines. The automatic creation they are capable of will have a political platform and ethical texture only if we endow them with it. But to achieve this, a horizon must be met by responsibly letting go.

Critics will say I'm establishing a series of double-binds here: let's control the lack of control, let's decide not to decide, and so forth. To which I respond that only a new mindset will allow us to break out of these loops. There can be no plasticity of law, ethics, and mentalities without a human transformation. Yet, just as I have distinguished between two types of loss of control, I also distinguish between two types of transformation. The "transhumanist" transformation corresponds to the loss of control implied in the first scenario: the drive for power masked by the fear of defeat. Transhumanism is the expression of a desire for power that posits that the increase in humans' natural abilities through prosthetic arrangements will raise humans to the level of machine performance. It's the scenario of ultraresemblance. By definition, it's impossible.

The second type of transformation is political, corresponding to a change in intersubjectivity based on the new legal, ethical, and social frameworks indispensable to the construction of chains of virtual mutual assistance that must become instances of true decision making. The vocation of these chains is to frame the future becoming of artificial intelligence in such a way that, again, it will enable a productive loss of control that promises progress. There is no future without a loss of control. The desire to program the development of machines that function without a program is a failure to understand the future. It shuts down the future.

Transhumanism is a form of hypernarcissism that channels the desire not to lose control and to continue to develop the image of mastery even when it is already obsolete. It seems to me that today artificial intelligence represents the fourth narcissistic blow to humanity. Recall Freud's famous statement:

> In the course of centuries the *naïve* self-love of men has had to submit to two major blows at the hands of science. The first was when they learnt that our earth was not the centre of the universe but only a tiny fragment of a cosmic system of scarcely imaginable vastness. This is associated in our minds with the name of Copernicus, though something similar had already been asserted by Alexandrian science. The second blow fell when biological research destroyed man's supposedly privileged place in creation and proved his descent from the animal kingdom and his ineradicable animal nature. This revaluation has been accomplished in our own days by Darwin, Wallace and their predecessors, though not without the most violent contemporary opposition. But human megalomania will have suffered its third and most wounding blow from the psychological research of the present time which seeks to prove to the ego that it is not even master in its own house, but must content itself with scanty information of what is going on unconsciously in its mind. We psychoanalysts were not the first and not the only ones to utter this call to introspection; but it seems to be our fate to give it its most forcible expression and to support it with empirical material which affects

> every individual. Hence arises the general revolt against our science, the disregard of all considerations of academic civility and the releasing of the opposition from every restraint of impartial logic.[19]

First Copernicus, followed by Darwin, then psychoanalysis, and now the fourth blow: the capturing of intelligence by its own simulation, exceeding and transcending it.

To recover from this kind of a blow requires first that it be accepted rather than denied. This is not to resign oneself to it but rather to reinvent trust. Paradoxically, some losses leave us stronger.

Catherine Malabou
Irvine, April 2018

NOTES

TRANSLATOR'S FOREWORD

1. Catherine Malabou, *What Should We Do with Our Brain?*, trans. Sebastian Rand (New York: Fordham University Press, 2008).
2. Contrary to John H. McWorter's claim in *The Language Hoax: Why the World Looks the Same in Any Language* (Oxford: Oxford University Press, 2014). McWorter presents arguments against the widespread neo-Whorfian assumption that languages shape not just culture but also thought.
3. Nicole Doerr, *Political Translation: How Social Movement Democracies Survive* (Cambridge: Cambridge University Press, 2018), 126.
4. Audre Lorde, "The Master's Tools Will Never Dismantle the Master's House," in *Sister, Outsider*: *Essays and Speeches* (Trumansburg, NY: Crossing, 1984).
5. Lawrence Venuti, *The Translator's Invisibility: A History of Translation* (New York: Routledge, 1995); Catherine Porter, "Translation as Scholarship," *ADFL Bulletin* 41, no. 2 (2009): 7–13.

PREFACE

1. Catherine Malabou, *What Should We Do with Our Brain?*, trans. Sebastian Rand (New York: Fordham University Press, 2008).

INTRODUCTION

1. On this point, see Lorraine Daston's analysis in "The Naturalized Female Intellect," in which she writes, "Intelligence as currently and conventionally understood by psychologists is a brashly modern notion." *Science in Context* 5, no. 2 (1992): 211.
2. See Jean David, *Le procès de l'intelligence dans les lettres françaises au seuil de l'entre-deux guerres, 1919–1927* (Paris: Librairie A. G. Nizet, 1966).
3. The authors of the article "A Collection of Definitions of Intelligence" identify no fewer than seventy definitions of the term, and their list is not exhaustive. Consequently, there is no single definition of intelligence. Shane Legg and Marcus Hutter, "A Collection of Definitions of Intelligence," in *Proceedings of the 2007 Conference on Advances in Artificial General Intelligence: Concepts, Architectures, and Algorithms: Proceedings of the AGI Workshop 2006*, ed. Ben Goertzel and Pei Wang (Amsterdam: IOS, 2007), 17–24.
4. Théodore Simon, preface to Alfred Binet and Théodore Simon, *A Method of Measuring the Development of the Intelligence of Young Children*, trans. Clara Harrison Town (Chicago: Chicago Medical Book Company, 1913), 25; my translation.
5. It should be noted, however, that the term "intelligence" [*intelligence*] is sometimes used to refer to an intuitive ability to understand—for instance, when Malebranche discusses "the understanding [*intelligence*] of the truths of faith." Nicolas Malebranche, *Dialogues on Metaphysics and Religion*, trans. David Scott (Cambridge: Cambridge University Press, 1997), 92.
6. Henri Bergson, *Creative Evolution* (1907), trans. Arthur Mitchell (London: The Electric Book Company, 2001). Ravaisson was the

first to introduce the concept of intelligence to philosophy in the unique manner Bergson inherited. See Felix Ravaisson, *Of Habit* (1838), trans. Clare Carlisle and Mark Sinclair (London: Continuum, 2008), 2:39.

