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Synchronizing Nature and Culture

Mediating Time in Geochronology and Dendrochronology, 1900–1945

Staffan Bergwik

Throughout the nineteenth century, geology opened previously incomprehensible timescales, displayed deep time, and produced an enormous expansion of temporal horizons accessible to human understanding. Knowledge about geological strata burst "the limits of time," and natural philosophers instructed onlookers that nature had a history existing long before the creation of humankind.[1] During the same period, history as a scholarly field and historicism as an idea emerged. Historians temporalized humanity and turned progress into the overarching idea about mankind's direction and changes. Multiple narratives were coordinated into ideas of time as linear, homogenous, and teleological. Both geology and history ushered in a temporalization, however at the turn of the twentieth century they had become two distinct enterprises.[2] While natural philosophers illuminated the deep and multiple times of nature, historians limited themselves to speaking about the history of humanity.

Present-day scholarship has repeated the divide, leaving history "a curiously fragmented subject." As methods develop and knowledge accumulates, hyperspecialization follows in their wake.[3] Nevertheless, the divide has been questioned in theoretical debates within the humanities during the last decade. Dipesh Chakrabarty has suggested that climate change brings with it the end of the old distinction between natural and human history. The recorded past of humans along with social and cultural histories of modernity, Chakrabarty argues, should be linked to a deep, species history of humanity. Moreover, the temporality of human history has to be connected to the geological temporality of nature.[4] Naomi Oreskes addresses historians of science with a similar argument, asserting that descriptions of humans as geological agents have scaled up our imagination. "Times have changed" she claims, and we "can no longer sustain a demarcation between natural history and human history."[5]

While these arguments are provocative, even visionary, they threaten to gloss over important aspects of combining natural history and human history. First, while pointing to the importance of turn of the twenty-first-century thinking about global warming and the Anthropocene is highly relevant, arguments such as Chakrabarty's and Oreskes's threaten to render invisible a longer history of efforts to coordinate "earth history" and "world history" in the former's words.[6] As Helge Jordheim has argued, while this distinction has been upheld in certain scholarship, detailed empirical studies reveal the many instances between 1700 and 2000 where natural and historical times became amalgamated in concrete historiographical activities.[7] Second, there are profound differences between geological temporality and human history. In fact, Chakrabarty has pointed to this very fact. While the Anthropocene debate has generated traffic between earth history and world history, the two are marked by inherently varying timescales, mirroring larger "planet-centered" and "human-centered" ideas. Moreover, representatives of the two ways of thinking are poorly trained to discuss both forms of history.[8]

The questions of intermingling earth history and world history—as well as of the knowledge system addressing the issue—come to life in the interconnected scientific fields of geochronology and dendrochronology. Both are examples of an historical and scholarly practice located at the crossroads of nature's times and historical times. This chapter focuses on Swedish geologist Gerard De Geer (1858–1943) and American astronomer Andrew Ellicott Douglass (1867–1962). De Geer established geochronology and studied layered clay, or "clay varves." According to celebratory stories, the Swede translated these inconspicuous chunks of matter into legible images of the past. Andrew Ellicott Douglass contributed to the founding of dendrochronology. This field studies tree rings and has created records of periodical changes in the climate going back to earlier times than other types of meteorological data.[9]

The two fields introduced and studied a shorter time period than the classic work of nineteenth-century geology, yet a longer timescale than academic history writing. The semi-long period they explored covered the last twenty thousand years; both fields tried to access a past where the long period of earth history and the shorter time of world history coalesced, and a fixed chronology of prehistoric times could be determined. Importantly moreover, both fields assigned great importance to the climate. They wanted to understand climatic rhythms and shifts between warmer and colder periods. My aim in the following is to move from the theoretical idea of combining natural history and human history to an exploration of how it was done in practice in geochronology and dendrochronology. First, I will investigate the temporal narrative created within the fields. I argue that they were media intensive, and I suggest that nature's time and historical time were synchronized and aligned in and through media turning abstract time into a legible account. Second, I will indicate how the fields were located in a broader knowledge ecology at the time. Since they addressed a semi-long time period, geochronology and dendrochronology envisioned scientific collaborations across the natural and cultural sciences, yet ultimately failed to create them in practice. It is my contention that this case serves to historicize and critically engage with current proposals to write earth history and world history in tandem, as well as with the difficulties involved in doing so.

My method in the following is to use two analytical lenses—media formats and knowledge organization—to investigate how geochronology and dendrochronology coordinated the timescales and rhythms of nature's time and historical time. After a brief introduction to how the fields were established, I engage with the literary and visual formats, through which the fields mediated nature's time and historical time. I indicate how they used the year as a culturally intelligible temporal unit to synchronize natural and cultural chronologies. Second, I investigate how De Geer and Douglass transposed the two timescales onto each other through metaphors of cultural documents: clay varves and tree rings were described as "diaries," "annals," and "calendar." Moreover, I highlight how they utilized timelines as a visual format to open and pin down abstract chronologies into intelligible temporal overview. The timeline served to translate the cyclical rhythm of nature into the linear time of history. In the final section, I turn to how geochronology and dendrochronology were part of, and envisioned, a knowledge organization based on the idea of a science of time measurement of the earth. Albeit part of a contemporary trend toward increased scholarly specialization, I will suggest that the two fields offer a case of interdisciplinarity—with a term smacking of anachronism—based on studies of time and chronology.

