ON CUTTING FORESTS AND AVOIDING PASTING
HEINRICH COTTA'S FOREST MAPS

Lisa Cronjäger

Forest maps have long been neglected in the history of cartography. At the end of the 18th century, land surveys were conducted throughout Europe and forest maps were drawn for this purpose. Often only the most impressive exemplars have been preserved in state archives, and in most cases they have been separated from contextual documents. Forest-assessment maps (*Forsttaxationskarten*), or, as they were later called, forest-management maps (*Forsteinrichtungskarten*), are a type of thematic map.[1] They were an important administrative medium and had the purpose of providing an overview of forested areas, their characteristics, and their wood resources. At the same time, they served as planning devices for defining the right logging time for each area and for anticipating future wood yields. This article shows that the way assessors dealt with the maps' materiality had a direct impact on forest environments. The methods, for instance, of subdividing the paper, cutting out parts of the map, and pasting new sheets of paper under it determined the system of how trees were felled and how regrowth was initiated afterward. Ultimately, the drawn, subdivided, cut, and pasted topographies on paper shaped how foresters managed forests *in situ*.

In order to reconstruct the historical techniques of forest mapping and the long-term planning of forest topographies, this paper draws on textbooks as the main source material. In contrast to the isolated forest maps preserved in archives, printed textbooks contain maps, legends,

1 For translations of these terms, see Karl Philipp, *Dictionary of German and English Forest-Terms*, Neudamm 1900, p. 44. In the following, I will use the general term forest map, or, to be more specific, forest-management map. I would like to thank the members of the Topographic Visual Media Network, Mirjam Hähnle, Anthony Mahler, and Stephan Meyer, for valuable comments and editing.

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descriptions, charts, and calculations as a complete conglomerate. In most cases, the authors of textbooks meticulously described all the working steps involved. Consequently, forestry textbooks provide important information on mapmaking strategies that cannot be gleaned from the maps themselves when they are isolated from their functional contexts. However, it has to be acknowledged that forest maps in textbooks were model maps and not authentic working results. The suggested procedures were taught in classes as ideal cases. Notwithstanding, textbooks serve as a helpful starting point for shedding light on forest maps as a neglected type of thematic cartography.

This paper analyses how forest maps were conceived as instruments for representing and managing forest topographies. The central question is: What role did paper techniques have in developing schedules for when to cut areas of the forest? How do practices such as drawing, cutting, pasting, and subdividing forest topographies on paper affect the function of maps as an epistemic device? After analyzing the strategies of visual representation in two examples of forest maps, I investigate how such maps impacted land-use practices. How were forest environments affected by the aesthetics of forest maps? Is there even a parallel between how pieces of paper were cut out of maps and how trees were cut in the forest?

First, I provide a short introduction to the context of forestry academies, where cartographic techniques were taught and published in textbooks. A significant example is the Royal Saxon Academy of Forestry in Tharandt, whose founder, Heinrich Cotta (1763–1844), became widely known for a supposedly sustainable technique of forest management.[2] In the second section, a close reading of one of Cotta's textbooks highlights practices of cutting and pasting on forest maps. Even though Cotta claimed that

2 In retrospect, Cotta's method of forest-management cartography was defined as "Flächenfachwerk", a method of determining the time to fell trees by area, in contrast to a "Massenfachwerk", a method of determining the time to fell trees by volume, which was elaborated by the forestry scientist Georg Ludwig Hartig and his colleagues. The distinction in the terminology is based on the prioritization of same-sized areas as the decisive unit for forest management in contrast to the estimated volume of wood yields, which was supposed to remain constant over time. For definitions and more information on forestry terminology, see Karl Hasel, *Forstgeschichte. Ein Grundriss für Studium und Praxis*, Hamburg et al. 1985, pp. 232–234. This differentiation is not key to the interests of this paper. Both Cotta's and Hartig's methods of forest-management cartography were regarded as sustainable forestry in spite of differences in the execution.

these paper techniques should be abandoned for a more durable method of representing forest landscapes, his arguments show that as former working practices, cutting and pasting had already shaped the logic of forest maps. In the last part of this article, I will describe a land-use conflict that was concomitant with the mapping of forests.

The forestry academy in Tharandt as a centre of knowledge and of map production

At the beginning of the 19th century, methods of forest mapping were standardized in many parts of Europe. State administrations were establishing and financing schools and academies of forestry. For instance, the Royal Saxon Academy of Forestry and Agriculture in Tharandt was officially inaugurated in 1811. Heinrich Cotta and his coworkers developed a method for making forest-management maps and a program for teaching it. The Tharandt Forestry Academy, which was close to Dresden, and its director Cotta were known throughout Europe for their methods of sustainable forestry.[3] Forestry academies served as centres of knowledge production where there were diverse interactions between foresters, artists, writers, and other scholars. Tharandt, for instance, was a popular place for outdoor landscape painting. Renowned engravers and artists from Dresden, such as Caspar David Friedrich, Johan Christian Dahl, Carl Blechen, and other representatives of the Romantic era, regularly visited the region.[4] Johann Gottfried Schultz's *Malerische Reise*, which is discussed in Tabea Braun's

3 On the history of sustainability in forestry, see Richard Hölzl, "Historicizing Sustainability. German Scientific Forestry in the Eighteenth and Nineteenth Centuries", *Science as Culture*, 19, 4 (2010), pp. 431–460; Paul Warde, *The Invention of Sustainability. Nature and Destiny, c. 1500–1870*, New York 2018; Ulrich Grober, *Sustainability: A Cultural History*, trans. Ray Cunningham, 1st ed. 2010, Totnes 2012; Roderich von Detten, "Waldwirtschaft/Forstplanung", in *Nachhaltigkeit interdisziplinär. Konzepte, Diskurse, Praktiken*, ed. Ursula Kluwick and Evi Zemanek, Wien et al. 2019, pp. 70–89.

4 Compilation of drawings, lithographs, and etchings of Tharandt can be found in Christian Friedrich Traugott Voigt, *Tarants schöne Natur in geselligen Liedern gefeiert*, ed Christoph Richter, 1st ed. 1806, Tharandt 2016; Dahl und Friedrich, Romantische Landschaften (exhibition catalogue Dresden/Oslo), ed. Petra Kuhlmann-Hodick et al., Dresden 2014; and Iris Berndt and Helmut Börsch-Supan, *Carl Blechen. Innenansichten eines Genies*, Berlin 2017, p. 20 (on Carl Blechen's painting of Tharandt Castle).

paper in this volume, also includes a drawing of Tharandt Castle, which was a popular motif among artists and writers.[5]

In the course of the 19th century, Tharandt became a well-known destination for students and scholars. Students came from Russia, Scandinavia, France, Spain, Portugal, Italy, Switzerland, Austria, Poland, Greece, Romania, and even Japan and the United States, as can be seen from diplomas, entry exams, and inquiries held by the archive of the Dresden University of Technology.[6] The foreign students were not only interested in forestry. Education reformers such as Anna and Elisabeth Blomqvist from Finland also stopped over in Tharandt, after visiting schools for women in Dresden.[7] And Cotta was not only an expert in forestry and agriculture, he also owned a mineral collection that was the subject of many scholarly conversations, including with Johann Wolfgang von Goethe.[8] After Cotta's death in 1844, Alexander von Humboldt arranged for Cotta's mineral specimens to be included in the Prussian Royal Minerals Cabinet, which is now an important collection in the Natural History Museum in Berlin.[9]

Due to these processes of knowledge transfer, the Forestry Academy in Tharandt was highly relevant in the international development of thematic cartography in the 19th century. But while map production in Gotha and Alexander von Humboldt's famous maps have received significant attention, the research on forest cartography in Tharandt is limited.[10] And this

5 See Tabea Braun's paper in this issue.

6 University Archive of the Technische Universität Dresden (UATUD), collection of the Forestry Academy in Tharandt, 007–010, "Aufnahme der Akademisten an der Forstakademie und landwirtschaftlichen Lehranstalt 1833–1878". For the diplomas of students from abroad, see 069 "Studienorganisation 1830–1873," 184–186, and 203–205. For the inquiries, see 076 "Anfragen zum Studium 1898–1917".

