Studies in History and Philosophy of Science 40 (2009) 431–438

Contents lists available at ScienceDirect

Studies in History and Philosophy of Science

journal homepage: www.elsevier.com/locate/shpsa

# Between meaning culture and presence effects: contemporary biomedical objects as a challenge to museums

Thomas Söderqvist, Adam Bencard, Camilla Mordhorst

*Medical Museion, University of Copenhagen, 18 Fredericiagade, DK-1310 Copenhagen K, Denmark*

ARTICLE INFO

*Keywords:*
Exhibitions
Material culture/materiality
Contemporary science
Technology and medicine
Presence effects
Public engagement with science
History of medical science

ABSTRACT

The acquisition and display of material artefacts is the *raison d'être* of museums. But what constitutes a museum artefact? Contemporary medicine (biomedicine) is increasingly producing artefacts that do not fit the traditional museological understanding of what constitutes a material, tangible artefact. Museums today are therefore caught in a paradox. On the one hand, medical science and technologies are having an increasing pervasive impact on the way contemporary life is lived and understood and is therefore a central part of the contemporary world. On the other hand, the objects involved in medical diagnostics and therapies are becoming increasingly invisible and intangible and therefore seem to have no role to play as artefacts in a museum context. Consequently, museums are at risk of becoming alienated from an increasingly important part of contemporary society. This essay elaborates the paradox by employing Gumbrecht's (2004) distinction between 'presence' and 'meaning'.





## 1. Introduction

Materiality is at the centre of the museum enterprise. The documentation, acquisition, conservation and display of material artefacts constitute, as Peter Vergo (1989, p. 2) points out, the 'conventional definition' of museums. Certainly museums have many other, more or less officially, recognised social and cultural functions as well. They are educational institutions; they are major arenas for the production of cultural identities; they are important parts of the leisure economy; and they are sites for the secular worship of culture and history that occupy 'exactly the space and function once reserved for the Temple' (Agamben, 2007, p. 85). But none of these or other functions are conceivable without material artefacts. Despite the plurality of political, cultural and discursive functions ascribed to the modern museum institution, the acquisition and display of material artefacts remain its *raison d'être*.

This 'conventional definition' is not unproblematic, however. What constitutes a museum artefact has continually been debated, both inside and outside the museum world. All cultures have their share of immaterial phenomena that fall outside the traditional understanding of what could be acquired for museum collections and displays. For example, the documentation of ideas and linguistic phenomena and the acquisition and conservation of the corresponding material substrates (books, posters, letters, etc.) have traditionally been the aim of institutions such as libraries and archives, but they also play a significant role in museums and thus make the 'conventional definition' of museum artefacts less distinct. Thus museums perpetually have to negotiate these boundaries to find out how they should relate to social and cultural phenomena that do not manifest themselves through material artefacts, and which therefore cannot be easily represented in collections and exhibitions.

More importantly, modern and postmodern societies have produced, and are to an increasing extent continuing to produce, objects that are in principle (i.e. ontologically speaking) material but which are not collectable and displayable as traditional material artefacts. The institutions of science, technology and medicine have always been particularly rich providers of such objects. Throughout modernity, the physical, chemical and biological sciences and technologies have produced objects, such as molecules and cells, that are indeed 'material' from a realistic epistemological viewpoint but for all practical purposes break with the traditional

*E-mail addresses:* ths@sund.ku.dk; adambencard@hotmail.com; cammor@kff.kk.dk.

0039-3681/$ - see front matter © 2009 Elsevier Ltd. All rights reserved.
doi:10.1016/j.shpsa.2009.10.010

museological understanding of what constitutes a material, tangible artefact.

The historical tendency is that such objects are playing a more and more important role both in scientific, technological and medical practice and in society as a whole as we approach the present era, often characterized as 'technoscientific' (Ihde & Selinger, 2003). Scientific and technical objects such as transuranic atomic species produced in nuclear reactors, protein molecules produced by transgenic bacteria, and artificial virus genomes are not immediately documentable, acquirable, conservable or displayable artefacts in any conventional museological sense. In this essay, we will discuss the consequences of the pervasiveness of such invisible and intangible technoscientific objects for the contemporary museum institution. We will focus our argument on one specific technoscientific sector, namely, biomedicine (Cambrosio & Keating, 2003), because we believe that the changes that have taken place in this area over the last decades provide a good illustration of the emerging problematic status of museum artefacts.

Our major point is that museums today are caught in a paradox. On the one hand, medical science and technologies are having an increasingly pervasive impact on the way contemporary life is lived and understood, and medical diagnostics and therapeutics fill more and more human lives, from the neonatal care unit to the intensive care unit (Clarke et al., 2003). On the other hand, the objects involved in medical diagnostics and therapies are becoming increasingly invisible and intangible. The objects of contemporary biomedicine are disappearing from the realm of the senses and therefore seem to have no role to play as artefacts in a museum context. A fundamental part of the material culture of contemporary society thus seems to fall outside Vergo's definition of what constitutes a museum. Institutions that focus on the contemporary biomedical heritage would not—in the conventional sense of what a museum is—be museums at all. Consequently, museums are at risk of becoming alienated from an increasingly important part of contemporary society.

