INTRODUCTION: MODERN PROSTHESES IN ANGLO-AMERICAN COMMODITY CULTURES

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Commodification in contemporary perspective

The present-day relationship between disability, technology and commerce in the developed world is hugely intricate. While the medical-industrial complex develops ever more innovative forms of myoelectric limb prostheses, cochlear ear implants and other devices designed to alleviate physical impairment, market responses to these technologies and the views these responses embody are diverse. For some, prosthetic technologies have certainly transformed lives, particularly those who have experienced impairment resulting from accidents, illness, trauma or war.[1] Other prostheses users, however, remain increasingly frustrated over the affordability, the functionality and general restrictions to innovation as a result of growing corporate monopolies and call for more effective, cheaper and more easily available products enabled by greater state sponsorship, the greater separation of design from manufacturing and, perhaps most crucially of all, user-generated platforms for open-source designs.[2]

Yet, at the same time, it is well recognised that those who rely on prostheses to 'fix' their body and transform it to a state of 'normalcy' are not representative of all prosthetic technology users' experiences. Scholars within the burgeoning academic fields of disability studies and disability history, along with many disability-rights activists, have highlighted and sought to correct the impact of the 'medical model of disability', a conception of disability as a bodily defect that modern medical science and engineering are well equipped to correct. Indeed, it may well be suggested that the user experiences just outlined are underscored by the presupposition of the medical model. Since the late twentieth-century growth of the modern disability-rights movements in both Great Britain and the United States, the rejection of prosthetic technologies – of cochlear ear implants among the Deaf community for example – has

often signalled attempts at forging identities that are not related to the medical profession's view of disability but rather to forms of community-building aimed at remedying the previous exclusion of impaired individuals from social, cultural, economic and political life.[3] Concurrently, however, some who reject medical conceptions of disability may have an uncomfortable relationship with prostheses; they may use an assistive device to function where barriers to access still persist, on public-transport systems, for example, and in such situations, their prosthesis conceals the social marker of impairment, allowing them to pass as 'able-bodied'. Other individuals subvert manufacturers' intended use for the technology by using their prosthesis as a proud assertion of their non-'normal' body, as artist Claire Cunningham does with the incorporation of her crutches into performance work.[4]

These diverse lived experiences of prosthetic technologies today represented through different interpretive frameworks are intricately tied to the past and to the study of the past. As scholars of disability know all too well, what constituted 'disabled' and 'abled' and the ways in which these two categories were viewed and constructed depends on temporal, social, geographical, cultural and economic contexts. This historical fluidity is also true for the relationship between innovation and commercialisation and between supply and demand, but our knowledge of the ways in which the changing status of prostheses and their markets relate to varying conceptions of disability is limited. Indeed, the 'new disability history', spurred by disability-rights activism and patient-centred narratives, has recently taken the lived experience of disability as its focus in order 'to join the social-constructionist insights and interdisciplinarity of cultural studies with solid empirical research' and could be usefully supplemented by an exploration into how markets for prosthetic technologies shape those user experiences.[5] Certainly, the general dearth in detailed market-focused histories of prostheses may be partly due to the fact that they initially appear to be at odds with the new disability history's efforts to emphasise the shortcomings of the medical model. Yet, as the diversity of experiences outlined above indicates, to neglect prostheses, how they came to be commodities and responses to them is to recount an incomplete lived reality of some individuals. Studying the commodification of prostheses may garner insight into how the medical model evolved, achieved its influence, and was institutionally realised. Understanding the ways in which such forces helped to develop and entrench the medical model may thus indeed serve those who seek to now limit its influence.

It is the purpose of this collection to contribute new insights into the historical experiences of disability by uncovering more about the nineteenth- and twentieth-century foundations of modern prosthesis industries and their many complexities. While today's high-tech myoelectric limb prostheses and cochlear

ear implants clearly differ from the relatively low-tech artificial limbs and hearing trumpets of the nineteenth century, this collection outlines the remarkable similarities between the commercial processes involved in successfully getting these seemingly different products to market. Yet, by taking a commodification approach, this collection does not seek to privilege its significance over and above other interpretive frameworks, or to suggest that historians have neglected economic approaches to disability and prostheses altogether. Indeed, the collection is informed by materialist histories of disability, which have drawn on Marxist political economy in order highlight the importance of modern industrial capitalism in shaping disability and prosthesis use.[6] Instead, its aim is to bring together a body of new scholarship from established historians and promising early careers researchers from a variety of historical sub-disciplines to consider in more depth the commodification processes surrounding prosthetics and the involvement of companies, users and others in these processes. In particular, a little-explored avenue in the history of disability, and of prostheses more specifically, is the significance of company investment in and their consideration of intellectual-property protection. In the nineteenth and twentieth centuries, just as today, patenting and copyright enhanced product commercial viability, and yet we know very little about their effect on prostheses markets.

In paying closer attention to commercial influences on prosthesis development and use, this volume not only outlines some of ways in which the expanding industries of prostheses and assistive devices of the nineteenth and twentieth centuries formed a precursor to those we recognise today but also proposes commodification as another useful analytical tool for the historian interested in disability. While materialist histories of disabilities have been criticised for emphasising the socio-economic context of industrialisation over cultural factors and vice versa, the essays in this collection seek to align these elements through a culturally embedded history of the prosthesis as a commodity. As historian David M. Turner has recently argued, 'an approach is required which simultaneously appreciates that disability is shaped by people's particular social and cultural identities and their positions, while recognising that social and medical discourses, institutional practices and spatial environments also act to shape bodies and experiences'.[7] By addressing the interrelation of these factors, a culturally informed commodification approach can inform ongoing efforts at reconceptualising disability.

Prosthesis commodification since the nineteenth century

As a descriptive term for an artificial body part, 'prosthesis' gained its modern meaning in the eighteenth century.[8] While artificial body parts were

certainly used prior to the eighteenth century, a growing body of scholarship has outlined how the rise of new pathological-anatomical understandings of the body in late eighteenth-century Western thought aligned with the beginnings of industrialisation that gave rise to the commercial production and promotion of new forms of prosthetic technologies.[9] New understandings of the body, which provided a more clearly defined medical perspective of disability, resulted in the medical profession's attempt to control the impaired body through new corrective procedures and was accompanied by a growing distaste for visible signs of physical impairment within 'polite society'.[10] In a new world oriented around the able-bodied, a prosthesis became a device crucial for those with physical or sensory impairment to participate in society. Replacement body parts such as artificial limbs were far from the only assistive devices available. As recent studies by Liliane Hilaire-Pérez and Christelle Rabier and by David Turner and Alun Withey have demonstrated, an increasing range of devices detached and detachable from the body, from rupture trusses, walking sticks and spectacles to elaborate machines, also become widely promoted from the late eighteenth century.[11] Like replacement body parts, these devices 'fashioned' the body to both restore functional capability and to create the aesthetic of 'normalcy'.