7. Hippolyte Taine, *De l'intelligence*, 2 vols. (Paris: Hachette, 1892).
8. Bergson, *Creative Evolution*, 184.
9. Bergson, *Creative Evolution*, 50 (translation modified).
10. Bergson, *Creative Evolution*, 148 (translation modified).
11. Bergson, *Creative Evolution*, 160.
12. Bergson, *Creative Evolution*, 156.
13. Henri Bergson, *The Creative Mind: An Introduction to Metaphysics*, trans. Mabelle L. Andison (New York: Citadel, 1946), 33.
14. Bergson, *Creative Evolution*, 186.
15. Bergson, *Creative Evolution*, 259.
16. Bergson, *Creative Evolution*, 171.
17. Bergson, *The Creative Mind*, 306n26.
18. See Bergson, *Creative Evolution*.
19. "Every day I set less store on intelligence." Marcel Proust, *Contre Sainte-Beuve* (1954; Paris: Gallimard, 1971), 211; trans. Sylvia Townsend Warner (1957; New York: Carroll & Graf, 1997), 19 (translation modified).
20. Proust, *Contre Sainte-Beuve*, 19 (translation modified).
21. Gilles Deleuze, *Difference and Repetition*, trans. Paul Patton (New York: Columbia University Press, 1994), 151. See also Jacques Derrida, *The Beast and the Sovereign*, trans. Geoffrey Bennington (Chicago: University of Chicago Press, 2009).
22. Sigmund Freud, *Beyond the Pleasure Principle* (1920), trans. James Strachey (New York: Norton, 1989), 30.
23. Jean Piaget, *The Psychology of Intelligence*, trans. Malcolm Piercy (London: Routledge & Kegan Paul, 1959), 7.
24. Piaget, *The Psychology of Intelligence*, 11.
25. John Dewey, *The Quest for Certainty*, in *The Later Works of John Dewey, 1925–1953*, 17 vols., ed. Jo Ann Boydston (Carbondale: Southern Illinois University Press, 1981–1990), 4:170.
26. John Dewey, *The Public and Its Problems* (New York: Henry Holt, 1927), 219.

27. See, for example, Stephen Hawking's concern expressed on the BBC on December 2, 2014: "The development of full artificial intelligence could spell the end of the human race." http://www.bbc.com/news/technology-30290540.

1. *g*: INTELLIGENCE AND GENETIC FATE

1. Stephen Jay Gould, *The Mismeasure of Man* (New York: Norton, 1996), 182–83.
2. Jean Piaget, *The Psychology of Intelligence*, trans. Malcolm Piercy (London: Routledge & Kegan Paul, 1959), 154.
3. Francis Galton, *Hereditary Genius: An Inquiry Into Its Laws and Consequences* (London: MacMillan and Co., 1869), viii.
4. Galton, *Hereditary Genius*, 39.
5. Galton, *Hereditary Genius*, titles for chapters 1 and 2, 6 and 14, respectively.
6. Galton, *Hereditary Genius*, 37.
7. Francis Galton, *English Men of Science: Their Nature and Nurture* (London: MacMillan, 1874). In his article "The History of Twins as a Criterion of the Relative Powers of Nature and Nurture," *Fraser's Magazine* 12 (1875): 566–76; repr., *International Journal of Epidemiology* 41 (2012): 905–11, Galton undertook tests to see if twins who were similar at birth diverged in dissimilar environments and whether twins dissimilar at birth converged when reared in similar environments. The result was predictable for, "except for those whose life-course was altered by a serious ailment," the twins continued unaltered up to old age, notwithstanding very different conditions of life. It is as if they "go on keeping time like two watches" (574).
8. Quoted in Gerard Meurant, *Genes, Culture, and Personality: An Empirical Approach* (London: Academic Press, 1989), 19.
9. Francis Galton, *Memories of My Life* (London: Methuen and Co., 1908), 130.
10. Francis Galton, *Hereditary Genius*, 1.
11. Following the "method of centiles," using a scale from 0 to 100. Galton, *Memories of My Life*, 267, 288.

12. Galton, *Memories of My Life*, 323.
13. See Galton, *Memories of My Life*, 320.
14. This laboratory later became the Galton Laboratory, based at University College, London.
15. On the appearance of the word "eugenics" and the historical context in which it came into being, see Laurence Perbal, *Gènes et comportements à l'ère post-génomique* (Paris: Vrin, 2011), 19–24.
16. Perbal, *Gènes et comportements*, 30 (my translation).
17. Perbal, *Gènes et comportements*, 31 (my translation). Perbal adds, "many British eugenics societies welcomed Nazi policies as an important test of what a state-run application of eugenicist ideas might look like. The American movement was very close to the German eugenics movement, and many Americans visited Germany after the Nazis took power in 1933 to observe the results of the sterilization policy that was implemented. The revelation of the Nazi camps of mass extermination provoked a vast movement rejecting the eugenics ideology definitively, even though this had already been initiated from the 1930s by various opposition groups, both secular and religious. The Nazi's genocidal policy did not, however, lead to the abolition of eugenics laws in all countries. Some countries, including Canada, Sweden, and Switzerland, continued their eugenics sterilization policy up to the 1970s" (my translation).
18. It is important to mention that today the term "eugenics" has a plural meaning that resists its full assimilation to an undertaking of racial purification. From this point of view, it is interesting to study the history of a society such as the American Eugenics Society, founded in 1921, which became the Society for the Study of Social Biology in 1972. As one of its founders said, "The name was changed because it became evident that changes of a eugenic nature would be made for reasons other than eugenics, and that tying a eugenic label on them would more often hinder than help their adoption. Birth control and abortion are turning out to be great eugenic advances of our time." Rebecca Messall, "The Long Road of Eugenics: From Rockefeller to *Roe v. Wade*," *Human Life Review* 30, no. 4 (2004): 67. More recently, in 2014, the name was changed to Society for Biodemography and Social Biology.