The purpose of this essay is diagnostic, not therapeutical. Our aim is not to suggest solutions, but to elaborate the paradox and find preliminary ways for conceptualising it. To that end we will employ the distinction between 'presence culture' and 'meaning culture' proposed by Hans Ulrich Gumbrecht (2004) in *The production of presence: What meaning cannot convey*. We have found the notions of 'presence' and 'meaning' and related concepts useful as an analytical point of departure for our engagement with the museological paradox raised by the emergence of contemporary biomedicine.

We also wish to emphasise that the museological problems occasioned by contemporary biomedicine are by no means restricted to science, technology and medical history museums. This part of the museum sector is particularly affected, of course, but contemporary technoscience has a wider significance for the museum institution as a whole, because of its profound impact on contemporary society and culture, including everyday life. Any museum institution with the ambition to document, acquire, conserve and display the contemporary material world would therefore have to consider the museological aspects of developments in recent biomedicine, including the consequences this development has for the understanding of what constitutes a museum artefact. Finally, and even if it falls outside the scope of this paper, we also believe that these development touch upon even wider transfigurations of the epistemological status of objects in general and our relationship to them. It seems as if the kind of object-based epistemology that the museum as an institution was involved with from its inception has shifted or even been superseded in many areas.

## 2. A historical backdrop: from *materia medica* to modern medical history museums

Throughout the last four hundred years the collection of medical artefacts has predominantly been a concern for specialised medical and medical history museums. The (so far largely unwritten) history of medical and medical history museums can be divided into three partly overlapping phases: first, the establishment of medical collections as an integrated part of the early modern natural historical inquiry; second, the establishment of modern medical collections for educational purposes; and third, the subsequent independence of the medical history museum as a specialised kind of the modern cultural history museum (e.g. Arnold, 2004, pp. 145–170).

The first medical museums were, as Paula Findlen pointed out in *Possessing nature* (Findlen, 1994), closely connected to the establishment of natural history collections in sixteenth-century Italy. Collecting medical objects was an integral part of the emerging late Renaissance interest in natural history and the need for managing the large amounts of natural artefacts that had been collected during the geographical expeditions of the fifteenth and sixteenth centuries. The early modern museum pioneers engaged in studies of such artefacts to understand their nature and utility, for example *materia medica* (herbs, oils, mineral, animals, and so forth) that could be used as raw materials in new pharmaceutical formulations (Cook, 1996, pp. 91–105; Mordhorst, 2003, 2009).

Such medical collections were not displaced to the margins of early modern culture. On the contrary, they were essential parts of the curricula of several leading European universities, for example in Basle and Bologna. The moving figures behind the Ashmolean Museum in Oxford and Royal Society's Repository had a medical background; so had Ole Worm, the founder of the Wormian Museum in Copenhagen (MacGregor, 1983; Hovesen, 1987). They all considered *materia medicia* such as rhinoceros horns, mummies, crystals and corals, to be among the most valuable and useful artefacts of their collections (Mordhorst, 2003, pp. 91–92; Olmi, 1993, pp. 247–249). From a modern medical point of view, such collections were pharmaceutical rather than medical because they did not contain any of those artefacts that are found in modern museums: there were no wet specimens of body parts, no surgical instruments, or any apparatus for diagnosis and medical treatment.

Medical collections in the modern sense, as we know them from nineteenth and twentieth-century museums, only appeared in the wake of modern empirical anatomy. For 250 years, following Vesalius's *De humani corporis fabrica*, hundreds of European anatomists described, in increasingly fine macroscopic detail, the nerves, muscles, glands and other inner organs of the human body. Fresh bodies were in short supply and woodcuts could not convey all necessary information; accordingly body parts and organs preserved in alcohol (later in formalin) were stored and displayed in study collections in universities and learned academies. Some of these specimens still exist; the best known is probably John Hunter's huge late eighteenth-century collection, the remains of which (most of the collection was destroyed in a bomb attack during the Second World War) are displayed in the recently reconstructed galleries of the Hunterian Museum at the Royal College of Surgeons in London. Preserved anatomical and pathological specimens in glass jars became a standard ingredient in the medical collections that sprouted like mushrooms throughout the nineteenth century and gave way to a large number of independent medical museums, often associated with medical schools; for example, in the USA there were so many that an Association of Medical Museums was established in 1907 (Arnold, 1996, pp. 15–29).