Establishing Geochronology and Dendrochronology

Starting in the mid-nineteenth century, geologists increasingly took an interest in the periods of glaciation, which apparently had occurred in the past. Rejected by many in the 1830s and 40s, the theory of Ice Ages had gained acceptance by most geologists in the 1860s. As a result, geologists tried to understand external factors working on the heating and cooling of the earth. Hence, the climate in more recent periods and the heat from sun radiation became key interests. Naturalist James Croll was among the first to discuss astronomical causation in geology, and in 1875 he argued that a varied radiation from the sun was a crucial climatological factor behind the Ice Ages.[10]

De Geer and Douglass approached these questions in their respective work, and they addressed a past where earth history and world history were brought together through the interest in the climate.

In the early stages of his career, Gerard De Geer worked at the Geological Survey of Sweden. From 1897 until his demise in 1943 he served as professor of geology at the University College in Stockholm. Albeit seldom mentioned in overviews of the turn of the twentieth century geology, he was a well-established scholar receiving honors from, and membership in, the geological societies in Berlin, London, Paris, New York, and St Petersburg. He was elected a member of the Royal Society, one of only fifteen Swedes since the seventeenth century to receive the honor.[11] De Geer's research treated the youngest geological period, Quaternary, taking place "but a brief moment ago" compared to older geological eras.[12] In 1879, De Geer performed his first measurements of varved clay, and he published a small study on the subject in 1882. In the mid-1880s he also started using the word chronology to describe layered clay. However, only in 1910 when he presided as chairman of the International Geological Congress in Stockholm did he launch the terms "geochronology" and "clay varves." Subsequently, he introduced his geochronological research program with considerable tenacity. Already in 1913, newspapers declared that his geochronological methods were known to broader publics.[13]

There was a public discourse on temporality at the turn of the twentieth century. Partly due to the interest in the natural history of nations, partly because of the fascination with the age of the earth, geology had become a public science. Geological museums and popular books, discussing and displaying time, had become widespread.[14] Gerard De Geer was among those who presented geological work to broader audiences, for example through the book *Om Skandinaviens geografiska utveckling efter istiden*, which consisted of lectures held in public and was printed in 1896.[15]

Clay varves became the key empirical object in De Geer's research. The clay sediments were excavated in areas once covered by inland ice: Scandinavia, North America, South America and the Himalayas.[16] They had been deposited in water since the Ice Age and a vital ambition for De Geer was to date the latest Ice Age and the ensuing, slow processes of deglaciation. During that era, the land had risen and the clay layers had become accessible for scientific study.[17] The clay varves ostensibly registered how many years had passed since the Ice Ages, and revealed the speed of melting and the rhythm of climatic changes.[18] Clay varves offered the opportunity to create a geological chronology—a geochronology—of the Ice Age and the gradual transition to present-day climate.[19] In the 1930s, an article presenting geochronology in a Swedish encyclopedia argued that De Geer had succeeded in creating a chronology covering eighteen thousand years leading up to our historical time.[20]

Andrew Ellicott Douglass is a virtually unrecognized actor in the history of astronomy.[21] In 1906, he moved to the University of Arizona at Tucson where he founded the Laboratory of Tree Ring Research, the first of its kind, in 1937. In Arizona, Douglass measured tree rings and focused on the great Sequoias of the American West. He published his first scientific paper on dendrochronology in 1909, and named his field of study "dendrochronology" for the first time in 1923.[22] The American astronomer argued that the study of tree rings offered information about climatic conditions and cycles in the past.[23] Already in the eighteenth century, natural philosophers had suggested that tree rings recorded effects of the weather, but Douglass turned dendrochronology into an academic field devoted to understanding time.[24] A chief concern for him was to create a chronology through meteorological data reaching back to prehistory. He created a long chronology through cross dating living and dead trees. Individual specimens were overlapped backwards in time, and Douglass sought progressively older wood specimens from a restricted area.[25] Newspapers described how he had managed to construct a "register of the climate covering 3,200 years."[26]

The field of dendrochronology has not been given a coherent history outside of scholars offering glimpses of their own history.[27] Gerard De Geer and geochronology has been researched in the Swedish history of science, but mainly through an interest in how natural and cultural history were performed in a nationalistic minded science with an interest in the importance of the Ice Age. Certainly, geochronology was a nationalistic project. According to De Geer, "the Swedish timescale" could form a basis for an international prehistoric time measurement.[28] In the following, I leave the nationalism aside to read geochronology and dendrochronology as part of a larger discourse on temporality at the turn of the twentieth century. Already in 1908, Gerard De Geer noticed the resemblance between tree rings and clay varves, surmising that the two types of layers were caused by the same phenomena.[29] The actual connection between De Geer and Douglass emerged only at a late stage in their careers, in the 1930s. De Geer's wife and assistant Ebba Hult De Geer described the fields as "doubles" to each other.[30] Even though the fields had developed in parallel for a couple of decades, they formed the basis for a joint science of chronology. When Douglass came to visit De Geer in Stockholm in 1930 both were intrigued by the resemblances in their respective research.[31]

Synchronizing Nature's Rhythm and Human Culture: The Year as a Temporal Unit

In an influential study, François Hartog claims that "the modern regime of historicity," which in its basic form held sway between the eighteenth and twentieth centuries, was marked by a dominant idea about the relationship between past, present, and future as well as about the rhythm and direction of history.[32] Taking issues with Hartog's ideas, Helge Jordheim has argued that the dominant regime of temporality, emphasizing progress as a teleological, homogenous and modern idea of time, was continuously challenged by other narratives. Natural and historical times have been compared and unified since the eighteenth century through what Jordheim calls "practices of synchronization." Rather than one overarching regime spanning two hundred years, synchronicity is the result of contingent "linguistic, conceptual and technological practices."[33] Geochronology and dendrochronology are examples of such practices. Both fields described a period in time marked by early forms of human culture and interrelated climatic factors. They portrayed a temporal organization between nature's time and historical time, and the individual year became key in their synchronizing effort.