19. Ann Robinson and Pamela R. Clinkenbeard, "History of Giftedness, Perspective from the Past Presage Modern Scholarship," in *Handbook of Giftedness in Children, Psychoeducational Theory, Research, and Best Practices*, ed. S. I. Pfeiffer (New York: Springer, 2008), 20.
20. *The Times* (London), October 19, 2007.
21. Gould, *The Mismeasure of Man*, 185, 187.
22. He comments, "the idea of measuring intelligence by measuring heads [seemed] ridiculous." Cited by Gould in *The Mismeasure of Man*, 178.
23. Gould, *The Mismeasure of Man*, 179.
24. Alfred Binet, *The Mind and the Brain* (1922), 8. Cited in Bernard Andrieu, "Alfred Binet, sa vie, son œuvre (1857–1911)," introduction to Alfred Binet, *Œuvres complètes* (Paris: Eurédit, 2001), 1:79 (my translation).
25. Antoine de la Garanderie, preface to Alfred Binet, *L'étude expérimentale de l'intelligence* (1923), in *Œuvres complètes* (Paris: Eurédit, 2001), 20:9 (my translation).
26. Binet, *L'étude expérimentale de l'intelligence*, 12 (my translation).
27. Binet, *L'étude expérimentale de l'intelligence*, 5, 10 (my translation).
28. Binet, *L'étude expérimentale de l'intelligence*, 63 (my translation).
29. Binet, *L'étude expérimentale de l'intelligence*, 5 (my translation).
30. Andrieu, "Alfred Binet, sa vie, son œuvre (1857–1911)," 37 (my translation).
31. The "three pioneers of hereditarism in America" are "H. H. Goddard, who brought Binet's scale to America and reified its scores as innate intelligence; L. M. Terman, who developed the Stanford-Binet scale, and dreamed of a rational society that would allocate professions by IQ scores; and R. M. Yerkes, who persuaded the army to test 1.75 million men in World War I, thus establishing the supposedly objective data that vindicated hereditarian claims and led to the Immigration Restriction Act of 1924, with its low ceiling for lands suffering the blight of poor genes." Gould, *The Mismeasure of Man*, 186.
32. Gould, *The Mismeasure of Man*, 205.
33. Gould, *The Mismeasure of Man*, 281. Later he writes: "In his 1904 paper, Spearman proclaimed the ubiquity of *g* in all processes deemed intellectual: 'All branches of intellectual activity have in

common one fundamental function . . . whereas the remaining of specific elements seem in every case to be wholly different from that in all the others. . . . This *g*, far from being confined to some small set of abilities whose intercorrelations have actually been measured and drawn up in some particular table, may enter into all abilities whatsoever' " (291).

34. See Ulrich Neisser, "Rising Score on Intelligence Tests," *American Scientist* 85 (1997): 440–47.
35. Gould, *The Mismeasure of Man*, 294.
36. Gould, *The Mismeasure of Man*, 185.
37. Gould, *The Mismeasure of Man*, 185, 188, 189. The term "moron" was invented by Goddard, "from a Greek word meaning foolish."
38. Alfred Binet and Théodore Simon, *A Method of Measuring the Development of the Intelligence of Young Children*, trans. Clara Harrison Town (Chicago: Chicago Medical Book Company, 1913), 7.
39. Binet and Simon, *A Method of Measuring the Development of the Intelligence of Young Children* (my translation from the French). *La mesure du développement de l'intelligence chez les jeunes enfants*, publication de la société Alfred Binet (Paris: Bourrelier, 1954).
40. Binet and Simon, *A Method of Measuring* (my translation).
41. John Fuller and Robert Thompson, *Behavior Genetics* (New York: Wiley & Sons, 1960). Many scientific journals dedicated to behavioral genetics emerged at the same time. On this topic, see Perbal, *Gènes et comportements*, 31–33.
42. Perbal, *Gènes et comportements*, 32 (my translation).
43. Richard J. Herrnstein and Charles Murray, *The Bell Curve: Intelligence and Class Structure in American Life* (New York: Free Press, 1994).
44. Herrnstein and Murray, *The Bell Curve*, 311.
45. Gould, "Critique of the Bell Curve," in *The Mismeasure of Man*, 367–90. See *The Bell Curve*, 270.
46. Gould, *The Mismeasure of Man*, 350.
47. *IGF-2R* is a gene on chromosome 6 that displayed a difference between two groups of people: high-IQ groups and average-IQ groups. Allele 5 of this gene was more common in extremely

high-IQ groups (46 percent had at least one *IGF-2R* allele 5) than in the average IQ group (only 23 percent had at least allele 5). This experiment was supposed to reveal differences between individuals with higher versus average intelligence.

48. Cited by Perbal in *Gènes et comportements*, 62.
49. See R. C. Lewontin, "The Analysis of Variance and the Analysis of Causes," *American Journal of Human Genetics* 26 (1974): 400–11. For Benzer's work on the successes and failures of the genetic dissection of behavior, see Perbal, *Gènes et comportements*, 60–72.
50. Henri Atlan, "Programme de recherche inter-centres biologie et société," 2009, https://journals.openedition.org/annuaire-ehess/20375 (my translation).
51. Fox-Keller's remark on this subject is very similar to Atlan's position: "The term 'genetic determinism' refers to a belief system that locates the cause of all biological development in an organism's genes: if we only knew enough about genes (about what they are and how they 'act'), we could understand all of biology. Such beliefs—codified in what I call the 'discourse of gene action'—have been of great importance to the history of genetics, and most recently to the launching of the Human Genome Project. But what does it mean to attribute—or, for that matter, to deny—causal power to genes? Without question, this way of talking has been immensely productive to research in genetics, but it has also impeded the formulation of a conceptual framework adequate to the study of developmental phenomena." Evelyn Fox-Keller, "Rethinking the Meaning of Genetic Determinism," Tanner Lectures, 1993, https://tannerlectures.utah.edu/_documents/a-to-z/k/keller94.pdf. See also Evelyn Fox-Keller, *The Century of the Gene* (Cambridge, MA: Harvard University Press, 2000).
52. Cited by Jacqueline Nadel, "L'intelligence, c'est ce que mesure mon test, disait ironiquement Binet," *Enfance* 2 (June 2011): 285 (my translation).
53. Edgar Morin, *La méthode*, vol. 3: *La connaissance de la connaissance* (Paris: Seuil, 1986), 75 (my translation).
54. In *Roman Lives* Plutarch reports on the tortoise, or *testudo*, strategy used by Marc Antony during the war against the Parthians:

"Then the Roman shieldbearers wheeled round and enclosed the lightarmed troops within their ranks, dropped down on to one knee, and held their shields out as a defensive barrier. The men behind them held their shields over the heads of the first rank, while the third rank did the same for the second rank. The resulting shape, which is a remarkable sight, looks very like a roof, and is the surest protection against arrows, which just glance off it." Plutarch, *Roman Lives: A Selection of Eight Lives* (Oxford: Oxford University Press, 1999), 399.

55. Alfred Binet and Théodore Simon, "Méthodes nouvelles pour le diagnostic du niveau intellectuel des anormaux," *L'Année Psychologique* 11 (1905): 195 (my translation).
56. Alfred Binet and Théodore Simon, *The Development of Intelligence in Children (The Binet-Simon Scale)*, trans. Elizabeth S. Kite (Baltimore, MD: Williams & Wilkins Co., 1916), 222, 239.
57. Henri Bergson, *Time and Free Will: An Essay on the Immediate Data of Consciousness*, trans. F. L. Pogson (London: George Allen & Unwin, 1950), 1.
58. Bergson, *Time and Free Will*, 1–2.
59. Alfred Binet, "Esprit et matière," in *Les grandes conférences du XX^e^ siècle: textes téléchargeables en intégralité*, Centenaire de la Société Française de Philosophie, section II, Psychologie, Psychiatrie, Psychanalyse (Paris, 2001), http://www.sofrphilo.fr/esprit-et-matiere/.
60. Georges Politzer (published under the pseudonym Arouet), *Quelques livres. La fin d'une parade philosophique. Bergson et le bergsonisme* (1929; repr., Paris: Éditions Jean-Jacques Pauvert, 1967), 192. Georges Canguilhem published an enthusiastic review of the book in *Libres propos d'Alain* (Nîmes), April 20, 1929. On Canguilhem's early writing, see Jean-François Braunstein, "Canguilhem avant Canguilhem," *Revue d'Histoire des Sciences* 53, no. 1 (2000).
61. Georges Canguilhem, "Qu'est-ce que la Psychologie?," lecture on December 18, 1956, published in *Études d'histoire and de philosophie des sciences* (Paris: Vrin, 1979), 365 (my translation).
62. Canguilhem, "Qu'est-ce que la Psychologie?," 377 (my translation).

63. Canguilhem, "Qu'est-ce que la Psychologie?," 378 (my translation).
64. Canguilhem, "Qu'est-ce que la Psychologie?," 378 (my translation).
65. Francis Galton, *Finger Prints* (1892; London: Macmillan, 1982). Galton establishes an experimental classification of more than 2,500 sets of fingerprints.
66. Canguilhem, "Qu'est-ce que la psychologie?," 382 (my translation).
67. Michel Foucault, *History of Sexuality: An Introduction*, trans. Robert Hurley (New York: Vintage, 1990), 137.
68. Giorgio Agamben, *Homo Sacer: Sovereign Power and Bare Life*, trans. Daniel Heller-Roazen (Stanford, CA: Stanford University Press, 1998), 145.
69. Foucault, *History of Sexuality*, 144.
70. Foucault, *History of Sexuality*, 65.
71. Martin Heidegger, "The Provenance of Art and the Destination of Thought," trans. Dimitrios Latsis, *Journal of the British Society for Phenomenology* 44, no. 2 (2013): 122–23.
72. Jacques Derrida, *Of Spirit: Heidegger and the Question*, trans. Geoffrey Bennington and Rachel Bowlby (Chicago: University of Chicago Press, 1989), 64.
73. Heidegger, "The Provenance of Art and the Destination of Thought," 123, 124.
74. Heidegger, "The Provenance of Art and the Destination of Thought," 124.
75. See Derrida, *The Beast and the Sovereign*, esp. session 7, 253ff., 187. Paul Valéry, *Monsieur Teste*, trans. Jackson Mathews (New York: Knopf, 1947), 9.
76. Valéry, *Monsieur Teste*, 12.
77. Derrida, *The Beast and the Sovereign*, 258ff., 191.
78. Derrida, *The Beast and the Sovereign*, 259ff., 191.

2. THE "BLUE BRAIN"

1. Pierre Bourdieu, *Pascalian Meditations*, trans. Richard Nice (Stanford, CA: Stanford University Press, 2000), 132.
2. Bourdieu, *Pascalian Meditations*, 132–133.