The emergence of the modern medical history museum, finally, is associated with the rise in social status of the medical profession

towards the end of the nineteenth century. As several historians have pointed out, the medical profession was largely powerless with respect to the treatment of diseases until the mid nineteenth century; some even suggest that iatrogenic (physician-generated) diseases became more frequent in the eighteenth and early nineteenth centuries as a result of the spreading of hospitals, which contemporary observers called 'hotbeds of infection' or 'gateways to death' (Porter, 1997, p. 375). During the second half of the nineteenth century, however, medicine began to make a difference, for at least three reasons: the political and economical measures to promote public hygiene; the discovery of bacteria as infectious disease agents; and the invention of anaesthesia that radically changed the scope of surgical intervention. These were followed by a host of constructs, discoveries and inventions, many of which were awarded Nobel Prizes in Physiology or Medicine after 1901. Medicine was eventually drawn into the great wave of industrialisation and modernisation, and as a consequence the medical profession rose in status, power and prestige.

As a consequence, medical doctors increasingly became engaged in documenting the history of their profession. Chairs in medical history were being established around the turn of the last century, followed by medical history institutes and journals, like the Institut für Geschichte der Medizin und der Naturwissenschaften in Leipzig and its *Archiv für Geschichte der Medizin*, both founded in 1906, and learned societies, like the American Association for the History of Medicine, founded in 1925. The profession's growing historical consciousness was also reflected in an interest in the material heritage of medicine. The armamentarium of modern medicine, its instruments, apparatuses, and inventions, was collected to provide medical doctors and students with an understanding of the progress of their art. These museums were open to the public as well, as mementos of medicine's place in the modernising process and, vice versa, as reminders of the horrors afflicting patients before the triumphs of modern scientific medicine.

The history of Medical Museion at the University of Copenhagen, exemplifies the establishment of medical history museums. In connection with the semicentennial anniversary of the Danish Medical Association (Den almindelige danske Lægeforening) in 1906, a group of Copenhagen physicians issued a call to their colleagues to collect broadly what they could find of old medical objects, including quackery remedies, curiosities, healthcare items, manuscripts and portraits. The newly founded Medical History Museum (Medicinsk-Historisk Museum) was soon flooded with donations and for many years complains about lack of space dominated its annual reports. The university took over the museum in 1918 and thirty years later it was moved to its present domicile in the former Royal Surgical Academy with adjacent buildings in central Copenhagen. The collections continued to grow, still largely by means of private donations, until the 1960s, when the flow of acquisitions began to recede.

Today the museum, renamed Medical Museion in 2003,[1] is one of the world's largest and richest repositories of medical history artefacts, including unique collections of microscopes, pharmacological utensils, radiological apparatus, odontological instruments, obstetric equipment and so forth. The collections hold about 60,000 registration units in total (each unit in turn often comprising several individual artefacts), ranging from the mid eighteenth to the mid twentieth centuries, organised like most other similar medical history collections around the world, namely, after health professional and medical specialisms: odontology, pharmacy, obstetrics, ophthalmology, surgery, microscopic anatomy, and so on. In addition, the museum holds some 60,000 iconographical specimens and a rich historical library.[2]

**Fig. 1.** This early nineteenth-century amputation saw is a typical evocative historical artefact that museum visitors can easily relate to (used with the permission of the Medical Museion, University of Copenhagen).

## 3. The presence of visible and tangible medical objects

With few exceptions, the artefacts in Medical Museion, as in other medical collections and medical history museums around the world, fit well into the traditional category of traditional collectable and displayable material artefacts. A typical artefact in medical history museums is a macroscopic, robust, material 'thing' that visitors can see, touch (at least in principle), and easily relate to, both cognitively and emotionally. Obstetric forceps and lithoclasts are excellent examples of such artefacts. Obstetric forceps have been used since the late seventeenth century to pull out the newborn child in case of obstruction to the natural birth process. The lithoclast (from Gr. *litho*, 'stone', and *klasto*, 'I crush') was invented in the early nineteenth century as an alternative to the painful and dangerous ancient method for removing bladder stones by cutting through the peritoneum; the new tong-like instrument was inserted through the urinary duct to crush the life-threatening stones inside the bladder.

Obstetric forceps and lithoclasts are made of familiar materials (wood and steel), they look similar to everyday objects (tongs), and their basic functions (crushing, pulling) are immediately understandable, even for young museum visitors. They are ideal museum artefacts because they stimulate the spectator's imagination by reminding them about how it feels to have medical instruments inserted into their precious body orifices. Women visitors usually have no problem envisioning how it may feel to be subjected to a pair of obstetric forceps. The lithoclast is among the favorite demonstration objects when the Medical Museion public exhibition guides want to catch the attention of an unruly group of school children; occasionally, young men faint when the guide tells them that it was inserted 'the natural way' and adds that the instrument was used routinely in the early nineteenth century—'before anesthesia'.