Geologists throughout the nineteenth century argued that transformations in nature occurred through uniform, cyclical, and incredibly slow developments of building and erosion. Geochronology and dendrochronology both described the rhythm of change in nature in similar ways. Gerard De Geer explained that major transformations in the development of the earth occurred slowly and without sudden shifts.[34] The long timescale of nature was also highlighted in the presentation of dendrochronology. Sequoias were portrayed as nature's living monuments to a long-lost time.[35] Moreover, De Geer and Douglass both underscored the importance of repeated cycles. They referred to "rhythms" in the earth's climate, including "the eleven-year sunspot cycle."[36] In a presentation of geochronology, *New York Times* described both shorter cycles of approximately fifteen hundred years with varying climate and rainfall and the "greatest super cycle of all" labeled the "ice age cycle, covering 21.500 years."[37] The radiation from the sun was pivotal for the slow, regular, and cyclical rhythm of nature. [38]

In the mid-1920s, Gerard De Geer argued that the existing timescale for the melting of the inland ice should be connected to the history of humanity.[39] Piece by piece, the timescale could be put together into a "coherent whole."[40] The Swedish geologist maintained that changes in nature provided a basic condition for culture. According to him, quaternary geology explored geological timescales as a "framework for knowledge about the origin of human culture."[41] His results were important for the study of "early man" and the "oldest history of our species."[42] Existing written and cultural records of human culture reached back five to six thousand years, while the longer era, during which "prehistoric stages of culture" occurred, was "dependent upon information gathered in geology."[43] The synchronizing ambition resonated with Gerard De Geer's wish to produce a worldwide chronology with the Swedish timescale as a "fixed system of time."[44] According to Swedish newspapers—stating the case with implicit national pride—the Swedish timescale was an international standard of the same importance as the Greenwich mean time.[45] In a celebratory remark on De Geer's research, his protégé Anton Sörlin argued that the Swedish geologist enabled a "time-parallel" in ancient time.[46]

A critical part of De Geer's and Douglass's ideas was to describe nature's processes in categories that were culturally intelligible. The year as a temporal entity became particularly important as temporal unit and literary media format. On the one hand, the year was a natural phenomenon, depending on orbits of celestial bodies and different climatic seasons displayed by clay layers and tree rings. Each varve represented a year, shifting from bright to dark, and the different tints showed alterations in the weather occurring over an annual season.[47] The individual tree ring displayed a lighter part formed during the spring and summer when the tree had grown because of ample access to light, warmth, and water, and a darker part of less porous wood formed during fall and winter when the weather inhibited its growth.[48] On the other hand, using the annual unit meant transforming nature's time into a cultural frame of reference, established and maintained through social and institutional practices—including calendars and clocks—with a long history.

Natural scientists at the end of the twentieth century did not typically discuss time in terms of years, even in the thousands or millions. Gerard De Geer, gesturing at existing geological research, maintained that the deep past of the earth had only been described through "vague chronological concepts."[49] In particular, he claimed that no universal measurement of time had been achieved regarding the youngest geological period. Existing efforts left little more than a "hint of the amount of time passed" to enable the development of culture.[50] The Swedish geologist addressed this lacunae, and aimed for a connection between the relative calendar of geology and the absolute human timescale.[51] In public presentations, De Geer explained that nature had produced a "fundamental keeping of time," which allowed us to "far beyond humanity's oldest written records" create "reliable" and "exact" determinations of the "immense epochs" preceding the development of human culture.[52] Research on the Ice Age and its disappearance promised the possibility to measure and define the order of years, thus enabling a "true measurement" of time.[53] De Geer sought a detailed calendar, down to the individual year, where nature's changes could become visible and interpreted against the advent of history. According to newspapers, the Swede had "introduced the year as a measure of time," also in geology.[54] Upon launching the term geochronology in 1910 he had turned "geology into a historical science with years."[55] Clay varves were the "annual rings of the earth," and they could provide an almanac of a long history.[56]

Andrew Ellicott Douglass harbored the same wish to connect climatic chronologies visible in tree rings to fixed years. Early on, he collected wood samples, which indicated shifts in nature, but which were floating chronologically as there was no way to date them exactly. In 1929 he managed to determine when a wood sample from an archeological site had been cut down, and achieved the desired synchronization.[57] In 1937, he stated that the long ring chronologies were accurately dated, displaying "annual changes." Indeed, the "ring of a tree is an annual affair," and the fundamental value of tree rings to the study of climate was their "yearly identity."[58] Moreover, sequoias were put in a context of cultural and political history in the presentation of dendrochronology. The "great events of world history are here marked in the form of thin layers of wood."[59] Douglass himself claimed that the trees opened a deeper history of the Americas; they revealed climatic events, which occurred at the time of William the Conqueror or the Moorish conquest of Spain.[60] Newspapers repeated the connection of natural and cultural history, and highlighted how some of the trees had stood tall already at the birth of Jesus Christ, or at the time of "the Trojan War" and the "exodus of the Jews from Egypt."[61] In the 1950s, an exhibition at the American Museum of Natural History displayed a cross section of a giant sequoia containing 1,342 annual rings. The rings were inscribed with historical events, including the invention of Galileo's refracting telescope and Napoleon's coronation as French emperor.[62] As synchronizing practices, geochronology and dendrochronology balanced the heterogeneity of natural and human history. The year as a temporal entity proved to be a productive locus of time organization because it was both a natural phenomenon and a cultural product.