3. Bourdieu, *Pascalian Meditations*, 141.
4. Bourdieu, *Pascalian Meditations*, 136.
5. Bourdieu, *Pascalian Meditations*, 136.
6. On the brain as a "global workspace" or "global neuronal network" (my translation), see Stanislas Dehaene, *Le code de la conscience* (Paris: Odile Jacob, 2014), 191.
7. *Nature* 409, no. 6822 (February 2001), https://www.nature.com/nature/journal/v409/n6822/index.html.
8. These results were confirmed by the new project ENCODE (Encyclopedia of DNA Elements) begun in September 2003, following the Human Genome Project.
9. See "Le génome humain cache de 'vastes déserts,' " *Le Monde*, February 13, 2001.
10. Henri Atlan, *La fin du "tout génétique"? Vers de nouveaux paradigmes en biologie* (Paris: INRA Éditions, 1999), 16 (my translation).
11. Henri Atlan, "Programme de recherche inter-centres biologie et société," 2009, https://journals.openedition.org/annuaire-ehess/20375 (my translation).
12. Henri Atlan, *La fin du "tout génétique"?*, 16 (my translation). See also "Épigénétique: l'hérédité au-delà des gènes," *La Recherche* 463 (April 2012): 38–54 (my translation).
13. Conrad Hal Waddington, *The Basic Ideas of Biology*, in *Towards a Theoretical Biology*, 4 vols. (Edinburgh: Edinburgh University Press, 1968–1972), 1:1.
14. For example, research into certain types of cress has shown that being exposed to cold during the winter led to structural changes in the chromatin, which silenced the flowering genes. These genes are reactivated in the spring when the longer and warmer days become suitable for reproduction.
15. Mary-Jane West-Eberhard, *Developmental Plasticity and Evolution* (Oxford: Oxford University Press, 2003), 34.
16. Eva Jablonka and Marion J. Lamb, *Evolution in Four Dimensions: Genetic, Epigenetic, Behavioral, and Symbolic Variation in the History of Life* (Cambridge, MA: MIT Press, 2005), 242.
17. See Jean-Pierre Changeux, Philippe Courrège, and Antoine Danchin, "Selective Stabilization of Developing Synapses as a

Mechanism for the Specification of Neural Networks," *Proceedings of the National Academy of Sciences* 70 (1973): 2974–78.

18. Jean-Pierre Changeux, "Les bases neurales de l'habitus," in *Croyance, raison et déraison* [annual colloquium at the Collège de France, directed by Gerard Fussman] (Paris: Odile Jacob, 2005), 149 (my translation).
19. Jean-Pierre Changeux, *Du vrai, du beau, du bien. Une nouvelle approche neuronale* (Paris: Odile Jacob, 2008), 371, 372. My translation here is from the French since the published English translation is a reworking of the French text.
20. Jeffrey M. Schwarz and Sharon Begley, *The Mind and the Brain: Neuroplasticity and the Power of Mental Force* (New York: HarperCollins, 2002), 365.
21. Bourdieu, *Pascalian Meditations*, 170.
22. Bourdieu, *Pascalian Meditations*, 135, 136.
23. Bourdieu, *Pascalian Meditations*, 140–41.
24. Jean Piaget, *Biology and Knowledge: An Essay on the Relations Between Organic Regulations and Cognitive Processes*, trans. Beatrix Walsh (Chicago: University of Chicago Press, 1971).
25. Jean Piaget, *Six Psychological Studies*, trans. Anita Tenzer (New York: Vintage, 1967), 3.
26. Piaget, *Six Psychological Studies*, 4.
27. A description of the stages can be found in Piaget, *Six Psychological Studies*, 5–6.
28. Piaget, *Six Psychological Studies*, 101.
29. Jean Piaget, *The Psychology of Intelligence*, trans. Malcolm Piercy (London: Routledge & Kegan Paul, 1959), 153.
30. Piaget, *The Psychology of Intelligence*, 6, 11.
31. Piaget, *The Psychology of Intelligence*, 29, 32; my emphasis.
32. Piaget, *The Psychology of Intelligence*, 17.
33. Piaget, *The Psychology of Intelligence*, 10, 11, 33, 8.
34. Piaget, *The Psychology of Intelligence*, 3.
35. Jean Piaget, *Introduction à l'épistémologie génétique* (Paris: PUF, 1950), 3:127 (my translation).
36. Piaget, *Six Psychological Studies*, 103.

37. Piaget, *Biology and Knowledge*, 23.
38. Piaget, *Six Psychological Studies*, 145.
39. Piaget, *The Psychology of Intelligence*, 120, 112.
40. Piaget, *The Psychology of Intelligence*, 27, 18.
41. Changeux, "Les bases neurales de l'habitus," 146 (my translation).
42. Recent research has shown that there is an epigenetic heritability of stress and traumatic memory. On this question, see the important work by Rachel Yehuda on the descendants of survivors of the Shoah, notably David Samuels, "Do Jews Carry Trauma in Our Genes? A Conversation with Rachel Yehuda," *Tablet*, December 11, 2014.
43. Changeux, "Les bases neurales de l'habitus," 150 (my translation).
44. Definition in the French-language edition of Wikipedia (my translation).
45. Changeux, "Les bases neurales de l'habitus," 148 (my translation).
46. Changeux, "Les bases neurales de l'habitus," 148 (my translation).
47. Christian Bautista, "IBM's Neuro-Synaptic Chip Mimics Human Brain," *Tech Times*, August 10, 2014, http://www.techtimes.com/articles/12593/20140810/ibm-synapse-computer-chip-mimics-human-brain-heres-why-its-amazing.htm.
48. Dharmendra S. Modha, "Introducing a Brain-Inspired Computer," IBM, August 15, 2015, http://www.research.ibm.com/articles/brain-chip.shtml.
49. Modha, "Introducing a Brain-Inspired Computer."
50. Modha, "Introducing a Brain-Inspired Computer."
51. Luc Steels, "Fifty Years of AI: From Symbols to Embodiment—and Back," in *Fifty Years of Artificial Intelligence* (New York: Springer, 2006), 27.
52. Steels, "Fifty Years of AI," 27.
53. Steels, "Fifty Years of AI," 26. It is important to mention the increasing importance of research in the field of artificial life and the biology of synthesis. The goal of artificial life is to create artificial systems inspired by living systems, either in the form of computer programs or robots. The biology of synthesis, or synthetic biology, is a scientific field known as "emerging

biotechnology." It combines biology with engineering principles with a view to creating and building ("synthetizing") new biological systems and functions, whose applications are developed today particularly in the agropharmaceutic, chemical, agricultural, and energy sectors.