Yet, while this array of devices was prominently promoted in the late eighteenth century, industrial structures and commercial markets for such products were relatively small and fragmented. It was from the nineteenth century, with the further advancement and alignment of medicine and modern industrial capitalism, that prosthetics flourished, in both scale of production and design innovation. Not only was the nineteenth century a moment of major redefinition in disability history, as various state-sanctioned institutions brought disabled people under professional supervision, but definite shifts in the economy occurred too.[12] As the UK established itself as the 'the workshop of the world', with the United States as its greatest English-speaking global economic rival following closely behind, the manufactured prosthetic tool was transformed into a standardised commodity that reached large numbers of commercially literate consumers across the world. New modes of production both excluded those with physical impairments and facilitated the manufacture of technologically more complex prostheses. Although it never became a mass-market good along the lines of a patent medicine, the prosthesis became a familiar piece of hardware that not only embodied economic value through market exchange but also standardised social and cultural meanings of disability as bodily impairments that required normalising.[13] Prostheses were thus commodified as they circulated and as ownership of them transferred from buyer and producer to seller and user. Property relations of a different kind,

in the form of intellectual property and patents, also became crucial from the nineteenth century as ownership of the individual body and rights over 'correcting it' became contested following revisions to patent laws.

Centring their analysis on prosthesis commodification and commercialisation, this collection of essays therefore takes a more inclusive view of prostheses, one that recognises devices external to the body, such as specialist cutlery (discussed in Chapter 4 by Laurel Daen), hearing trumpets (discussed in Chapter 1 by Graeme Gooday and Karen Sayer) and amplified telephones (discussed in Chapter 3 by Coreen McGuire), as well as the replacement body parts discussed by Jaipreet Virdi, Ryan Sweet, Caroline Lieffers and Julie Anderson. Accordingly, the collection provides us with a more holistic and thus more meaningful analysis of the technologies that users incorporated into their daily lives in order to 'correct' or hide their bodily difference. At its most extreme definition, prostheses may incorporate any device that intervenes on human subjectivity, such as computers, even to the extent that they have the power to transform humans into cyborgs.[14] While it is important to note that this book does not adopt a Foucauldian perspective on technologies of self-fashioning, it does view assistive technology as a mere variation of traditional prosthetics because both assist, and have long assisted, with independent living and access to life- and work-related activities. The two terms are therefore used more or less interchangeably. However, this collection does incorporate one crucial tenet of post-modern critiques: prostheses are more than just hardware. Like other technologies, prostheses are and were ideological tools, and their widespread consumption is contingent on the economic, social and cultural contexts in which they are designed, produced and promoted.

By addressing several commodification processes simultaneously, each chapter highlights the complex intertwined relationships between them. Processes divided into neat divisions were certainly not an industry feature. Nonetheless, these divisions according to invention, design and production; use, consumption and identity; and intellectual property and promotion aid reader orientation of this book. The themes also orient the collection towards recent scholarship in three main areas: disability and prosthetics history; history of science, technology and medicine (HSTM); and economic history. The chapters are influenced by scholarship in the 'new disability history', particularly around the historical construction of disabled identities, but they also contribute to a growing body of scholarship that increasing aligns HSTM and economic history. As historians increasingly recognise, the complexities and nuances involved in patterns of innovation and use analysed by historians of technology parallel the production–consumption cycles commonly found in commercial and economic histories.[15] Some essays also address the ways in

which the new commercial approach informs scholarship in material culture studies and literary criticism.

Before the remainder of this introductory essay addresses each commodification process in turn in order to contextualise the essays, it is important to reiterate the powerful influence of medicine and the market in shaping social and cultural meanings of disability in nineteenth- and twentieth-century Great Britain and the United States. Accordingly, the Anglo-American medical establishment is a main focus of this collection. This focus is not an attempt to valorise medical conceptions of disability. Indeed, unpacking the significant historical legacy of the medical establishment's involvement in shaping and controlling impairment is crucial to our understanding of prosthesis commodification today, despite how distasteful this might appear to those schooled in histories told from the bottom up and how uncomfortably it sits within current disability-rights discourse. As Beth Linker has recently argued, the ways in which the disabled have interacted with health-care institutions, caretakers and the medical establishment are too significant to be written out of disability history.[16] This medical control, underpinned and reinforced by commercial and corporate interests is, in fact, so significant that it convinced generations of those with physical impairments that prostheses were required to fully participate in society, and is still successful in doing so. Recasting those with physical impairments as consumers and promoting a range of inventive prostheses to them provided these generations with an illusion of choice. It is questionable whether consumers in a society that converts impairments into disabilities could choose any alternative but to consume prostheses, although Jean Baudrillard's influential sociological work on the structures of consumption makes us reconsider whether any type of consumer has ever had free choice over the commodities they consume.[17] The historical medical control over impairment is also, of course, in no small part responsible for the subsequent rise of disability activism and of patient-activism groups more broadly. By uncovering more about the medical practitioners who defined and aimed to shape disability through prosthetic commodities, the empirically grounded chapters make the case for a scholarly approach that sees economics, and commodification specifically, as part and parcel of the social, cultural and indeed medical milieu that historically defined disability.

Invention, design and production

As the first stage of the commercialisation process, the invention of a prosthesis, or adaptation of an existing prosthesis, involved a complex alignment of engineering, design and medicine. Individual prosthesis makers, large

medical companies, surgeons and others worked collaboratively to ensure that each prosthesis was fit for its functional purpose, whether that be walking, hearing or something more intricate, such as eating and playing cards.[18] Crucially, these decisions were not only steered by those within the industry but were also dictated by the sensibilities of users. As historians of technology and of commerce have long recognised, invention and innovation do not take place in a vacuum but are stimulated by the reciprocal relationship between supply and demand.[19] With its foundations in the late eighteenth century, the stigmatisation of the physically impaired in nineteenth- and twentieth-century polite society, which depicted disability in terms of personal tragedy, shame and loss, meant that affluent middle- and upper-class consumers not only demanded a prosthesis that was functional but also required one indistinguishable from a real body part. Such disguised prostheses provided users with the appearance of 'normalcy'. The most expensive artificial limbs designed during this period mimicked human limbs in terms of shape and colour, while hearing aids made from fabric, silver and porcelain were disguised as everyday objects, including beards, fans, ornaments and hair accessories.[20] Ferris & Co., artificial-limb makers of London, stated in 1910: 'We have taken Nature as our guide, imitating as closely as possible every action of the human leg.'[21] The importance of invisibility in prosthesis design is a major theme within some of the chapters in this collection. Gooday and Sayer's chapter (Chapter 1) extends existing research on disguised hearing aids; Virdi addresses the invisibility of hitherto-neglected artificial tympanums (Chapter 2), and McGuire discusses the conspicuous design of amplified telephone (Chapter 3), while Sweet contributes to work in English literature on the disguised nature of limbs and other prostheses in Victorian marriage plots (Chapter 5), and Anderson focuses on the production of disguised designs for artificial limbs (Chapter 7).

