

Stratigraphies of Time and History

Beyond the Outrages upon Humanity's Self-Love

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In his recent essay on “Anthropocene time,” the historian Dipesh Chakrabarty asks why people in general and historians in particular have such a hard time thinking about “questions of geological time” mobilized by the concept of the “Anthropocene.”¹ Instead, he argues, these questions “fall out of view and the time of human world history comes to predominate,” with the effect that “we do not take into account Earth-history processes that outscale our very human sense of time,” and thus “do not quite see the depth of the predicament that confronts humans today.”² Chakrabarty goes on to offer several examples of how ongoing debates about climate change and geological periodization fail to reconnect “human-centered and planet-centered time,” as he puts it in a paraphrase from Jan Zalasiewicz.³ As Chakrabarty is well aware, this split between historical and geological time, foregrounded in the concept of “the Anthropocene,” has a long history, going back to the eighteenth century and the dissolution of *historia naturalis* as the main paradigm for gaining knowledge about both the natural and the cultural world.⁴

In this chapter, I will discuss how questions of geological time are coming into and out of view at different moments in the history of knowledge in Western Europe, and how they relate to historical, human-centered time. At the center of these historiographical conceptual movements are a set of theories about times in plural, multiple times, organized according to a specific spatial pattern, known as “stratigraphy.”⁵ Before we can turn to the history of stratigraphy as a theory of time and history, capable of structuring both geological and phenomenological temporalities, we need to take a closer look at one of the most forceful interventions in the history of knowledge giving shape and meaning to the entanglements between geology and human history, by some of the pathbreaking scholars in the field.

The Fourth Outrage upon Humanity's Self-Love

In the historiography of the history of the earth, or in Martin Rudwick's term "geohistory," two classic studies stand out; both want to understand the impact of the radical expansion of the time frame of the existence of the planet, from a few thousand to millions and later billions of years.⁶ On the one hand, there is Rudwick's own magisterial work, *Bursting the Limits of Time*, from 2005; on the other hand, there is the even bigger classic, a pioneering study in the history of science *tout court*, Stephen Jay Gould's *Time's Arrow, Time's Cycle* from 1987. Both of them deal with what Gould refers to as "the discovery of geological time," and what Rudwick calls "the reconstruction of geohistory." Another thing they have in common, however, is that both of these luminaries in the historiography of the earth sciences kick off their investigations with reference to a claim made in a very different scholarly context, far removed from eighteenth-century geology—here Gould:

Humanity has in course of time had to endure from the hand of sciences two great outrages upon its naïve self-love. The first was when it realized that our earth was not the centre of the universe, but only a speck in a world-system of a magnitude hardly conceivable. . . . The second was when biological research robbed man of his particular privilege of having been specially created and relegated him to a descent from the animal world.⁷

Any reader with a general knowledge of the Western intellectual tradition will recognize this quote to be from Sigmund Freud, more precisely from his introductory lectures on psychoanalysis, delivered 1915–17. Most readers will also know perfectly well which two events in the history of knowledge Freud is referring to: first, the Copernican revolution, second, Darwin's theory of evolution. In the next section of the original passage, Freud adds himself to the list, more precisely what he calls "present-day psychological research which is endeavoring to prove to the 'ego' of each one of us that he is not even master in his own house, but that he must remain content with the veriest scraps of information about what is going on unconsciously in his own mind."⁸ Picking up directly from Freud's famous summary of Western intellectual history, Gould makes the following addition: "But Freud omitted one of the greatest steps from his list . . . He neglected the great temporal limitation imposed by geology upon human importance—the discovery of 'deep time.'"⁹

This way of restoring geology to its proper place in the history of knowledge, alongside the other revolutions—the cosmological, the biological and the psychological—which fundamentally alter how we humans look at ourselves and our place in the universe, is striking in itself. Especially interesting is the way these four "outrages," as Freud originally called them, all present themselves as reconfigurations of space and time. After Gould added geology,

there is even a symmetry: two of them are concerned mainly with space, the space of the universe and the space of the human mind respectively, and two of them mostly with time, the evolutionary and the geological. Even more striking, however, is the way this summary is repeated, almost verbatim in Rudwick's *Bursting the Limits of Time*. The first sentence of the introduction goes as follows: "Sigmund Freud claimed that three revolutions had transformed what his generation—in blissful innocence of modern political correctness—often called 'Man's Place in Nature.'"¹⁰ Then he goes on to explain what first Copernicus, then Darwin, and then Freud did to man and man's self-understanding, adding only the slight caveat that "historians of science are now uneasy about calling any such intellectual changes 'revolutions,' except perhaps to sell their books," thus putting some historical and intellectual distance between himself and Gould.¹¹ Then he goes on: "But anyway, as Stephen Jay Gould pointed out, Freud's list omitted one major historical change that certainly deserves a place in the same league. Compared to the other three, it has been grossly underexplored by historians, and neglected by those who popularize science and its history . . . , perhaps because it cannot so easily be labelled with the name of any specific Dead White Male."¹²

Even though they focus on different people and events, Rudwick and Gould are in agreement about how this moment in the history of Western knowledge should be framed and placed into a larger narrative. At stake is the "discovery of time," more specifically, of "deep time," when the "deep space" of astronomers was matched by the "deep time" of geologists, to borrow a phrase from a third seminal book contributing to the same story, although without the reference to Freud, by Stephen Toulmin and June Goodfield, published in 1965.¹³ To these discoveries of "depths," we can add the mostly unconscious depths of the human mind. Rudwick offers his own formulation, more in line with Freudian idiom about how the human is decentered, both spatially and temporally, when he describes the "dramatic" shift from "regarding human history as almost coextensive with cosmic history to treating it as only the most recent phase in a far longer and highly eventful story, almost all of it *prehuman*."¹⁴

If our interest was in finding an answer to Chakrabarty's question about our difficulties in combining human and geological time, we apparently need to look no further. Two of the leading historians of science from the last decades seem to agree that the only way to make us appreciate the full implications of what happened in the geological "revolution" is to quote Freud and take his words as their own, adding geology to the list that already includes cosmology, biology, and psychology, or in other words, shaping this event in the history of knowledge in the mold of three previous events. The realization that the earth was not four or six thousand years old, as proclaimed by Biblical chronology, but actually several million, based on the discovery of fossils, dating of rock

layers, and a better understanding of the genesis of the globe, is thus understood as an event of psychoanalytical proportions. To really integrate the deep time of geohistory into our human-centered historical worldview would then logically be as hard as bringing to the surface our own personal fears and traumas hidden deep in our unconscious mind. Both of them are called “deep” for a reason; they represent something hidden, invisible, and suppressed, but still active underneath the surface.

