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ORIGINAL PAPER

History as a biomedical matter: recent reassessments of the first cases of Alzheimer's disease

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Abstract This paper examines medical scientists' accounts of their rediscoveries and reassessments of old materials. It looks at how historical patient files and brain samples of the first cases of Alzheimer's disease became reused as scientific objects of inquiry in the 1990s, when a genetic neuropathologist from Munich and a psychiatrist from Frankfurt lead searches for left-overs of Alzheimer's 'founder cases' from the 1900s. How and why did these researchers use historical methods, materials and narratives, and why did the biomedical community cherish their findings as valuable scientific facts about Alzheimer's disease? The paper approaches these questions by analysing how researchers conceptualised 'history' while backtracking and reassessing clinical and histological materials from the past. It elucidates six ways of conceptualising history as a biomedical matter: (1) *scientific assessments of the past*, i.e. natural scientific understandings of 'historical facts'; (2) *history in biomedicine*, e.g. uses of old histological collections in present day brain banks; (3) *provenance research*, e.g. applying historical methods to ensure the authenticity of brain samples; (4) *technical biomedical history*, e.g. reproducing original staining techniques to identify how old histological slides were made; (5) *founding traditions*, i.e. references to historical objects and persons within founding stories of scientific communities; and (6) *priority debates*, e.g. evaluating the role particular persons played in the discovery of a disease such as Alzheimer's. Against this background, the paper concludes with how the various ways of using and understanding 'history' were put forward to re-present historic cases as 'proto-types' for studying Alzheimer's disease in the present.

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1 Introduction

In March 1998, the journal *Science* reported in its "News & Comment" section, under the headline "First Alzheimer's Diagnosis Confirmed":

> Ending a 2-year-long search, German scientists have uncovered a piece of science history: brain samples from Auguste D., the first Alzheimer's patient ever to be described in medical literature. The finding, published this week in *Neurogenetics*, is likely to put an end to lingering doubts about the cause of Auguste's dementia. Some scientists had argued that she may have suffered not from Alzheimer's, but from another, rarer brain disease. (Enserink 1998, p. 2037)

Contrary to journalist Enserink's report, the issue of what kind of disease the case of Auguste D instantiated was not settled after the original brain samples had been found. A number of subsequent publications presented further genetic analyses of the histological preparations that aimed to identify the disease-causing genetic mutation; so far without reaching a scientific consensus (see Rupp et al. 2014). Neither the psychiatrists of the 1900s who first suggested the introduction of the new category of "Alzheimersche Krankheit" as a severe form of rapidly progressing dementia (Kraepelin 1910; Alzheimer 1911), nor the neurogeneticists a century later, provided a firm diagnostic conclusion. Nonetheless, the reassessment of patient files and histological slides bearing conserved brain samples were featured in high impact medical and scientific journals from the 1990s onwards, and Alzheimer's 1906 report about Auguste D's case is nowadays perceived as a historical but still instructive first description of Alzheimer's disease (see even critical accounts of recent Alzheimer research, such as Whitehouse and George 2008; Lock 2013).

The broad interest in the rediscovery and reassessment of historical cases needs, on the one hand, to be evaluated in light of the unfulfilled search for an efficient therapy, a valid aetiological model, or even a stable concept of Alzheimer's disease—beyond it's status as a dreadful neurodegenerative epidemic of ageing societies—within the ever bigger enterprise of biomedical research in the past three decades (see Lock 2013 for a panorama of the development of Alzheimer's research). On the other hand, the protagonists of the rediscovery enterprises, Frankfurt-based psychiatrist Konrad Maurer, and Munich neuropathologist Manuel Graeber, used the public attention for Alzheimer's original case to articulate an academic lineage of German neuropathology and psychiatry that linked the "pioneering" work of Alois Alzheimer (1864–1915) to present neuropsychiatric research. To understand why old cases are researched (and, indeed, re-searched) as particularly valuable scientific objects, it is therefore instructive to look at how contemporary biomedical researchers conceptualise, study, and use 'the history' of a disease.

For this purpose, the paper examines the rediscovery and re-diagnosis of medical material referring to Auguste D, later identified as Auguste Deter, and to a second patient, Johann Feigl, whose disease courses Alzheimer described in 1906 and 1911.[1] In looking at the very ways in which the past has been made a biomedical matter within the re-searches for original Alzheimer cases, the paper aims to provide a tentative taxonomy for examining the uses and conceptions of historical narratives, methods, and materials within and for the biomedical community (or, communities). As such, it studies the practices of 'science history' and retrospective diagnosis from a history of knowledge perspective. Section 2 will explore the implications of this approach towards biomedical uses of the past and contextualise it by providing a brief historiography of history in science.

Section 3 then introduces the case study, including the protagonists, places, and self-reported accounts of the rediscoveries of the remains of Alzheimer's patients in the 1990s. Against this background, Sect. 4 discusses six ways of conceptualising history as a biomedical matter, all of which refer to distinctive aspects of how historical methods, narratives, and materials were used and interpreted within the case study. Section 5 returns to the initial question of what the researchers hoped to learn from the present about the past, and from the past about the present and future of research on Alzheimer's disease.

2 Science history, history in science, and retrospective diagnosis

Historians of science, from the very beginnings of the professionalization of their 'discipline', have tended to oppose their projects to scientists' 'science history'.[2] For instance, Thomas Kuhn (1962) famously opened his book on *The Structure of Scientific Revolutions* with a chapter on "A Role for History". His critique of scientists' cumulative accounts of progress in science provided the contrastive foil for his historiography. Though Kuhn's 'paradigm shifts' have made it into common language, the general critique of linear accounts of histories of progress towards truth seems today to be no less pertinent than in the 1960s. With respect to the *Science* news quote, with which I opened this paper, one may ask: What exactly is "uncovered" when a patient that Alois Alzheimer diagnosed, posthumously, with

[1] In general, medical publications pseudonymise or abbreviate patients' names to ensure medical confidentiality. The full names of Auguste D and Johann F have, however, been used in books and articles, exhibitions, and even in the Wikipedia, and are, therefore, given here, too. On broader ramifications of masking a patient's identity versus providing his or her name when working with these and other psychiatric sources, see Keuck (2016).

[2] The opposition of 'historians' and 'scientists' should not obscure the pluralism of historiographical approaches both among historians and among scientists or physicians (see Brush 1995; Huisman and Warner 2004). Furthermore, many historians and philosophers of science, including Thomas Kuhn, started their careers as scientists. On notions of 'science history', see Debus (1971) and Brush (1995). They are closely related to notions of history of disease and retrospective diagnosis; see Latour (2000) and Cunningham (2012) on this topic. For an overview of different ways in which histories of disease are written, many of which crisscross the junction between 'medical history' and 'history of medicine', see Jackson (2017); see also Labisch's account of "history *in* medicine" as referring to the "self-reflection on the conditions of medical knowledge and practical medical action in the special light of their change over time" in order to help "solve current medical problems" (Labisch 2004, p. 424).

'Alzheimersche Krankheit' in 1911, is diagnosed with 'Alzheimer's disease' almost a century later? This seems to be a case for Georges Canguilhem's (1968) critique of scientists' amateurish approach to the history of science that mistakes terms (in our case: "Alzheimer's disease") with concepts (what the term in question meant in the 1910s, and in the 1990s, respectively). Canguilhem used scientists' accounts of history to characterise how his epistemological history differed from a naïve form of 'science history' that looks for precursors, and that conflates the object of the science with the object of the history of the science (see Rheinberger 2010; see also Rees 2016). Historians who are interested in understanding the past in its own right, may legitimately ask: what can reassessments of brain slices from 1906, using diagnostic tools and disease classifications of the 1990s, contribute to a better understanding of what Alzheimer's disease meant in the context of Imperial German psychiatry?[3] Moreover, the celebratory picture that is drawn of Alois Alzheimer will remind many of the self-assuring, myth-building functions of anniversary volumes for a hero-made-founder-of-a-scientific-school (see Abir-Am 1982). While it is still important to challenge the historical significance of such 'science histories', critical objections alone tell us little about what kind of questions the involved scientists hope to answer when they venture into the past.

This way of looking at science history implies to ask how the participating researchers themselves conceptualise history. In this respect, my paper owes a lot to critical analyses of the use of genetics and genomics for creating narratives about the past and using these for contemporary identity politics.[4] Marianne Sommer (2010, 2016) has applied the term "history *within*" to point to the use of genes as "historical documents", and of DNA as an "archive of history". Sommer's work contributes to histories of knowledge about the uses and conceptions of 'history' in the life sciences. This paper likewise aims to do so. As such, it does not evaluate the researchers' claims about biomedical history as 'proper' historical ones, but asks how their 'results' have been applied within the context of the genesis of biomedical facts about Alzheimer's disease.[5] An important disclaimer is necessary here: not every use of the terms 'history' and 'historical' will appeal to academic historians, and some might even seem the contrary of what historians understand to be their field and method of study.[6] Yet the very nature of my approach implies that it aims to carve out the uses of 'history' as the involved actors comprehend this term, and not as historians do. Thus it is noteworthy, for example, that the biomedical researchers under scrutiny here used old materials, in particular the conserved brain

[3] For an introduction into Imperial German psychiatry, see Engstrom (2003). For the role of the different types of psychiatric institutions in Frankfurt and Munich, in which Alois Alzheimer worked, while diagnosing and posthumously examining the case of Auguste Deter, see Engstrom (2007).

[4] See, for instance, Wailoo and Pemberton (2006), and Schramm et al. (2012).

[5] 'Biomedical facts' hints at Fleck's (1979 [1935]) *Genesis and Development of a Scientific Fact*, and his famous argument that a scientific fact has to be articulated within the contemporary thought style of a given scientific community in order to become accepted.