7 Helena Westermarck, Elisabeth Blomqvist, *hennes liv och gärning. En biografisk studie, enligt brev och dagboksanteckningar*, 2 vol., Helsinki 1917, vol. 2, 1917. On the education reformers' stay in Tharandt and the forestry education of their brother Anton Gabriel Blomqvist, see Anders Benjamin Helander, *Anton Gabriel Blomqvist ja hänen aikalaisensa*, Helsinki 1936, p. 15; Schweitzer, Robert, "'In Tappes Tapfen' oder 'von Berg zu Berg'? Verbindungen zwischen Finnland und der Forstakademie Tharandt (Sachsen) im 19. Jh. Ein Beitrag zur Geschichte des Auslandsstudiums der Finnen", in *Finnland, das Zarenreich und die Deutschen. Gesammelte Studien zum europäischen Nordosten. Festgabe zum 60. Geburtstag des Verfassers*, ed. Uta-Maria Liertz, Helsinki et al. 2008, pp. 327–348.

8 See Maria Wagner, *Goethe und die Forstwirtschaft*, 1st ed. 2007, Remagen 2011.

9 Alexander von Humboldt. *Minerale und Gesteine im Museum für Naturkunde Berlin*, ed. Ferdinand Damaschun and Ralf Thomas Schmitt, Göttingen 2019.

10 On the Perthes publishing house in Gotha, see Petra Weigel, "Geographische Wissensproduktion – Reflexionen aus

is despite the fact that one of Humboldt's early academic career steps had been in the mining administration close to Tharandt. In 1791 and 1792, Humboldt was a student at the Freiberg Mining Academy for eight months. Freiberg and the nearby mining districts, which relied on steady wood supplies, were located close to Tharandt.[11] It can be assumed that Humboldt was influenced by diverse scholarly interactions at both academies. In particular, he might have been inspired by thematic maps as they were developed at mining and forestry academies. The forest maps discussed in this paper could be compared to plant distribution maps and petrographic maps, whose logic was important for Humboldt.[12] However, in contrast to plant-distribution maps in botany, forest-management maps represent not only tree species but also soil types, topographic features, wood yields, and past and future times of logging. In fact, this type of thematic cartography combines different symbolic systems to draw connections between various kinds of information. In addition, it is a type of map that faces the

der Perspektive der geographie- und kartographiehistorischen Sammlung Perthes der Forschungsbibliothek Gotha", *Berichte zur Wissenschaftsgeschichte*, 40, 1 (2017), pp. 86–90; Philipp Felsch, *Wie August Petermann den Nordpol erfand*, München 2010; Nils Güttler, "Unsichtbare Hände. Die Koloristinnen des Perthes Verlags und die Verwissenschaftlichung der Kartographie im 19. Jahrhundert", *Archiv für Geschichte des Buchwesens*, 68 (2013), pp. 133–153. On Alexander von Humboldt's cartographic techniques, see Amrei Buchholz, *Zwischen Karten. Alexander von Humboldts "Atlas géographique et physique des régions équinoxiales du Nouveau Continent"*, Berlin et al. 2020; Dominik Erdmann and Oliver Lubrich, *Das zeichnerische Werk. Alexander von Humboldt*, Darmstadt 2019; Lorraine Daston, "The Humboldtian Gaze", in *Science as Cultural Practice. Cultures and Politics of Research from the Early Modern Period to the Age of Extremes*, ed. Moritz Epple and Claus Zittel, Berlin 2010, pp. 45–60.

11 On the history of mining in Saxony, see Sebastian Felten, "The History of Science and the History of Bureaucratic Knowledge. Saxon Mining, circa 1770", *History of Science*, 56, 4 (2018), pp. 403–431.

12 On plant-distribution mapping, see, for instance, Janet Browne, *The Secular Ark. Studies in the History of Biogeography*, New Haven et al. 1983; Nils Güttler, "Drawing the Line. Mapping Cultivated Plants and Seeing Nature in Nineteenth-Century Plant Geography", in *New Perspectives on the History of Life Sciences and Agriculture*, ed. Denise Phillips and Sharon Kingsland, Cham 2015, pp. 27–52; Patrick Anthony, "Mining as the Working World of Alexander von Humboldt's Plant Geography and Vertical Cartography," *Isis*, 109, 1 (2018), pp. 28–55. On different types of thematic cartography, see Arthur Howard Robinson, *Early Thematic Mapping in the History of Cartography*, Chicago et al. 1982; Josef Wolf Konvitz, *Cartography in France, 1660–1848. Science, Engineering, and Statecraft*, Chicago 1987.

challenge of representing changes in the landscape over time. Foresters had to renew or revise maps in predefined time intervals and would then send the results to different offices that were subordinate to state treasuries. The representational strategies and epistemic functions of forest maps are therefore of interest to the history of topographic visual media.

The necessity to cut and paste maps

While research has been carried out on paper techniques as "tools of knowledge,"[13] little attention has been paid to forest maps and the paper techniques that bring them into being.[14] Neither art and visual historians nor historians of science have scrutinized forest-management maps. Most edited volumes on the history of cartography, too, do not treat forest mapping separately.[15] In the course of the 19th century, however, textbooks on forest-management cartography were published in considerable numbers and many languages. Among the circulating textbooks,

13 On the concepts of tools of knowledge and paper knowledge, see Peter Becker and William Clark, *Little Tools of Knowledge. Historical Essays on Academic and Bureaucratic Practices*, Ann Arbor 2001; Anke te Heesen, *Cut and Paste um 1900: Der Zeitungsausschnitt in den Wissenschaften*, Berlin 2002; Lisa Gitelman, Paper *Knowledge. Toward a Media History of Documents*, Durham 2014; the special issue "Histories of Bureaucratic Knowledge", ed. Sebastian Felten and Christine von Oertzen, *Journal for the History of Knowledge*, 1, 1 (2020); Christine von Oertzen and Lotte Schüssler, "Für, mit und auf Papier. Papiertechnologien und ihre Versorgungsketten," *Zeitschrift für Medienwissenschaft*, 14, 2 (2022), pp. 119–30. On recent praxeological approaches in the history of science, knowledge, and media, see, among others, the special issue "Cultural Techniques", ed. Geoffrey Winthrop-Young et al., *Theory, Culture & Society*, 30, 6 (2013); *Connect and Divide. The Practice Turn in Media Studies*, ed. Erhard Schüttpelz et al., Zurich 2021.