Whether it makes sense to theorize our inability to act upon the knowledge involved in renaming our own present, possibly even some centuries of it, “the Anthropocene,” as repression in the psychoanalytic terms, is a discussion for another time. My interest here is more historical and historiographical. In this chapter, I take this somewhat strange Freudian element of repetition in the works of generally quite original and innovative scholars as a sign that something might not be completely right with this argument and thus with the way we tend to frame this particular moment in the history of knowledge. Did the discovery of deep time at the end of the eighteenth and the beginning of the nineteenth century really have a similar effect on human self-understanding as the Copernican revolution, the theory of evolution, and the discovery of the unconscious? Presuming that Gould and Rudwick are right and that this fourth “outrage” has not been granted the same prominent place in the history of knowledge as the others, maybe this has other reasons than the historiographical and narrative ones Gould referred to. Did geological time just slip out of view again, almost before it got our attention, to use Chakrabarty’s phrase? The point here is not to compare the relative effects of different moments, “revolutions,” if you want, in the history of knowledge, nor is it to reject the effect of deep time on human knowledge and understanding. Rather I want to argue that to grasp this particular moment in the history of knowledge and the effects it has had, and still has, on the relationship between human and natural history, other forms and figures of understanding might be more useful than thinking about it as an “outrage against humanity’s self-love,” since humanity and all its relations to self and others might not belong on the same timeline, or in the same narrative as the breakthrough of geohistory.

At the same moment when the limits of time are burst, to use Rudwick’s phrase, historical time also splits up into multiple durations, speeds, and rhythms, allowing for different forms of subjectivity and agency.¹⁵ By consequence, what could have been an “outrage against humanity’s self-love,” displacing man from the center of time, in the same way that man had previously been displaced from the center of space, was literally disciplined by the reordering of the field of knowledge, by which man and earth, whose histories had been completely entangled in Christian historiography, were pulled apart by separate epistemologies and methodologies—what we recognize today as

geology and history. These two disciplines, on either side of the gap between what C. P. Snow will later call “the two cultures,”¹⁶ based themselves on two distinct temporal frameworks or arrangements: on the one hand, the horizontal, linear, uniform, homogenous time of historical progress; on the other hand, the vertical, multilayered, heterogenous time of rock and mountain formations in the earth’s crust. Whereas the history of humanity was understood according to the first one, for example in the works of Johann Gottfried Herder and Georg Wilhelm Friedrich Hegel, the history of the earth was understood according to the second one. In the following, I will first explore how the collapse of broad integrated knowledge fields such as “natural philosophy” and “natural history” gave rise not just to various disciplines but to different temporal arrangements. Then, I will zoom in on the lesser known of them, at least within the humanities and social sciences, that in the nineteenth century is termed “stratigraphy,” and trace the trajectory of this specific temporal arrangement, from its origin in seventeenth century Italy, via the eighteenth- and nineteenth-century rise of geohistory, into twentieth-century historiography and historical theory.

After *Historia Naturalis*

Prior to the eighteenth century, knowledge about the external world had been organized mainly in two large and amorphous fields, “natural philosophy” and “natural history.”¹⁷ As Brian Ogilvie convincingly argues, both fields took shape during the Renaissance, drawing on works from Greek and Roman Antiquity, such as Aristotle’s *Physics* and Pliny’s *Natural History*, in which an encyclopedic view of knowledge was established.¹⁸ Whereas both natural philosophers and natural historians were interested in understanding nature, they based their activities on different concepts of knowledge and method. These conceptual and methodological frameworks found their most distinct and durable forms in the late seventeenth and early eighteenth centuries, with two works that set new standards in both fields: Isaac Newton’s *Philosophiæ Naturalis Principia Mathematica*, first published in 1687, and Comte de Buffon’s *Histoire Naturelle*, published in sixteen volumes between 1749 and 1789.

After Galileo Galilei, the goal of natural philosophy had been to create a quantitative and mathematical science of nature, “based on mathematical principles,” as Newton puts it in the title of his work. It “discouraged studying the particular, which was no part of philosophy, and urged instead the ascent to universals, the discovery of natures and essences.”¹⁹ Natural history, on the other hand, based its knowledge claims on the practices of observing, collecting, and describing external objects, with the aim to produce an account of

the earth and its life forms, their origins and their characteristics. In his own “discourse on method,” *Discours de la manière d’étudier et de traiter l’Histoire Naturelle*, which opens the first volume, Buffon argues why his work cannot be based on “mathematical evidence.”²⁰ The “true method” for these studies, he states, is not the “mathematical method,” but to “make observations, to assemble them and then make new ones, in sufficient numbers to ensure us of the truth of the most principal facts.”²¹ In other words, *historia naturalis*, which in the eighteenth century enters the vernaculars as *histoire naturelle*, *natural history*, and *Naturgeschichte*, did not originally aim to produce knowledge about the past or about historical changes in particular, except in terms of explanations for present phenomena, like rock formations or fossils.