Functional and disguised designs were more likely to be commercially successful. Yet, as existing histories of prosthetics have argued, prosthetic innovation was limited until demand reached suitable levels in the mid nineteenth century. Rising numbers of amputees and those with hearing impairments – resulting from industrial accidents and as casualties of the American Civil War (32,000 amputees from the Union Army alone) – often financially aided by the medical profession and the state, led to the emergence of many more designs of limbs and an assortment of hearing devices produced by growing number of specialist makers, all competing for custom.[22] Prior to the mid nineteenth century, those with impairments more often designed and constructed their own apparatus, as Daen demonstrates for apparatus designed by Captain George Webb Derenzy in the 1820s.

More often than not, commercial prosthesis makers, or mechanicians as they were sometimes known, were either surgeons themselves or worked closely with surgeons, albeit in demarcated physical spaces, as Anderson shows us through her detailed analysis of the nineteenth- and early twentieth-century. artificial limb trade in Britain. Makers and surgeons worked together to combine technical ingenuity with new invasive surgical procedures considered too dangerous before the mid nineteenth-century advent of anaesthesia, antisepsis and asepsis.[23] Among the most significant innovations in artificial legs prior to the Civil War adhering to new methods of amputations was American physician Douglas Bly's of 1858, which not only fitted better on a neater and less painful stump but also incorporated a ball and socket ankle mechanism users found helpful when walking up slopes and on uneven surfaces. B. Frank Palmer's 'American' leg, an important precursor to Bly's leg, was used by approximately 1,200 people in Britain, and permutations on the original remained in use until the First World War.[24] Lieffers' chapter (Chapter 6) expands our knowledge of the commercialisation of Palmer's leg, while Sweet's chapter locates Palmer's leg in a wider context of Victorian fiction (Chapter 5). Similarly, a wider variety of designs for hearing trumpets gained popularity following news of Queen Victoria's use of one alongside the development of new audiological innovations, such as the artificial tympanums addressed here by Virdi which corresponded with new invasive procedures of the inner ear.

Growing prosthesis innovation was accompanied by increased prosthesis production. The increasing adoption of industrial methods, machinery and processes into prosthetic trades, particularly after the First World War, began to gradually transform production from small-scale jobbing workshops to production-line-oriented units inspired by Henry Ford's famous assembly-line production of the Model T.[25] Such a transformation broke down and standardised individual tasks. The desire for standardised prostheses was not only a result of mass-production techniques but also paralleled a more homogenising view of the human body and its mechanisms under the medical gaze. Yet, while some elements of prosthesis manufacture began to mirror larger-scale production of mass-consumer technologies, the trade also retained many of its craft-based processes in order to ensure the continued production of bespoke products. Balancing the production of made-to-order and increasingly standardised goods was no easy task, as Anderson and McGuire demonstrate (Chapter 7 and Chapter 3). Both Anderson and McGuire highlight the growing involvement of the British state in attempts to increase standardised twentieth-century prosthesis production. Drawing on studies that depict the First World War as a crucial turning point for

reconfiguring the spaces of prosthesis production, Anderson outlines the increasing involvement of the Ministry of Pensions in the production of artificial limbs in the 1910s and 1920s, while McGuire demonstrates how the British Post Office's monopoly over amplified telephony in the inter-war period allowed them to attempt to standardise the apparatus.[26] Changes to production in artificial limbs and in amplified telephony resulted in significant cost implications for both private companies and the public sector, particularly as the British state's involvement meant that some users did not pay for these prostheses in an age of growing welfare reform. Perhaps more crucially, however, attempts at standardisation created tensions with users because they sought to minimise accommodation for the requirements of the individual body.

The wider effects of industrialisation also had an impact on prosthesis development. Scholars are paying increasing attention to the effects of modern capitalism on the 'industrial body' in various sites, including the South Wales coalfields and the factories of industrial Pittsburgh.[27] The factory, the coalfield and urban working environments were a major cause of physical disablement in the nineteenth and twentieth centuries and led to the philanthropic intervention of local manufacturers, businessmen, medical-aid societies and others who sought to conceal bodily damage through the increased provision of prostheses.[28] Edward Slavishak's recent study of industrial Pittsburgh demonstrates how prosthetic devices not only 'normalised' the worker's impaired body but enhanced it by shaping it into a machine.[29] Yet sites of labour simultaneously became increasingly important for the employment of physically impaired workers. Attempts by philanthropists, benevolent businessmen and others to find suitable work for impaired workers typically excluded from new modes of production represented another charitable attempt at 'normalising' individuals as workers in a capitalist economy and increasing national productivity. By analogising assembly-line production to a prosthetic extension of the worker's body, Henry Ford saw the modern factory as a way of extending the capacities of the physically impaired and non-impaired alike.[30] These two effects of modern capitalist economies and the resulting philanthropic interventions – the provision of prostheses to impaired workers and the inclusion of impaired workers in the labour market – are an important part of prosthetics history. Lieffers addresses the second of these effects by expanding Lisa Herschbach's study on ways in which artificial limb manufacturers in early nineteenth-century America claimed to be dedicating themselves to benevolence (Chapter 6). She highlights the philanthropic motives of US artificial-limb maker, B. F. Palmer, and his use of patents for limbs for this purpose.

Prosthesis use, consumption and identity

The sheer variety of prosthetic appliances on the market in the nineteenth and early twentieth centuries, as well as a plethora of designs for each type of appliance, reflects the assortment of users and their specific requirements. In some ways, the identities of the prosthesis users in this collection are obscured. As Katherine Ott has remarked, disabled individuals were 'too busy living to be restrained by our post-structuralist worries over the cultural contingencies of what they did or who they were'.[31] Yet, the proliferation of hearing aids and artificial limbs with a 'natural' function and appearance in this period provide us with important clues as to how users saw themselves. Indeed, in contrast to late twentieth and early twenty-first-century disability-rights activists, who have sought out a variety of identity forms not anchored to medical technology, the users uncovered in this collection did align at least one part of their identities with prostheses. The proliferation of disguised prostheses suggest that many physically impaired individuals consumed and used prostheses in order to be able to 'pass' as able-bodied in society. Recent sociological work on the concept of disability 'passing' has highlighted the complex and diverse methods in which individuals concealed markers of impairment to avoid the stigma of disability and has outlined how these methods encompassed an imposed identity of others on these individuals.[32] The use of disguised prostheses was one method of concealment, and the multifaceted ways in which this use shaped disabled identities and how it stimulated innovation and production are key themes of this collection. Indeed, as McGuire and as Gooday and Sayer highlight, users of the amplified telephone and of other hearing devices would not have recognised today's self-proclaimed cultural identity of the Deaf community or even a hard-of-hearing community, but would have simply used their technology to 'pass' as hearing individuals.