Metaphors of Cultural Documents

In 1921, the Swedish daily *Dagens Nyheter* offered a thought-provoking proposition: "Imagine a historian suddenly finding whole packs of ancient diaries, covering thousands of years, with not a single year missing!"[63] Furthermore, the newspaper suggested, "imagine that these diaries contained detailed information about events, on a day-to-day basis!"[64] The article brought together a source for history writing—the diary—with the timescale of geochronology and dendrochronology. Examples from the nineteenth century where concepts from human historiography affected the understanding of nature abound. Natural philosophers Charles Lyell and James Hutton spoke about the analogy of geology and history as well as about "nature's archive."[65] They were not alone in using such descriptions. In fact, according to Martin Rudwick, the study of human history was a crucial source for efforts to historicize nature from the late eighteenth century onwards. Ideas, concepts, and methods from historical investigations were "transposed" into natural history. This was no coincidence as the study of human history took its modern shape during that very period with a more rigorous reading of sources and with ideas about the otherness of earlier historical periods.[66] At the turn of the twentieth century, descriptions of nature's documents and annals had become widespread, and they were repeated in geochronology and dendrochronology. Gerard De Geer and Andrew Ellicott Douglass, as well as reporters covering their work, used metaphors of cultural documents—including "diaries," "record," "books," "annals," and "calendar"—as a literary format to present the two fields of knowledge.

In presenting dendrochronology, Andrew Ellicott Douglass stated that the trees were "the yearbook of the sun."[67] In public presentations, he spoke of how the forest was nature's book presenting a "long and vivid story."[68] Each ring became "an annual report" and the trees offered "prehistoric records."[69] By the 1920s, Douglass gained some public appeal as he was interviewed on the radio and wrote popular texts. In these lectures and texts, he repeated the metaphors bringing together nature and document: trees were "nature's stenographers" and "monkish penmen."[70] In 1929, *The National Geographic Magazine* published a paper by Douglass on his expedition to Arizona to study tree rings. The editor introduced the text by stating that "talkative tree rings" had carried American history back to the year 700 and offered "a calendar" for twelve hundred years.[71] According to Douglass, the stories and chronology established by tree rings were more accurate than "if human hands had written down the major events."[72] In the rhetoric of this public presentation, the American astronomer claimed that dendrochronologists had learned to read the "diaries of trees."[73] The trees were "chronographs, recording clocks, by which the succeeding seasons are set down through definite imprints."[74]

Gerard De Geer argued that a "natural chronology" could be "registered" in clay.[75] In the mid-1920s, the geologist claimed that he and his collaborators had collected and put together "nature's annals" into a chronology spanning roughly eighteen thousand years.[76] Newspapers stated that "bulletins of the weather going back twenty thousand years" were "hidden in the clay varves."[77] The layered clay formed nature's own massive and "fascinating document."[78]

The calendar offered yet another cultural document, based on the year, to make nature's time meaningful.[79] In the face of these metaphors, the issue of readability was also discussed. After all, layered clay lacked every form of written signs, and they needed to be read and interpreted to become meaningful. The language of the clay was hidden and decipherable only if one read the thickness of the varves.[80] Therefore, the scholars and their knowledge production were repeatedly emphasized. The geochronologist and dendrochronologist had not only collected the annals of nature, they also made an impact through the act of interpretation.[81] Since the records of nature did not contain written signs, "the key to their meaning" lie in the "measurements of their varying thickness."[82]

Reporters and scholars blurred boundaries between clay, wood, and cultural documents to capture and read time. The study of clay varves and tree rings coalesced with the practice of keeping, reading, and deciphering records. But perhaps these descriptions were merely rhetoric meant to engage the audience and make the study of natural history intelligible to nonexperts? There were certainly aspirations to create an engaging story in newspapers, yet a deeper connection was also at stake. Reports on cultural documents worked to connect nature's time and historical time as it allowed the two versions of history writing to communicate and shape a joint reading of the past.

To elaborate the point, I wish to extrapolate a discussion on calendars from media scholar John Durham Peters. His arguments about calendars are valid for the other metaphors of cultural documents as well, including "diary" and "annals." In practice, according to Peters, calendars are impacted by natural phenomena—in particular astronomical facts—yet in any calendar, there is cultural arbitrariness. The heavens as well as cultural mores are equally important as the source material for constructing them.[83] In geochronology and dendrochronology, clay and trees were important as natural materials to construct calendars in practice, yet they were also tied to the emergence of human culture as indicated by the importance of the year as a temporal unit. According to John Durham Peters moreover, calendars are "logistical media" in the sense that they negotiate between nature and culture; they coordinate astronomic, biological, and cultural events.[84] The metaphors of cultural documents used in presenting geochronology and dendrochronology were media that displayed the long-term and stored and extrapolated the past. The idea of "diary," "annals," and "calendars" bound, measured, organized, and made sense of abstract time. Put differently in this context, they served to render intelligible the potentially obscure images of times past that were produced in geochronology and dendrochronology.