In his entry on *Geschichte* in the eight-volume *Geschichtliche Grundbegriffe*, Reinhart Koselleck describes what he considers to be the shift from non-temporalized *historia naturalis* to temporalized *Naturgeschichte*.²² As long as *historia*, in the Aristotelian tradition, meant little more than empirical knowledge, or knowledge about particulars, gained through induction, with no particular ambition of arriving at a general principle or law, neither the temporal distinction past-present, nor the natural distinction human-nonhuman was especially significant. In the entry, Koselleck shows how nature is temporalized, and is invested with a time and a history of its own, linked to genesis, transformation, and persistence.²³ This shift opens the way for theories of evolution that will come to dominate the nineteenth century.

According to Koselleck, temporalization happens in both natural and human history, in parallel. In other essays, he describes how history with a capital H, history as *Kollektivsingular*, emerges through a “destruction of natural chronology”²⁴ and a “denaturalization” of time.²⁵ They are replaced by forms of time inherent to history itself, including development, progress, acceleration, revolution, and others. What Koselleck does not discuss at any length, however, is how this parallel, synchronous temporalization of natural history, on the one hand, and human history, on the other, forces the two of them to part ways. As history starts moving, from the past, through the present, and into an unknown future, increasingly picking up speed, accelerating, it frees itself of all the other forms of life included in Aristotelian *historia*, transforming into a history of humans, and humans only. According to Koselleck, this process of temporalization is necessarily linked to human hopes, memories, and actions, or in his own terms, to experiences and expectations.²⁶

Temporalization of both natural and human history was a direct cause of the broad integrative knowledge project of natural history, practiced by scholars seeing themselves simply as “naturalists,” disintegrating and giving way to a new order of knowledge. Among the new disciplines were those that later came to be subsumed under the label “geology,” including mineralogy, geognosy, oryktognosy, and mining sciences, practiced at universities,

societies, mining academies and even by artists and authors all over Europe.²⁷ “Geohistory,” which is the term Rudwick uses for these closely related knowledge practices, took it upon itself to organize different forms of knowledge having to do with the earth: how it is put together, its structure and elements, how it came into being and gained its present shape. As emphasized by Gould and Rudwick, geology was a science of time, much more time than any other knowledge projects had ever dealt with. This gestation of geology happened more or less at the same time as another science of time emerged: the modern discipline of history.

The modern disciplines of geology and history are both products of the same process of temporalization, which brought *historia naturalis* to collapse and gave way to a new order of knowledge. If we accept this theory, our view of this historical moment will deviate radically from the Freud-inspired idea of the four outrages to human self-confidence. My claim here is that the rise of geology in the late eighteenth and early nineteenth century was a very different type of event than the Copernican revolution, the emergence of the theory of evolution, and the exploration of the human unconscious. To conceptualize this difference, I want to argue that whereas the three latter in different ways came with an anthropology, a theory of human life and behavior, geohistory did not—at least not to the same extent. Cosmology offered a view of humanity from outside, relative to other forms of possible life in the universe, exemplified for instance in Bernard de Fontenelle’s *Entretiens sur les pluralité des mondes* from 1686—what Michael Sauter has called a “celestial anthropology.”²⁸ Evolution, on the other hand, understood humans as a product of a long succession of often microscopic changes, mutations and struggles for survival, and gave rise to a new anthropological literature, by scholars like August Comte, Herbert Spencer, and others. Finally, Freud expanded human consciousness to include the unconscious, responsible for many, if not most of our feelings, needs, and even actions. Geology, however, does not seem to make a similar anthropological claim, at least not at the moment of its emergence, discussed by Gould and Rudwick. Apparently, the breakthrough of geohistory failed to produce or give rise to a new anthropology, which would have been not a “celestial” but a “terrestrial” one, in the most literal meaning of the word. Instead, at the end of the eighteenth century, terrestrial anthropology found its disciplinary home within another field of knowledge: *Geschichte*, History with capital H.²⁹

In the eighteenth and early nineteenth centuries, the various research interests and forms of scholarship that had made up the field of “natural history” or “natural philosophy” disentangled and branched out in a series of disciplines: mathematics, astronomy, physics, chemistry, but also history, philology, and philosophy.³⁰ Undoubtedly, and as discussed in detail by Rudwick, eighteenth-century geology involves a temporalization of life, both

in its human and natural forms. Whereas the temporalization of nature found its primary disciplinary form in geology, which organized itself around a deep and multilayered time, the temporalization of the human found another form altogether, namely the modern concept and discipline of history. In other words: one reason why geology never developed an anthropology was that the anthropology of the radically temporalized human being found another home: in the discipline of history, which developed a very different way of organizing, or indeed synchronizing the heterogeneous times, rhythms, durations, and speeds of human life—namely according to the model of progress.³¹ Whereas geology opened up to a field of different forces—Neptunists giving priority to water, Plutonists to fire—in the evolution of the earth, also including climate, planetary movements etc., history turned to nations, cultures, and individuals. By consequence, the genre of universal history was systematically stripped of its universal ambitions, and reduced to “world history,” which in fact was a history of nations and empires, expanded by migrations and imperial and colonial endeavors.³² In most cases, world history was either the successive histories of nations and cultures dignified enough to have a history, or it was the history of civilization, in its Western mode, spreading and expanding across the globe.³³ In this way, time was made linear and homogenous, governed by the forces of progress, very different from the multilinear, heterogeneous time of geology. For history then, as the vestige for human anthropology in its modern temporalized form, the limits of time does not seem to have been “burst” at all, as Rudwick claimed in the title of his work; on the contrary, historical time remained safely “in the grip of sacred history,” to use a phrase from Andrew Shryock and Daniel Lord Smail.³⁴ The majority of historians kept their work within the boundaries of those six thousand years, at the most, which was the temporal framework of Biblical history.³⁵

Moving out of the eighteenth and nineteenth centuries, what we can observe is not an integrative science of time, replacing the Early Modern *historia universalis*, but several disciplinary undertakings, which deal with time in different ways, including biology, geology, chemistry, cosmology, and history. Two of these disciplines, geology and history, develop their own specific theories of historical time. Whereas the modern discipline of history explores pasts, presents, and futures by means of a singular, future-directed timeline, doubling as the vector of progress, the discipline of geology bases all scientific endeavors on a multilayered, vertically oriented time, from deep, hidden pasts to superficial, visible, and tangible presents. But what if it had been different? The second part of this chapter explores some of the possibilities of thinking about stratigraphical, not linear, time as the primary temporal form structuring all kinds of historiography, both natural and cultural, nonhuman and human.