It was those who experienced impairment later in life, in particular, who were heavily influenced by commerce and the medical profession's intent to restore them to the 'normal' state of their former selves through prostheses: Colonel Derenzy, the protagonist of Daen's chapter (Chapter 4), and the First World War soldiers discussed by Anderson (Chapter 7), for example, experienced physical impairment as a result of war. Similarly, Virdi (Chapter 2) outlines how intermediaries in the form of medical professionals could impose deaf and hard-of-hearing identities on the end-users of artificial tympanums. She outlines how aural surgeons regulated their patients' use of the device, thus taking away responsibility from the end-user. McGuire's chapter (Chapter 3) goes further by explicitly forcing us to consider the amplified telephone as the British Post Office's tool for imposing its own categorisation

of deafness on its amplified telephone users, while Gooday and Sayer (Chapter 1) demonstrate that the relationship between hearing-aid users and designers was mutually beneficial precisely because it centred on issues of identity, trust and efficacy. Purchasing a prosthesis did not necessarily mean, however, that its owner passively accepted the technologies presented to them or used it in the manner for which the designer and manufacturer intended, if at all. Prosthesis users have always adapted devices to accommodate their needs, and these adaptations may have subverted the foreseen uses of the inventor and designer, as a number of the chapters here will outline.

Beyond the use of prostheses as a way for individuals to 'pass' as able-bodied, it is important to recognise that disability has never been a discrete identity category. Accordingly, identities of prosthesis consumers are further complicated by the intersection of other axes of social identity, including gender, class and occupation.[33] Yet, while studies of artificial limbs have demonstrated the gendered and sometimes class-based nature of prosthesis consumption, particularly as symbols of masculinity among Civil War and First World War soldiers, research on the complex intersectionalities surrounding prosthesis use is in its infancy.[34] The authors in this volume expand on current thinking on the intersectional identities of prosthesis users. Extending a growing scholarship on female users of Victorian prostheses, Sweet demonstrates how the interchangeability of the content of works of fiction and trade literature sought to influence female readers to use disguised prostheses as an embodiment of femininity and in order to secure their social positions as wives and mothers.[35] As Joanna Bourke has pointed out, artificial limbs were generally the reserve of those who could afford them until after the Second World War.[36] Daen fruitfully expands on recent work on both masculinity related to artificial-limb use and on the reception of tasteful yet functional assistive devices within polite society by uncovering how and why Derenzy's apparatus for the one-handed only appealed to male wealthy officers like himself in particular, despite his attempt to gain wider appeal.[37] Complementing the growing scholarship on the body of the industrial worker, McGuire demonstrates that middle-class businessmen like Raymond Harris could also be important hard-of-hearing consumers of the telephone.

While prosthesis users implicitly or explicitly fed back their requirements to manufacturers, it is also clear that some prosthesis users contributed much more to the commercialisation of prosthetic devices than existing studies suggest.[38] Numerous artificial-limb makers and hearing-aid manufacturers were prompted into the industry through their own experiences of impairment. For example, Marcel Desoutter, who after having his leg amputated after a flying accident, became an artificial-limb maker along with his brother, Charles, in

London in 1914. Desoutter Brothers Ltd became very successful, particularly during the First World War.[39] User-designers believed that their personal experience would provide them with a greater degree of understanding of the needs of others with limb loss or hearing impairment but their development of new prostheses was also a way of expressing their dissatisfaction with existing designs. Chapters in this volume therefore uncover more about user-designer motivations: Daen discusses Derenzy's ambition to help fellow one-handed users following his own limb loss; Lieffers explores Palmer's voyage into the commercialisation of artificial limbs following his own limb loss; and McGuire outlines Raymond Harris's own telephone design, which he proposed to give freely to other hard-of-hearing subscribers. While Palmer was the only one of these three users to form and operate a business in order to sell his designs, all three of these chapters do much to highlight the complexities in relationships between designers, users and user-designers. Moreover, the fact that Derenzy and Harris were prepared to freely promote their designs to other users without any desire to make a profit from them has far-reaching implications for how we view the relationship between prostheses and intellectual property.

Intellectual property, patenting and promotion

With the number of different designs for artificial limbs and hearing devices increasing in the nineteenth and twentieth centuries, protecting one's intellectual property through the use of patents and other formal forms of protection became a growing concern for designers and user-designers.[40] The number of patents registered for such designs was certainly much smaller than for other types of invention, but, even prior to the inventive impetus first provided by the Civil War, the patent record is littered with designs for walking sticks, splints, hearing aids, artificial limbs, teeth, eyes and hair, and other assistive devices. According to the United States Patent and Trademark Office, 130 American patents were granted for artificial limbs between 1790 and 1873, and artificial limbs were the second-highest category of all medical devices patented during the nineteenth century.[41] B. F. Palmer, the US-based manufacturer-user discussed by Lieffers, became a prolific patentee after first patenting his 'American' leg in 1846. Palmer was quickly followed by other US manufacturers, as well as those in Britain. There were six English patents issued just for 'improvements in artificial legs' alone in 1857, and in 1858, Douglas Bly patented his innovative lateral motive ankle joint for artificial legs. By 1895, the number of US artificial-limb patents rose to 144, while approximately 5 per cent of the 14,000 patents filed in Britain annually were for prostheses and other assistive devices by the end of the decade.[42]

An increasing number of patents were also registered for prostheses beyond limbs into the twentieth century as surgeons and appliance makers realised the commercial potential of such devices, including artificial breasts, as Kirsten Gardner has recently argued, and artificial tympanums, as outlined by Virdi in this collection.[43]