[6] Thus, science history is often accused of presentism and whiggishness. Brush (1995, p. 220) distinguishes between presentism and whig history as follows: "The present-minded historian asks questions about the past inspired by concerns of the present; the whig historian gives answers that are distorted by those concerns". The notion of a Whig interpretation of history draws on Butterfield (1931). For an overview on various notions of presentism in history, see Moro-Abadía (2009).

slices, and re-examined them as evidence for a 'correct' diagnosis of Alzheimer's disease.[7] They approached these objects as cherished historical artefacts of Alzheimer's microscopic laboratory. The preparations of Auguste Deter's brain not only serve as a "relic" for the Alzheimer community (see Keuck 2016), but also reflect the advanced technical skills that allowed for the fact that the samples endured for decades. The conservation of the brain slices was the precondition to incorporate the old histological slides into new research environments, where they were no longer treated as artefacts that represent techno-scientific expertise, but as biological material that can be empirically studied to analyse a past pathological process. This dual approach to old objects as historical artefacts and products of nature shows similarities to archaeological reasoning through material evidence, though the critical reflection on the underlying presuppositions in the biomedical case might arguably be not as developed as in the field of archaeology, for which practices of gaining insights about the distant past through an examination of material remains are fundamental.[8] Yet, archaeologists' approaches to the past seem in general more compatible to those of the biomedical researchers than to those of many historians' (though some historical approaches, for instance in environmental history, seem less remote).

Though one might debate, against this background, how 'humanistic' the examined biomedical practices actually are, this paper drew nonetheless inspiration from recent work in the history of science on humanistic practices in the sciences, for instance on collecting and re-studying type specimens in botany, or historical meteorological records in climate science. Lorraine Daston looked at these (and other) examples to elucidate what she called the 'sciences of the archive' and the use of 'history *in* science' (Daston 2012, 2017). The important point for her is that the sciences occupied and used places usually associated with the humanities, in particular the library and the archive. In a different vein, focusing more on pedagogical uses of history in biology, Jeffrey Skopek argued that we must rethink the ways in which the historical and the scientific can intertwine. Genetics textbooks of the 1920s created a "virtual historical environment, a reconstruction of the past in which the student was socialized, developing the tacit skills needed to see, discriminate and evaluate with the geneticists' approach" (Skopek 2011, p. 218). Interestingly, Skopek also looked at botany textbooks from the 1920s, where historical accounts were cancelled out, because they were considered irrelevant for learning plant anatomy. The big differences concerning the evaluation of the usefulness of 'history' for learning something about genetics and botany in the 1920s lead me to a second disclaimer, which concerns the representativeness of my

[7] Like other material things, microscope slides can also be scrutinised as sources in 'proper' historical studies, e.g. for understanding how the slides were used, stored, and presented in the past (see Löwy 2011b, 2013). Bettina Bock von Wülfingen (2017) examines how neuropathological collections were organised in the late nineteenth and early twentieth century. She emphasises that the historical labelling and note-keeping practices form a central precondition for 'reactivating' old histological preparations, including the slides of the Alzheimer cases that Manuel Graeber rediscovered and reassessed.

[8] See Chapman and Wylie (2015, 2016) for in-depth analyses of how archaeologists use material remains as repositories of evidence. I want to thank an anonymous reviewer for pointing me to the comparison of my case study to archaeology.

analysis. The rediscovery and reassessment of the material remains of the first cases of Alzheimer's disease is, of course, not the only incident in which 'history' *in* the contemporary biomedical sciences has been put to work. It is, however, the only case study on which my taxonomic framework of 'history as a biomedical matter' is based. Therefore, this paper neither provides an answer to the question of the extent to which the framework is generalisable, nor does it analyse in a systematic comparative manner how biomedical uses of 'history' overlap with and differ from other ways of (medical) knowing in the past and present.[9]

For sure, also in medicine, the compiling of archives, as well as the possibility to go back to old cases and to re-align them with new ones to form entire series, have been central epistemic practices since the early modern period (see Pomata 2005; Hess and Mendelsohn 2010). The travelling and reassessment of patient documents through time might therefore seem rather familiar to physicians. What is interesting in the present case, however, is that the rediscovery and reassessment of old brain slices are also considered to elucidate the natural history of Alzheimer's disease in a similar manner as, for instance, recent re-examinations of patterns of past outbreaks of plague. With respect to "patterns of plague", Samuel Cohn has argued for a close collaboration between historians and biological scientists to address questions such as: "Did the general disappearance of pneumonic plague from Western Europe around 1400 or before depend on an adaptation between pathogen and the host, or was it the consequence of a genetic mutation?", for which he provided the outlook that "[p]erhaps later genetic analysis with specifically dated plague pits might be able to unravel this enigma" (Cohn 2017, p. 171). The motivation to analyse old bodily remains as newly discovered scientific objects (thereby also putting the question aside whether one is allowed to experiment with these human remains), is here to understand, first, the biological underpinnings of what a given disease was when it was first diagnosed as such, and, second, the question of how these underpinnings relate to the biology of newer diagnoses.

This approach to "settling an issue" or "unravelling an enigma" of the past with the help of present-day biomedical concepts and methods can be elucidated by Bruno Latour's analysis of anachronistic, retrospective diagnoses. He argued that we can only make sense of the modern re-diagnosis of tuberculosis as the cause of the death of Ramses II, 3000 years ago, if we acknowledge "the expense at which it is possible for us to think of the extension in space of Koch's bacillus, discovered (or invented, or made up, or socially constructed) in 1882" (Latour 2000, p. 248). This expense includes the work, institutions, instruments, and materials that were necessary to diagnose the mummy with modern means. For Latour, a Whig interpretation of history is characterised by the fact that it ignores the labour (being itself embedded in a particular context and time) that is necessary to apply present-day knowledge to objects of another time. In the case of the rediscovery of the histological slides of the acclaimed first cases of Alzheimer's disease, the translation from Alois Alzheimer's histological descriptions of senile plaques to present-day molecular understandings of amyloid plaques as hallmarks of the disease may be

[9] On medical ways of knowing, see Ilana Löwy (2011a) who draws on Pickstone's (2000) *Ways of Knowing*.

less incommensurable than the translation of the Egyptian term "Saodowaoth" to tuberculosis. Yet, the molecular genetic assessment of some of the brain preparations that was carried out in order to identify the genetic mutation of the patients who died decades ago, involved similar processes of labour-intensive practices as in the case of Ramses II; in our case, this included the ultimate destruction of some of the cherished histological slides as they were dissolved in the process of gaining material for the molecular assessment (see Graeber and Mehraein 1999; Müller, Winter and Graeber 2013; Rupp et al. 2014).

The following section reconstructs the work involved in the rediscovery and reassessment of Alzheimer's original cases. It focuses on the accounts of the protagonists of the two teams who launched searches (or, as journalist Enserink put it, a competitive "hunt") for the material remains of Auguste D and Johann F: Professor of psychiatry Konrad Maurer in Frankfurt, and neuropathologist Manuel Graeber in Munich.

3 The rediscovery of Alzheimer's cases

The rediscoverers of the patient documents and histological slides of the first described cases of Alzheimer's disease did not aim to obscure the labour-intensiveness of their endeavour. On the contrary, Maurer and Graeber repeatedly narrated the difficulties they encountered in the different steps of their re-search that started in the early 1990s (Graeber 1999; Maurer et al. 1999; Maurer 2006). First, searching the original publications of Alzheimer and his colleagues for names and other identifiers of the patients in order to know what to look for: in the medical publications, biographical data such as the age of patients were often included, but their names were presented in abbreviated form, as in the case of 'Auguste D'. Second, getting acquainted with medical paper tools of the 1900s, and finding them: the patient files from the psychiatric hospital in Frankfurt am Main, where Auguste Deter was brought to in November 1901 and stayed until her death in 1906, and where Alzheimer worked until 1902, were no longer housed in a proper archive. Instead, the file was finally found in the attic of the Frankfurt hospital building. In Munich, where Alzheimer headed the microscopic laboratory in the Royal Psychiatric Clinic of the University from 1903 to 1912, and where the sectioning and preparation of the brains of Auguste Deter and Johann Feigl took place, patient files from this time are lost. The admission books, one-page epicritical reports (comprising a short summary of each patient's case), and autopsy books were, however, archived. They allowed to trace the movement of patients and their bodily remains through the Munich hospital. The histological slides travelled in the 1980s to yet another place, the cellar of the Institute for Neuropathology, where they were unsystematically stored, but could be finally identified since every slide bore the last name of the respective patient (see also Bock von Wülfingen 2017). Third, once documents and slides were found, and the way in which they were ordered and referred to each other was understood, the handwriting needed to be deciphered, and the content of the paper traces as well as the microscopic images had to be compared with the wording and illustrations in Alzheimer's original publications.

The rediscoverers needed to make sure that they had found the right material, and that they could exclude both, intentional acts of fraud and involuntary mistakes. Finally, the slides for genetic analysis had to be selected, and processed according to the available protocols.

The whole process of rediscovery took several years from the beginning of the searches around 1992 to the publication of their first findings in 1997 and 1998. Both protagonists of this enterprise, Konrad Maurer in Frankfurt, and Manuel Graeber in Munich, described how their interest in Alzheimer's life and work, and their pursuit for the original medical records and histological preparations, began as side issues to their actual scientific research and medical practice. In the course of their endeavours, however, they not only drew more and more lines between their academic positions in psychiatry or neuropathology and what they saw as Alzheimer's legacy, but also presented their reassessments as important achievements in their career and for the Alzheimer community.