Steno and the Origin of Stratigraphy

According to *OED*, the term “stratigraphy” refers to a “branch of geology that is concerned with the order and relative position of the strata of the earth’s crust,” and was coined in the mid-nineteenth century.³⁶ “Strata,” plural of the Latin “stratum,” originally referred to something spread or laid down, such as a piece of bedding, coverlet, bed or couch, saddlecloth, horse-blanket, level floor, or platform. In the second half of the seventeenth century, this word took on another kind of meaning, which we today identify as geological: “a natural layer or bed of sediment or rock having a consistent composition and representing a more or less continuous period of deposition.”³⁷ The first work to bring forward something similar to a theory of stratigraphy and stratigraphic superposition, today recognized as the origin of this basic tenet of geological thinking, was *Nicolia Stenonius solido intra solidum naturaliter contento dissertationis prodromus*, mostly abbreviated as *Prodromus*, published in 1669.³⁸

The idea that the earth is made up of layers and that these layers vary in age, according to a specific pattern, the oldest at the bottom, the youngest at the top, was first given systematic expression by the Danish anatomist and geologist Nicolaus Steno, or in Danish Niels Stensen. Steno’s career as a scholar took him from Copenhagen to Amsterdam and Leiden and onwards through France to Italy, before he settled in Padua, then in Florence. He began as an anatomist, and wrote books on the origins of tears and saliva, as well as on the anatomy of the brain. Then his interest turned towards the sciences of the earth, today’s paleontology and geology.³⁹ What caught Steno’s attention was what Rhoda Rappaport in her book *When Geologists Were Historians* refers to as “the fossil question.”⁴⁰ In October 1666 two fishermen caught a huge female shark near the town of Livorno, and Ferdinando II de’ Medici, Grand Duke of Tuscany, ordered its head to be sent to Steno. Dissecting it, the Danish scientist noted that the shark’s teeth bore a striking resemblance to certain stony objects, found embedded within rock formations, that his contemporaries referred to as *glossopetrae* or “tongue stones.” At the time explanations for this peculiar natural phenomenon ranged from the suggestion by Pliny the Elder that these stones had fallen from the sky, to more recent ones, for example by Athanasius Kircher, who considered the building of fossils to be an inherent characteristic of the earth.⁴¹ Steno’s conclusion, in a paper published in 1667, was that the *glossopetrae* must be shark’s teeth. This led him to ask the more general question, namely how any solid object can be found embedded within another solid object. The answer came in a work published in 1669, in Latin, but with a title that was later translated into English as *The Prodromus of Nicolaus Steno’s Dissertation concerning a solid body enclosed by process of nature within a solid*. In it, he writes:

The first question was, whether *Glossopetrae Melitenses* were once the teeth of sharks: this, it was once apparent, is identical with the general question whether bodies which are similar to marine bodies, and which are found far from the sea, were once produced by the sea. But since there are found also on land other bodies resembling those which grow in fresh waters, in the air, and in other fluids, if we grant to the earth the power of producing these bodies we cannot deny to it the possibility of bringing forth the rest.⁴²

An earth that brings forth solid bodies is by necessity also an earth, in which the forces of time are at work and have been for a long while already. Steno's *Prodromus* is a book about "the process of time," by which animals, plants, shells, and mollusks change into rock, and become contained within other rocks, while they are still in their fluid state.⁴³ Thus, in Steno's work, we find the first comprehensive draft of what will become the framework of modern geology, including the law of superposition, the principle of original horizontality, as well as the principle of lateral continuity—in other words, a full-fledged theory of rock layers or strata and their position relative to each other, known today as stratigraphy.⁴⁴ In the following I will take a closer look at how Steno conceives of his different layers or strata, what kind of times he grants them, and how they are present in any historical moment.

To start with the final point, the historical moment that Steno wants to understand is Italy around the middle of the seventeenth century, more precisely the landscape of Tuscany: "In what way the present condition of any thing discloses the past condition of the same thing," he writes, "is above all other places clearly manifest in Tuscany."⁴⁵ Steno also has a theory of how this kind of history of the present can be practiced, by observing "inequalities of surface" that "in their appearance today contain within themselves plain tokens of different changes."⁴⁶ In this tentative language and probing formulations, the concepts of surface and depth are introduced as a way of thinking about history, or in Steno's words, "different changes." For Steno, the materiality of history consists of rock strata and formations. What he wants to understand is how these strata are formed and what is their relationship to time. In his attempt to explain how one solid body, a tooth, a crystal, a diamond, an animal, or a plant can be contained within another solid, that is, within a layer of rock, Steno argues that all solid bodies have been produced from fluids, by way of sedimentation, thus creating the strata of the earth. The position of the strata, above and underneath each other, is entirely a question of time. Thus, when Steno formulates what is later referred to as "the law of superposition," it all depends on when—at what time—the different strata in the earth's crust were formed. That Steno's "theory of the earth," to use Rudwick's term,⁴⁷ is also a theory of time is first signaled by the fact that in his list of claims, on which he bases his theories, all start with "at the time," as in these two examples:

1. At the time when a given stratum was being formed, there was beneath it another substance which prevented the further descent of the comminuted matter . . .
4. At the time when any given stratum was being formed, all the matter resting upon it was fluid, and therefore, at the time when the lowest stratum was being formed, none of the upper strata existed.⁴⁸