This proliferation of patenting activity was in part enabled by Acts of legislation. The Patent Act of 1790 in the US, its revision in 1836, and the Patent Law Amendment Act of 1852 in Britain created modern patent systems, the basis of which still operate today. The passing of these Acts meant that patents for designs of devices, as well as for processes, were easier and cheaper to obtain, while the liberal conditions in England in particular meant the country was a magnet for inventions. Prior to the 1790 Act, North America had followed its colonial rulers and used a patent system established centuries before in the reign of Elizabeth I. This outdated system, which expressed royal patronage rather than any meaningful legal protection, was long criticised for its ineffectiveness, its exclusivity and injustice. The American 1790 Act and British 1852 Act, along with subsequent legislation, provided each country with the framework to develop slightly different patent systems, but, despite their differences, patents remained attractive for individual inventors in both countries because they were a lawful acknowledgement of proprietary rights and created a monopoly over a particular design for a designated period of time. A patent was (and still is) a device to prevent the diffusion of new methods before the original inventor had recovered profit adequate to induce the requisite investment. At its most fundamental level then, a patent represented an important but largely overlooked form of commercial intent within the industry for prostheses, regardless of whether the commercial potential was realised or not. As Zorina Khan has noted in her study of late nineteenth-century American household goods, the very attempt to obtain a patent signalled a commercial orientation, and multiple patents of one type of device supports the idea that markets were profitable.[44] The patenting activity within the prosthesis industry thus highlights the belief in the commercial potential of their designs by a variety of inventors. Patents in both countries became statue-based weapons of capitalist competition.[45]

While the prosthesis industry shared this view of the patent system with other industries, there were also important elements that made patenting activity within this industry unique. It was not unusual for patentees in the prosthesis industry and beyond to conceptualise a patent as a form of social contract with the public. As Lieffers in particular outlines, prosthesis patentees were awarded a temporary monopoly in return for disclosure of their secret. Yet what made this concept particular to the prosthesis industry were

manufacturers' claims that patents benefited those with impairments because their securement of knowledge rights would result in an improved standard of living through the development of assistive devices. As Lieffers informs us, Palmer asserted the benevolent nature of his patenting activity when applying for a patent extension for one of his artificial limbs in 1860. Moreover, the relationship between prostheses and patents was in fact closer than those within other industries because both concepts enshrined similar ideas over intellectual property and ownership. Statutes protecting intellectual property over prosthesis designs were introduced and revised at the same time as modern concepts of ownership and autonomy over one's own body were emerging. Following the increasing emphasis on individual responsibility for health, the consumption of goods for bodily adornment or enhancement thus grew rapidly.

Yet, despite the presence of dynamic patent cultures for prostheses, it is important to emphasise that the majority of prosthesis designs were not patented, and, accordingly, not all of the authors in this collection address prostheses that were officially patented. Even against the commercial backdrop of the era and the concomitant patenting of artificial limbs, certain hearing devices were not commonly patented. Consideration of the reasons for and consequences of not patenting are just as important, if not more so, for revealing crucial insights into prostheses as commodities. Certainly, ethics played a large role in decisions not to patent, particularly when medical professionals were involved in invention or design. As historians of medicine have recently discussed, formal and informal codes of medical ethics in both Britain and the United States prohibited medical professionals from any involvement in patenting appliances because it was seen as an ungentlemanly activity of tradesmen and as profiteering from the ill-health of patients.[46] While beyond the scope of their occupation, some appliance makers were also influenced by medical ethical codes and refrained from patenting to align themselves with codes of medical professionalism. Indeed, it is possible that heavy medical professional involvement in the development of new hearing-aid designs prevented large-scale patenting activity, as indeed it does today with regard to cochlear ear implants, although more research in this area is needed to further examine this. Both Lieffers and Virdi provide in-depth analyses of the ethical complications of involving medical professionals in prosthesis patenting activity. While Lieffers emphasises the ways in which Palmer took the responsibility for patenting artificial limbs away from doctors and framed such activity in benevolent intentions, Virdi demonstrates that the patenting of artificial tympanums was not hindered by the involvement of aural surgeons but served to blur the boundaries between assistive technologies and curative ones.

The patenting of prostheses was not only restricted by medical intervention, however. Modern patent systems in both Britain and America elicited debate over whether patenting restricted or encouraged a national culture of invention. Indeed, critics stated that one of the paradoxes of patenting systems was that in order to stimulate invention they inhibited diffusion.[47] This lack of diffusion prevented other innovators from building on patented designs for as long as the patent was valid, and, thus, many inventors refrained from patenting in order to give their design freely to the nation and to other inventors. Such views on the restrictive nature of patenting made a significant impact in the prosthesis industry where philanthropy and benevolence played a prominent part, as the chapters here by Daen and McGuire demonstrate. Both Derenzy (discussed by Daen, Chapter 4) and Harris (discussed by McGuire, Chapter 3) neglected to patent their apparatus for the one-handed and telephone for the hard-of-hearing respectively. Crucially, as prosthesis users themselves, Derenzy and Harris wished to make it easy for others not only to use their devices but to build on them. In the case of Harris, the lack of restriction on his design for a telephone for the hard-of-hearing meant that the Post Office was free to not only adopt his design but also to adapt it and commercialise it as they saw fit.

Moreover, such was the commercial value of a patent that prosthesis manufacturers, along with producers of other medical goods, attempted to profit from them without filing for them. Some manufacturers instead made patents tools of advertising. Existing histories of prosthetics have emphasised that advertising was central to transforming prostheses into commodities, typically through perpetuating the stigmatising discourse of personal tragedy, shame and loss of disability within detailed and copiously illustrated trade catalogues and at visually impressive international exhibitions.[48] In fact, Herschbach has called trade literature of the Civil War period itself prosthetic because it imaginatively repaired veteran's damaged body while creating an ideal of the reconstructed veteran.[49] Yet, even those who draw on a Marxist-materialist framework have rarely mentioned the promotional value of prosthesis patents. As Gooday and Sayer's chapter in particular shows, hearing-aid manufacturers rarely patented their devices but nonetheless used the patent mark as an important advertising tool both on their devices and in their trade literature as a way of conveying product reliability and company trustworthiness. Functioning as promotional tools then, such patent markings are part of what historians of science Christine Macleod and Greg Radick have called 'broad' forms of intellectual property.[50] The very use of patent (and indeed trademark) markings, alongside other 'broad' form of intellectual property, such as eponymy common to the medical profession, hinted at proprietary rights but still legally

allowed other inventors and users to build on the designs. These markings were displayed on the promotional literature of other prosthesis manufacturers too, including US manufacturers John S. Drake and A. A. Marks (addressed by Sweet in this volume) and manufacturers based out of Roehampton Limb Fitting Hospital (addressed by Anderson). Sweet's chapter also demonstrates the similarities between trade literature and works of fiction by highlighting how prosthesis manufacturers drew on literary sources that encapsulated disability stigma, while Anderson draws on patents within trade literature, as well as other features, to examine the effect of the First World War on the industry for artificial limbs. Even without the inclusion of patented discourse, print more generally did much intellectual-property work for its authors. For prosthesis manufacturers and for Derenzy, publications ensured proprietary recognition for products and for ideas, although this was often contested.