Moreover, as indicated by Martin Rudwick, the usage of metaphors from history writing from the late eighteenth century onwards resonated with an ambition to create a chronology of nature, of creating a temporal structure with specific events taking place at particular dates. Interpreting documents in history writing was a method to construct a dating and a sequence. In the same way, the usage of documents and annals could create a reconstruction of an actual categorization of distinctive events in nature's history. A critical evaluation and reading of the records of nature could, like in history writing, give witness to historical reality in precise historical natural events.[85]

Timelines as a Visual Media Format

In academic journals, newspapers, and popular journals, geochronology and dendrochronology introduced and discussed timelines as a visual media format. The timelines were "chronographics," which registered, displayed,

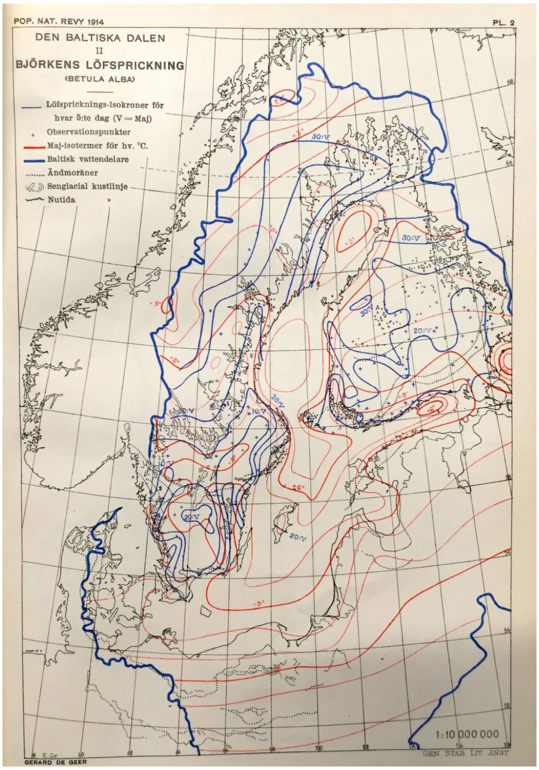

Figure 9.1 Temporal map of the deglaciation of Scandinavia, 1914, Gerard De Geer, "Om naturhistoriska kartor öfver den baltiska dalen," *Populär naturvetenskaplig revy* 4. National Library of Sweden (Kungliga biblioteket). Public domain.

and distributed temporal phenomena.[86] They translated the abstract matter of long timescales into concrete images of temporal overview. Moreover, they were templates that, just like the metaphors of cultural documents described above, created a temporal organization between nature's time and historical time. Indeed, they served to translate the cyclical time of nature into the linear time of history.

In 1914, at the very outset of his effort to launch geochronology, Gerard De Geer constructed a timeline in the form of a temporal map meant to display the gradual receding of the inland ice over Scandinavia (Figure 9.1). The production of geological maps was part of normal science in geology at the turn of the twentieth century, as they described the presence of natural resources but also geological time.[87] De Geer made several other temporal maps covering changes between the Ice Age and the Neolithic Age, several of which were published as an appendix to the book *Om Skandinaviens* *geografiska utveckling efter istiden*. The maps had also been put on display at the International Geological Congress in London in 1895.[88]

The temporal map in Figure 9.1 had originally been part of exhibition material at the Baltic Exposition in Malmö in 1914, and it was later printed in the popular magazine *Populär naturvetenskaplig revy*. De Geer made four different maps, three of which displayed the chronological migration and evolution of species after the Ice Age in Scandinavia. The first map, the one I focus on here, instead described the chronology of the melting of the inland ice. It displayed the main phases and the chronology, during which Scandinavia was gradually freed from the ice, which had halted the developments of virtually all life forms. The image created an overview of the geochronological studies De Geer had performed. The template was a map produced for Swedish schools, printed at the Lithographic Institute of the General Staff of the Swedish Army.[89]

The three blue solid lines, named *ekvicess* by De Geer, in the southern part of contemporary Sweden marked the recession of the ice in intervals of five hundred years. The blue horizontal lines, with segments of small blue vertical lines within them, marked the phases in the melting that De Geer had named the Daniglacial, the Gotiglacial, the Finiglacial and the Postglacial stages. The first designated the period when the inland ice receded over the Danish landmass, while the second covered the period when the ice disappeared from southern Sweden. The Finiglacial period was described as the final stage of the Ice Age, when the inland ice receded over the middle part of Sweden. During the Postglacial phase, the last remnants of the inland ice were still present and slowly melting in Sweden's most northern parts; segments of the ice remained in glaciers in the very north, and mountainous landscape, of Scandinavia. This stage lasted eight thousand years up until the present.[90]

My second example is a timeline created by De Geer to illustrate his article "*Förhistoriska tidsbestämningar*," published in 1925 in *Ymer*, the journal for the Swedish Society for Anthropology and Geography (Figure 9.2).

The timeline displayed the "Swedish timescale," i.e., a chronology of periods, fixed in time and given names indicating their order: Middle Quaternary, Late Quaternary, Lateglacial, and Postglacial. In addition, the periods were layered so that the overarching era of Late Quaternary encapsulated the Late Glacial and Postglacial epochs. These periods in turn spanned the time of the melting of the ice. The period Late Quaternary contained the epochs Daniglacial, Gotiglacial and Finiglacial.[91] Moreover, the times of nature were juxtaposed with the cultural time of Neolithic, Bronze, Iron, and Historical. Moreover, the year was crucial as a basis to anchor the timeline in a chronology possible to relate to the now. While the actual year for the start of Late Quaternary could not be exactly determined according to De Geer, the ambition was to turn the chronology of phases in nature and culture into actual years.

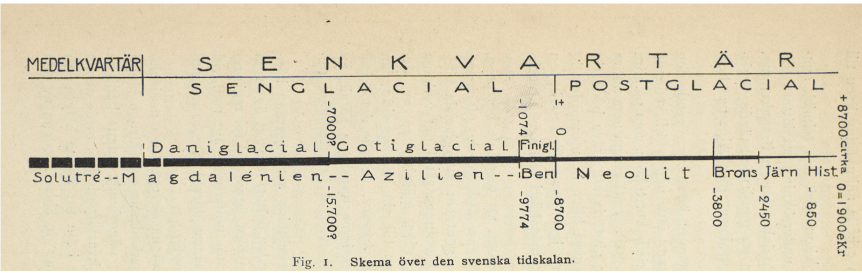

Figure 9.2 Gerard De Geer, "Förhistoriska tidsbestämningar," *Ymer: Tidskrift utgiven av Svenska sällskapet för antropologi och geografi* 45, no. 1 (1925). National Library of Sweden (Kungliga biblioteket). Public domain.