Other popular items for museums that wish to catch the attention of visitors are pathological organs in jars, mummified skinned head preparations, trepanation drill sets, and amputation saws (Fig. 1) in practical travel cases. All medical history museums contain plenty of similar wet specimens, instruments, and other emotionally evocative artefacts. They are 'good' museum artefacts for public display, because they elicit emotions, (sometimes painful) memories and associations, and make visitors pause in front of them with a variety of feelings: disgust, horror, curiosity and

[1] The choice of the name Medical Museion emphasises that research, teaching, collection activities and public outreach (including exhibitions) are closely integrated and mutually supporting activities. In other words, instead of making the traditional distinction between an academic university department and a museum, we consider research, curating and acquisition to be closely related forms of 'inquiry', and scholarly publishing, teaching and exhibitions as closely related aspects of 'presentation'.

[2] See further, www.museion.ku.dk.

wonder; and even physiological reactions. They provide the kind of thrill, 'the lure of leeches, body snatchers and pickled organs' (Moore, 1995), which has always drawn the public to medical history museum displays. Such popular notions 'provide a key to understanding the strength of feeling' to which these museums can have 'a privileged access' (Arnold 1996, p. 15).

In other words, popular medical history museum artefacts are those that relate to a clinical body which dominated medical discourse and practice from the early modern period to the mid twentieth century. The artefacts present themselves in a more or less straightforward manner to the senses because they relate to a human body with which we have an immediate perceptual and sensual relationship, namely what Rose (2007, p. 11) calls the 'molar' level: the scale of limbs and organs. Such traditional, visible, and, in principle, tangible medical artefacts make the past immediately present for the spectator, both cognitively and emotionally, by mobilising their personal bodily experiences; they provide opportunities for the spectators to connect with history in ways that textual descriptions rarely can. Both instruments and body macroparts are immediately accessible on an experiential level, with little or no need for mediating explanations or interpretations. They have what Gumbrecht (2004) calls 'presence effects'. The concept of 'presence' refers to an immediate and spatial relationship between the world and the body and its senses, rather than a relation between the world and the interpretative mind: 'What is 'present' to us (very much in the sense of the Latin form *prae-esse*) is in front of us, in reach of and tangible for our bodies' (ibid., p. 17).

A presence approach to museums involves a process of inquiry—probably best called 'aesthetics', or more specifically what Seel (2005) calls studies of 'appearances'—which focuses on other forms of world-appropriation than that which meaning conveys, and which takes seriously the fact that apprehending things in respect to how they appear momentarily to our senses is a genuine way in which human beings encounter the world. 'Appearance', in Seel's analysis, is the sum of conditions through which the world is given to us and presents itself to our senses. As Gumbrecht points out in a commentary to Seel, an aesthetics of appearance 'tries to bring back to our consciousness and to our bodies the thingness of the world' (Gumbrecht, 2004, p. 63). The dimension that this understanding of aesthetics opens up for, then, is one which tries

> to identify and to understand those conditions and devices through which appearance can be produced in a social and cultural environment where meaning attribution—and not sensual perception—is institutionally primordial in the ways in which we deal with the world. (Ibid.)

The research dimension that opens up, then, is to identify and understand 'those conditions and devices' through which appearance and presence effects can be produced in what is otherwise an apparently meaning-hegemonic museum setting. Such a research agenda would expand the possible impact of display activity in museums by eschewing the overwhelming emphasis on meaning, cognition and narrative, and instead paying attention to the ways in which we appropriate the world around us.[3]

Drawing on Gumbrecht's vocabulary, we suggest that it is precisely the expectation of being confronted with the presence-producing features of medical artefacts that lures the public into medical museums. In order to satisfy their visitors, museum curators therefore have every reason to continue to select such artefacts for their medical collection and exhibition activities. When doing so explicitly, however, curators are up against their own professional identity. The primary institutional identity of medical history museums is to promote public learning and understanding of medicine and medical science, that is (for medical history museums) to explain and make sense of what goes on in the world of medicine, medical science, and medical technology, and preferably with reference to history at large. The attribution of meaning to artefacts is the primary curatorial activity. In Gumbrecht's words, medical history museums (like museums of science and technology) are first and foremost concerned with 'meaning production', that is, scientific understanding, cultural interpretation, historical contextualisation, and so on. Consequently, the presence effects of artefacts—literally relating to the things as they immediately appear in front of us—is often overlooked, or ignored, in a museum culture based on meaning and interpretation.

Even if the evocative effects of medical artefacts are tacitly acknowledged in everyday practice and sometimes hinted at in museological discourse (as, for example, by Arnold, 1996), such effects are usually relegated to a secondary position vis à vis 'meaning effects' and are not systematically dealt with in the museological literature. The bulk of museological literature discusses artefacts in terms of 'meaning culture'. This hegemonic status of 'meaning culture' and 'meaning production' in the collective museological mindset is also reflected in the way material artefacts are treated in most academic museological studies. The 'thingness' qualities of material artefacts tend to slip out of the inquiry and are rapidly turned into language, into text. Scholars who write about artefacts often do not even seem to miss the sensation of holding the objects, of touching them, smelling them, inspecting them closely—even though the very 'thingness' of the objects was the point of departure for their studies (Olsen, 2004; Ingold, 2007). However, it should be noted that there have been several recent attempts at opening new spaces in museological discourse for other features of material objects—features more tied to 'the excessive and transient aspects of living' than those of cultural meaning. These studies are loosely structured around notions such as evocative or sensible objects (Turkle, 2007; Edwards et al., 2006), non-representationality (Thrift, 2007; Lorimer, 2005), affect (Thrift, 2004; McCormack, 2003), haptics (Hetherington, 2003; Obrador-Pons, 2007; Candlin, 2006), and presence (Gumbrecht, 2004; Runia, 2006). But while these recent attempts to refigure the study of material culture towards non-meaning based modes of engagement suggest a loosening of the grip of language and culture on museological discourse, the study of meaning and cultural context still remains the dominant mode of engaging with objects.