Not all commercial activity can be encapsulated in patenting activity, but prosthesis manufacturers' use or non-use of patents nonetheless formed a crucial but overlooked part of the commodification process. While this book does not cover all, or even many of, the motivations behind or implications of prosthetic patent cultures, it is clear that some designers were keen to protect their proprietary rights, and some desired to give their designs away freely to other inventors and to the public. Others valued patents as promotional tools. Indeed, the extended implications of patenting cultures of prostheses, as well as patentees' motives, including profiteering from the sale of patent rights or licensing their use to others, require further study.

Methods and sources

This book's focus on commodification, and on intellectual property in particular, extends the focus of recent historical work that has aimed to reinterpret source material as a way of recovering disability histories. Douglas C. Baynton's 2001 assertion that 'disability is everywhere in history, once you begin looking for it' reminds us that, far from being a paucity in relevant sources, narratives of disability and the actors within these narratives have only ever been overlooked, ignored or silenced.[51] Indeed, historical examination of disability previously solely based on medical pathology misinterprets or filters out a great deal of evidence. Some chapters within this volume therefore draw on sources scholars have highlighted as potentially fruitful for providing new insights into disability, including trade literature, fictional texts, periodicals and artefacts. Sweet, for example, draws on a growing literary tradition of using works of fiction to highlight contemporary social and cultural attitudes to prostheses and disability. While existing studies have highlighted Victorian

and Edwardian perceptions of prostheses as an effective way to restore bodies to normalcy and economic productivity, Sweet demonstrates how we can also read Victorian fictional works as valuable indications of views on prostheses industries and the market forces that dictate them.[52] Conversely, Gooday and Sayer draw on a range of neglected artefacts, while Anderson and Lieffers draw on an array of trade literature to uncover more about users and their consumption patterns. Through their focus on the meanings embedded in the material form of these artefacts and literature, which change across adaptations and editions, these chapters extend recent scholarly work on the history of print and material culture of medicine and disability. Such work is indebted to anthropological approaches, which frame objects in terms of their 'biography', 'trajectory' or 'life story'.[53]

In addition, some chapters examine sources on which disability scholars are yet to draw. Chapters by Gooday and Sayer, Lieffers, Anderson and Virdi in particular draw on patent specifications for designs of artificial limbs, hearing aids and tympanums. While economic historians have long used the patent record as evidence of inventive activity, they have been slow to recognise its usefulness in identifying processes of commercialisation and for connecting these processes to specific user groups.[54] With intricate textual descriptions and illustrations, patent records not only contain detailed evidence of design, production and the extent of entrepreneurial creativity but can also reveal intentions over the pursuit of profit and a patentees' potential for understanding of the needs of impaired users. Patents can also reveal much about inventors for whom no other evidence exist, particularly user-designers and those whose attempts to commercialise their designs any further failed. In conjunction with other re-examined sources then, patent records provide crucial insights into prosthesis commodification and the ways in which this commodification fed into the everyday experience of disability.

Content and outline

The chapters in this collection run chronologically and are thematically divided into two parts, the first focusing on prostheses for hearing impairment and the second on prostheses for limb loss. The collection's focus on only two types of prosthesis is deliberate. The historiography of disablement and prosthetics has long emphasised the proliferation of both artificial limbs and hearing devices during this period, often to the exclusion of other devices, and it is precisely within this well-established discourse that a case needs to be made for greater engagement with a commercial approach. By maintaining its focus on these two types of prosthesis, this book does not suggest that their function

and availability, nor indeed the experiences of their users, were homogenous. Using a hearing trumpet to facilitate communication was categorically not the same as wearing an artificial limb, and it is the diversity of prosthetic technologies that provide further insights into the range of lived experiences of users. Yet, it was the medicalisation of hearing impairment and of limb loss and the resulting social exclusion of those with these physical impairments that subsequently produced the set of disability-specific histories and 'politics of identity' with which we have all become familiar. Indeed, all groups experienced some form of discrimination, despite the fact that subsequent activism developed around and within disability-specific groups, and thus deaf individuals and those with limb impairments marked parallel historical paths.[55] This shared experience of discrimination and common political interests led in some cases to cross-disability coalitions seeking to create 'access for all' and 'equal access'.

With commodification as the starting point, as opposed to distinct disability histories, it will therefore become clear that the two types of technology and their users have more in common than immediately appears. Medical and commercial enterprise sought to exploit these different types of users attempting to 'pass' in similar ways. The first two chapters by Gooday and Sayer and by Virdi assess the role of medical companies and practitioners producing hearing trumpets and artificial tympanums in the late nineteenth and early twentieth centuries, while the following paper by McGuire moves into the twentieth century to focus on the complicated relationship between the British state and the hard-of-hearing telephone-user in the mid twentieth century. In the second section, the first chapter by Daen focuses on the role of the early nineteenth-century user-inventor, while the following three chapters by Sweet, Lieffers and Anderson demonstrate the prevalence of disability commodity culture in works of Victorian fiction and the role of the medical profession, prosthesis manufacturers and the state in the production, promotion and patenting of artificial limbs and associated appliances. Yet, despite the commodification links between these chapters, it remains important to recognise the individual experiences of users, within these categories of 'hearing impaired' or 'amputee' and beyond.

The collection's focus on Great Britain and North America from the 1820s until the Second World War highlights the important concomitant developments in medicine and the market in shaping disability in this period and the transatlantic exchange of prostheses in similar types of commodity cultures. In addition, by situating their essays in the broader geographic context of the British Empire, Daen and Sweet provide some indication of what a global trade of prostheses in this period might have looked like. Nevertheless, commercial and medical involvement in prosthesis development is by no means

exclusive to Anglo-American history, and further studies in the burgeoning history of disability field are required to analyse the diversity of experiences of prosthesis development and use in different geographical contexts in this period and beyond. Moreover, while Sweet's essay includes discussion of wigs and dentures, the collection's overall focus on artificial limbs and hearing aids can be, and indeed should be, extended to include other forms of commodified prostheses, including breasts, dentures, ears, larynxes, noses and penises, wheelchairs and furniture. Such omissions mean that this collection certainly cannot claim to be comprehensive, and much more empirically grounded historical research drawing on 'the new disability history' needs to be conducted before simplistic 'medical' and 'social' models of disability are abandoned altogether. Studies of commodification and patent cultures on a global scale, of prosthetics and also of technologies more broadly, are in their infancy but form an exciting field that may further expand insights into disability experiences.[56] Yet, historical and methodological gaps notwithstanding, the seven chapters here offer small glimpses into prosthesis commodification and, together, suggest new ways of thinking about disability's pasts.