Since the 1980s, Konrad Maurer, now an emeritus professor of psychiatry, has collected together with his wife Ulrike, a former editor, all kinds of historical materials referring to Alois Alzheimer—ranging from Alzheimer's personnel records from the Munich clinic to the embroidery work of Alzheimer's sister. These are partly displayed in the Alzheimer museum in Alzheimer's birthplace in the small town of Marktbreit in Bavaria, and partly kept in Maurers' private estate. While being professor of psychiatry in the nearby city of Würzburg from 1983 to 1993, Konrad Maurer searched together with Ulrike Maurer for the former house of the Alzheimer family in Marktbreit. In 1994, when Konrad Maurer was already director of the Department for Psychiatry, Psychosomatic Medicine and Psychotherapy of the University Hospital in Frankfurt am Main—the successor institution to the one where Alois Alzheimer had practiced and first encountered Auguste Deter in 1901—Maurer convinced the pharmaceutical company Eli Lilly to buy the house and let his wife turn it into a museum and conference hall. The rediscovery of the patient file of Auguste Deter was not only featured in the "News & Comment" section of *Science* (O'Brien 1996), and in a paper Maurer and colleagues published in *The Lancet*, but also formed the basis for Konrad and Ulrike Maurer's popular science book on the life and work of Alzheimer (Maurer and Maurer 1998, translated into English as Maurer and Maurer 2003). Mr and Mrs Maurer themselves refer to their interest in Alzheimer as 'a life task' (*eine Lebensaufgabe*).[10]

The second protagonist, Manuel Graeber, currently professor of neuropathology at Sydney University, worked at the Institute of Neuropathology at the University of Munich from 1992 to 1996, and headed from 1996 to 1999 the Molecular Neuropathology Laboratory in the Department of Neuromorphology (directed by Georg Kreutzberg) at the Max Planck Institute for Neurobiology in Munich.[11] For

[10] Interview with Konrad and Ulrike Maurer, conducted by L.K., 31 July 2014.

[11] The Max Planck Institute of Neurobiology used to form the theoretical section of the Max Planck Institute of Psychiatry. It moved to the new campus in Martinsried in 1984, and achieved an independent status in 1998 (https://www.neuro.mpg.de/2341/history, accessed 9 February 2016). Georg Kreutzberg became a director of the Max Planck Institute of Psychiatry in 1979, and founded the Department of Neuromorphology in 1984 (https://www.neuro.mpg.de/kreutzberg/de, accessed 9 February 2016).

Graeber, too, Alzheimer has played an important role, though in a different way than for Maurer. In his appreciation of Alois Alzheimer in the *History of Neuroscience Series* of the International Brain Research Organization (IBRO) Graeber argues that

> [t]hrough his early histopathological research in psychiatry, Alzheimer became one of the founding fathers of neuropathology, nurturing a unique brain research tradition in Germany that lasted for almost a century

adding in a footnote:

> This tradition has become known as the 'Munich School of Neuropathology'. Nissl, Alzheimer and Spielmeyer are credited for its creation (Spatz 1961). It ended with the closure of Georg Kreutzberg's Department at the Max-Planck-Institute of Neurobiology in 2000; for additional historical information see Graeber 1999.[12]

Maurer and Graeber's accounts frequently mention the places of the (re-)discovery of the first Alzheimer cases, Frankfurt am Main and Munich. This needs to be contextualised with respect to the German Max Planck Society with its particular impact on discipline dynamics due to the 'Harnack principle' (the principle that the thematic and methodological orientation of a Max Planck Department is subject to the respective director's choice and hence changes after his or her retirement). Moreover, Alois Alzheimer (who was married to a Jewish woman, and who died in 1915) seems to be a comfortable candidate for an unburdened founding figure in neuropathologically-inclined psychiatry. This allows neuropathologists to place themselves in a longer tradition and to speak about advantages of storing and studying brain samples. At the same time, they avoid to directly address continuities with research in National Socialist Germany, including, in particular, the acquisition and archiving of anatomical collections from 'euthanised' patients (see, e.g., Weindling 2012; Roelcke et al. 2014; Hildebrandt 2016).

The circulation of Alzheimer's histological slides, and their changing status as diagnostic evidence in 1906–1910, as storage in the attic for many decades, and as rediscovered precious object in the 1990s, illustrates the disciplinary development of neuropathology in Germany, and the ambivalent relationship of neuropathologists to old anatomical collections. Graeber rediscovered the microscope slides in an institute that was only founded in 1965, the Institute of Neuropathology in Munich. The preparations had not been used for almost 90 years, but had moved from Alois Alzheimer's microscopic laboratory at the Royal Psychiatric Clinic at Munich in Nußbaumstraße 7 to the places where his (self-)acclaimed successors of "The Munich School of Neuropathology" had worked: to the *Deutsche Forschungsanstalt für Psychiatrie (DFA)*, founded in 1917, which became the Max Planck Institute for Psychiatry in 1966, and, in the late 1980s, to the Institute of Neuropathology of the Ludwig Maximilians University of Munich. Graeber (1999)

[12] Graeber (2003, p. 1). The article closes with the following dedication: "I would like to dedicate this article to Professor Georg W. Kreutzberg, Munich, and to the memory of the 'Munich School of Neuropathology'" (Graeber 2003, p. 7).

recounts that the Psychiatric University Clinic or the Max Planck Institute of Psychiatry "cleaned out" old materials in the 1980s, and "without the interest" of Neuropathology Professor Parviz Mehraein "the sections would most likely have been lost" (Graeber 1999, p. 239). He framed the personal involvement in the keeping of, and searching for, these brain sections as an essential part of this, in the literal, affective sense, *amateur* 'science history': the appreciation of, and self-identification with, a certain scientific tradition played a central role for the maintenance of old documents and objects. The microscope slides were kept because they came from certain laboratories. Alzheimer's preparations of the brains of Auguste Deter and Johann Feigl had thus "travelled anonymously" to the institute, where they were "adopt[ed] for conservation purposes" by former DFA disciple, Professor Parviz Mehraein (Graeber 1999, p. 239). The reason why Alzheimer's sections (more than 400 in total) were eventually looked up within the large amount of stored preparatory boxes was, however, because of what they contained, namely the bodily remains of the first patients supposedly presenting cases of Alzheimer's disease. The laborious rediscovery was at the same time marked as a courtesy to the community of Alzheimer researchers and neuropathologists, and as being fuelled by the increasing media coverage of Alzheimer's disease as both an icon of the fear of loosing one's self, and as a public health problem for which a biomedical intervention was needed.[13] Manuel Graeber wrote in a letter in 1992: "With public interest in Alzheimer's disease growing, I personally think that funds should be made available in the future" for the search for the original cases (Graeber 2003, p. 239). Indeed, he received funding from the German Research Foundation (Graeber et al. 1997, p. 79). These impact-generating aspects motivated the rediscoverers, and surely mattered for the editors of *The Lancet* or *Science*, both journals that address a broad scientifically-literate audience, to report on the findings.

Both Maurer and Graeber thus engaged themselves not only in the scientific reassessment of Alzheimer's original cases, but also in the self-historisation of their own contributions to the rediscovery of these cases, and in popularizing the historical role of Alois Alzheimer. This is reflected in four kinds of publications about the historical material that each of them published:

1. scientific papers documenting the rediscovered medical records and brain samples of the cases Alzheimer described in 1906 and 1911 (Maurer et al.1997; Graeber et al. 1997; Graeber and Mehraein 1999; Möller and Graeber 1998);

[13] For a contemporary critique of these developments within medicine, see social gerontologist Tom Kitwood (1997), who coined the phrase "Alzheimerization of dementia" and blamed the strong attention for the biomedical underpinnings of the concept of Alzheimer's disease for misleading therapeutic approaches to disregard the individual patient. In a similar vein, though originally being himself heavily involved in biomedical research on Alzheimer's disease, neurologist Peter Whitehouse spoke of the making of "a disease of the century" that was "worthy of massive research efforts", and that was actively marketed to journalists and politicians, noting that the "aggressive medicalization of brain aging" was accompanied with "military metaphors" and popular references to the fear that, as Alzheimer's patients, we might "lose ourselves" (Whitehouse and George 2008, pp. 91–109).

2. scientific papers on molecular genetic reassessments of the brain samples looking for disease-associated mutations (Graeber and Mehraein 1999; Müller et al. 2011, 2013; Rupp et al. 2014);
3. reports on how searches for the historical materials were pursued (Graeber 1999; Maurer et al.1999; Maurer 2006), and
4. popular historical accounts of Alois Alzheimer's life and work (Maurer and Maurer 1998; Graeber 2003).