## 4. Are contemporary biomedical objects devoid of presence–effects?

The last decades have seen profound changes in medical research and clinical practices. The model of the molecular structure of DNA in 1953 and subsequent developments in molecular, and later cellular, biology have radically changed the research agendas and curriculums of medical faculties. A rapidly growing number of molecular technologies have changed diagnostic and therapeutic methods beyond everyday recognition. Digitalisation too has changed biomedical research and clinical practices drastically in the last decades so that many person-based procedures are now computer

[3] Note that the distinction between 'presence production' and 'meaning production' is ideal-typical. There are no 'pure' presence effects or meaning effects, and no presence production or meaning production as such. All museums are engaged in display practices that combine elements of ideal presence production versus meaning production. Both presence effects and meaning effects are culturally contingent, and the balance between them depends on the visitor's hermeneutical skills and prior knowledge, especially in the history of medicine. Nevertheless, we believe the distinction between the two ideal types is useful for providing a better understanding of what is going on in medical museum displays.

based. The concept of 'biomedicine' summarizes this fusion of molecular biology, cell biology and information technology with clinical medicine, diagnostics and therapeutics (Rhodes, 1996; Gaudillière, 2002; Cambrosio & Keating, 2003).

There are, of course, still thousands of different macroscopic, tangible, recognisable and robust material 'things' in today's medical institutions. Balances, centrifuges, and mice still fill the research laboratories. Stethoscopes, infusion pumps, syringes, and white coats are among the objects that still make us recognise a clinic in a glance. And for a patient involved in many of the clinical practices brought about by the biomedical revolution, there are any number of presence effects—one still shows up with ones body and have a myriad of experiences of moving, waiting, and being poked, prodded and punctured. But these experiences are more often qualitatively different from earlier forms of medicine, in that the biomedical engagement with the body takes place outside or below the threshold of physical relationality or commonsensical purpose. Typical contemporary medical objects are quite different from medical museum artefacts at the molar level and therefore do not easily fit into the traditional understanding of material museum artefacts. Many biomedical objects today are not visible or tangible in the conventional modern sense. Glass vessels and test tubes in research laboratories have largely been replaced by microwells and microarrays, increasingly at the nanolevel (microfluidics); light microscopes for visual inspection of tissue structure have been substituted by digitised instruments that detect fluorescent signals in the invisible ultraviolet spectrum at the cellular or even molecular levels; and research animals are increasingly giving way to inconspicuous cell and tissue cultures or microscopic bacteria and viruses. Similarly, the manual analytical chemical procedures at the bench in hospital laboratory departments have largely disappeared; today's analyses of micro, nano or pico amounts of body fluid constituents are taking place inside machines, and human hands have been replaced by genderless robotic arms that mindlessly perform the mixing of reagents and automatically read and calculate the results.

The examples can be multiplied. Doctors in X-ray departments used to produce pictures of the inner parts of the body on large, tangible photographic plates in a procedure analogous to photography; now floor space and medical prestige has been taken over by nuclear medicine specialists whose MRI and PET scanners have little similarity to cameras or X-ray apparatuses. In hospital operation theatres, scalpels and surgical tongs are gradually substituted by laparoscopic and cybersurgical methods. Hospital clinics, finally, bear little resemblance to the traditional ward that we know from illustrations in medical history textbooks or reconstructions in medical history museums; both in neo-natal and intensive care units, today's patients are supervised by a host of digitised monitoring systems reminiscent of aircraft cockpits with blinking diodes and fluorescent screens.

Molecularisation, automatisation, digitisation, miniaturisation: these are some of the keywords for the profound changes that have swept across medical laboratory and clinical culture in the last decades. One consequence of this transformation of medicine is the increasing cultural production, circulation and consumption of objects that do not harmonize with the traditional understanding of museum artefacts. The material culture of contemporary biomedicine no longer primarily involves macroscopic, visible, tangible, recognisable, and robust 'things'. The most significant objects in contemporary biomedical laboratories and hospital clinics are still material from the viewpoint of realistic epistemology, but they are microscopic rather than macroscopic, invisible rather than visible, intangible rather than tangible, unfamiliar rather than recognisable, delicate rather than robust. Furthermore, they often transcend the border between the material and the immaterial.