Notes

1 In 2009, there were over 2 million amputees or people with limb absence in the United States. Many of these amputees were veterans of the Iraq and Afghanistan conflicts. Stories surrounding US and UK soldiers who successfully, even heroically, use prostheses as replacements for limbs lost in the recent wars are the subject of much recent discussion. See, for example, B. Bailey and R. H. Immerman (eds), *Understanding the US Wars in Iraq and Afghanistan* (New York, NY: New York University Press, 2015); T. Mills and M. Brotherton, *As Tough as They Come* (New York, NY: Convergent Books, 2015). For the medical-industrial complex, see S. Blume, 'Medicine, technology and industry', in R. Cooter and J. Pickstone (eds), *Companion Encyclopaedia of Medicine in the Twentieth Century* (London and New York, NY: Routledge, 2003), 171–86.

2 See, for example, the Open Prosthetics Group wiki, available at www.instructables.com/group/openprosthetics/ (accessed 22 January 2015).

3 For Deaf responses to the cochlear ear implant, see S. Blume, *The Artificial Ear: Cochlear Ear Implants and the Culture of Deafness* (New Brunswick, NJ: Rutgers University Press, 2010).

4 See http://www.disabilityartsinternational.org/artists/profiles/claire-cunningham/; http://www.clairecunningham.co.uk/ (accessed 18 January 2016). For a recent discussion on how the world of art has taken up prosthetics, see M. Smith and J. Mora (eds), *The Prosthetic Impulse: From a Posthuman Present to a Biocultural Future* (Cambridge, MA: MIT Press, 2005).

5 P. K. Longmore and L. Umansky, 'Introduction: Disability history – from the margins to the mainstream', in P. K. Longmore and L. Umansky (eds), *The New Disability History: American Perspectives* (New York, NY: New York University Press, 2001), 1–33, at 15. See also L. J. Davis, *The Disability Studies Reader*, 4th edn (London and New York, NY: Routledge, 2013); L. J. Davis, *Enforcing Normalcy: Disability, Deafness and the Body* (London: Verso Press, 1995); S. Birch and M. Rembis (eds), *Disability Histories* (Urbana, IL: University of Illinois Press, 2014).

6 See B. Gleeson, *Geographies of Disability* (London and New York, NY: Routledge, 1999), Chapter 6; M. Oliver, 'Capitalism, disability and ideology: a materialist critique of the Normalization principle', in R. J. Flynn and R. A. Lemay (eds), *A Quarter-Century of Normalization and Social Role Valorization: Evolution and Impact* (Ottawa: University of Ottawa Press, 1999), 163–72.

7 D. M. Turner, 'Introduction: approaching anomalous bodies', in D. M. Turner and K. Stagg (eds), *Social Histories of Disability and Deformity* (London and New York, NY: Routledge, 2006), 1–16, at 3.

8 S. S. Jain, 'The prosthetic imagination: enabling and disabling the prosthesis trope', *Science, Technology, and Human Values*, 24:1 (1999), 31–54, at 31.

9 See, for example, I. Metzler, *A Social History of Disability in the Middle Ages: Cultural Considerations of Physical Impairment* (London and New York, NY: Routledge, 2013).

10 Turner, 'Introduction', 6.

11 L. Hilaire-Pérez and C. Rabier, 'Self-machinery? Steel trusses and the management of ruptures in eighteenth-century Europe', *Technology and Culture*, 54:3 (2013), 460–502; D. M. Turner and A. Withey, 'Technologies of the body: polite consumption and the correction of deformity in eighteenth-century England', *History*, 99:338 (2014), 775–96; A. Withey, *Transforming the Body: Technology, Self-Fashioning and Politeness in Eighteenth-Century Britain: Refined Bodies* (Basingstoke: Palgrave, 2015).

12 Longmore and Umanksy, 'Introduction', 22.

13 For a useful overview of the history of the cultural meaning of commodities, see A. Appadurai, 'Introduction: commodities and the politics of value', in A. Appadurai (ed.), *The Social Life of Things: Commodities in Cultural Perspective* (Cambridge: Cambridge University Press, 2014), 3–63.

14 For a post-modern analysis on prosthetics, see, for example, D. Harraway, *Simians, Cyborgs and Women: The Re-invention of Nature* (London and New York, NY: Routledge, 1991).

15 For example, R. Fox (ed.), *Technological Change: Methods and Themes in the History of Technology* (Amsterdam: Harwood Academic Publishers, 1996); T. Pinch and N. Oudshoorn (eds), *How Users Matter: The Co-construction of Users and Technologies* (Cambridge, MA: MIT Press, 2003); J. Brown and M. B. Rose (eds), *Entrepreneurship, Networks and Modern Business* (Manchester: Manchester University Press, 1993).

16 B. Linker, 'On the borderland of medical and disability history: a survey of the fields', *Bulletin of the History of Medicine*, 87:4 (2013), 499–535. See also B. J. Gleeson, 'Disability studies: a historical materialist view', *Disability and Society*, 12:2 (1997), 179–202.

17 J. Baudrillard, *The System of Objects*, trans. J. Benedict (London: Verso, 2005), 151.
18 See Chapter 5.
19 For example, W. E. Bijker, T. P. Hughes and T. J. Pinch (eds), *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology* (Cambridge, MA: MIT Press, 1987); Pinch and Oudshoorn, *How Users Matter.*
20 C. C. Sarli, R. M. Uchanski, A. Heidbreder, K. Readmond and B. Spehar, '19th-century camouflaged mechanical hearing devices', *Otology and Neurotology*, 24:4 (2003), 691–8.
21 J. Ferris and E. Ferris, *From the Surgical to the Mechanical Art: A Treatise on the Manufacture of Artificial Limbs* (n.p., 1910), 15.
22 For example, L. Herschbach, 'Prosthetic reconstructions: making the industry, re-making the body, modelling the nation', *History Workshop Journal*, 44 (1997), 22–57; J. D. McDaid, 'How a one-legged rebel lives: confederate veterans and artificial limbs in Virginia', in K. Ott, D. Serlin and S. Milm (eds), *Artificial Parts, Practical Lives: Modern Histories of Prosthetics* (New York, NY: New York University Press, 2002), 119–43; J. Virdi-Dhesi, 'Curtis's cephaloscope: deafness and the making of surgical authority in London, 1816–1845', *Bulletin of the History of Medicine*, 87:3 (2013), 347–77. Without a comprehensive geographical survey, it is difficult to know the precise number of existing prosthesis makers. London trade directories for the late nineteenth century suggest that the city was home to at least twenty specialist prosthesis suppliers: *Post Office London Directory for 1899* (HMSO, 1899). For a directory demonstrating the increase in medical companies generally in Britain in this period, see C. L. Jones, *The Medical Trade Catalogue in Britain, 1870–1914* (London: Pickering & Chatto, 2013), 161–210.
23 For a medical perspective of amputation, see J. Kirkup, *A History of Limb Amputation* (London: Springer Verlag London Limited, 2007).
24 G. Philips, *Best Foot Forward: Chas. A. Blatchford & Sons Ltd. (Artificial Limb Specialists) 1890–1990* (Cambridge, MA: Granta Editions, 1990), 30.
25 Jain, 'The prosthetic imagination', 33–9.
26 For the First World War as a stimulus in the prosthesis industry, see R. Cooter, 'The disabled body', in R. Cooter and J. Pickstone (eds), *Companion Encyclopaedia of Medicine in the Twentieth Century* (London and New York, NY: Routledge, 2003), 367–84; S. Koven, 'Remembering and dismemberment: crippled children, wounded soldiers and the Great War in Great Britain', *American Historical Review*, 99:4 (1994), 1167–202; M. Guyatt, 'Better legs: artificial limbs for British veterans of the First World War', *Journal of Design History*, 14:4 (2001), 307–25.
27 Cooter, 'The disabled body', 373.
28 For the coalfield, see B. Curtis and S. Thompson, '"A plentiful crop of cripples made by all this progress": disability, artificial limbs and working-class mutualism in the South Wales coalfield, 1890–1948', *Social History Medicine*, 27:4 (2014), 708–27.
29 E. Slavishak, *Bodies of Work: Civic Display and Labor in Industrial Pittsburgh* (Durham, NC: Duke University Press, 2008), particularly Chapter 6.
30 Jain, 'The prosthetic imagination', 34.