14 Henry E. Lowood, "The Calculating Forester. Quantification, Cameral Science, and the Emergence of Scientific Forestry Management in Germany", in *The Quantifying Spirit in the Eighteenth Century*, ed. Tore Frängsmyr et al., Berkeley 1990, pp. 315–342; James C. Scott, *Seeing like a State. How Certain Schemes to Improve the Human Condition Have Failed*, New Haven et al. 1998. See the chapter "Nature and Space", pp. 11–52, for an analysis of forest maps and their consequences. However, both publications do not trace the techniques of forest mapping.

15 See *The History of Cartography*, ed. Matthew H. Edney and Mary Sponberg Pedley, 6 vol., Chicago et al. 1987–2020, vol. 4: *Cartography in the European Enlightenment*, 2 parts, 2020; *Die Werkstatt des Kartographen. Materialien und Praktiken visueller Welterzeugung*, ed. Steffen Siegel and Petra Weigel, München 2011.

Heinrich Cotta's *Systematische Anleitung zur Taxation der Waldungen* was a central reference.[16] In his book, Cotta reflects on strategies of mapmaking and dedicates a whole chapter, "On Drawing Forest Maps," to the topic.[17] In the following quotation, he explains how foresters had created and used maps in the past, before pointing out the advantages of one standardized method. Cutting and pasting maps play a vital role in this passage. These practices result from the continuous necessity to revise maps, for instance after the felling of trees.

> If such a forest map did not already become incorrect after a few years, the dark coloring of the map would have to turn into light wherever cuttable wood had been cleared. But the inventive spirit still knew what to do even in these situations. One cut the part with the cleared area out from the map and placed a blank sheet of paper underneath, so in a manner of speaking, a cutting was performed on the map, too.[18]

As we can read in Cotta's textbook, the act of cutting trees not only creates cleared areas in the landscape but also renders forest maps inaccurate. Cotta explains that the darkly colored areas of a map that used to represent dense forest cover suddenly has to be switched to a bright color indicating empty space. The necessary change of color from dark to white is practically impossible unless the cartographers excise the dark areas out of the paper and paste a blank sheet of paper under it, realizing an act of hewing on the map. According to Cotta, however, indicating felled forest areas by cutting and pasting paper does not turn out to be a good solution.

16 For example, students of the French National School of Forestry in Nancy read Cotta's and Hartig's textbooks in their first semesters. See Charles Guyot, *L'Enseignement Forestier en France. L'École de Nancy*, Nancy 1898. European textbooks on forest-management cartography often quote Cotta's and Hartig's publications. See, for instance, Claes Wilhelm Gyldèn, *Suomalaisen Metsänhoidon Opas*, ed. and trans. Matti Leikola, 1st ed. 1853, Helsinki 1998, p. 14.

17 Heinrich Cotta, *Systematische Anleitung zur Taxation der Waldungen*, Berlin 1804.

18 Cotta 1804 (note 17), p. 67; all quotations translated by L. C. Original quotation: "Wenn nämlich ein solcher Forstriß nicht nach den ersten Jahren schon unrichtig werden sollte; so mußte da, wo haubare Hölzer abgetrieben worden waren, die dunkele Farbe des Risses nun mit Einemmale ins Lichte übergehen. Doch auch hier wußte der Erfindungsgeist noch Rath. Man schnitt die Fläche des abgetriebenen Schlages aus dem Risse heraus, und unterlegte die Stelle mit weißem Papier; so daß auch auf dem Riß gleichsam eine Hauung geführt wurde."

Over time, the map suffers from repeated collages. Even if the responsible foresters try to conduct this method as accurately as possible, it jeopardizes the accurate depiction of the forest.

Unfortunately, an example of such a forest map has not yet been found. The paper practices of cutting and pasting were probably less common than Cotta suggests. His description of the disadvantages of cutting and pasting forest maps could be an exaggeration intended to support his arguments in favor of a new standardized system of annotation. Nevertheless, there is a high possibility that most pasted-over hand-colored forest maps from the 18th century were not considered to be of archival value. The few archived forest maps from before 1800 possess extraordinary characteristics or are parts of state surveys that were not meant to be revised. Cutting and pasting maps could have played, however, a role in the working routines of smaller administrations, whose materials did not enter archives. Without doubt the practices of cutting and pasting maps point at a general problem in cartography: the impossibility of representing the temporality of topography on a single map. Changes in the landscape and complex interrelations within socionatural systems could not be sufficiently grasped on conventional two-dimensional maps.

One 18th-century method for dealing with this problem—which probably resembles the cutting and pasting Cotta criticized—can be found in a book on arithmetic and geometry for forestry by Johann Ehrenfried Vierenklee from 1767. Since it belongs to the early canon of forestry text-books, it saw several reprints.[19] It includes model maps and illustrations. Although Cotta does not mention Vierenklee's maps, the book can illustrate what was new about standardized methods of forest maps that remained up to date over a long period of time.

In a map from Vierenklee's textbook **(Fig. 1)**, the richly colored topography with a lake and a hill is structured by a geometrical grid of 50 consecutively numbered squares. The map resulted from assessments undertaken in the forest district of Freudenberg close to Berlin. The map's template-like title—"Plan of the royal (seigneurial) forest N. N. under the

19 Johann Ehrenfried Vierenklee, *Mathematische Anfangsgründe der Arithmetik und Geometrie, in so fern solche denjenigen, die sich dem höchstnöthigen Forstwesen auf eine vernünftige und gründliche Weise widmen wollen, zu wissen nöthig sind*, Leipzig 1767.

commission of N.N., measured and subdivided by N.N."—indicates that it served as a model for forest assessments. The legends at the margins are rich in detail. Numerous pictograms and symbols resemble those used by Cotta around 1800. Of particular interest are the color patterns defined in the legend at the bottom.

Every color stands for a type of tree. Pine trees are represented by grey, checker trees and other foliage trees by green, birch trees by red, oak trees by yellow, and beech trees by brown. Moreover, each color is subdivided into shades or patterns: dark brown represents beechwood that can be logged soon, while light brown represents young beech. Stripes of dark brown and light brown indicate forest areas with a mix of young trees and old-growth trees. White areas with a brown edging indicate young beech seedlings. The stronger colors thus draw the observer's attention to places where cuttable trees are growing. On the upper part of the map, one can find old oak trees of high quality in yellow right next to cuttable birch trees in a strong reddish brown. However, the colors and color intensities only represent the condition of the wood in these locations in the year the map was made. As soon as the trees were logged, the darkly colored areas would have had to be changed to a bright color again. Vierenklee does not explain how to solve this problem and whether he recommends cutting and pasting. But the logic of Vierenklee's 1767 map perfectly illustrates the practical problems of forest cartography that Heinrich Cotta addressed around 1800.