**Fig. 2.** This early twenty-first-century GeneChip® can analyze the expression level of many thousands of well characterized genes in a single run, but lacks the qualities of a traditional evocative museum object (used with the permission of the Medical Museion, University of Copenhagen).

The following two examples—DNA microarrays and molecular therapy—illustrate the challenge to museums presented by these transformations in the features of biomedical objects. DNA microarray analysis is one of the most sophisticated methods in the post-genomic laboratory. It is based on the so-called hybridisation reaction, that is, that two single-stranded oligonucleotide molecules coil together in a double helix if their nucleotide sequences are complementary. A known oligonucleotide sequence can thus be used as a probe to identify an unknown sample sequence. In a microarray hundreds of thousands of known oligonucleotides are used to identify the unknown messenger-RNA species; the method makes it possible to gauge the level of gene expression in the entire genome, that is, which genes are 'on' and which are 'off', in one single run. The analytical power of microarrays has ushered a rapid growth of expectations in the biomedical research community and the pharmaceutical industry to translate genomics into diagnostic and therapeutic tool for individualized drug treatment: 'The explosion in interest in DNA microarrays has almost been like a gold rush', says the author of a standard textbook in the field (Knudsen, 2004, p. 2). The most widely used and best known microarray platform, the Affymetrix GeneChip®, was invented around 1990 and put into industrial production a few years later.[4]

While microarray analysis is a ubiquitous and most powerful method in all kinds of biomedical research, it presents a problem

[4] For Affymetrix's own historiography, see Affymetrix, Inc. (n.d.).

for museum curators. What is immediately available for display of a GeneChip® is only the 1 × 2 inch plastic casing. The ½ × ½ inch 'chip' inside, with some half million oligonucleotide molecular-sized probes attached to it in an array pattern, is not immediately visible, or intelligible. Furthermore, the result of the test is visible only indirectly; the expression data are produced by reading the hybridization pattern on the chip with a laser scanner (which looks like an advanced coffee brewing machine) and the result is interpreted by a computer program. It is hardly necessary to say that the GeneChip® (Fig. 2) and other microarray systems, which are now revolutionizing medical diagnostics, make for lousy museum artefacts. The components of the platform—molecules, digital code, incomprehensible manuals—are abstract, intangible, anonymous and unrecognisable. The artefacts that together constitute the microarray platform hardly evoke any memories or emotional reactions for ordinary museum visitors and they are difficult to relate to in a bodily and spatial manner.

Another example of how recent biomedicine presents a challenge to museums is molecular therapy. Traditionally, pharmacology is based on trial-and-error experience. The administered drug may not even be chemically characterized (as in folk herbal medicine) and physicians usually have no knowledge of the biochemical mechanism behind the effect; it just happens to work. Molecular therapy means that the black box is being opened up so that the biochemical mechanism that mediates between the active substance and the physiological response is elucidated. A good recent example of molecular therapy is AstraZeneca's Losec®, the world's best-selling drug against ulcer and heartburn in the 1990s. Before the 1990s, ulcer patients were largely treated with surgery; today they are given antibiotics against the *Heliobacter* infection together with Losec® to decrease stomach acidity. Losec® and a number of copy drugs are also most common and effective non-prescription drugs against heartburn.

The active substance in Losec® and similar drugs is a synthetic molecule, omeprazol, which specifically blocks the proton pump and hence acid production in the stomach lining; the omeprazol molecules work as a kind of 'biochemical microsurgery'. It is a smart therapy (and a major source of income for AstraZeneca), but hardly a bestseller for medical history museums. A pill with omeprazol looks like any other pill with any other active substance. The presence effect of the pill is restricted to its generic quality of being a pill, not to its quality of being this particular wonder drug with these specific effects. Also, even though the pill is tangible, the billions of 'molecular knives' (omeprazol molecules) are intangible and invisible; in the same way, the object of the 'surgery' (the ion channels in the gastric lining) are intangible and invisible to the naked eye. Furthermore, the most interesting 'object' is neither the pill nor the molecule, but the international network of scientists, medical doctors, advertising firms, and financial analysts who made a business success out of the omeprazol molecule. A museum curator could, of course, put a pill on a piece of black cloth under a spotlight and play a recorded deep voice telling the visitor that it gave AstraZeneca eight billion US dollars in revenue in the year 2000 only. But such stories are probably better told in books and magazines than in exhibitions. Likewise, the molecular and biological mechanisms of omeprazol are better told in book pages and computer screens than in museums.

Microarray technology and molecular therapies exemplify the problems involved in collecting and exhibiting recent biomedicine. Biomedical artefacts of the last decades are very different from those traditional material artefacts displayed in medical history museums. They are smaller (often microscopic), more abstract and mediated, less (if not altogether in-) tangible, and generally much less emotionally evocative than traditional medical objects. Increasingly, biomedical objects are not even unequivocally 'material' in the traditional sense, but rather a kind of 'boundary artefacts' (Star & Griesemer, 1999), namely, they are 'material objects', 'texts' and 'images' simultaneously, depending on the context.