The self-reports of the rediscoverers stress that it was the increasing scientific *and* popular interest in Alzheimer's disease that motivated their searches in the first place. While Alzheimer's disease was rarely diagnosed until the mid 1970s, it has since then gained ever more attention as "a major killer" in ageing societies—as one of the most prominent figures in Alzheimer research, then New York-based neurologist and later co-founder of the Alzheimer's Disease and Related Disorders Association (ADRDA), Robert Katzman put it in an editorial of the *Archives in Neurology* in 1976.[14] A side issue of the huge increase in public awareness of 'Alzheimer's' following the massive research funding and the changing diagnostic criteria in the classification of the disease, was the emerging interest of journalists, psychiatrists, public health officials, and biomedical researchers in the early history of Alzheimer's disease. In 1987, Katherine Bick, then at the National Institute of Mental Health and another important figure in the founding of the ADRDA, neurologist Luigi Amaducci, and pharmacologist Giancarlo Pepeu, translated the first descriptions of Alzheimer's disease into English (Bick et al. 1987).[15] Amaducci and Bick were also proponents of the hypothesis that the first case that Alois Alzheimer had described in 1906 was not suffering from Alzheimer's disease but from metachromatic leukodystrophy (Amaducci et al. 1991).[16] Maurer and Graeber sought to challenge this hypothesis. Maurer hoped "to corroborate Alzheimer's findings" (Maurer et al. 1997, p. 1549). Graeber recalled that his search was initiated by an enthusiastic colleague from Japan, Kohshiro Fujisawa, who wanted to "go back and look into those brains and rediscover what he [Alzheimer] had thought he discovered therein" (letter from Fujisawa to Graeber, 11 December 1992, quoted after Graeber 1999, p. 239). All interested researchers who partook in

[14] Katzman (1976). The major classification systems of diseases and mental disorders, the *International Statistical Classification of Diseases and Related Health Problems* and the *Diagnostic and Statistical Manual of Mental Disorders*, officially omitted the 'pre-senility' criterion in the early 1990s. The taxonomic changes mirrored the change in meaning of 'senility' or 'old age': while considered an exclusion criterion in the mid-century, old age is nowadays regarded as the major risk factor for Alzheimer's disease (see, e.g., Ballenger 2006; Keuck 2011; Lock 2013).

[15] An English translation of the first case report of Alzheimer's disease appeared already in 1912, but was subsequently forgotten (Fuller 1912; see also Bick 1994; Hamann 1997). Another one by Robert Wilkens and Irwin Brody was published under the rubric "Neurological Classics" in *Archives of Neurology* in 1969 (Wilkens and Brody 1969).

[16] In an edited volume of proceedings from a symposium that took place in Alzheimer's birthplace Marktbreit in 1997, featuring Konrad Maurer, Manuel Graeber, and Luigi Amaducci amongst others, the editors write about Amaducci's hypothesis: "Though Amaducci did not persuade many of his colleagues on this point, his argument was plausible enough that it had to be reckoned with. (…) Sadly, Amaducci did not live long enough to see the discovery of the original slides of Auguste D.'s brain tissue prepared by Alzheimer" (Whitehouse et al. 2000, p. 17).

the re-diagnosis of Auguste D's disease took as their starting points a handful of publications, in which Alzheimer's disease was first publicly discussed as such, most importantly two contributions of Alois Alzheimer, and a textbook entry of Emil Kraepelin (1856–1926).

In 1910, Kraepelin, director of the Royal Psychiatric University Clinic in Munich (*Königlich Psychiatrische Universitätsklinik*), introduced the eponym 'Alzheimer's disease' (*Alzheimers Krankheit, Alzheimersche Krankheit*) in the eighth edition of his influential textbook on clinical psychiatry, stating that

> Alzheimer described a peculiar group of cases with very severe cellular changes. These cases involve the slow development of an immensely severe lingering mental illness with the blurred symptoms of an organic brain disease.[17]

Psychiatrist-neuropathologist Alois Alzheimer ran his microscopy laboratory in Kraepelin's clinic from 1903 through 1912. In 1906, at a meeting of psychiatrists in Tübingen, Alzheimer presented a 'peculiar case' of a woman in her early 50s (published as Alzheimer 1907). In an article published in 1911, he presented his 1906 talk as the first description of the disease that had by then been named after him:

> In the year 1906, I described a case of a disease of the presenile age that presented during the patient's life a picture that differed from all known diseases and that showed cortical differences in the microscopic examination that were unknown at that time.[18]

In the same 1911 paper, Alzheimer discussed in length the clinical assessment and microscopic findings of a 56-year old male patient whom he referred to as Johann F. The patient presented severe, progressive symptoms of mental deterioration and a massive occurrence of plaques in the brain cortex (Alzheimer 1911).

Besides Kraepelin's textbook definition of Alzheimer's disease and Alzheimer's discussions of two cases, particular attention was given to an article of Alzheimer's co-worker, Gaetano Perusini (1879–1915), who presented in 1909 a clinical and histological discussion of a series of four cases, one of which was the same (that of "Auguste D") that Alzheimer had spoken about in 1906 (Perusini 1910; see also Berrios 1990, p. 361, for a table with all published cases of Alzheimer's disease between 1907 and 1912). Space does not permit to survey in this paper the mostly very uncritical and decontextualised ways in which the history of the discovery of Alzheimer's disease has been told. What should be noted, however, is that none of the involved psychiatrists of the early twentieth century provided clear-cut

[17] "Eine eigentümliche Gruppe von Fällen mit sehr schweren Zellveränderungen hat *Alzheimer* beschrieben. Es handelt sich um die *langsame Entwicklung eines ungemein schweren geistigen Siechtums mit den verwaschenen Erscheinungen einer organischen Hirnerkrankung*." (Kraepelin 1910, p. 624, translation L.K., original emphasis spaced out).

[18] "Im Jahre 1906 habe ich einen Fall von Erkrankung des präsenilen Alters beschrieben, welcher während des Lebens ein von den bekannten Krankheiten abweichendes Bild bot und bei der mikroskopischen Untersuchung Veränderungen in der Hirnrinde aufwies, die damals noch unbekannt waren." (Alzheimer 1911, p. 356, translation L.K.).

definitions of Alzheimer's disease. Even in their publications, Kraepelin (1910) and Alzheimer (1911) left it explicitly open whether the "peculiar cases," as they called them, should be considered as atypical forms of senile dementia, rather than as exemplars of a specific, not formerly classified disease. Around 1910, Alzheimer's disease was a category that was thought about, and that was tentatively applied in Kraepelin's clinic, but that was not sharply defined. Whether Alzheimer and Kraepelin had described a 'new disease' remained up for discussion, even for themselves.

In the context of the rediscovery, the issue whether these early cases should be considered instances of Alzheimer's disease, was to be settled through the identification of the original materials and their reassessment. The historical descriptions by Alzheimer, Perusini and Kraepelin were foremost treated as wanted lists for patient documents and histological slides. This becomes clear in the protagonists' own accounts of the story of their searches (e.g., Graeber 1999; Maurer 2006). Konrad Maurer, who published together with two colleagues in 1997 their discovery of the original patient record of Auguste D's case, pointed to Perusini's 1910 paper for the "initials of the surname, the complete Christian name, and the profession of her husband (…) ('D. Auguste, wife of an office clerk, aged 51 1/2 years')" (Maurer et al. 1997; Maurer 2006, p. 29). Manuel Graeber (1999), who retrieved and reassessed together with colleagues the original brain samples of Auguste Deter and Johann Feigl referred to his search as "detective work".[19] This brings us to the question of how the involved researchers conceptualised 'history'.

4 Six ways of conceptualising history as a biomedical matter

To approach the re-uses of historical patient records as resources for current biomedical research, this section introduces a tentative taxonomy that elucidates six ways of conceptualizing history as a biomedical matter in the examined case study. It exemplifies in turn (Sect. 4.1.1.) *scientific assessments of the past*, i.e. natural scientific understandings of 'historical facts'; (Sect. 4.1.2.) *history in biomedicine*, e.g. uses of old histological collections for present-day brain banks; (Sect. 4.2.1.) *provenance research*, e.g. applying historical methods to ensure the authenticity of brain samples; (Sect. 4.2.2.) *technical biomedical history*, e.g. reproducing original staining techniques to identify how old histological slides were made; (Sect. 4.3.1.) *founding traditions*, i.e. references to historical objects and persons within founding stories of scientific communities of neuropathologists and Alzheimer researchers; and (Sect. 4.3.2.) *priority debates*, e.g. evaluating the role particular persons played in the discovery of a disease such as Alzheimer's.

The six ways of conceptualising history as a biomedical matter fall into three broader categories: (Sect. 4.1.) the biomedical use of old documents and objects, that is, of *materials* that historians would treat as sources; (Sect. 4.2.) applying

[19] "Special funding will be necessary, however, since a pertinent search seems likely to take not only months but years of detective work." (Graeber 1999, p. 239, quoting his letter, dated 17 November 1992, to Henry de F. Webster, then Chief of the Laboratory of Experimental Neuropathology at the National Institutes of Health in Bethesda, Maryland).

specific, rather technical, or archaeological-criminological, methods that could be conceived as auxiliary historical *methods*; and (Sect. 4.3.) using, writing, and making own historical *narratives*.

Most certainly, this classification is not complete. In particular, due to this paper's primary focus on scientific publications, biomedical uses of 'history' for educational purposes, for the popularization of knowledge about Alzheimer's disease (including popular novels, radio, television and theatre shows about Alzheimer's discovery), and disease awareness campaigns, all fields in which the rediscovery of the first cases have been featured prominently, are not examined here.

4.1 Reuse of old materials

Scientific assessments of the past and *history in biomedicine* represent strategies of provisioning old materials as legitimate and valuable objects of research for the current biomedical community. When reused in scientific settings, histological slides are treated in their function as having conserved biological material, and as such a direct rendering of the disease, over time. Their character as an historical artefact is only relevant in so far as the historicity of the specific case was a selection criterion to examine these old preparations (and not others).