Heinrich Cotta's forest maps

Cotta's method of mapmaking is characterized by a distinction between general maps and specialized maps. A general map should provide an overview of the area and its surroundings, while a specialized map focuses on one particular forest district and the exact depiction of its parts. The two types of thematic maps offer different kinds of information. With their larger scales, general maps represent important topographical features, such as the altitude, the course of hills, and the dominant tree species, which were depicted with the help of colors. All in all, general

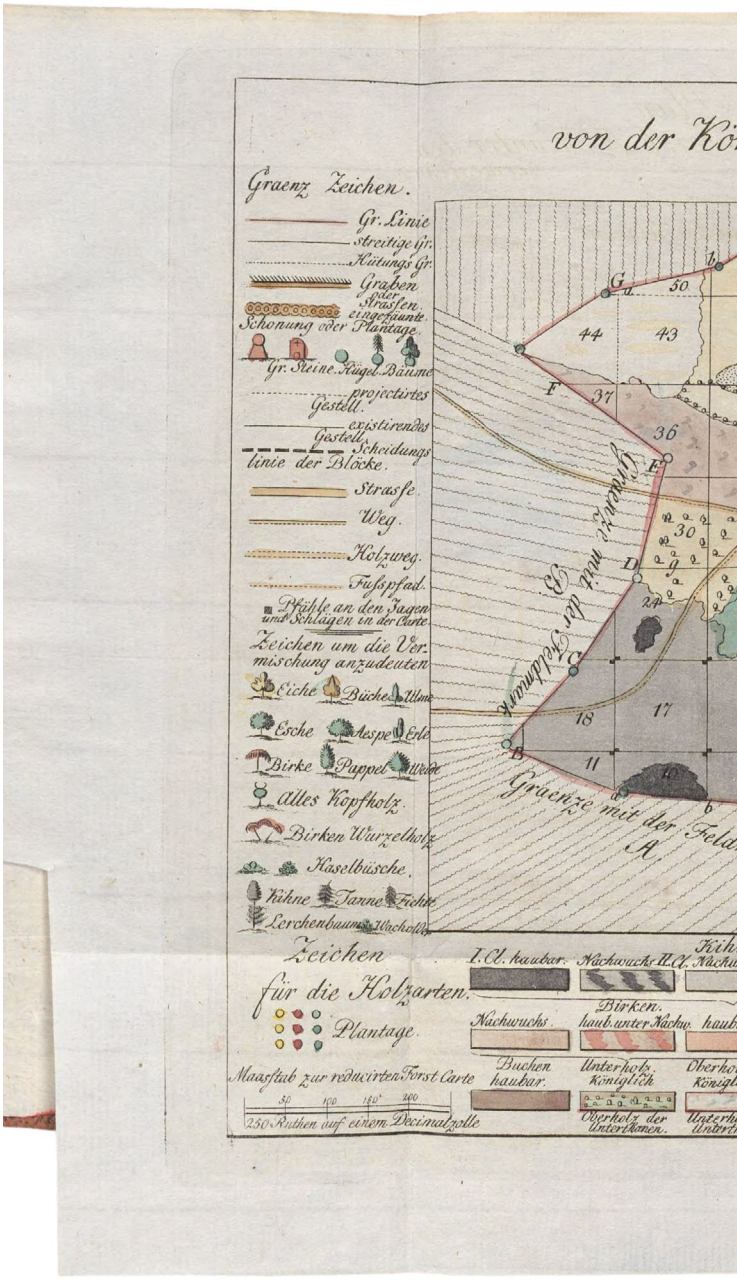
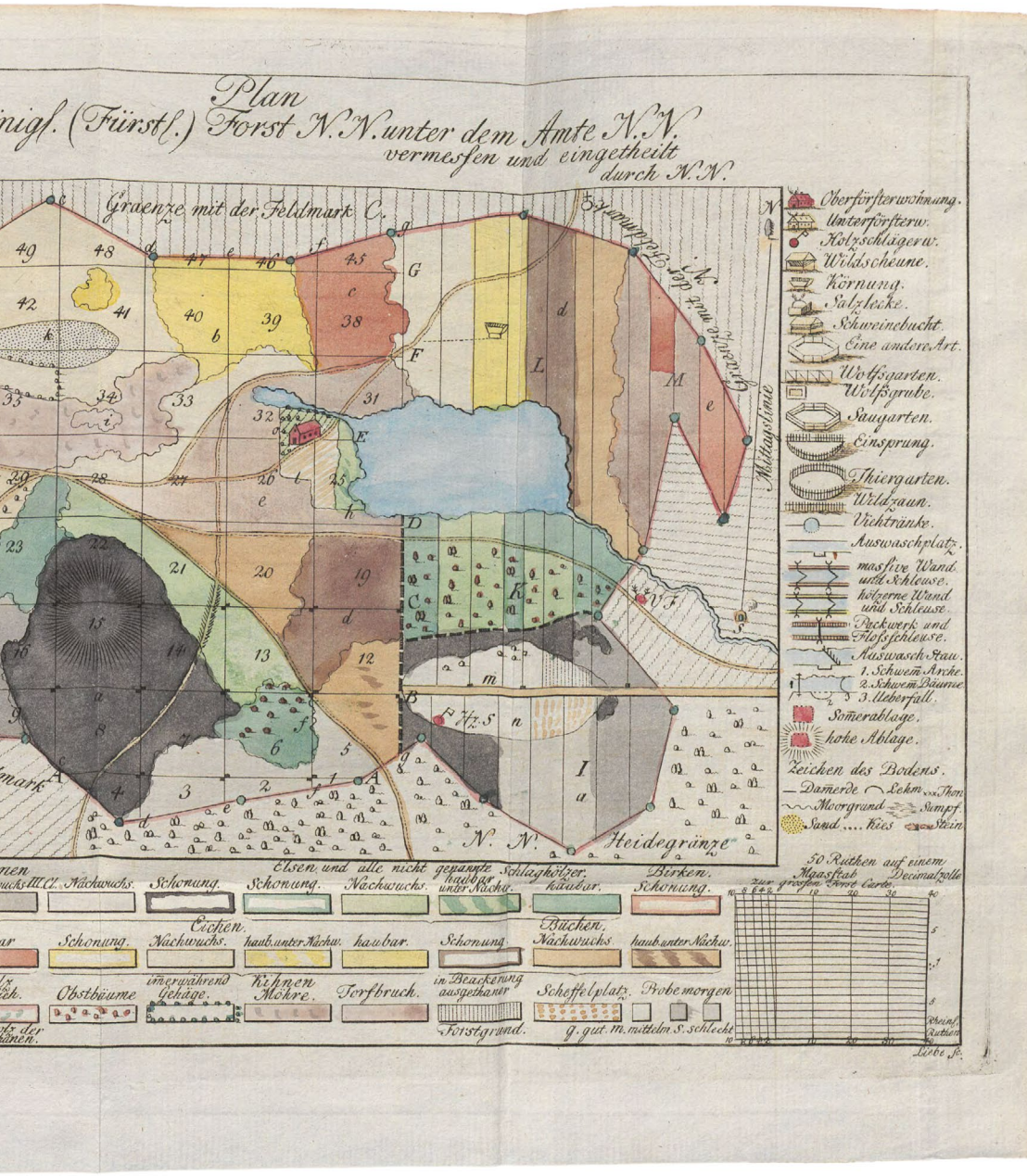


Fig. 1
Johann Ehrenfried Vierenklee, Plan of the Royal (Seigneurial) Forest N.N. under the commission of N.N., measured and subdivided by N.N., from his *Mathematische Anfangsgründe der Arithmetik und Geometrie, in so fern solche denjenigen, die sich dem höchstnöthigen Forstwesen auf eine vernünftige und gründliche Weise widmen wollen, zu wissen nöthig sind* (1767), ed. Friedrich Meinert, Leipzig 1797, appendix, unpaginated