31 K. Ott, 'The sum of its parts: an introduction to modern histories of prosthetics', in K. Ott, D. Serlin and S. Milm (eds), *Artificial Parts, Practical Lives: Modern Histories of Prosthetics* (New York, NY: New York University Press, 2002), 1–44, at 5.
32 J. A. Brune and D. J. Wilson (eds), *Disability and Passing: Blurring the Lines of Identity* (Philadelphia, PA: Temple University Press, 2013).
33 S. Birch and M. Rembis, 'Re-membering the past: reflections on disability histories', in S. Birch and M. Rembis (eds), *Disability Histories* (Urbana, IL: University of Illinois Press, 2014), 1–13, at 2.
34 J. Bourke, *Dismembering the Male: Men's Bodies, Britain and the Great War* (Chicago, IL: University of Chicago Press, 1996); Herschbach, 'Prosthetic reconstructions'; E. O'Connor, '"Fractions of men": engendering amputation in Victorian culture', *Comparative Studies in Society and History*, 39:4 (1997), 742–77.
35 For example, see M. Smith, 'The vulnerable articulate: James Gillingham, Aimee Mullins, and Matthew Barney', in M. Smith and J. Morra (eds), *The Prosthetic Impulse: From a Posthuman Present to a Biocultural Future* (Cambridge, MA: MIT Press, 2006); V. Warne, '"To invest a cripple with peculiar interest": artificial legs and upper-class amputees at mid-century', *Victorian Review*, 35:2 (2009), 83–100.
36 Bourke, *Dismembering the Male*, 47.
37 Turner and Withey, 'Technologies of the body'.
38 For consumers feeding back into product-development processes, see C. L. Jones, '(Re-)reading medical trade catalogs: the use of professional advertising in British medical practice, 1870–1914', *Bulletin of the History of Medicine*, 86:3 (2012), 361–93.
39 Desoutter Brothers, *Progress* (n.p., 1922); Guyatt, 'Better legs'.
40 Intellectual property is, of course, a late twentieth-century term that encompasses patenting, brand marks, trade names and other forms of formal protection. Certainly, our historical actors would not have used this term nor would they have banded them together under one descriptive category, partly because laws kept them distinct. Nonetheless, intellectual property is a useful term for our purposes. See C. MacLeod and G. Radick, 'Claiming ownership in the technosciences: patents, priority and productivity', *Studies in History and Philosophy of Science*, Part A, 44:2 (2013), 188–201.
41 J. M. Edmonson, 'United States patents for medical devices: patterns of inventive activity in the nineteenth century', *Congress of the European Association of Museums of History of Medical Sciences (7th); 1994, 'Medical objects and* their writings' (Lyon: Fondation Mérieux, c. 1996), 45–54, ill.
42 Edmonson, 'United States patents'. With no comprehensive study, it is difficult to know exactly how many patents for prostheses were issued. *Abridgements for Patents: Medicine, Surgery and Dentistry* (London: HMSO, 1855–66, 1880, 1893–6, 1900, 1903) remain a useful source of reference.
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44 B. Z. Khan, '"Not for ornament": patenting activity by nineteenth-century women inventors', *Journal of Interdisciplinary History*, 33:2 (2000), 159–95.

45 C. Macleod, 'The paradoxes of patenting: invention and its diffusion in eighteenth and nineteenth century Britain, France and North America', *Technology and Culture*, 32:4 (1991), 885–910, at 888.

46 J. M. Gabriel, *Medical Monopoly: Intellectual Property Rights and the Origins of the Modern Pharmaceutical Industry* (Chicago, IL: University of Chicago Press, 2014); Jones, *The Medical Trade Catalogue*, Chapter 6.

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49 Herschbach, 'Prosthetic reconstructions', 50.

50 Macleod and Radick, 'Claiming ownership in the technosciences'.

51 Douglas C. Baynton, 'Disability and the justification of inequality in American history', in P. K. Longmore and L. Umansky (eds), *The New Disability History: American Perspectives* (New York, NY: New York University Press, 2001), 33–57, at 52.

52 R. G. Thomson, *Extraordinary Bodies: Figuring Physical Disability in American Culture and Literature* (New York, NY: Columbia University Press, 1997); M. S. Holmes, *Fictions of Afflictions: Physical Disability in Victorian Culture* (Ann Arbor, MI: University of Michigan Press, 2004); J. Esmail, *Reading Victorian Deafness: Signs and Sounds in Victorian Culture* (Athens, OH: Ohio University Press/Swallow Press, 2013).

53 For example, Appardurai, *The Social Life of Things*; L. Daston, *Things that Talk: Object Lessons from Art and Science* (Cambridge, MA: MIT Press, 2004).

54 For example, K. L. Sokoloff, 'Inventive activity in early industrial America: evidence from patent records, 1790–1846', *UCLA Economics Working Papers* 499 (Los Angeles, CA: UCLA Department of Economics, 1988).

55 Longmore and Umansky, 'Introduction', 4.

56 S. Wilf and G. J. N. Gooday (eds), *International Diversity in Patent Cultures: A Historical Perspective* (Cambridge: Cambridge University Press, in preparation); J. F. Stark, 'Owning health: medicine and Anglo-American patent cultures', *British Journal for the History of Science*, 49:4 (2016).