4.1.1 Scientific assessments of the past

'Scientific assessments of the past' emphasises the use of new technologies in retrospective diagnosis. The extraction and analysis of DNA from the conserved brain slices as well as the diagnostic re-evaluation of the original patient file and histological slides to "corroborate Alzheimer's findings" (Maurer et al. 1997, p. 1549) corporate the alleged scientific authority of present-day diagnostic tool-kits. When the rediscoverers looked through their new microscopes, and applied the diagnostic thinking of their own times, they treated the patient in question as if she had lived and died not 90 years ago but just yesterday. This procedure relies on two preconditions, first, that the slides have been "meticulously conserved" (Enserink 1998, p. 2037) so that they can provide the material basis for retrospective diagnosis, and, second, that diagnostic criteria and biomedical technologies are universally applicable tools. This approach towards the past is also exemplified by Latour's Ramses II case, and Marianne Sommer's "history within", in so far as the historical material is treated as a source not for understanding how the identity of a disease was conceived of in the past, i.e. to study a historical question, but for settling an ontological issue: did Auguste Deter and Johann Feigl *really* suffer from Alzheimer's disease? In their papers, Maurer and Graeber address this question, thereby refuting the alternative hypothesis that the 'first case' was *actually* a case of metachromatic leukodystrophy (Amaducci et al. 1991). Scientific assessments of the past want to solve a 'historical' question (did Ramses II die of tuberculosis? Did Auguste D suffer from Alzheimer's disease?) in the sense of 'what really happened in terms of today's understanding of reality'. Put more drastically, such approaches might be regarded as an erasure of historical differences between conceptions of

reality in the present and the past (see also Canguilhem 1968). Scientific reassessments of old materials allow, however, or precisely therefore, to treat material evidence of the past as a contribution to present-day debates, for instance with regard to the question where a proper line of demarcation between forms or kinds of diseases has to be drawn.

Scientific realism and materialism guide such a notion of the history of a disease as something that can be "uncovered" by "hunting" (*ibid.*) for a brain. In this conception of 'history', the patient's brain exhibits the materiality of the disease, and, as such, can be re-examined outside of its original context to inquire whether it shows the hallmarks of the disease, amyloid plaques and neurofibrillary tangles, as understood at a given point in time.

4.1.2 History in biomedicine

A second strand that runs through the "uncovering" endeavours of science history, is what has been called "history *in* science" (Daston 2012, p. 159, her emphasis) in order to point out different kinds of historical consciousness within the sciences that, for instance, turn to archives of data and type specimens to answer new research questions.

Indeed, the material and textual preparations of the early cases of Alzheimer's disease have not only been treated as dead museum objects that serve as dusty witnesses of former times. They have been worked on, and worked with, since their rediscovery in the mid-1990s. Moreover, the reassessment of the brain samples was used to stress the value of saving, archiving, and working with material remains of old, well-described and well-conserved cases within current research. In this context, Graeber argued that

> archived, well-studied brain tissue will become an important resource in studying the relationship between known genetic defects and disease symptoms. …and many of them are old. (quoted in Enserink 1998, p. 2037)

Here, the original Alzheimer cases serve as prominent exemplars for the multitude of old brain samples that still need to be saved from decay, to be archived, and to be reassessed. The identification of the genetic alterations of the Alzheimer cases represent potential 'proofs of principle' that old brain samples in new brain banks could provide many insights of value for future biomedical research.[20] While this instance of 'history in biomedicine' relies on 'scientific assessments of the past', it makes a broader claim about the usefulness of old samples for new research that extends the focus of settling a particular diagnostic issue through a genetic reassessment of the respective brain slices. The exemplary evidence of the past ("first Alzheimer's diagnosis confirmed") becomes here a research resource side-by-side with thousands of other, in principle no less important, archived brain tissues from deceased patients.

[20] For a brief history on brain banks, see Gere (2005).

4.2 Methods of authentication

The next two paragraphs move from strategies of mobilising the past for the present to the question of ensuring originality and authenticity. *Provenance research* and *technical biomedical history* represent two different strategies of authenticating the historical origin of the object in question. Both methods of authentication treat the histological slides as preparations that carry traces of their production, which can be examined empirically.

4.2.1 Provenance research

The scientific authority of present-day tool-kits is complemented with a certain set of historical methods in order to uncover the *provenance* of the studied material—a concern known from fields as diverse as art history, archaeology, genetic history, epidemiology and criminology. Provenance research inquires into the origin and ownership of an object. This can mean to trace how a work of art travelled from its creator to different owners, or to examine from which region an archaeological artefact came, or to search for 'founder' or 'index cases' of hereditary or infectious diseases.[21] With respect to provenance research in genetic medicine, Susan Lindee (2005) differentiated between biological and intellectual ownership. Biological ownership indicates that "[e]very [blood] sample belonged to a certain person, and that person's identity was specified in some form in the textual record built around the blood sample" (Lindee 2005, p. 58). Intellectual ownership is "a way of characterizing the experience of knowing something: just as blood came from specific persons, so too did data, evidence, and interpretation" (*ibid*.). In our case, the biological and intellectual ownership of the brain preparations was addressed as interlaced questions. The aims of provenance research were here, first, to secure that the brain slices were (biologically) stemming from the patients that Alzheimer (intellectually) described. Therefore, the researchers studied the historical publications of Alzheimer and Perusini to know what to look for, and to retrieve the matching patient records in relevant archives. The old admission record provided, according to Graeber, the "missing link" that connected the published case, which noted the first name and the first letter of the last name of the patient ("Johann F."), with histological preparations that only carried the full last name "Feigl" on it (see Graeber et al. 1997, p. 78). With respect to the other case, that of Auguste Deter, the *Science* journalist Martin Enserink quoted Manuel Graeber saying that

> [t]here is no doubt about the brain's authenticity […]: The arrival at Alzheimer's clinic was recorded in the hospital's autopsy book, and every single slide is labelled with Auguste's last name—a very rare one in Germany. (Enserink 1998, p. 2037)

[21] Lindee's (2005, pp. 58–89) chapter on 'Provenance and the Pedigree' examines Victor McKusick's field work on constructing the pedigree of the hereditary disease Ellis-van Creveld syndrome in Pennsylvania Amish in the early 1960s. This kind of 'provenanceprovenance research,' which aims to follow the transmission of a disease throughout generations, was also applied to trace founder cases of familiar forms of Alzheimer's disease in the 1990s (see Pollen 1993).

In a second step, the rediscoverers wanted to make sure that the preparations were indeed ninety years old to rule out the possibility of a fraud. To do so, they recruited external experts to examine the handwriting and the quality of the ink:

> In order to confirm the actual age of the tissue sections, a comparative analysis of the ink used to label them was performed by specialists from the Bavarian State Bureau of Criminal Investigation. (Graeber 1999, p. 240)

While historians of medicine have been interested in historical psychiatric records in order to reconstruct practices of book-keeping and the management of patients, Graeber and colleagues used these records to ensure, and prove to possible critics, that they were actually working with the right, original, authentic materials.

4.2.2 Technical biomedical history

Another proof of the authenticity of the preparations was to check the details of the staining technique that had been applied in their original production. This approach has some commonalities with technical art history, an interdisciplinary field of research that aims to reproduce how pieces of art have been made, for instance in employing old recipes to understand how pigments were produced and how colours looked like 500 years ago (see, e.g., Ainsworth 2005). In a similar way, Karin Stöltzing, the technical assistant of Graeber's neuropathology laboratory, approached the old histological preparations of Alzheimer. The method section of a paper by Graeber and colleagues states:

> Stains were identified by comparison with those from Alzheimer's case Johann F., and by means of reproductions of the original staining methods (manuscript in preparation). (Graeber et al. 1998, p. 226)

Unfortunately, the manuscript in preparation was never published, but the acknowledgement section of the same paper states:

> The excellent work performed by K[arin] Stöltzing in the verification of historical histological stains is gratefully acknowledged. Some reagents for these experiments which originally came from Walther Spielmeyer's laboratory were retrieved with the kind help of D. Büringer and G.W. Kreutzberg. (Graeber et al. 1998, p. 227)

In mentioning that some of the reagents came from Spielmeyer, the successor of Alzheimer in Munich, the historical experimentation gained an additional authority that granted its authenticity.[22] *Technical biomedical history* complements *provenance research* in so far as the first applies historical biomedical techniques to "verify" the authenticity of the stain, while the second applies present techniques for dating and authenticating the historical origin of the examined materials.

[22] Indeed, another way to frame 'technical biomedical history' would be to contextualise it as a form of historical experimentation (for an overview, see Chang 2011). Since the focus in the present case study was, however, not on the replication of an experiment but on the replication of a preparation, I think the analysed approach to history has more in common with technical art history than with historical experimentation.

4.3 Consolidating continuity

The (bio-)medical researchers' employment of historical materials and methods were accompanied by their strategies of showcasing 'science history' and making this history their own within *founding traditions* and *priority debates*. It is noticeable that the construction of a historical lineage is not, at least in the examined cases, regarded as a reflective task in the sense of carefully weighing words and discussing the chosen historiographical approach. Likewise, sources are not critically addressed in their historical context, but treated as providing evidence on their own.

4.3.1 Founding traditions

Section 3 already pointed out how Maurer and Graeber used their rediscoveries to articulate the academic lineages between Alzheimer and German Psychiatry, and in particular of Alzheimer and the 'Munich School of Neuropathology'. Founding narratives often stress 'generational' relationships between researchers to give research fields, approaches, projects or concepts historical depth. The assertion of a certain line of historical continuity (and omission of others) can serve as a way to legitimate present endeavours. The self-presentation of the Munich Brain Bank provides one such example of employing this strategy. Founded in 1990, it presents a photograph of 1910 on its website that displays Alois Alzheimer, Emil Kraepelin, Robert Gaupp and Franz Nissl on a boat trip on Lake Starnberg, as "The forerunners of the Munich Brain Bank".[23] The public awareness of Alzheimer's disease as well as the on-going use of Nissl's stain in histopathology, the significance of Kraepelin's taxonomy for historically-interested psychiatrists, and the reassessment of the brain samples of the first cases of Alzheimer's disease by Munich neuropathologists all figure in tying the present-day scientific community of brain-bankers within a particular scientific tradition.