It should be emphasized that timelines have their own rich and varied history, even though it has rarely been made the subject of scholarship. As Daniel Rosenberg and Anthony Grafton discuss in *Cartographies of Time*, "the line," although crucial for visual chronologies, is a fairly recent innovation. Visual representations of time along an axis with a regular distribution of dates only started to flourish in the late eighteenth century. As with many other timelines, the ones produced by Gerard De Geer were visual chronologies displaying "scale, succession, and simultaneity." Moreover, they collected "masses of facts in a single, unified structure."[92] Both timelines constructed by De Geer served as a visual technique where time was conceptualized, conveyed, and circulated.

In what sense then were these examples literally time*lines*? The second example (Figure 9.2) has a clear chronological structure, where time moves from left to right. The first example (Figure 9.1) is a time map. While less obviously a line, time has a chronological direction as the recession of the ice in a northerly course demonstrated the passing of time. These illustrations were a crucial tool to transfer nature's time into a legible and comprehensible chronology, turning time into an arrow with a direction. An image published in the Swedish daily *Dagens Nyheter* from May 5, 1935 is yet another case in point (Figure 9.3).

A whole page was devoted to dendrochronology under the heading "*Träden som förhistoriska tidmätare.*"[93] Besides contributing to the popular presentation of dendrochronology, the photograph presented tree rings, and with them the climatic cycles of nature. The written marks on the wood indicated the eleven-year cycles of the sunspots as the accompanying text explained. Accordingly, the image resonated with the descriptions of nature's cyclical timescale, yet the photograph of the tree rings also conveyed a timeline going from the innermost ring outwards in the trunk. The wood in combination with the written inscriptions—as well as the photograph capturing both—drew

DAGENS NYHETER Söndagen den 5 Maj 1935

TRÄDEN som förhistoriska tidmätare.

Av ANTON SÖRLIN.

ANDREW ELLICOT DOUGLASS.

HÄR NEDAN DETALJER AV TVÅ TALLSTOCKAR, DEN ÖVRE FRÅN EBERSWALDE, PREUSSEN, DEN UNDRE FRÅN BULVERKET I TINGSTÄDE TRÄSK, BÅDA UTVISANDE DEN 11-ÅRIGA SOLFLÄCKSPERIODEN. BULVERKSSTOCKEN INGÅR I DET MATERIAL SOM GIVIT VID HANDEN ATT BULVERKET BÖRJADE UPPFÖRAS OMKRING 450 E. KR.

Figure 9.3 *Dagens Nyheter*, May 5, 1935. National Library of Sweden (Kungliga biblioteket). Public domain.

together large chunks of time, making the onlooker see nature's changes and rhythms as well as chronology going from a prehistorical *then* to a historical *now*.

Varves and rings taken in isolation merely displayed chronologically free-floating cycles. They became linked to an intelligible chronology only when they were translated into a meaningful timeline, and this in turn contributed to the order between nature's time and historical time. Gerard De Geer claimed that the temporal map in Figure 9.1 covered the period up until the present when the "people of the Baltic region" had contributed to "human culture."[94] The timeline in Figure 9.2 placed the two timescales within the same template. Geological time captured in the eras Middle Quaternary, Late Quaternary, Lateglacial, Postglacial, Daniglacial, and Gotiglacial was visually connected to the era of prehistory and history through a juxtaposition with the Bronze, Iron, and Historical periods. Placed alongside each other in the timeline meant coinciding in the past. As De Geer described it, the timeline displayed "phases in time" fixated through geochronology, as well as "corresponding stages of culture."[95]

It is important to note that at least Gerard De Geer was a firm believer in evolutionary theories and the progress of western scientific culture. He understood culture as linear, and he maintained that it continuously gained in strength. However, neither he nor Douglass contributed to the writing on cultural history and its standard, diachronic narrative at the time. Both geochronology and dendrochronology instead focused on a longer timescale than historicism, and the timeline as an abstract space worked to synchronize events and periods during thousands of years. As noted by Helge Jordheim, timelines organized and represented different temporalities in one synchronic space.[96] Above all, geochronology and dendrochronology linked two temporal regimes: cyclical nature was coordinated with linear culture.

Timescales and Knowledge Organization

Existing studies have suggested that before the mid-nineteenth century the human and natural sciences constituted a single field of time study, primarily held together by the biblical vision of creation and history. Subsequently, a major change occurred as the study of time was caught in a "straitjacket of disciplinary history," leaving history isolated from geology or paleontology.[97] Indeed, it is a commonplace in the history of science that the specialization of the scientific community increased throughout the nineteenth and twentieth centuries. New professional positions, specialized societies, and disciplinary journals drove the change.[98] However, coexisting with this overarching trend were research fields where emerging disciplines were still intermingled. These contradictory trends marked geochronology and dendrochronology: both fields envisioned links to related research areas, yet they did not succeed in shaping them in practice. In particular, the issue of temporality was considered an interdisciplinary undertaking by Gerard De Geer and Andrew Ellicott Douglass. The combination of the two fields offered opportunities to include archaeology, paleontology, meteorology, astronomy, biology, and cultural history.[99] Their effort to coordinate and synchronize different times created a corresponding ambition to integrate knowledge.