Plan
nigsl. (Fürstl.) Forst N.N. unter dem Amte N.N.
vermessen und eingetheilt
durch N.N.
Gränze mit der Feldmark C.
Gränze mit der Gemeinde
Mittagslinie
Oberförsterwohnung.
Unterförsterw.
Holzschlägerw.
Wildscheune.
Körnung.
Salzlecke.
Schweinebucht.
Eine andere Art.
Wolfsgarten.
Wolfsgrube.
Saugarten.
Einsprung.
Thiergarten.
Wildzaun.
Viehtränke.
Auswaschplatz.
massive Wand und Schleuse.
hölzerne Wand und Schleuse.
Packwerk und Flossschleuse.
Auswasch-Stau.
1. Schwem-Arche.
2. Schwem-Bäume.
3. Ueberfall.
Somerablage.
hohe Ablage.
Zeichen des Bodens.
Dammerde Lehm Thon
Moorgrund Sumpf
Sand Kies Stein
N. N. Heidegränze
Elsen, und alle nicht gepaarte Schlaghölzer. Birken.
Schonung. Nachwuchs. Schonung. Schonung. Nachwuchs. haubar unter Nachw. haubar. Schonung.
Eichen. Buchen.
Schonung. Nachwuchs. haub. unter Nachw. haubar. Schonung. Nachwuchs. haub. unter Nachw.
Obstbäume. immerwährend Gehäge. Kiehnen Möhre. Torfbruch. in Bearbeitung ausgethaner Forstgrund. Scheffelplatz. Probe morgen
g. gut. m. mittelm. S. schlecht
50 Ruthen auf einem Maasstab Decimalzolle
Rhein. Ruthen
Liebe Sc.

and specialized maps were meant to complement each other. For this reason, foresters had to assemble them in the same folder.[20] In his book, Cotta emphasizes the advantages of these rather small maps: they did not have to be rolled out and rolled up. Using two kinds of maps made it possible to provide accurate details on specialized maps and to compare them to a broader overview of the area on the general map.

The "General map of the first section of the forest district of Buchenau under the higher forest commission of Tanneberg" **(Fig. 2)** was printed as an example in the book chapter "On Drawing Forest Maps." The map's title contains administrative information that facilitates locating the depicted area within the forest bureaucracy. Section 1 with all its subsections is located on the right bank of the river Werra, south of the villages of Holzhausen, Herrenstein, and Veltheim and west of Buchenau, where the higher forest commissioner's house was located. When the map was produced in 1802, these places belonged to the principality of Saxony-Weimar-Eisenach.

At first glance, the different colors catch our attention. A red line distinguishes the multicolored forest section 1 in the middle from the surrounding area in black and white. In addition, a net of brown meandering lines represent the internal division of the forest section. If we zoom in on the map, there are various pictograms whose meaning is explained in the legend. As is typical of general maps, it provides extensive practical information that helped foresters orientate themselves in the area. Different pictograms and signs depict different kinds of mills, furnaces, and mining facilities. All in all, the general map contains condensed information on the economic uses of the forest.

But how were the timber resources represented and managed with the help of the map? Similar to Vierenklee, Cotta employs colors to depict tree species. But in contrast to the preceding model map, bold colors do not stand for areas that are ready for immediate logging. Instead, the brightness of the colors indicates whether the trees in the area belong to a timber forest (*Hochwald*) or a coppice forest (*Niederwald or Schlagholz*).[21] Coppice

20 Cotta 1804 (note 17), p. 69.

21 Cotta 1804 (note 17), p. 82. On the terminology, see Matthias Bürgi, "How Terms Shape Forests: 'Niederwald', 'Mittelwald' and 'Hochwald', and their Interaction with Forest Development in the Canton of Zurich, Switzerland", *Environment and History*, 5 (1999), pp. 325–344.

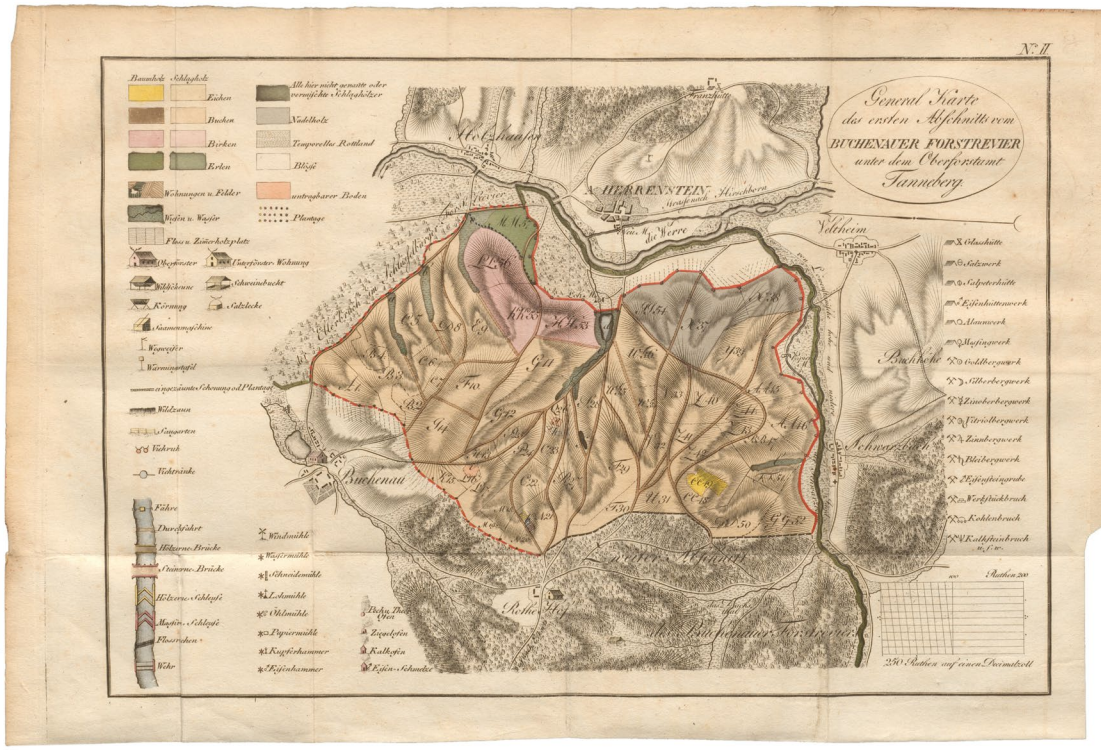


Fig. 2
Heinrich Cotta, General map of the first section of the forest district Buchenau under the Higher Forest Commission of Tanneberg, from his *Systematische Anleitung zur Taxation der Waldungen*, Berlin 1804, between p. 82 and p. 83

forests were common in many parts of Germany until the 19th century. This particular type of forest consists of rather small foliage trees that are cut down to the trunk and sprout up again. The bendable branches of, for example, willow and birch trees were useful in the household economy, such as for making furniture, baskets, fences, and roofs, and also as firewood.[22] There was a tendency in 19th-century forestry to try to convert

22 Alicia Unrau, Gero Becker and Raffaele Spinelli, *Coppice Forests in Europe*, Freiburg (Breisgau) 2018, URL: http://www.eurocoppice.uni-freiburg.de/coppice-forests-in-europe (accessed 01.04.2021).

coppices into timber forests that promised huge amounts of valuable wood. We can even conjecture this prioritization of high timber forests on the general map provided by Cotta.