A PET (positron emission tomography) scanner is a case in point. The instrument produces images that represent the inner metabolism of the body: the patient is injected with glucose molecules marked with a short-lived isotope that emits positrons which in turn can be measured by a detector. The ensuing data are then interpreted by a computer program to represent slices (tomography) of the spatial distribution of glucose metabolism in the body on a screen. For example, the screen image of metabolism in the brains of patients with Alzheimer's disease is significantly different from that in 'normal' patient brains. The PET scanner is an impressive piece of combined digital and molecular technology that has already had great impact on medical diagnostics. As with other contemporary imaging technologies, such as MRI, it is a potential 'must' in any museum that wishes to document and exhibit significant features of recent biomedicine. But, whereas earlier imaging technologies, like X-ray machines, are easily understandable in terms of 'modern medicine' and hardly create any problems for medical museum curators, the PET scanner poses at least two museological problems. First, it defies traditional museological display strategies. The directly visible and tangible 'objects'—the enclosing cabinet and the bed that the patient is placed on during the scanning procedure—are largely irrelevant for the functionality of the scanner. The working material parts are either invisible and non-tangible (the isotope molecules) or non-intelligible (the detector and the computer hardware) and in addition do not make much sense without the resulting screen image. The 'image' in turn is indeed visible as long as the machine runs, but it is not tangible; it is an ephemeral result of the handling of signal data by the 'text', that is, the computer program code. (Another important text, placed outside the combined material–visual–textual artefact, yet part of the PET platform, is the manual, which is as complicated as the artefact.) The other problem (and this is why we are placing the words 'object', 'image' and 'text' between inverted commas) is that the PET scanner blurs the traditional categories of 'object', 'image' and 'text'. How shall it be classified as a contemporary medical heritage item? Does it belong among other museum artefacts? Or is it better placed (as an image) in an iconographical collection? Or even (as program code) in the archives?

As for their value as museum specimens—and in contrast to 'good' artefacts like the obstetric forceps and lithoclasts discussed above—the new biomedical objects are 'bad' museum artefacts, because they hardly trigger the spectator's spontaneous attention. They do not elicit memories, they do not evoke emotions, and they do not make visitors pause in front of them with a sense of horror, curiosity or wonder. They do not provide the thrill and lure of leeches, body snatchers and pickled organs. They are molecular, not molar, and thus operate on a level that we are not used to relating to in our lives and self-understanding. To invoke Gumbrecht's (2004) vocabulary again, such artefacts do not have any noticeable presence effects. Unless, of course, the museums visitor is a biomedical or biotech geek, these kinds of artefacts—indeed the whole armamentarium of objects that the biomedical and biotechnological industry produces ad libitum in these days need heavy explanation, contextualisation and interpretation to make sense to most audiences.

## 5. Cultural interpretation and historical contextualisation as museological escape routes?

Our main argument is that museums today are caught in a paradox. On the one hand, biomedicine invades more and more aspects of our life trajectories, from preconception genetic testing

and counselling to the terminal visit to the intensive care unit (and even beyond, to the cryogenic body bank and the expectations of a future breakthrough in tissue engineering), and, as a consequence, sets increasingly influential agendas for political and ethical discourses. The new bioeconomy, that is, the market interactions between the transnational biomedical–industrial complex (Big Pharma) and the steadily growing popular demand for better health care, is turning biomedicine into a significant player on the global economic arena. Biomedicine has entered the political scene too. While some view its recent developments as a threat to basic human values, others see it as a key to the future of humankind. New technologies such as cloning, stem cell manipulation, tissue engineering, and nanomedicine have raised both professional and popular expectations of the powers of biomedicine, to combat, for example, cancer and degenerative diseases. The public has every reason to demand that museums (in general, not just medical history museums), as institutions for 'the documentation, acquisition, conservation and display of material artefacts' (Vergo, 1989, p. 2), will bring this vital sector of contemporary society world into museums and find a place in their collections and exhibitions for the new biomedical objects.

However, the whole idea of what constitutes a museum collection and what is displayable is becoming questionable as biomedicine has made medical diagnostics and treatment and the functions of the normal and diseased human body less and less visible, less and less tangible, and less and less sensuous. Is there any point in collecting and displaying such material, yet invisible, intangible and anonymous, objects as museum artefacts? After all, who would bring their family to the local museum on a Sunday afternoon to gaze at plastic cabinets discretely labelled PerkinElmer or Hewlett-Packard, look at anonymous small white pills or inconspicuous plastic vials allegedly filled with monoclonal antibodies, watch video screens representing repetitive patterns of DNA hybridization, or read pages of software code? Will not those members of the public who are curious about the emergence of biomedicine and its impact on the contemporary world rather download the molecular images on their computers or read about the history of genomics and proteomics on a webpage, in a book, or in a magazine article? It makes sense to visit a museum to watch lithoclasts, amputation saws, and tumours in glass jars? But why on earth visit a museum if one wants to 'see' the marvels of contemporary biomedicine?