Swedish newspapers declared that Gerard De Geer represented a new science called "time-measurement of the earth."[100] The Swede suggested a coherent science of developments and historical trajectories where several disciplines could coexist. He argued that the interest in the evolution of humans had put the younger geological strata and quaternary geology center stage.[101] The geologist advocated a scholarly collaboration based on particular locales, which were once covered by ice. In the study of such places, the "geophysical, biological and archaeological development" could be examined. Moreover, De Geer argued that geochronology had a bearing on geophysics and on the physics of the sun.[102]

In particular, De Geer proposed a close connection between geochronology and archaeology. The fact that archaeology bordered both history and geology is a well-known fact in histories of the discipline.[103] As the science historian Christer Nordlund has discussed in a study of late nineteenth-century research on the Ice Age in Sweden, scholars from fields studying both nature and culture dug for remnants of the Swedish past. In Sweden, connections between geology and archaeology were also facilitated through the anthropological society—established in 1873 with Gerard De Geer as one of its founders—and its journal *Ymer*. Moreover, the Geological Survey of Sweden repeated an international practice to map and document archaeological findings alongside its geological examinations of the landscape.[104]

Already in the book *Om Skandinaviens geografiska utveckling efter istiden* from 1896 did De Geer include a whole chapter on the geography of the Neolithic age, with the ambition of tying geology to archaeology.[105] Throughout the first decades of the twentieth century, he repeatedly stated how he tried to match studies of clay layers with the archaeological study of prehistoric tools and fossils.[106] Presentations in the newspapers argued that the fields shared an interest in "the development of culture from the dawn of humanity up until the present."[107] Knowledge produced by De Geer benefitted the effort among archaeologists to research the "earliest history of Sweden" and "prehistoric stages of culture."[108] In fact, when De Geer suggested cooperation he was simultaneously arguing the particular value of his own research program. According to him, geochronology could form a scholarly basis, and it had the capacity to strengthen, and even correct, the work of archaeologists.[109] From the perspective of the geologist, archaeological findings only offered an approximate idea of the age of the findings. A chronology based on clay varves instead supplied archaeology with a "firm ground to build upon."[110] Indeed, geochronology was introduced as a new dating method in Swedish archaeology in the 1920s since it created an absolute time when the ice receded and humans colonized the landscape.[111]

Dendrochronology was also described as an interdisciplinary undertaking. De Geer's wife Ebba Hult characterized Andrew Douglass as a representative of an exact mathematical science studying biological material to measure solar phenomena precisely. His work connected botany with studies of the history of the earth and the climate, as well as with explorations of the rhythm of the sun.[112] Douglass himself also discussed the relatedness of dendrochronology to geochronology, meteorology, botany, and anthropology. The connection to meteorology consisted in the ambition to create long chronologies of climate and weather patterns, while the botanical connection concerned the understanding of ring morphology.[113] Between 1915 and the mid-1920s, Douglass linked his research to studies of ancient building sites in the American Southwest more explicitly. He built on archaeological dating efforts to determine the age of old ruins made of wood, which he analyzed with the tools of dendrochronology.[114] According to the American astronomer, the "transition to archaeology" was easy, and the archaeological studies would enable an understanding of movements and traditions among "tribes" of the American Southwest. This in turn would lead to insights into "tribal activities" and climatic conditions, and thus a study of the "influence of climate on human history."[115]

Douglass himself declared that even though the study of the relation between solar activity and the weather was part of astrophysics, the research also generated "contacts."[116] In his John Wesley Powell lecture from 1937, he explained that tree-ring work was "a co-operative search for nature's secrets along the paths of astronomy, botany, and climate."[117] Tree-ring research also dovetailed with anthropology; in collaboration with dendrochronology, anthropologists could "secure the exact construction dates of their prehistoric buildings."[118] Indeed, his studies of climatological conditions offered the possibilities of a study of the influence of the climate on "the history of man."[119]

While both Gerard De Geer and Andrew Ellicott Douglass suggested scholarly liaisons across the nature–culture divide, their efforts occurred at a time of increasing specialization of the academic disciplines. For example, the nineteenth century practice of mapping both geological and archaeological findings in the field waned at the turn of the twentieth century, in Sweden and abroad, adding to the divide between the two fields of knowledge making.[120] Indicative of these structural changes, De Geer and Douglass did not manage to leave a science of time measurement of the earth behind. At the same time that they published the bulk of their studies, academic history went through changes, which at first glance should have brought geochronology, dendrochronology, and history closer together. History writing in the nineteenth century had been shaped by metaphysical ideas about progress and an interest in the nation as a political entity.[121] From the 1920s onwards however, influential historians—for example Fernand Braudel and the early *Annales* school—began to search for slower temporalities, taking an interest in cycles, layers, strata, and sediments. Braudel picked up on findings in other scientific fields showing the longer history of hominids. The fact that time was measured in millions of years, and that even the Neolithic Age was recent in this perspective, impacted his idea about the *longue durée*. To the Frenchman, history became a dialectic between different structures and levels, understood as having separate temporalities. History was increasingly given a multilayered character.[122]

Nevertheless, to my knowledge, there are no cross references or influences between this type of history writing on the one hand and geochronology and dendrochronology on the other. At most, it seems that the connection is of a vague, discursive nature, in particular through the interest in layers of time to capture the long-term. When juxtaposing them, the commonalities are accompanied by an apparent breakage between the projects. Braudel directed his attention to the emerging social sciences, and he has primarily been the interest of scholars in the history of historiography. Conversely, Gerard De Geer and Andrew Ellicott Douglass play a role (although marginal) only in history writing about the natural sciences. The rift mirrors a broader history of knowledge organization based on *Naturwissenschaften* and *Geisteswissenschaften* as they were increasingly launched in the early twentieth century.[123] History, geology, and dendrochronology were all shaped by rising professionalization and disciplinary identity through the elaboration of methods and objects of study, as well as through institutional belonging. Regardless of the causal factors behind the rift, in the modern, twentieth century, knowledge divides separated nature from culture, natural sciences from humanities, geologists from historians, and Gerard De Geer from Fernand Braudel.