Apparently, the symbolism of the colors implies an assessment of value. The intensive color leads the viewer to expect lumber of high quality grown in the timber forest. However, in 1802, the year the maps were completed, the forests close to Buchenau mainly consisted of not-so-valuable beech coppices, as indicated by the light brown. How long had the beech trees already been growing at Buchenau? How much yield could be expected from these rather small trees compared to high forests? Answering questions like these was the purpose of the specialized map **(Fig. 3)**.

Specialized maps focus on the internal organization of a forest section, and they serve as historical records of when each subsection was cut last. Color use on specialized maps differs from that on general maps. On specialized maps, the colors depict different soil types and their qualities. Additionally, there are densely written words, capital letters, Arabic numbers, small letters, and dots in some subsections; they indicate different tree species and their proportions in the forest cover. Each subsection is marked with a combination of capital letters and numbers. In the eastern corner of the Buchenau forest district, the counting starts with A1, followed by B2, B3, and B4, which together form a section that could also be treated as a compound cluster. Then there are C5, C6, and C7 right next to the latter area. The counting continues until subsection Z44, which was located on a mountain called the Hengstberg. Then the alphabet begins anew at the neighboring sections with the indexes AA45, AA46, and so on, until finally MM57 is reached at the top of the forest district. The numbers indicate the year in which the specific forest subsection should be logged, so foresters were supposed to cut A1 in the first year, followed by A2, and so forth. After fifty-seven years, cutting could start again at forest section A1, which would then consist of trees that would have regrown. In the logic of the forest map, each of the subsections would always provide fifty-seven-year-old trees after the first round had been completed. The alternation of logging and a regrowth period of fifty-seven years could, theoretically, be repeated eternally. The only condition was that everyone involved adhered to the plan.

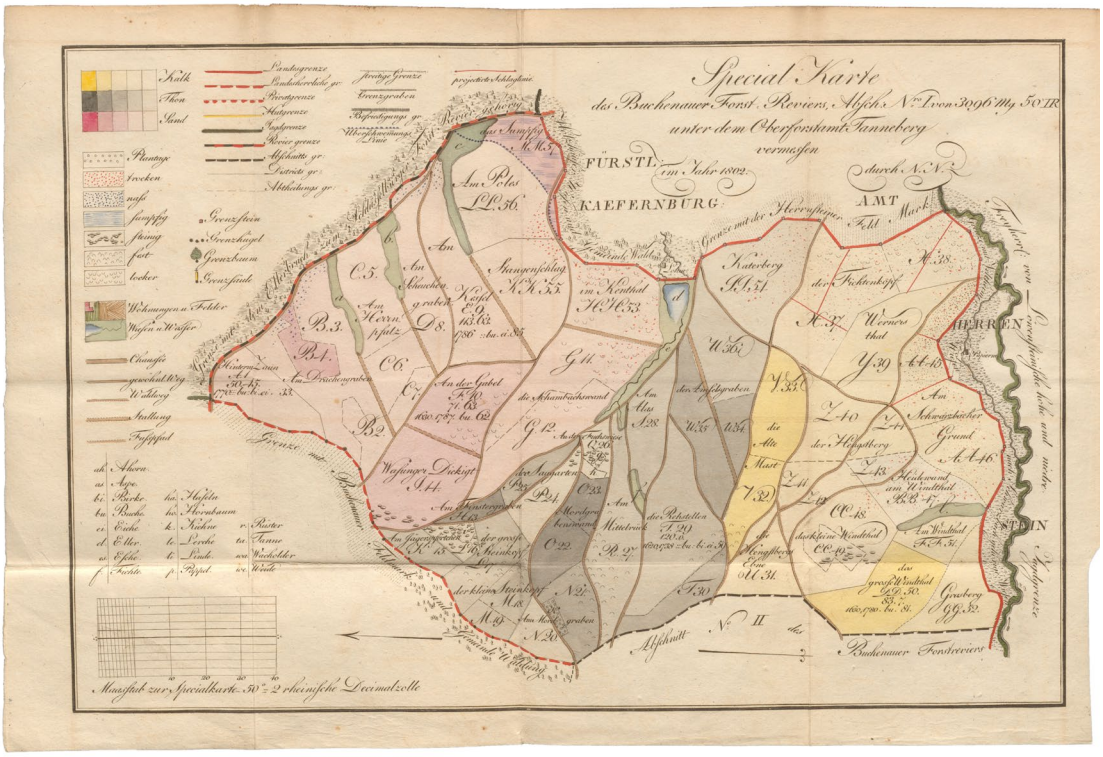


Fig. 3
Heinrich Cotta, Special map of the forest district Buchenau. Section No. I, from his *Systematische Anleitung zur Taxation der Waldungen*, Berlin 1804, before the title page.

The growing period of the trees was called the "Umtriebszeit," or "Umtriebsperiode," which translates as "rotation time" or "rotation period."[23] The forester's task was to define the rotation periods of each forest section by calculating the year in which logging would produce the highest possible timber yield based on local conditions. Cutting trees in an area whose turn had not yet arrived could endanger this system of "sustainable" forest management, as Cotta and other forestry scientists called it. Rotation periods have a long tradition in the history of forests. The practice of

23 Philipp 1900 (note 1), p. 46. For a contemporaneous definition, see "Umtrieb", in *Forstliches und forstnaturwissenschaftliches Conversations-Lexikon. Ein Handbuch für Jeden, der sich für das Forstwesen und die dazu gehörigen Naturwissenschaften interessirt*, ed. Georg Ludwig Hartig and Theodor Hartig, Berlin 1834, pp. 127–128.

subdividing a forest according to time periods may have been developed in the cultivation of coppice forests. On common land in Europe, a multiplicity of land-use practices usually coexisted. There was often a rotation cycle consisting of strictly clocked phases. For example, after trees were cut, the remaining bushes were burned and then the users of the shared coppice forests ploughed the fertile soil. The entitled community of users treated the area as agricultural land until the trees started to regrow after two or three years. Then sheep, cows, goats, or pigs were herded among the trees, until the wood had grown enough to be cut again. There were various historical systems of rotating land use on forest land that was common property.[24] But neither the general nor the specialized map in Cotta's textbook indicate the use of forest land as a pasture or for agricultural purposes.

Although the system of rotation cycles was probably inspired by rotating land-use practices in common forest land, forest maps solely depict aspects of land-use that were important for the mining industry, which was above all the production of timber and fuel. Even though, there is one pictogram on the legend called dwellings and fields ("Wohnungen und Felder"), the specialized map does not use this pictogram. Within the borders of the forest district Buchenau, all subsections are dedicated to the production of wood, and no space is left for pastures, agriculture, or other forest uses that were typical in coppice forests.