54. Nick Bostrom, "How Long Before Superintelligence?" *Linguistic and Philosophical Investigations* 5, no. 1 (2006): 11–30.
55. Ray Kurzweil, *The Singularity Is Near: When Humans Transcend Biology* (New York: Viking, 2005), 22–23.
56. Kurzweil, *The Singularity Is Near*, 23, 29. The list of effects of this "paradigm shift," which cannot be cited here in full since there are thirty-four points, is found on 25–28.
57. Kurzweil, *The Singularity Is Near*, 27, 38.
58. Catherine Malabou, *What Should We Do with Our Brain?*, trans. Sebastian Rand (New York: Fordham University Press, 2008), 34–35.
59. Spike Jonze, dir., *Her* (Warner Bros., 2013).
60. "Un nouveau souffle pour le Human Brain Project?" *La Recherche* 499 (May 2015): 25 (my translation). See also Stephen Theil, "Why the Human Brain Project Went Wrong," *Scientific American*, October 1, 2015. Although he is aware of all the criticisms of the project, the author concludes: "Although the mediators criticized the HBP for raising 'unrealistic expectations' with regard to understanding the brain and treating its diseases, resulting in a 'loss of scientific credibility,' even critics such as Dayan and Mainen fully support the project's parallel goals of delivering computational tools, data integration and mathematical models for neurological research. Concentrating on Big Data, a core part of Markram's vision from the start, might even make Europe's HBP a perfect complement to the U.S.'s BRAIN Initiative, whose new technologies are expected to generate huge volumes of neurological data. If the HBP scales down to its technological core—developing useful computational tools and models for neurological research, as mundane as that may sound—then Henry Markram may well leave a great and lasting legacy on neuroscience."

3. LIKE A POLLOCK PAINTING

1. Pierre Bourdieu, *Pascalian Meditations*, trans. Richard Nice (Stanford, CA: Stanford University Press, 2000), 130, 169.
2. Bourdieu, *Pascalian Meditations*, 178.
3. This is the name of the "merchandise" the TF1 television network sold clients as advertising spaces: "What we are selling Coca-Cola is human-brain free time." *L'Expansion-L'Express*, July 9, 2004 (my translation).
4. Larry Hickman, "John Dewey: Philosopher of Technology," *Free Inquiry* 14, no. 4 (1994): 43.
5. John Dewey, "Intelligence and Power," *New Republic*, April 25, 1934.
6. John Dewey, *Human Nature and Conduct: An Introduction to Social Psychology* (1922), in *The Essential Dewey*, 2 vols., ed. Thomas M. Alexander and Larry A. Hickman (Bloomington: Indiana University Press, 1998), 2:38.
7. John Dewey, *A Common Faith*, in *The Later Works of John Dewey, 1925–1953* (hereafter *LWJD*), 17 vols., ed. Jo Ann Boydston (Carbondale: Southern Illinois University Press, 1981–1990), 9:52.
8. John Dewey, *Essays* (1926), in *LWJD*, 2:60.
9. On this point, see Colin Koopman's fine presentation in *Pragmatism as Transition, Historicity and Hope in James, Dewey, and Rorty* (New York: Columbia University Press, 2009).
10. John Dewey, *How We Think* (Boston, 1910), chap. 6, part 2.
11. John Dewey, "The Pattern of Inquiry," in *Logic: The Theory of Inquiry*, in *The Essential Dewey*, 2:171.
12. John Dewey, *Human Nature and Conduct*, in *The Middle Works of John Dewey, 1899–1924* (hereafter *MWJD*), 15 vols., ed. Jo Ann Boydston (Carbondale: Southern Illinois University Press, 1976–1983), 14:126. See also "Inquiry and Indeterminateness of Situations," *Journal of Philosophy* 39, no. 11 (1942): 290–296.
13. Dewey, *Human Nature and Conduct*, in *MWJD*, 14:109.
14. John Dewey, *Experience and Education*, in *LWJD*, 13:54.
15. John Dewey, *Miscellany*, in *MWJD*, 11:346.

16. Dewey, "The Pattern of Inquiry," in *The Essential Dewey*, 2:173.
17. John Dewey, *Liberalism and Social Action* (1935), in *LWJD*, 11:37.
18. Dewey, *Human Nature and Conduct*, in *MWJD*, 14:183.
19. John Dewey, *Art as Experience* (1934), in *LWJD*, 10:42.
20. George Herbert Mead, *Mind, Self, and Society from the Standpoint of a Social Behaviorist*, ed. Charles W. Morris (Chicago: University of Chicago Press, 1934), 100.
21. John Dewey, *The Public and Its Problems* (New York: Henry Holt, 1927), 209.
22. Dewey, *The Public and Its Problems*, 218, 219.
23. Myron C. Tuman, an illiteracy specialist, connects Dewey to Piaget on the question of education, showing that Dewey deepens the meaning of Piaget's "assimilation-accommodation" pair. Piaget might be misinterpreted as thinking that assimilation implies a passive aptitude that consists in matching our desires to the order of the world, while accommodation represents the opposite attempt "to change the world in thought or reality to conform our wishes." Dewey removes this ambiguity. Tuman shows that for Dewey the goal of education is, in fact, to make accommodation "increasingly deliberate" and assimilation "increasingly constructive," in a word, to make the automatisms of intelligence more intelligent. M. C. Tuman, *A Preface to Literacy: An Inquiry Into Pedagogy, Practice, and Progress* (Tuscaloosa: University of Alabama Press, 1987), 79.
24. John Dewey, "Ethical Principles Underlying Education," in *The Early Works of John Dewey, 1882–1898* (hereafter *EWJD*), 5 vols., ed. Ann Jo Boydston (Carbondale: Southern Illinois University Press, 1969–1972), 65.
25. John Dewey, "Plan of Organization of the University Primary School," in *EWJD*, 5:224–43.
26. John Dewey, "My Pedagogic Creed," in *EWJD*, 5:93.
27. Bourdieu, *Pascalian Meditations*, 139.
28. Bourdieu, *Pascalian Meditations*, 139.
29. David Bates, "Automaticity, Plasticity, and the Deviant Origins of Artificial Intelligence," in *Plasticity and Pathology: On the Formation of the Neural Subject* (New York: Fordham University Press, 2016), 195.