In other words, the most important characteristic of the different rock layers identified by Steno is that they have been formed at different times in the history of the earth and thus they have different durations and periodizations inherent in their matters and forms. Then, Steno continues to discuss and systematize what he calls “the matter of the strata,” which depends on when the strata were formed as well as their diachronic succession:

1. If all the particles in a stony stratum are seen to be of the same character, and fine, it can in no wise be denied that this stratum was produced at the time of creation from a fluid which at that time covered all things . . .
2. If in a certain stratum . . . the parts of animals and plants are found, it is certain that the said stratum must be reckoned among the strata which settled down from the first fluid at the time of the creation.
3. If in a certain stratum we discover traces of salt of the sea, the remains of marine animals, the timbers of ships . . . it is certain that the sea was at one time in that place.⁴⁹

This enumeration goes on, also including trees and ashes, indicating that there has been fires, etc. In this way Steno tells the history of the earth, from creation, when a fluid “covered all things,” until the emergence of plants and animals, as well as humans, evident in Steno’s reference to “ships,” as documented in the different rock layers.⁵⁰ All these layers are present at the same time in the mountainous landscape of Tuscany. Even though the strata have formed regularly, according to laws, creating a seemingly stable structure of superposition, there are also more sudden events, such as volcanic eruptions and collapsing caves, which give rise to valleys and mountains.

For reasons I cannot go into here, it took more than a hundred years before anyone picked up where the Danish anatomist and geologist left off. According to Rudwick, it was not until the early nineteenth century that stratigraphy and the law of superposition became the foundation for what was to become the modern science of geology.⁵¹ However, as the Danish historian of science Jacob Bek-Thomsen has argued convincingly, Steno does not present us with a modern science *in nuce*, which just needs some more time to come into its own. Instead, he is significantly indebted to the Early Modern *historia naturalis*, which rather than to look for laws and establish

cause-and-effect chains, practiced the art of description and categorization, based on external characteristics.⁵² In the middle of the eighteenth century, natural history branched out into multiple fields of knowledge dealing with minerals and rocks, practiced and taught at so-called *Bergakademien* (mining academies), across the European continent and England, such as in Freiberg in Germany and Kongsberg in Norway.⁵³ Practitioners of these fields, mineralogy, geognesy, and oryktognesy, which later became part of the modern science of geology, adopted the stratigraphic theory of time at the end of the eighteenth and the beginning of the nineteenth centuries, as can be recognized in the works of famous geologists such as James Hutton, Charles Lyell, and later William Smith.

Stratigraphies of Time and History

In seventeenth- and eighteenth-century natural history, natural and human events were taken to belong to the same group of particulars, which could be studied according to their temporal and spatial coordinates in the prism of Aristotelian *historia*.⁵⁴ As can be seen from works by Steno, Buffon, and others, the dramatic expansion of the earth's temporal scale as well as the introduction of the stratigraphic theory of time affected the human and the nonhuman equally. Due to the emergence of the uniform and linear time of historicism, multilayered time never came to dominate the increasingly professionalized discipline of history in the same way as the discipline of geology.⁵⁵ It was not until approximately 150 years later that the first systematic attempts were made to regain the theory of multiple layers of time, in other words, the stratigraphy of time, pioneered by Steno, for human history.

In his groundbreaking, but often overlooked work *L'ordre du temps*, published in 1984, the Polish philosopher and cultural historian Krzysztof Pomian launches his conception for what he calls a "stratigraphy of time and history."⁵⁶ According to Pomian, the phrase marks a shift from a "diachronic" to a "purely synchronic analysis" of historical events in order to understand "the fundamental reasons for the polysemic nature of the word 'time.'"⁵⁷ Still, Pomian's choice of a term to name his exploration of this polysemy of time in social and human sciences comes as something of a surprise. Three centuries after the principles of stratigraphy were first formulated, Pomian takes it upon himself to introduce strata and stratigraphy in human historiography and theory of history. In his work, the term represents a way of thinking about what he refers to as "the polysemic nature of the word 'time,'" which in a less semiotically, more ontologically determined idiom would be simply "multiple times" or "times in plural." In this sense, "stratigraphy" emerges as an alternative theory of the multiple, often nonsynchronous, or even conflicting times

inherent in any historical moment, irreducible to chronological succession or linear progress.⁵⁸

Pomian is not the only historian who has thought of human history in terms of geological layers or strata. Almost at the same time, but in a different language, the German historian Reinhart Koselleck developed his “theory of historical times,” which, however, was not systematized in geological terms until more than a decade later, in the introduction to the first volume of his collected essays, published in 2000 with the title *Zeitschichten*, “layers of time.”⁵⁹ In the recent, excellent Anglophone edition of Koselleck’s selected essays, the translators have made this reference to geology even more explicit, when they selected for the German coinage *Zeitschichten* the English equivalent “sediments of time,” as the title of the collection.⁶⁰ Based on these readings, I would argue that Koselleck and Pomian, and before them the last great historian of the French *Annales* school, Fernand Braudel, who I will return to soon, are involved in similar intellectual undertakings. All three of them borrow terms and expressions from natural history and geology, describing layers in the earth’s crust, in order to suggest alternatives to historicism’s addiction to singular chronologies and narratives. In short, what the three of them argue is that human history has the same multilayered character as the history of the earth, or at least can be analyzed in this way, and that in every historical moment there are various times, durations, rhythms, and speeds at work, operating in different strata of the historical present. The “matters of these strata,” to use Steno’s terms, vary. In the case of Koselleck’s *Zeitschichten*, the layers are made up of meanings, experiences, and patterns of action organized by what he refers to as *Wiederholungsstrukturen*, “structures of repetition,” which differ in their historical origin, duration, and rhythm.⁶¹ In the case of Braudel and Pomian, these strata may consist of different kinds of historical material, depending on the position and origin of the strata themselves.