Conclusion

Through their interest in the semi-long period of the last twenty thousand years, researchers in geochronology and dendrochronology coordinated and synchronized multiple timescales across the nature–culture divide. De Geer and Douglass portrayed how nature had a cyclical and slow rhythm, and they took particular interest in the climatological changes, while also linking it to the linear and more rapid temporality of historical cultures. In particular, I have analyzed the organization of nature's time and historical time through media formats and knowledge organization, both of which were ways to envision joint knowledge-making about time measurement.

First, I discussed how times of nature and times of history were integrated through the year as a temporal unit. It was both a natural phenomenon and a culturally intelligible category, making it possible for nature and culture to share a calendar. Second, I indicated how metaphors of cultural documents illustrated the long-term processes of nature. As media formats, the metaphors displayed the interconnected timescale of nature and culture. Drawing together, binding and organizing different temporalities, they specifically turned nature's cycles into discrete chronological events. Just like in history writing, using clay and wood as annals, diaries and records meant constructing knowledge about precise natural events in a sequence—"on a day-to-day basis."

Third, I discussed timelines as a media format, which offered an abstract visual space where time could be written down, captured, and displayed. Within that space moreover, nature's time and historical time could be integrated and literally seen simultaneously. Both the literal and visual media formats organized, measured, and visualized the multiple times that geochronology and dendrochronology explored and presented. On the one hand, they illuminated the prehistory of humanity through the interest in climate and cycles. On the other, the formats served to translate the cyclical timescale of nature into a linear, chronological, and culturally fixated time down to the individual year. Fourth, I have suggested that the interest in temporality also emanated in a suggested, interdisciplinary knowledge organization built around the issue of time measurement. The two fields grew out of an academic landscape marked by both existing scholarly collaborations and an emerging specialization of science.

In closing, I wish to return to the theses put forward by Dipesh Chakrabarty and Naomi Oreskes. While there is no doubt that the discussions about climate change and the Anthropocene have had a disruptive power in the late twentieth century and reformed the field of history writing broadly construed, overemphasizing this shift threatens to render invisible the many historical examples of efforts to write nature's time and historical time in tandem. The case of geochronology and dendrochronology displays an example of concrete practices and discourses in the past where earth history and world history were combined. In fact, judging from this historical case, the divide between scholarship on nature's time and historical time has a strikingly short history in the deep time of knowledge. Moreover, while this case indicates efforts to transgress nature and culture, it also illustrates the difficulties in doing so in the face of structural changes in modern knowledge organization. The response from historians to geochronology and dendrochronology was, as far as the empirical material indicates, virtually nonexistent, and De Geer's version of geochronology even abandoned in geology. As Chakrabarty himself has noted, time as it has come to be understood and defined in the historically produced disciplines of geology and history is not the same.

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NOTES

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25. McGraw, "Andrew Ellicott Douglass and the Giant Sequoias," 25.
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80. "Naturvetenskap som vägbrytare," *Dagens Nyheter*.
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94. De Geer, "Om naturhistoriska kartor öfver den baltiska dalen," 189.
95. De Geer, "Förhistoriska tidsbestämningar," 8.
96. Jordheim, "Introduction," 515.
97. Shryock and Smail, "Introduction," 5–7.
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100. "Prof. Gerard De Geer 70 år," *Svenska dagbladet*. See also "Geokronologiska institutets hem skall öppnas idag," *Dagens Nyheter,* April 25, 1925.
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107. Sörlin, "Träden som förhistoriska tidmätare."
108. "Väderleksbulletiner för nära 20,000 år," *Dagens Nyheter*; De Geer, "Förhistoriska tidsbestämningar," 2 and 8–9.
109. De Geer, "Förhistoriska tidsbestämningar," 2. See also De Geer, "Om solens spår," 345; Sörlin, "Den varviga leran som geologisk tidsmätare," 538.

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111. Nordlund, *Det upphöjda landet*, 247 and 254.
112. Hult De Geer, "Geokronologi och biokronologi," 290.
113. McGraw, *Andrew Ellicott Douglass and the Role of the Giant Sequoia*, 67.
114. Douglass, "Some Aspects of the Use of the Annual Rings of Trees in Climatic Study," 20–21; McGraw, "Andrew Ellicott Douglass and the Giant Sequoias," 25.
115. Douglass, "The Secret of the Southwest," 745 and 770.
116. Douglass, "Some Aspects of the Use of the Annual Rings of Trees in Climatic Study," 6–7.
117. Douglass, "Tree Rings and Chronology," 5. See also Douglass, "Some Aspects of the Use of the Annual Rings of Trees in Climatic Study," 15.
118. Douglass, "Tree Rings and Chronology," 5, 15; Douglass, "Some Aspects of the Use of the Annual Rings of Trees in Climatic Study," 6–7.
119. Hult De Geer, "Geokronologi och biokronologi," 307.
120. Nordlund, *Det upphöjda landet*, 221–24.
121. Iggers, Wang, and Mukherjee, *A Global History of Modern Historiography*, 73–74 and 130.
122. Hartog, *Regimes of Historicity*, 13–14; Jordheim, Chapter 1, this volume; Jordheim, "Introduction," 506–7.
123. Iggers, Wang, and Mukherjee, *A Global History of Modern Historiography*, 73–74, 119–33, and 166–69.

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