One might be tempted to see the employment of straight lines of continuity between 'founding fathers' and present-day research communities as a mere rhetorical strategy to attract public awareness and funding for one's research. Indeed, the public information brochure of the *Neurobiobank München* (2015) uses an excerpt from Auguste Deter's patient file along with a picture of the rediscovered histological slides to showcase the work of Munich neuropathology, and to advertise its long scientific tradition, to which patients are invited to contribute through donating their brains after their death to the brain bank. Even so, it should not be underestimated how such founding stories form not only an external image, but also an internal ground for present-day scientists and medics from diverse backgrounds to conceptualise themselves as having at least common ancestors. The concluding section argues in a related way that the 'founder cases' Auguste D and Johann F provide an anchor to a shared starting point in the search for the moving, and

[23] http://www.brainnet-europe.org/index9ffc.html?option=com_content&view=article&id=19&Itemid=19, accessed 15 March 2017. The original photograph is on display at the exhibition of the history of the Munich psychiatric clinic.

fragmenting, target of Alzheimer's disease, and as such take up a consolidating role for the scattered community of Alzheimer researchers (geneticists, epidemiologists, neuroscientists, etc.) and doctors (neurologists, psychiatrists, gerontologists, etc.).

4.3.2 Priority debates

While founding traditions serve homogenising field-building functions as they allow the diverse community of Alzheimer researchers to employ common narratives about founding events and persons, priority debates represent the other side of the coin of scientists' own appropriations of 'their' history. In the case of the rediscovery of the first cases of Alzheimer's disease, the priority debates are small-scale and not divisive for the 'Alzheimer field'.[24] They revolve around the respective importance of Kraepelin or Perusini over Alzheimer, and the wish to give appropriate credit to other involved actors. With respect to the latter, Boston-based geriatrician Claus Hamann used the public interest surrounding Maurer's rediscovery of the patient file to publish a letter in *The Lancet* on

> the largely forgotten role of Dr Solomon Carter Fuller (1872–1953) who, in 1912, reported the tenth of a heterogeneous early group of cases called "Alzheimer's disease". […] Alzheimer had been in Munich for only 1–2 years when they collaborated, at a time when Auguste D was in the terminal stage of her illness in the Frankfurt asylum. (Hamann 1997, pp. 297–298)

Appraisal of such 'hidden local heroes' does not target the priority of discovery, but it might raise the question of why the case history of Auguste D should be more significant for understanding Alzheimer's disease than the diagnostic records of the group of cases described by Fuller. Neurologist Amaducci's hypothesis that Auguste Deter actually suffered from metachromatic leukodystrophy is a less subtle incidence of challenging the priority of Alzheimer's discovery, since it directly questions whether Alzheimer's description of Auguste D's case qualifies as first record of Alzheimer's disease or whether the acclaimed discovery was a misdiagnosis (Amaducci et al. 1991). As detailed above, Graeber and Maurer explicitly took issue with this hypothesis, and concluded in their reassessments of the rediscovered documents and microscope slides that Deter's case was no form of metachromatic leukodystrophy. Their 'confirmation' of Alzheimer's diagnosis stabilised the founding role of Alois Alzheimer and of the cases he described (see also Whitehouse et al. 2000).

[24] I would like to thank Kat Maxson for pointing me to priority debates as an additional way of using history writing within biomedicine. Her example was the recent "war" over the discovery of CRISPR-cas9, which makes the divisive aspects of priority debates much more tangible than the Alzheimer's case. In the CRISPR-cas9 "war", scientific prizes and patents are at stake, and "who claims them will be decided in part by what version of history becomes accepted as 'the truth'" (Comfort 2016, not paged).

5 Conclusion

In Section 1 of this paper I discussed the distinction between 'science history' and history of science, and pointed to Georges Canguilhem's characterisation of how his project of an epistemological history differs from the historical projects of scientists. He noted that scientists tended to engage in the search for early apologists of the "truth of today" when new understandings within their science emerged (which, from his conceptual point of view, had *no* linear history; see Canguilhem 1968, Rheinberger 2010). If we compare this to the Alzheimer case study, there is an important difference. Though the history of Alzheimer's disease is likewise addressed from a presentist point of view, the involved scientists not only read the past in present terms, but also looked into the past for guidance about what the present concept of Alzheimer's should capture, or, put differently, what the 'truth' of their history might be. As indicated in Section 3, the concept of Alzheimer's disease has been a moving target ever since its coming into being.[25] This has been particularly evident in the past four decades. While it was a rarely diagnosed form of pre-senile dementia in the middle of the last century, Alzheimer's began to be ranked among the ten most common causes of death in the United States from the 1980s onwards. The expansion of the classification and its tentative development into a catch-all category for processes of 'brain ageing' at large has not gone without notice, and has raised considerable debates within the scientific community of Alzheimer researchers, as medical anthropologist Margaret Lock (2013) traced in her ethnographic study of the "Alzheimer conundrum".

The debated validity and stability of the present-day category of Alzheimer's disease has figured within Maurer and Graeber's evaluation of the epistemic value of their reassessments of historical cases. In the previous section, we have seen how they applied toolkits from contemporary biomedicine like gene sequencing with the aim to cut across history and identify whether Auguste D *really* suffered from Alzheimer's disease and if so, due to which gene mutation. Vice versa, they also used the historical specimens to situate the contemporary understanding of Alzheimer's disease. A letter reacting to the rediscovery of the original medical record of the case of Auguste D illustrates the practice of re-reading the clinical records in search of evidence for contemporary biomedical hypotheses:

> One intriguing sentence in Alzheimer's handwritten notes, taken on Nov 26, 1901, the day after Auguste D was admitted to the Frankfurt hospital, describes the "considerably reduced muscular strength of her left side compared with the right side". Almost a century later, the significance of brain asymmetry in Alzheimer's disease is not fully understood, and often overlooked. […] Hopefully, by the time the brain sections of Auguste D are also found, we shall have more insight on the perplexing issue of brain asymmetry in Alzheimer's disease. (Gurwitz 1997, p. 298)

[25] I cannot discuss all of the reasons for the disease's concept being a moving target here. The notion of a mental disorder as a moving target draws on Ian Hacking's argument that classification in the human sciences works differently from classification of things that cannot consciously react to the classification of their properties (see, e.g. Hacking 1986).

The case of Auguste Deter is treated here as a 'proto-type' of Alzheimer's disease. 'Proto-type' reflects the particular relationship between first cases and their current uses. The meaning of the term oscillates between the proto-type's being "'typical,' in terms of the vital processes they exemplify or the diseases they manifest" (Creager 2002, p. 329), and the provisional nature of a proto-type. As such, it differs from a holotype, i.e. a single specimen, for instance of a plant species that fixes the application of a species name (see Daston 2004; see also Witteveen 2015). 'Proto-type' captures the common medical understanding that disease concepts may have originated from a case or a series of cases but can, legitimately, depart from these referents (see also Star 1989; Ankeny 2011). Whether a "historic case" like that of Auguste Deter or Johann Feigl should be regarded more as a provisional or more as a typical characterisation of Alzheimer's disease as it is understood today, has been addressed as a scientific question. The brain sections play a particular role here, because of their materiality that is treated as rendering of her disease. This is in line with Hans-Jörg Rheinberger's analysis of histological sections and other preparations as "self-configured traces made durable" (Rheinberger 2015, p. 323). Preparations exhibit "a particular indexicality", "they point at themselves", and are "renderings, not representations" (*ibid.*).

As we have seen, this does not mean that the artificiality of histological preparations was ignored. Quite the contrary, the fact that the biological material was prepared in Alzheimer's laboratory moved into the foreground once the rediscoverers began to address issues of authenticity, and when they stressed the neuropathological tradition. The iterative meandering between learning from the present about the past and learning from the past about the present becomes particularly clear in Graeber's positioning of the particularities of the case of Johann F. within current debates on the concept of Alzheimer's disease:

> [T]he case of Johann F. may belong to a subgroup of Alzheimer disease not only from a clinical and histopathological but also from a molecular genetic point of view. This fits well with the emerging concept of Alzheimer disease not representing a single disease entity but a heterogeneous group of disorders (Roses 1996). The finding that neuropathological tissue which has been stored for more than 80 years can be used successfully for molecular genetic analysis may be of general relevance in this context as the results of our study strongly support the concept that epidemiologically relevant data may be obtained using retrospective genotyping of archival brains (Graeber et al. 1995). (Graeber et al. 1997, p. 79)

The rediscovered case is presented here as an exemplar for studying Alzheimer's disease.[26] It serves, in a material sense, as a specimen that combines the virtues of having been clinically characterised by Alzheimer as an interesting case and that is researchable with new biotechnologies. At the same time, it also provides the opportunity to put forward a general neuropathological research programme of

[26] For a discussion of accounts of models, exemplars, prototypes and experimental systems in the historiography of the life sciences, see Creager (2002, pp. 317–333); for an assessment of their functions in 'science without laws', see Creager et al. (2007). For an account of materialised models of and for Alzheimer's disease, see Huber and Keuck (2013).

storing and re-examining brain preparations, not only of Alzheimer patients. The settling of a 'historical' issue through retrospective genotyping, the scientific value of old, well-conserved and clinically characterised materials to decide present debates on what the concept of Alzheimer's disease should capture, and the rhetorical use of famous cases to popularise brain banking, go hand-in-hand.