The work that kicks off this reorientation in the relationship between geology and history, at the same time reintroducing the eighteenth-century genre of natural history into twentieth-century history writing, is Braudel’s *La Méditerranée et le Monde méditerranéen à l’époque de Philippe II*, first published in 1949.⁶² Originally, Braudel wanted to write a dissertation about diplomacy in the Mediterranean area during the reign of Phillip II, supervised by Lucien Febvre. Encouraged by his supervisor, who together with Marc Bloch was in the process of developing an alternative to the dominating positivist trends in French historiography, known today under the name of the *Annales*, Braudel shifted the balance of the project, away from Phillip II, toward the Mediterranean Sea, which more and more turned into the protagonist of the story. He spent twelve years gathering material, then the war came, and the two first parts of the work were written in captivity in Germany. When the book finally was published in 1949, it was comprised of three parts:

Le part de milieu; Destins collectifs et mouvements d'ensemble; and Les événements, la politique et les hommes. The first part deals with the environment, mountains, plains, coastlines, islands, climates, but also routes and cities. The second is dedicated to economies and demographics, resources, trade, and transportation, whereas the third and last part treats the topics that were originally supposed to fill the entire dissertation, mostly wars, treatises, and the lives of people in power. By banishing the historiography of people and events to the final volume, Braudel made common cause with Febvre and Bloch, against traditional event-focused historiography. What interests us here, however, is less the historiographical trench wars and more the way Braudel frames his transformation of the discipline of history, which in the mid-twentieth century was still practiced much in the same way as during the late eighteenth and the nineteenth centuries.

In *La Méditerranée*, Braudel revives two eighteenth-century formats in order to write a new kind of history: one is the genre of natural history, the other is a system of layers or planes of time. He combines objects of study that by now belong to different disciplines, like mountains, oceans, and cities. These objects are no longer Aristotelian particulars, like in the *historia naturalis*, but invested with times and histories of their own, like emergence, transformation, and persistence, and thus form parts of multiple temporal movements. In order to create a new framework for writing natural history in the twentieth century, Braudel needs to find a principle for organizing these multiple times, inherent in his various objects of study. This principle is the stratigraphy of time and history, which Steno applied to the history of rocks and minerals and which Braudel introduces as a metatheory of all historiography.

Stratigraphy as a general theory of history is implemented already on the level of the chapters of the book, which renders it even more important to remember that there is nothing self-evident about this way of theorizing. Encouraged by his supervisor Febvre to deal not only with people and events, Braudel organizes his material into three chapters, discussing environment, social structures, and events respectively. Even at this point in the work, Braudel could very well have chosen to theorize these multiple “matters” in many different ways, for example according to dichotomies like human/nonhuman, or life/nonlife; but instead he decides to make multilayered time, a stratigraphy of time and history, the overarching structural principle of his work and lays it out in the introduction.

The first part, Braudel writes, “is devoted to a history whose passage is almost imperceptible, that of man in his relationship to the environment.” Then he goes on to qualify this particular form of time, which in addition to the “almost imperceptible passage” is characterized by slowness, “constant repetition,” and “ever-recurring cycles.” Hence, the part of the book that

deals with “mineral deposits, types of agriculture, and typical flora” contains an “almost timeless history.”⁶³ The way in which Braudel uses stratigraphy to imagine the multiple times of history is made explicit when he introduces the second part of the book, containing the history of economies, resources, and demography. This history, he writes, takes place “on a different level from the first.”⁶⁴ These differences in levels are differences in time, in duration, speed, and rhythm. Braudel hesitates to call it “*social history*,” because of the usage of that term in contemporary historiography, and rather adopts the phrase “the history of groups and groupings.”⁶⁵ Again, he looks for ways to qualify the specific form of time at work on this level of history. Time moves in “swelling currents” and at “slow but perceptible rhythms,” influenced by “deep-seated forces.”⁶⁶

Finally, Braudel explains the plan for the third part of the book, written after he had come back to France and in which he returns to the topic he originally was planning to write about: politics, war, and diplomacy in the Mediterranean region during the reign of Phillip II. This form of historiography he labels “traditional history.”⁶⁷ Before he goes on to describe the specific form of time associated with traditional history, he gives it another significant spatial and indeed ontological definition: “history, one might say, on the scale not of man, but of individual men.” In other words, this kind of history writing is fitted to describe events that happen to or are caused by the actions of specific individuals, typically kings, princes, ministers, and generals. At this point in the introduction, he introduces the term “*histoire événementielle*,” which later will be closely associated with his own work, but which he inherits from another French historian, Paul Lacombe.⁶⁸ At the end of the nineteenth century, Lacombe had been leading in the exchanges between historians and sociologists, recapitulated by Braudel in his 1958 essay on the *longue durée*, in which Lacombe faces off with the sociologist François Simiand. But Braudel does not content himself with flatly rejecting the primacy of events in history.⁶⁹ He also wants to understand the specific form of time that event-history gives rise to: “surface disturbances, crests of foam that the tides of history carry on their strong backs,” in other word, a “history of brief, rapid, nervous fluctuations, by definition ultrasensitive; the least tremor sets all its antennae quivering.”⁷⁰ Towards the end of this chapter, I will come back to this surprising conflation between rapid temporal movements, sudden changes, and fast rhythms with nervous responses and specific forms of heightened human sensibility. This conflation also appears as striking because it picks up on the alignment between the discovery of the human subconscious and the discovery of geological time that we find in the introductions to the books by Gould and Rudwick.