Before returning to land-use practices that were mainly excluded from wooded areas during the enclosure of common land, we should examine the other numbers noted on some of the subsections. The purpose of these numbers was to provide detailed information about how much and what kind of wood could be expected when the time for logging came.[25] Consider the area A1 as an example. It bears the name "Hinterm Zaun," meaning behind the fence. The numbers "50.45" indicate the size of the surface area in the local units of morgen and rods. The year when this coppice forest area was last cut is indicated with the number "1770," so thirty-two years

24 For an overview, see M. P. Eichhorn et al., "Silvoarable Systems in Europe – Past, Present and Future Prospects", in *Agroforestry Systems*, 67, 1 (2006), pp. 29–50; *Kollektive Weiden und Wälder. Ökonomie, Partizipation, Nachhaltigkeit – Pâturages et forêts collectifs. Economie, participation, durabilité*, ed. Anne-Lise Head-König et al., Zürich 2019.

before the map was created. The abbreviations "bu," "bi," and "ei" stand for beech trees, birch trees, and oak trees. The dots indicate that there are nine out of twelve parts beech trees, two out of twelve parts birch trees, and one part oak trees. The number at the end of this line indicates the amount of timber per acre estimated for the first round of cutting.

Cotta's intention was that these maps would remain usable for a considerable period. He also tried to make it easy for foresters to add new information without having to erase or paste over older calculations. For instance, it was possible to alter the proportions of tree species by adding new dots above or under the letters. In addition, Cotta propagated the advantage of adding the actually measured amount of timber after cutting was complete. The specialized map would thereby provide a means of "instructive control."[26] The calculations made in advance could be compared to the actual wood yield, resulting in what Cotta calls a "dense chronic of an area's forest economy and its success."[27] All in all, the system of annotation and cartographic representation served as an epistemic tool. It simultaneously contained knowledge about the depicted forest areas, their conditions, recent and anticipated changes in the forest topography, and the estimated and actual wood yields.

This meticulous system of annotation raises a number of questions. How were forest administrators trained to address land-use practices that actually disturbed the logic of the forest map? What practices defied the logic of strictly divided forest parcels that were mainly dedicated to the long-term production of timber? What happened when practices negatively impacted the amount of timber that could be felled at the end of one rotation period? Although the cyclical organization of coppice forests might have originally been an inspiration, Cotta's maps leave no space for alternating land-use practices. This is rather surprising if we consider some of his many other publications. A small essay from 1819, entitled *Die Verbindung des Feldbaues mit dem Waldbau*, advocates the combination of agriculture with forestry.[28] Cotta recommends planting fruit-bearing

25 Cotta 1804 (note 17), p. 73.
26 Cotta 1804 (note 17), p. 79.
27 Cotta 1804 (note 17), p. 80.
28 Heinrich Cotta, *Die Verbindung des Feldbaues mit dem Waldbau, oder die Baumfeldwirthschaft*, Dresden 1819.

trees at the borders of fields and on river banks. Indeed, he even suggests transforming forested areas into fields mixed with trees. But this publication was not successful in the scientific community. Instead, the plea for high timber forests with long rotation periods gained acceptance.[29] Using forests for agricultural purposes, which had been common, was forbidden for the sake of protecting timber forests that had to remain standing for long time periods in order to produce higher amounts of timber.

Land-use conflicts in the forests of Tharandt: collecting litter

Banning coppice forests with their alternating land-use practices led to conflicts. One such land-use conflict can be found in an archival document from 1830, entitled *Allgemeine Beschreibung vom Tharanter Walde*. In this general description of the Tharandt forest, Heinrich Cotta's son Wilhelm complains that the soil "has suffered from the practice of litter collection."[30] This argument was dominant in 19th-century forestry literature. Removing leaves, needles, and brushwood was said to result in a loss of nutrients in the soil, which in turn negatively influenced the growth of timber.

In fact, the collection of brushwood, ground litter, and tree leaves within the forest was a controversial agricultural practice in the 18th and 19th centuries.[31] Such ground litter, in German *Waldstreu*, was used to feed cattle in the stable during winter or as a means to collect farm animals'

29 On the impact of long-term forestry planning on biopolitics and current debates, see Julia Nordblad, "Time for Politics. How a Conceptual History of Forests Can Help Us Politicize the Long Term", *European Journal of Social Theory*, 20, 1 (2017), pp. 1–19.

30 Original quotation: "Obschon der Boden – wie dies bei einer so großen Fläche kaum anders zu erwarten steht – mitunter sehr dürftig ist, zum Theil durch Streunutzung ausserordentlich gelitten hat." Wilhelm Cotta, *Allgemeine Beschreibung vom Tharanter Walde*, 1830, UATUD, collection of the Forestry Academy in Tharandt, 753, fol. 3 (unpaginated).

31 On conflicts over the collection of ground litter in other German regions, see Bernd-Stefan Grewe, *Der versperrte Wald. Ressourcenmangel in der bayerischen Pfalz (1814–1870)*, Köln et al. 200; Christoph Ernst, *Den Wald entwickeln. Ein Politik- und Konfliktfeld in Hunsrück und Eifel im 18. Jahrhundert*, München 2000; Uwe Eduard Schmidt, "Waldfrevel contra staatliche Interessen. Die sozialgeschichtliche Bedeutung des Waldes im 18. und 19. Jahrhundert", *Der Bürger im Staat*, 51 (2001), pp. 17–23.

excretions to use them as manure on the field.[32] To some extent, peasants depended on ground litter to complement the hay produced on the fields. Laws that animals be housed in stables were another reason why the need for brushwood increased. Before the prohibition of forest pastures, it was common to bring cattle and pigs into the forest where they could forage and where their manure was left behind, thereby returning nutrients to the forest ground.

In Saxony, a forest ordinance from 1822 officially defined wood theft. According to the first paragraph, green wood, dry wood, trees growing on other tree's roots, wood already cut, and wood blown down by the wind should not be taken out of the forest without permission. In addition, this law banned the collection of resin, moss, and brushwood. Depending on the worth of the stolen forest products, convicted wood thieves had to go to prison for twelve days to three weeks.[33] The penalty reveals the highly controversial context of these criminalized practices of forest use.

Criminal records throughout Germany and Switzerland show a rise in the prosecution of people involved in wood theft in the first half of the 19th century. As a Prussian state, Saxony was affected by the Prussian law of 1822 that defined wood theft.[34] While this law abolished corporal punishments for forest offences, it also denied the accused the right to legal defense, because the courts were clogged with too many wood-theft cases. The trial records for wood theft often mention women. The French historian Michelle Perrot has pointed out that women often initiated and carried out conflicts and rebellions against forest officials.[35] However, women's involvement in 19th-century forest conflicts remains

32 For a description of litter-collection practices in Switzerland, see Martin Stuber and Matthias Bürgi, *Hüeterbueb und Heitisträhl. Traditionelle Formen der Waldnutzung in der Schweiz 1800 bis 2000*, Bern 2011.

33 Friedrich August von Sachsen, *Mandat über die Bestrafung der Holzdiebstähle und Baumfrevel*, 22.11.1822, UATUD, Institut für Waldpolitik, Forstgesetzgebung Sachsen (Abschriften 1821–1898), 270, § 1 Holzdiebstahl.

34 The trial records for wood theft in the Prussian Privy State Archives in Berlin-Dahlem have been analysed by the social historian Dirk Blasius in *Kriminalität und Alltag zur Konfliktgeschichte des Alltagslebens im 19. Jahrhundert*, Göttingen 1978, pp. 81–82.