30. Bates, "Automaticity, Plasticity," 195, 196.
31. Bates, "Automaticity, Plasticity," 197.
32. Bates, "Automaticity, Plasticity," 197.
33. Bates, "Automaticity, Plasticity," 208.
34. Cited in Bates, "Automaticity, Plasticity," 209.
35. Cited in Bates, "Automaticity, Plasticity," 211; also see 218n52. "When our brain is injured, Peirce noted, we act in 'new ways.'" "In special cases, 'disease of the brain may cause an improvement in general intelligence.'" Cited in Bates, "Automaticity, Plasticity," 201n20.
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37. Gilbert Simondon, *Du mode d'existence des objets techniques* (Paris: Aubier, 1989), 11–12; cited in Bates, "Automaticity, Plasticity," 214.
38. Bates, "Automaticity, Plasticity," 214.
39. See Martin Heidegger, "Serenity," in *The Question Concerning Technology and Other Essays*, trans. William Lovitt (New York: Harper and Row, 1977).
40. Jean Piaget, *Six Psychological Studies*, trans. Anita Tenzer (New York: Vintage, 1967), 100.
41. Alex Garland, dir., *Ex Machina* (Universal Pictures, 2015).
42. "Ex Machina Writer/Director Alex Garland Talks Robots, Consciousness, and Jackson Pollock," Ryan Britt, *Electric Lit*, May 7, 2015, https://electricliterature.com/ex-machina-writer-director-alex-garland-talks-robots-consciousness-and-jackson-pollock-c631736a5efe.
43. Vieira Medeiros et al., "Connecting Multiple Intelligences Through Open and Distance Learning: Going Toward a Collective Intelligence?" *European Journal of Open, Distance, and E-Learning* 17, no. 1 (2014): 108.
44. See Börje Holmberg, *Theory and Practice of Distance Education* (London: Routledge, 1995); Manuel Castells, *Networks of Outrage and Hope: Social Movements in the Internet Age* (Cambridge, MA:

Polity, 2012); Pierre Lévy, "Toward a Self-Referential Collective Intelligence: Some Philosophical Background of the IEML Research Program," in *Computational Collective Intelligence, Semantic Web, Social Networks, and Multiagent Systems*, ed. Ngoc Thanh Nguyen et al., ICCCI 2009, Wroclaw (Poland) (Berlin: Springer, 2009), 22–35; David Keegan, ed., *Theoretical Principles of Distance Education* (London: Routledge, 1993); Otto Peters, "Distance Education: A Revolutionary Concept," in *Distance Education as a Two-Way Communication: Essays in Honour of Börje Holmberg*, ed. G. E. Ortner et al. (Frankfurt: Peter Lang, 1992).

45. Howard Gardner, *Frames of Mind: The Theory of Multiple Intelligences* (New York: Basic Books, 1983).
46. Howard Gardner, *Intelligence Reframed: Multiple Intelligences for the Twenty-First Century* (New York: Basic Books, 1999), 150.
47. Gardner's seven types of intelligence are listed in the first edition of *Frames of Mind*. This list reappears notably in Howard Gardner, *Changing Minds: The Art and Science of Changing Our Own and Other People's Minds* (Cambridge, MA: Harvard Business Review Series, 2006).
48. Gardner, *Intelligence Reframed*, 44.
49. See Lewis L. Thurstone, *The Nature of Intelligence* (London: Routledge, 1924).
50. Medeiros et al., "Connecting Multiple Intelligences," 109; quoted in Gardner, *Intelligence Reframed*, 162.
51. Pierre Lévy, *Cyberculture*, trans. Robert Bononno (Minneapolis: University of Minnesota Press, 2001), 147.
52. Lévy, *Cyberculture*.
53. Katherine Hayles, *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics* (Chicago: University of Chicago Press, 1999), 4.
54. Pierre Lévy, *Cyberculture*, 74. Lévy explains that the word "cyberspace" was invented by William Gibson in 1984 in the science-fiction novel *Neuromancer*.
55. Lévy, *Cyberculture*, 152.
56. Lévy, *Cyberculture*, 91, 92.

57. Lévy, *Cyberculture*, 111, 112.
58. Jacques Rancière, *Hatred of Democracy*, trans. Steve Corcoran (London: Verso, 2006), 96, 97.
59. Michel Foucault, "What Is Enlightenment?" in *The Foucault Reader*, ed. Paul Rabinow (New York: Pantheon, 1984), 45.
60. Foucault, "What Is Enlightenment?" 45–46.
61. Foucault, "What Is Enlightenment?" 46, 45.
62. Patrick Colm Hogan, "Literary Brains: Neuroscience, Criticism, and Theory," *Literature Compass* 11, no. 4 (April 2014): 293.
63. Hogan, "Literary Brains," 294.
64. Jonah Lehrer, *Proust Was a Neuroscientist* (New York: Houghton Mifflin, 2007).
65. Jean-Pierre Changeux, "Beauty in the Brain: For a Neuroscience of Art," *Rendiconti Lincei* 23, no. 3 (September 2012): 315–20.
66. The lecture, given on December 20, 2012, is available on the Collège de France website, https://www.college-de-france.fr/site/karol-beffa/seminar-2012-12-20-15h00.htm.
67. Cited in Jacques Drillon, "Musique: c'est la guerre au Collège de France," *L'Obs*, July 23, 2013 (my translation).
68. Philippe Manoury, "Mais de quoi donc ce 'neo' veut-il nous parler?" April 24, 2013, http://www.philippemanoury.com/?p=5182 (my translation).
69. Manoury, "Mais de quoi donc ce 'néo' veut-il nous parler?" (my translation).