In his introduction to *La Méditerranée*, Braudel does not limit himself to describing three forms of time, linked to three different sets of historical

matters, already a major theoretical innovation compared to the work of his supervisor, the co-founder of the *Annales* journal and school. Already in his first work, he goes a step further, combining them all and relating them to each other in what we recognize as a full-fledged stratigraphic system:

The final effect then is to dissect history into various planes, or, to put it another way, to divide historical time into geographical time, social time, and individual time. Or, alternatively, to divide man into a multitude of selves. This is perhaps what I shall least be forgiven, even if I say in my defense that traditional divisions also cut across living history which is fundamentally *one*.⁷¹

The key word in this summary are “planes” and “levels,” by which Braudel launches his stratigraphic theory of history, which will later emerge as his most influential contribution to the history of historiography. At the top are a plane of quick rhythms of events and individual actions; underneath it we find a plane of somewhat slower rhythms of various groups and collectives, whereas the bottom level are “those underlying currents, often noiseless, whose direction can only be discerned by watching them over long periods of time.”⁷² However, these planes or levels are not disconnected from one another; on the contrary, Braudel suggests that “resounding events are often only momentary outbursts, surface manifestations of these larger movements and explicable only in terms of them.”⁷³ In the language of geology, into which Braudel is clearly tapping here, the “outbursts” refer to volcanic eruptions, by which lava, or occasionally just gas, is expelled from a volcanic vent or fissure in the earth’s surface, mostly caused by compression and decompression of gas within magma. “Surface manifestations,” on the other hand, might also include other effects caused by movements of tectonic plates, on which the land masses of the earth rest, like earthquakes. Even though the planes or levels of time are distinguishable from one another, since they are made up of different events and processes, there exist connections, even causal relationships between them.

From the Human into the Natural, and Back

In Braudel’s later work, especially in his famous 1958 article on the *longue durée*, his appeal to a stratigraphy of time adopted from geology, appears as less dynamic and more designed to change history from an ideographic to a nomothetic science, in accordance with structuralist dogma.⁷⁴ In his *magnum opus* on the Mediterranean, however, his goal appears to be to develop a theory of multiple times that is able to reconnect traditional event-history with the slower rhythm of social and economic structures and cycles, as well

as with the *longue durée* of landscapes, geography, and climate. Historians like Pomian and Koselleck, who do not share Braudel's structuralist leanings, later take up this idea, thus bringing the exchanges between the human world and the natural world back into play, in ways that have been absent from historiography the last two hundred years.

In his work on eighteenth- and nineteenth-century geohistory, Rudwick traces how the “novel geohistorical approach was derived from transpositions from the human world into the natural.”⁷⁵ At the same time as history was transposed into the inside of the earth and became multilayered, history on the surface lost its temporal complexity and became unified and uniform. For Koselleck, developing his theory of *Zeitschichten*, “layers” or “sediments of time,” represents an attempt at “transferring” geological time, now in terms of a stratigraphy of time and history, “back” into history.⁷⁶ This transposition from the natural to the human is described in Koselleck's introduction to the article collection *Zeitschichten* from 2000, when he observes how “layers of time, just like their geological prototype, refer to various temporal levels of diverse duration and diverse origin, which still exist and are effective at the same time.”⁷⁷ Koselleck begins by pointing to the origin of this “spatializing” metaphor in geology. Then, he makes a series of brief references to the late eighteenth century, to Kant and Buffon who “opened a new temporal horizon” by putting the earth into “historical perspective,” by temporalizing creation and replacing it by a long process, spanning millions and millions of years, during which the mountains were formed.⁷⁸ In a next step, these long time spans were “transferred back,” as he puts it, into human history, for instance, when the German author Joseph Görres makes the point that “in the history of the earth the period of the original granite rock relates to the period of the sedimentary rock like old times to new times.”⁷⁹ Thus, he concludes, the historical concept of structure, what we here call “stratigraphy,” has geological origin. This is as far as Koselleck's interest in geology goes. Instead he shifts his line of argument and stresses that from the late eighteenth century on “historical times can be fundamentally separated from natural time,” before he jumps two hundred years ahead to pay homage to Braudel's *longue durée*. What he leaves out, is how from the seventeenth century onwards a theory is developed, in which time is relative and multilayered, and which at the end of the eighteenth century catches the imagination of geohistorians all over Europe, at exactly the same time as Herder and others begin championing the one, linear, homogenous, teleological time of historicism. At this moment in the history of historiography, when the history of man and the history of nature, and thus natural time and historical time, were still part of the same narrative continuum, historians of the human could reasonably have chosen to think about time in layers, instead of choosing the Newtonian option of absolute, linear, homogenous time. Or, to put it another way: when modern

historians in the postwar era return to the image of layers and sediments they are not really transferring a metaphor from another science, but recuperating a way of thinking which once emerged from within Western historiography.

Even though the theory of multiple layers of time, in terms of Braudel's *longue durée*, Pomian's "stratigraphy of history," or Koselleck's *Zeitschichten*, offers a comprehensive and coherent solution to the predicament of multiple temporalities and their nonsynchronicity, the question remains of what it fails to include and describe. Does it really make sense to think of time and history as layered—with the quick rhythms of human actions and events, including the life of the everyday, at the top, fully visible and even tangible, and then a set of progressively slow, progressively long-term, and progressively unexposed layers, until we reach the bottom, where we find the incredibly slow, almost imperceptible changes of landscapes and civilizations? A counterexample can be found in the current debates on climate change. All of a sudden the longest, slowest, and most imperceptible layers take on event-character, in the form of extreme weather and natural catastrophes, increasing CO₂-levels in the atmosphere, political decisions or non-decisions etc., whereas the fast-paced events of the everyday sink down through the layers of time until they disappear into the almost unchanging mythological layer of nature, well-known from Roland Barthes' work on mythologies of the everyday.⁸⁰