35 Michelle Perrot, "Rebellische Weiber. Die Frau in der französischen Stadt des 19. Jahrhunderts", in *Listen der Ohnmacht. Zur Sozialgeschichte weiblicher Widerstandsformen*, ed. Claudia Honegger and Bettina Heintz, Frankfurt (Main) 1981, pp. 71–98, especially p. 84.

rather underrepresented in German social history.[36] At any rate, the mass prosecution of wood theft encouraged Karl Marx to publish several critical articles in the *Rheinische Zeitung* in 1842.[37] According to the young Marx, who had just graduated in philosophy, it was unfair to charge the poorest part of the population for delicts they depended on to have firewood and to feed their livestock. Furthermore, he pointed out, collecting brushwood and ground litter on someone else's property had been a customary right before it was abolished in the course of the enclosure of the commons. It is crucial to point out that these supraregional conflicts were caused by the mass prosecution of wood-theft cases and the abolishment of a variety of previously legal forest-use practices. Consequently, it is worth asking how the causes of wood-theft conflicts were related to methods of forest cartography.

When Wilhelm Cotta wrote *Allgemeine Beschreibung vom Tharanter Walde* in 1830, he had just graduated to the status of a master and was given the leadership position at the Institute for Forest Surveying at the Tharandt Forestry Academy. In the preceding years, he had gained working experience on land surveys in the Kingdom of Saxony and was then responsible for teaching forest management to international students.[38] In this position, Heinrich Cotta's son advocated forest-management maps for protecting the forests of Tharandt from destruction and exploitation. As Wilhelm Cotta puts it, the forester in command—who carried out forest mapping as recommended in textbooks—"diligently strove for the

36 There are several studies on the role of women and exhibited femininity in forest conflicts in the history of France. See, for instance, Chandra Mukerji, "The Great Forestry Survey of 1669–1671. The Use of Archives for Political Reform", *Social Studies of Science*, 37, 2 (2007), pp. 227–253; Peter Sahlins, *Forest Rites. The War of the Demoiselles in Nineteenth-Century France*, Cambridge 1994. On wood theft as a strategic form of social protest carried out by women and unmarried men, see Andreas Suter, *"Troublen" im Fürstbistum Basel (1726–1740). Eine Fallstudie zum bäuerlichen Widerstand im 18. Jahrhundert*, Göttingen 1985.

37 See Karl Marx, "Verhandlungen des 6. Rheinischen Landtags. Von einem Rheinländer. Debatten über das Holzdiebstahlgesetz", *Rheinische Zeitung* 298 (25 October 1842); Peter Linebaugh, "Karl Marx, the Theft of Wood, and Working-Class Composition. A Contribution to the Current Debate", *Social Justice*, 40, 1–2 (2014), pp. 137–161.

38 On the history of the application of forest management in Tharandt, see Wilhelm Cotta, "Ueber die Entwickelung des Taxationswesens in Sachsen", in *Forstliches Cotta-Album*, ed. J. von Pannewitz, Breslau et al. 1844, pp. 85–99.

regulation of ground litter collection in the forest in a more sustainable and ordered way."[39] This quotation reveals that forest-management maps were seen as a means for exercising control over land-use practices such as ground-litter collection that were considered a threat to the forest.

After the analyses of the maps taken from two different textbooks, I would claim that the paper practices involved in making forest maps have to be considered in the context of land-use conflicts in the first half of the 19th century. In the history of topographic media, it is of importance to attend to the epistemic violence that can be exerted through maps.[40] The aesthetics of Heinrich Cotta's maps captured and confirmed the ideal that forests should consist of strictly divided parcels. As scientific illustrations, forest maps made similarities between areas visible, such as similar soil conditions or stocks of trees. At the same time, the maps legitimated scientific arguments, for instance, in favor of timber forests that should be logged after predefined periods of rotation and that should produce a determined amount of timber. Ultimately, forest maps exercised epistemic violence against the knowledge and traditions of local people—in particular against land-use practices that did not fit the plan, such as collecting ground litter, practices that were regulated or banned in the process of making forest-management maps.

Conclusion

Cutting paper leads to multiple pieces or to an explicit division of the material. In the case of forest maps, the strict internal divisions of forest sections and subsections obviously resulted in a land-use regime that rendered it impossible to preserve a diversity of silvicultural practices. Cotta describes cutting out an area of a paper map and pasting a new sheet of paper under the maps as a typical 18th-century method for revising maps. He calls it an act of "hewing on paper." It seems as if this performative

39 Original quotation: "Er [...] trachtete überhaupt auf das eifrigste und gewissenhafteste dahin, die Streunutzung der Forste regelrechter und nachhaltiger zu gestalten." Cotta 1830 (note 30), fol. 13 (unpaginated).

40 For an overview on theories on epistemic violence, see Claudia Brunner, Epistemische Gewalt. Wissen und Herrschaft in der kolonialen Moderne, Bielefeld 2020.

act affirms the capacity to substitute one type of landscape with another one: a white sheet of paper that can be designed according to the planner's needs or a clearing where foresters can plant seedlings of one tree species and age class.

White spaces have a long tradition in the history of cartography as *terra incognita*—the land marked as unknown by mapmakers. Alexander von Humboldt also made use of white areas on his maps, not in the sense of terra incognita, but as an epistemic tool for drawing connections between different topographic aspects, as Amrei Buchholz has shown.[41] For Vierenklee, too, white spaces on forest maps played an important role as epistemic devices: blank spaces could be colored and, afterwards, the color intensity could be increased in the course of time according to the growth of the trees. The mapmaking strategy presented by Cotta with its system of rotation periods relied on white spaces as well. On specialized maps, white areas provided space to add notes, such as the actually measured amount of timber at the end of one rotation period or the year in which the last hewing took place.

According to the thesis of this paper, the possibility of pasting blank paper parts onto maps encouraged foresters to imagine and initiate abrupt changes in forest landscapes. Whenever the end of one rotation period was approaching, the cutting of trees would be repeated as an act of cutting and pasting inside the map. Heinrich Cotta strove for methods of mapmaking that would ensure the map's long-lasting adaptability. That is why he suggested an annotation system that would make cutting and pasting unnecessary. However, this new system builds on the modes of cartographic representation established under the influence of cutting, pasting, and dividing paper. Eventually, Cotta's efforts were linked to the aim of sustainable forestry to guarantee stable wood yields over long periods. But according to this system of topographic visualization, perfect control over forest growth could only be achieved in forest landscapes that had the same characteristics: one tree species and one age class per area. In the 19th century, forest maps in Europe were meant to represent and plan this kind of sustainable timber forest. Mixed forests and diverse

41 Buchholz 2020 (note 10), pp. 90–91.

land-use practices would not only jeopardize the aim of maintaining stable wood yields over long time periods; they would also disturb the system of rotation periods and the annotation system developed by Cotta and other forestry scientists. Taken all together, agrosilvopastoral land-use systems, with their interdependencies and fluent transitions, would have required different strategies of representation than the ones that were standardized during the foundation period of forestry schools after 1800.

To conclude, forest maps and the involved paper techniques did not merely represent the forest; they rather served as tools of knowledge that made forests legible and utilizable according to state administrations' priorities on wood-consuming economic sectors. The aesthetics of strict divisions on forest maps can be interpreted as a consequence of cutting and pasting as well as of adjustments to methods of subdividing paper in order to prescribe specific rotation periods to forest areas. These seemingly neutral paper practices thus facilitated politics of land-use that relied on strict boundaries between land parcels and that only allowed one land-use practice per area.