Accordingly, the material remains of the 'original Alzheimer' cases have been attributed a particular status as devotional and educational objects that are showcased and treated as precious objects (and as 'gifts' or 'loans' of Professor Mehraein). Nowadays, a number of the histological slides are exhibited in the Alzheimer museum in Marktbreit and in a presentation on the history of the Psychiatric University Clinic in Munich created to commemorate the clinic's centennial in 2004.[27] The display cases in the latter exhibit, one of which is dedicated to the discovery and rediscovery of the first cases of Alzheimer's disease, surround the large conference table in the former microscopy room of Alois Alzheimer in the Munich clinic. The display text (in German) about the histological slides signifies the meandering between past and present, and the appreciation of the proto-typical character of Alzheimer's patients:

> Box with original preparations of the case J.F. [Johann Feigl]: The histological preparations of this case contain amyloid plaques but no neurofibrillary tangles ("Plaques only" case). Despite the lack of neurofibrillary tangles, Alzheimer himself recognised this case as Alzheimer's disease. (Loan: Prof. Mehraein). (Translation L.K.)

All of the described uses of history played decisive roles in vouching for the treatment of Auguste D and Johann F as proto-types for studying Alzheimer's disease: the conception of history as scientific assessment of the past permitted the researchers to re-use old materials within current biomedical settings while keeping their particular history of discovery attached to them. It enabled Maurer and Graeber to draw on historical events without having to buy into historical relativism: the past, in this reading, provides old, valuable material, and knowledge to build on ("Alzheimer himself recognised…"), and if 'historical' methods are applied, they contribute to technical reconstructions of the details of old stains and to ensuring the authenticity of the samples, not to understand the past in its own terms.

Yet, the reason why the researchers became interested in the old material is that it stemmed from *historic* cases deeply embedded in the founding narratives of the field of Alzheimer research. Graeber's complicity with Alzheimer and 'the Munich School of Neuropathology' lent historical authority to the project of using archived brain samples. When historical medical materials are re-assessed with present means to then become re-used as "relevant epidemiological data" for future biomedical research, this might seem deeply anachronistic for historians. For the

[27] Space does not permit to give a full account of the exhibition of objects, documents, books, and photographs of the clinic's history. The conference-exhibition room is not openly accessible. Within the publications of the clinic, the display is sometimes referred to as a "museum", sometimes as an "exhibition", and the door sign says "Psychiatriehistorische Sammlungsstelle". For a general introduction into the musealisation of science, and the often lacking distinction between archive, museum, collection, and exhibition, see te Heesen and Vöhringer (2014).

involved scientists, however, it is a way of revitalising old cases to warrant for continuity when the validity of the present disease category is contested. The subjects of inquiry of the reassessment enterprise become sources of evidence for Alzheimer's disease. This calls for a closer examination of the distinct roles that amateur history plays within the negotiation of expert uncertainty about the 'nature' of a disease or mental disorder.

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References

Abir-Am, P. G. (1982). How scientists view their heroes: Some remarks on the mechanism of myth construction. *Journal of the History of Biology, 15,* 281–315.

Ainsworth, M. W. (2005). From connoisseurship to technical art history: The evolution of the interdisciplinary study of art. *Getty Conservation Institute Newsletter, 20,* 4–10.

Alzheimer, A. (1907). Über einen eigenartigen schweren Erkrankungsprozeß der Hirnrinde. *Neurologisches Centralblatt, 23,* 1129–1136.

Alzheimer, A. (1911). Über eigenartige Krankheitsfälle des späteren Alters. *Zeitschrift für die gesamte Neurologie und Psychiatrie, 4,* 356–385.

Amaducci, L., Sorbi, S., Piacentini, S., & Bick, K. L. (1991). The first Alzheimer disease case: A metachromatic leukodystrophy? *Developmental Neuroscience, 13,* 186–187.

Ankeny, R. A. (2011). Using cases to establish novel diagnoses: Creating generic facts by making particular facts travel together. In P. Howlett & M. S. Morgan (Eds.), *How well do facts travel? The dissemination of reliable knowledge* (pp. 252–272). Cambridge: Cambridge University Press.

Ballenger, J. F. (2006). *Self, senility, and Alzheimer's disease in modern America.* A history. Baltimore: The Johns Hopkins University Press.

Berrios, G. E. (1990). Alzheimer's disease: A conceptual history. *International Journal of Geriatric Psychiatry, 5,* 355–365.

Bick, K. L. (1994). The early story of Alzheimer disease. In R. D. Terry, R. Katzman, & K. L. Bick (Eds.), *Alzheimer disease* (pp. 1–8). New York: Raven Press.

Bick, K. L., Amaducci, L., & Pepeu, G. (Eds.). (1987). *The early story of Alzheimer's disease: Translation of the historical papers by Alois Alzheimer, Oskar Fischer, Francesco Bonfiglio, Emil Kraepelin, Gaetano Perusini*. Padova: Liviana Press.

Bock von Wülfingen, B. (2017). Beschriften, Wiederfinden und Reaktivieren: Die Rolle von Objektträgeretiketten im Auffindsystem am Beispiel von Alzheimers Auguste D.-Präparaten. *Berichte für Wissenschaftsgeschichte, 40,* 247–270.

Brush, S. G. (1995). Scientists as historians. *Osiris, 10,* 214–231.

Butterfield, H. (1931). *The Whig interpretation of history*. London: Bell.

Canguilhem, G. (1968). *Études d'histoire et de philosophie des sciences concernant les vivants et la vie*. Paris: Vrin.

Chang, H. (2011). How historical experiments can improve scientific knowledge and science education: The cases of boiling water and electrochemistry. *Science & Education, 20,* 317–341.

Chapman, R., & Wylie, A. (Eds.). (2015). *Material evidence. Learning from archaeological practice*. London: Routledge.

Chapman, R., & Wylie, A. (2016). *Evidential reasoning in archaeology*. London: Bloomsbury.
Cohn, S. (2017). Patterns of plague in late medieval and early-modern Europe. In M. Jackson (Ed.), *The Routledge history of disease* (pp. 165–182). London: Routledge.
Comfort, N. (2016). *A Whig history of CRISPR*. http://genotopia.scienceblog.com/573/a-whig-history-of-crispr/. Accessed March 15, 2017.
Creager, A. N. H. (2002). *The life of a virus. Tobacco mosaic virus as an experimental model, 1930–1965*. Chicago: University of Chicago Press.
Creager, A. N. H., Lunbeck, E., & Wise, M. N. (Eds.). (2007). *Science without laws. Model systems, cases, exemplary narratives*. Durham: Duke University Press.
Cunningham, A. (2012). *The identity of the history of science and medicine*. Farnham: Ashgate.
Daston, L. (2004). Type specimens and scientific memory. *Critical Inquiry, 31,* 153–182.
Daston, L. (2012). The sciences of the archive. *Osiris, 27,* 156–187.
Daston, L. (Ed.). (2017). *Science in the archives: Pasts, presents, futures*. Chicago: Chicago University Press.
Debus, A. G. (1971). The relationship of science-history to the history of science. *Journal of Chemical Education, 48,* 804–805.
Engstrom, E. J. (2003). *Clinical psychiatry in Imperial Germany. A history of psychiatric practice*. Ithaca: Cornell University Press.
Engstrom, E. J. (2007). Researching dementia in Imperial Germany: Alois Alzheimer and the economies of psychiatric practice. *Culture, Medicine and Psychiatry, 31,* 405–413.
Enserink, M. (1998). First Alzheimer's diagnosis confirmed. *Science, 27,* 2037.
Fleck, L. (1979 [1935]). *Genesis and development of a scientific fact*, reprinted with an introduction by T.S. Kuhn. Chicago: University of Chicago Press.
Fuller, S. C. (1912). Alzheimer's disease (senium praecox): The report of a case and review of published cases. *Journal of Nervous and Mental Diseases, 39,* 440–557.
Gere, C. (2005). *A brief history of brain archiving. IBRO history of neuroscience*. http://ibro.info/wp-content/uploads/2012/12/A-Brief-History-of-Brain-Archiving.pdf. Accessed September 05, 2017.
Graeber, M. B. (1999). No man alone: The rediscovery of Alois Alzheimer's original cases. *Brain Pathology, 9,* 237–240.
Graeber, M. B. (2003). *Alois Alzheimer. IBRO history of neuroscience.* http://ibro.info/wp-content/uploads/2012/12/Alzheimer-Alois-2003.pdf. Accessed September 05, 2017.
Graeber, M. B., Kösel, S., Egensperger, R., Banati, R. B., Müller, U., Bise, K., et al. (1997). Rediscovery of the case described by Alois Alzheimer in 1911: Historical, histological and molecular genetic analysis. *Neurogenetics, 1,* 73–80.
Graeber, M. B., Kösel, S., Egensperger, R., Schnopp, N. M., Bise, K., & Mehraein, P. (1995). Strategies for using archival brain tissue in neurogenetic research. *Journal of Neuropathology and Experimental Neurology, 54,* S27–S28.
Graeber, M. B., Kösel, S., Grasbon-Frodl, E., Möller, H. J., & Mehraein, P. (1998). Histopathology and *APOE* genotype of the first Alzheimer disease patient, Auguste D. *Neurogenetics, 1,* 223–228.
Graeber, M. B., & Mehraein, P. (1999). Reanalysis of the first case of Alzheimer's disease. *European Archives of Psychiatry and Clinical Neuroscience, 249*(Supplement 3), 10–13.
Gurwitz, D. (1997). Auguste D and Alzheimer's disease. *Lancet, 350,* 298.
Hacking, I. (1986). Making up people. In T. C. Heller, M. Sosna, & D. E. Wellbery (Eds.), *Reconstructing individualism: Autonomy, individuality, and the self in western thought* (pp. 222–236). Stanford: Stanford University Press.
Hamann, C. (1997). Auguste D and Alzheimer's disease. *Lancet, 350,* 297–298.
te Heesen, A., & Vöhringer, M. (Eds.). (2014). *Wissenschaft im Museum – Ausstellung im Labor*. Berlin: Kulturverlag Kadmos Berlin.
Hess, V., & Mendelsohn, J. A. (2010). Case and series: Medical knowledge and paper technology, 1600–1900. *History of Science, 48,* 287–314.
Hildebrandt, S. (2016). *The anatomy of murder: Ethical transgressions and anatomical science during the Third Reich*. New York: Berghahn Books.
Huber, L., & Keuck, L. K. (2013). Mutant mice: Experimental organisms as materialised models in biomedicine. *Studies in History and Philosophy of Biological and Biomedical Sciences, 44,* 385–391.
Huisman, F., & Warner, J. H. (2004). Medical histories. In F. Huisman & J. H. Warner (Eds.), *Locating medical history: The stories and their meanings* (pp. 1–30). Baltimore: Johns Hopkins University Press.