At the end of the eighteenth century, conceptualizations of the multiplicity of times were displaced from the academic world by the new order of knowledge, in which the lifetimes of human actors were separated from the lifetimes of species, minerals, and planets. The all-encompassing genres of natural history and natural philosophy collapsed, giving way to the modern order of disciplines, in which geology, biology, and cosmology broke loose from the study of man. At the center of this process of reordering knowledge were the convergence of timescales and life scales, giving rise to new disciplinary lifetimes, with their own finitude. Since then, the nexus of clock-time and historical time called "modern," spreading across the globe on the back of capitalism and imperialism, has made up the temporal framework within which human actions and events have been understood.⁸¹ At present, this seems about to change: on the one hand, "the modern temporal regime," or in short, "progress," is losing much of its explanatory value, because it is no longer able to synchronize all the different aspects of human life into a progressive narrative; on the other hand, other chronologies are returning to the scene.⁸² These are bio-, geo-, and cosmochronologies, which have in common that they subject humans to the scales, rhythms, and durations of nature—not original nature, but nature as it has been produced by scholars and scientists during the last three hundred years. On the one hand, chronology, the question of time reckoning and time organization is returning to the study of the human⁸³; on the other hand, "nature," in the form of the biological body of man, the geological

body of the earth, or the cosmological body of the universe, is imposing itself onto the temporal configuration of global society in ways that can no longer be ignored.⁸⁴ In this situation the most important aspect of “the stratigraphy of time and history,” as it has been conceived by Braudel, Pomian, Koselleck, and others, might be the ability to reforge the connections between natural and human history. As long as human history is measured by a clock or by the standard of civilization and progress, nature will continue to be shut out, as by necessity. But if, on the contrary, human history is again included into a much more comprehensive theory of scales of life and scales of time, in which historical time is perceived as multilayered, in a continuum with the times of rocks and sediments, a different and broader set of possibilities for reconnecting the human with other parts of nature emerge. At least this is one way of answering Chakrabarty’s question.

Conclusion: Passions, Papers, and Human-Centered Time

According to Freud, the last half millennium has seen three “great outrages” upon mankind’s “naïve self-love”; to which Gould and Rudwick added a fourth. As I have tried to show in this chapter, however, human self-love was never really outraged, or even seriously afflicted by the radical expansion of time produced by the knowledge of stones, rocks, and minerals, both horizontally into deep pasts and futures and vertically into the lower strata of the earth’s crust. In fact, there is little indication that eighteenth- and nineteenth-century geohistory actually displaced humanity from the center of the temporal universe, in the same way as the Copernican revolution displaced it from the spatial center. On the contrary, historians all over Europe—Giambattista Vico in Italy, Edward Gibbon in England, and Johann Gottfried Gatterer and August Ludwig Schlözer in Germany—construed a new, alternative universe, in which man could still occupy the center, and in which all dimensions were fitted to human reality. This alternative temporal universe acquired the label “history,” and was inhabited by actors, events, nations, and empires. From the late eighteenth century onwards, “history” in this particular sense—“time fitted to human dimensions”—came to dominate the explorations and representations of the temporalized and accelerating human world. What Braudel first suggests to his supervisor in 1929 is clearly “history” in this traditional, human-centered sense; however, as we just saw, it is also what he ends up rejecting, or at least radically decentering. Based on this, we can at least suggest that the fourth “outrage upon humanity’s naïve self-love,” presented by geological time, did not happen in eighteenth- or nineteenth-century geological texts, from Steno to Lyell, but only much later, in Braudel’s *La Méditerranée*. In the introduction, he distances himself not

only from political event-history, but from any kind of history designed to fit the dimensions of the human:

We must learn to distrust this history with its still burning passions, as it was felt, described, and lived by contemporaries whose lives were as short and as short-sighted as ours. It has the dimensions of their anger, dreams, or illusions. In the sixteenth century, after the true Renaissance, came the Renaissance of the poor, the humble, eager to write, to talk of themselves and others. This precious mass of paper distorts, filling up the lost hours and assuming false importance. The historian who takes seat in Phillip II's chair and reads his papers finds himself transported into a strange one-dimensional world, a world of strong passions certainly, blind like any other living world, our own included, and unconscious of the deeper realities of history, of the running waters on which our frail barks are tossed like cockle-shells.⁸⁵

In making the Mediterranean his object of study, Braudel mobilized a new and different concept of space, and thus suggested a novel way of relating to history and geography; but in the paragraph above, taken from the introduction, the dimensions at stake are not spatial, but temporal. According to Braudel, the temporal dimension of traditional human history is one of “burning passions,” of “anger, dreams, and illusions,” and, not least, of papers. What they all have in common, is that they are short-lived: passions burn out, anger recedes, dreams end, and illusions are broken. Although papers are kept, assembled, and archived for a certain period of time they will eventually become brittle, faded, and then disappear. Anyone who enters this world of passions and papers, a politician or a historian, becomes shortsighted, blind, or at least one-eyed, and the world turns “one-dimensional.” Braudel wrote this passage more than half a century ago, but even today we would be hard-pressed finding a better answer to Chakrabarty’s question of why “questions of geological time” keep falling “out of view and the time of human world history comes to predominate.”⁸⁶ To change this, to reintegrate individual human lives, with their passions and papers, into the history of nature, human-centered time needs to be expanded not only horizontally, but vertically, and be reconnected with the times of nature by means of stratigraphies of time and history.

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NOTES

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81. Vanessa Ogle, "Whose Time is it? The Pluralization of Time and the Global Condition," *American Historical Review* 118, no. 5 (2013): 1376–1402.
82. Jordheim, "Synchronizing the World."
83. Helge Jordheim, "Return to Chronology," in *Rethinking Historical Time: New Approaches to Presentism*, ed. Marek Tamm and Laurent Olivier (London: Bloomsbury, 2019), 41–56.
84. See Dipesh Chakrabarty, "The Climate of History: Four Theses," *Critical Inquiry* 35, no. 2 (2009): 197–222.
85. Braudel, *Mediterranean*, 21.
86. Chakrabarty, "Anthropocene Time," 6.

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