CONCLUSION

1. Marcel Detienne and Jean-Pierre Vernant, *Cunning Intelligence in Greek Culture and Society*, trans. Janet Lloyd (Chicago: University of Chicago Press, 1978), 3–4.
2. The French *malin* (cunning) or *avisé* (shrewd) is a more faithful translation of the German *klug* than the adjective "intelligent." *Malin* is the translation Henri Albert chose in Friedrich Nietzsche, *Œuvres*, ed. Jean Lacoste (Paris: Lafont, 1993), 2:1129. Eric Blondel

used *avisé* in the French translation of *Ecce Homo* (Paris: Flammarion, 1992), 71. But "intelligent" could have been selected just as easily.

3. Friedrich Nietzsche, *Ecce Homo: How to Become What You Are*, trans. Duncan Large (Oxford: Oxford University Press, 2007), 48.
4. Nietzsche, *Ecce Homo*, 57.
5. "Nicknamed the 'Swiss army knife of genetics,' a new molecular tool makes it possible to modify genomes at will in all living beings. In granting humanity the ability to change its biological fate, it gives rise to the wildest medical hopes and the most troubling eugenicist nightmares." Nathaniel Herzberg, "Crispr, le big bang et la génétique," *Le Monde*, July 20, 2016 (my translation).
6. "Faith in the power of intelligence to imagine a future which is the projection of the desirable in the present, and to invent the instrumentalities of its realization, is our salvation. And it is a faith which must be nurtured and made articulate: surely a sufficient task for our philosophy." John Dewey, "The Need for a Recovery of Philosophy," in *Creative Intelligence: Essays in the Pragmatic Attitude*, ed. John Dewey (New York: Holt, 1917), 69.
7. Detienne and Vernant, *Cunning Intelligence in Greek Culture and Society*, 157.

POSTSCRIPT TO THE ENGLISH TRANSLATION. ARTIFICIAL INTELLIGENCE: THE FOURTH BLOW TO OUR NARCISSISM

1. Cf. *Forum Libération/France Inter*, "Voyage au cœur de l'intelligence artificielle" [Voyage to the heart of artificial intelligence], Maison de Radio France, Paris, with Cédric Villani, Isabelle Falque-Pierrotin, Christophe Demurger, and Catherine Malabou, January 24, 2018.
2. Yuval Noah Harari, *Homo Deus: A Brief History of Tomorrow* (Readtrepreneur, 2017); Laurent Alexandre, *La guerre des intelligences. Intelligence artificielle vs intelligence humaine* [The war of

intelligences: artificial intelligence versus human intelligence] (Paris: Lattès, 2017).

3. J. Joshua Yang, "UMass Amherst Researchers Try to Make Computers More Like the Brain by Integrating Memristive Synapses and Neurons Into Neural Networks," March 1, 2018, https://www.umass.edu/newsoffice/article/umass-amherst-researchers-try-make. The UMass Amherst electrical and computer engineering (ECE) department led a twenty-four-person international team of researchers from Loughborough University in the United Kingdom, Hewlett Packard Labs, the US Air Force Research Lab, and the Institute of Microelectronics, Tsinghua University, in China. The paper appears in the February online issue of *Nature Electronics* (https://www.nature.com/articles/s41928-018-0023-2) and is a follow up to a 2017 paper in *Nature Materials* (https://www.nature.com/articles/nmat4756) by the same team.
4. Frédéric Alexandre, "Quelques lois d'adaptation pour neurones artificiels et réels" [Several adaptation laws for artificial and real neurons], in *Journée sur l'adaptation*, ed. F. Le Ber and J. Lieber (Champenoux, 2000), 6 (my translation).
5. Bernard Stiegler, "Nous sommes à la fin du nihilisme" [We have reached the end of nihilism], *France Culture*, podcast, August 12, 2017, https://www.youtube.com/watch?v=bxPr35WH2vI.
6. "Elon Musk avec Neuralink veut connecter nos cerveaux à Internet" [Elon Musk wants to connect our brains to the internet with Neuralink], *Forbes France*, June 6, 2017.
7. For example, Laurent Alexandre, "La police des robots ne sera pas humaine" [Policing robots will not be human], *L'Express*, February 21, 2018.
8. Mark Zuckerberg, "Building Global Community" Facebook, February 16, 2017.
9. Zuckerberg, "Building Global Community."
10. Facebook's "community standards" can be found at https://www.facebook.com/communitystandards/.
11. Frédéric Charles, "L'intelligence artificielle pourrait grandir sans contrôle, sur les gisements de données" [Artificial intelligence

might grow uncontrolled, drawing from data deposits], *Blog Green SI*, Zednet, February 19, 2017, http://www.zdnet.fr/blogs/green-si/l-intelligence-artificielle-pourrait-grandir-sans-controle-sur-les-gisements-de-donnees-39848698.htm.

12. Eric Schmidt is the executive chairman of Alphabet, Inc., the company that owns Google, Inc., and other technology businesses. Schmidt joined Google as its CEO in 2001 and helped grow the company from a Silicon Valley startup to a global leader in technology. He is a regular speaker and writer on topics related to the future of technology, with a focus on machine learning and artificial intelligence.
13. Charles, "L'intelligence artificielle pourrait grandir sans contrôle."
14. Alexandre, *La guerre des intelligences*, 22.
15. Currently the private sector and research groups such as the signatories of the "23 Asilomar principles" (including the astrophysicist Stephen Hawking and the entrepreneur Elon Musk) have gone furthest in developing and thinking about the ethics of artificial intelligence.
16. Guillaume Renouard, "Ce que contient le texte voté par le Parlement européen sur la robotique" [What the text on robotics voted on by the European Parliament says], *Prospective*, February 2017, https://atelier.bnpparibas/prospective/article/contient-texte-vote-parlement-europeen-robotique (my translation).
17. "Motion for a European Parliament Resolution, with Recommendations to the Commission of Civil Law Rules on Robotics," http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+REPORT+A8-2017-0005+0+DOC+XML+V0//EN#title1.
18. "Motion for a European Parliament Resolution."
19. Sigmund Freud, *Introductory Lectures on Psychoanalysis* (1916), in *The Standard Edition of the Complete Psychological Works of Sigmund Freud*, ed. James Strachey (London: Hogarth, 1963), 16:284–85.

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