Jackson, M. (Ed.). (2017). *The Routledge history of disease*. London: Routledge.
Katzman, R. (1976). The prevalence and malignancy of Alzheimer disease: A major killer. *Archives of Neurology, 33,* 217–218.
Keuck, L. (2011). In quest of 'good' medical classification systems. *Medicine Studies, 3,* 53–70. **(published as L. K. Kutschenko)**.
Keuck, L. (2016). Thinking with gatekeepers: An essay on psychiatric sources. In J. Bangham, & J. Kaplan (Eds.), *(In)visible labour: Knowledge production in the human sciences*, Preprint 484 (pp. 107–115). Berlin: Max Planck Institute for the History of Science.
Kitwood, T. M. (1997). *Dementia reconsidered: The person comes first*. Buckingham: Open University Press.
Kraepelin, E. (1910). *Psychiatrie. Ein Lehrbuch für Studierende und Ärzte. Achte, vollständig überarbeitete Auflage, II. Band, Klinische Psychiatrie, I. Teil*. Leipzig: Verlag von Johann Ambrosius Barth.
Kuhn, T. S. (1962). *The structure of scientific sevolutions*. Chicago: Chicago University Press.
Labisch, A. (2004). Transcending the two cultures in biomedicine: The history *of* medicine and history *in* medicine. In F. Huisman & J. H. Warner (Eds.), *Locating medical history: The stories and their meanings* (pp. 410–431). Baltimore: Johns Hopkins University Press.
Latour, B. (2000). On the partial existence of existing *and* non-existing objects. In L. Daston (Ed.), *Biographies of scientific objects* (pp. 247–269). Chicago: University of Chicago Press.
Lindee, M. S. (2005). *Moments of truth in genetic medicine*. Baltimore: Johns Hopkins University Press.
Lock, M. (2013). *The Alzheimer conundrum: Entanglements of dementia and aging*. Princeton: Princeton University Press.
Löwy, I. (2011a). Labelled bodies: Classification of diseases and the medical way of knowing. *History of Science, 49,* 299–315.
Löwy, I. (Ed.). (2011b). *Microscope slides: Reassessing a neglected historical ressource*, Preprint 415. Berlin: Max Planck Institute for the History of Science.
Löwy, I. (Ed.). (2013). Microscope slides: Reassessing a neglected historical ressource. *History and Philosophy of the Life Sciences, 35*, 305–496.
Maurer, K. (2006). The history of Alois Alzheimer's first case Auguste D. How did the eponym'Alzheimer's disease'came into being? (sic!). In M. Jucker, K. Beyreuther, C. Haass, R. Nitsch, & Y. Christen (Eds.), *Alzheimer: 100 years and beyond* (pp. 13–34). Berlin: Springer.
Maurer, K., & Maurer, U. (1998). *Alzheimer: Das Leben eines Arztes und die Karriere einer Krankheit*. München: Piper Verlag.
Maurer, K., & Maurer, U. (2003). *Alzheimer: The life of a physician and the career of a disease*. Translated by Neil Levy with Alistair Burns. New York: Columbia University Press.
Maurer, K., Volk, S., & Gerbaldo, H. (1997). Auguste D and Alzheimer's disease'. *Lancet, 349,* 1546–1549.
Maurer, K., Volk, S., & Gerbaldo, H. (1999). Auguste D. The history of Alois Alzheimer's first case. In P. J. Whitehouse, K. Maurer, & J. F. Ballenger (Eds.), *Concepts of Alzheimer disease: Biological, clinical, and cultural perspectives* (pp. 5–29). Baltimore: Johns Hopkins University Press.
Möller, H. J., & Graeber, M. B. (1998). The case described by Alois Alzheimer in 1911: Historical and conceptual perspectives based on the clinical record and neurohistological sections. *European Archives of Psychiatry and Clinical Neuroscience, 248,* 111–122.
Moro-Abadía, O. (2009). Thinking about 'Presentism' from a historian's perspective: Herbert Butterfield and Hélène Metzger. *History of Science, 47,* 57–77.
Müller, U., Winter, P., & Graeber, M. B. (2011). Alois Alzheimer's case, Auguste D., did not carry the N141I mutation in PSEN2 characteristic of Alzheimer Disease in Volga Germans. *Archives of Neurology, 68,* 1210–1211.
Müller, U., Winter, P., & Graeber, M. B. (2013). A Presenilin 1 mutation in the first case of Alzheimer's disease. *Lancet Neurology, 12,* 129–130.
Neurobiobank München. (2015). *Infobroschüre*. http://www.neuropathologie.med.uni-muenchen.de/download/neurobiobank_infobroschuere.pdf. Accessed March 15, 2017.
O'Brien, C. (1996). Auguste D. and Alzheimer's disease. *Science, 273,* 28.
Perusini, G. (1910). Über klinisch und histologisch eigenartige psychische Erkrankungen des späteren Lebensalters. In F. Nissl & A. Alzheimer (Eds.), *Histologische und histopathologische Arbeiten über die Grosshirnrinde mit besonderer Berücksichtigung der pathologischen Anatomie der Geisteskrankheiten, Dritter Band* (pp. 297–358). Jena: Gustav Fischer.

Pickstone, J. V. (2000). *Ways of knowing: A new history of science, technology and medicine*. Manchester: Manchester University Press.

Pollen, D. A. (1993). *Hannah's heirs: The quest for the genetic origins of Alzheimer's disease*. New York: Oxford University Press.

Pomata, G. (2005). Praxis historialis: The uses of historia in early modern medicine. In G. Pomata & N. G. Siraisi (Eds.), *Historia: Empiricism and erudition in early modern Europe* (pp. 105–146). Cambridge: MIT Press.

Rees, T. (2016). *Plastic reason: An anthropology of brain science in embryogenetic terms*. Oakland: University of California Press.

Rheinberger, H.-J. (2010). Georges Canguilhem: Epistemological history. In H.-J. Rheinberger (Ed.), *An epistemology of the concrete: Twentieth-century histories of life* (pp. 37–49). Durham: Duke University Press.

Rheinberger, H.-J. (2015). Preparations, models, and simulations. *History and Philosophy of the Life Sciences, 36,* 321–334.

Roelcke, V., Topp, S., & Lepicard, E. (Eds.). (2014). *Silence, scapegoats, self-reflection. The shadow of nazi medical crimes on medicine and bioethics*. Göttingen: Vandenhoeck & Ruprecht.

Roses, A. D. (1996). The Alzheimer diseases. *Current Opinion in Neurobiology, 6,* 644–650.

Rupp, C., Beyreuther, K., Maurer, K., & Kins, S. (2014). A Presenilin 1 mutation in the first case of Alzheimer's disease: Revisited. *Alzheimer's & Dementia, 10,* 869–872.

Schramm, K., Skinner, D., & Rottenburg, R. (2012). *Identity politics and the new genetics: Re/creating categories of difference and belonging*. New York: Berghahn Books.

Skopek, J. (2011). Principles, exemplars, and uses of history in early 20th century genetics. *Studies in History and Philosophy of Biological and Biomedical Sciences, 42,* 210–225.

Sommer, M. (2010). DNA and cultures of remembrance: Anthropological genetics, biohistories, and biosocialities. *BioSocieties, 5,* 366–390.

Sommer, M. (2016). *History within: The science, culture, and politics of bones, organisms, and molecules*. Chicago: The University of Chicago Press.

Spatz, H. (1961). Franz Nissl. In W. Scholz (Ed.), *50 Jahre Neuropathologie in Deutschland (1885–1935)* (pp. 43–66). Stuttgart: Thieme.

Star, S. L. (1989). *Regions of the mind: Brain research and the quest for scientific certainty*. Stanford: Stanford University Press.

Wailoo, K., & Pemberton, S. (2006). *The troubled dream of genetic medicine*. Baltimore: Johns Hopkins University Press.

Weindling, P. (2012). Cleansing anatomical collections: The politics of removing specimens from German anatomical and medical collections 1988–92. *Annals of Anatomy-Anatomischer Anzeiger, 194,* 237–242.

Whitehouse, P. J., & George, D. (2008). *The myth of Alzheimer's: What you aren't being told about today's most dreaded diagnosis*. New York: St. Martin's Griffin.

Whitehouse, P. J., Maurer, K., & Ballenger, J. F. (Eds.). (2000). *Concepts of Alzheimer disease: Biological, clinical, and cultural perspectives*. Baltimore: Johns Hopkins University Press.

Wilkens, R. H., & Brody, I. A. (1969). Alzheimer's disease. *Archives of Neurology, 21,* 109–110.

Witteveen, J. (2015). Naming and contingency: The type method of biological taxonomy. *Biology and Philosophy, 30,* 569–586.