An immediate answer to this museological paradox from a seasoned museum curator would be to avoid these invisible, non-sensuous and intangible objects, and focus instead on narratives that contextualise biomedicine, socially, culturally and historically. There is much that speaks in favour of this solution. The combined process of molecularization and digitalization of the laboratory and the clinic ('biomedicalization') is indeed embedded in a broader social, political and cultural context (Clarke et al., 2003). For example, microarray technology provides a good focusing point for understanding the history of recent biomedicine and post-genomics. First, it can serve as the centerpiece in a broader narrative of the cognitive and institutional development of biomedicine in the last fifty years as the progressive merger of molecular biology with information technology and the fusion of studies of normal biology with clinical studies. Second, the technology can illustrate the restructuring of healthcare in advanced post-industrial societies towards increased individualisation of diagnostics and treatment. Third, by drawing on globally produced and globally available sequence data bases it epitomizes another salient aspect of the biomedical revolution, namely, its integration in the process of globalization. A fourth way to contextualise microarray technology could be to contrast the commercial appropriation of the technology by Affymetrix, Roche and other companies, on the one hand, and microarrays produced by the vibrant laboratory open source technology movement, on the other, thereby showing how biomedical technologies is situated in the triple helical tension between government, private industry and a non-proprietary university research culture. Furthermore, as one of the few biomedical technologies that has made it to the front page of the *Financial Times*, the GeneChip® is an example of how cutting edge university research often has given rise to successful private enterprises (the 'Silicon Valley effect') over the last decades. Finally, microarray technology reminds us of Sloterdijk's (1999) point that biotechnology, for better or for worse, can make the old vision of eugenics come true. There are many interesting stories to tell, and the little $1 \times 2$ inch plastic chip could be the centerpiece for them all.

But whatever narratives museums choose to tell, curators are still stuck with the problem that the traditional *raison d'être* of museums is that they are institutions for collecting and displaying tangible, material artefacts. Narratives and contextualisations are wonderful additions to the display of the artefacts. But it is still the artefacts that count, and if they begin to disappear from the sight of the spectator, or dissolve into pixels and code, then so much the worse for museums. Therefore—given that tangible, material objects are the *sine qua non* of the museum institution—will a focus on recent biomedicine be a suicide act for museums who take this sector of contemporary society seriously? We believe that this is a genuine museological problem and one that all museums with medical artefacts will have to face in the near future—unless they want to restrict their activities to the safe realm of 'modern medicine' from the seventeenth century to the mid twentieth.

## Acknowledgments

This paper draws on the integrated research and curatorial project 'Biomedicine on Display' at Medical Museion, University of Copenhagen, funded by the Novo Nordisk Foundation in 2005–2009.

## References

Affymetrix, Inc. (n.d.). *Pioneering an industry*. http://www.affymetrix.com/support/technical/other/pioneer_brochure.pdf. Santa Clara, CA: Affymetrix, Inc.
Agamben, G. (2007). *Profanations*. Cambridge, MA: Zone Books.
Arnold, K. (1996). Time heals: Making history in medical museums. In G. Kavanagh (Ed.), *Making histories in museums* (pp. 15–29). London: Leicester University Press.
Arnold, K. (2004). Museums and the making of medical history. In R. Bud (Ed.), *Manifesting medicine* (pp. 145–170). London: Science Museum.
Cambrosio, A., & Keating, P. (2003). *Biomedical platforms: Realigning the normal and the pathological in late-twentieth-century medicine*. Cambridge, MA: MIT Press.
Candlin, F. (2006). The dubious inheritance of touch: Art history and museum access. *Journal of Visual Culture*, *5*, 137–154.
Clarke, A., Shim, J., Mamo, L., Fosket, J., & Fishman, J. (2003). Biomedicalization: Technoscientific transformations of health, illness, and U.S. biomedicine. *American Sociological Review, 68*, 161–194.
Cook, H. (1996). Physicians and natural history. In N. Jardine, J. A. Secord, & E. C. Spary (Eds.), *Cultures of natural history* (pp. 91–105). Cambridge: Cambridge University Press.
Edwards, E., Gosden, C., & Phillips, R. B. (Eds.). (2006). *Sensible objects: Colonialism, museums and material culture*. Oxford: Berg.
Findlen, P. (1994). *Possessing nature: Museums, collecting, and scientific culture in early modern Italy*. Berkeley: University of California Press.
Gaudillière, J. (2002). *Inventer la biomedicine: La france, l'amérique et la production des savoirs du vivant (1945–1965)*. Paris: La Découverte.
Gumbrecht, H. (2004). *Production of presence: What meaning cannot convey*. Stanford: Stanford University Press.
Hetherington, K. (2003). Spatial textures: Making place through touch. *Environment and Planning A, 35*, 1933–1944.
Hovesen, E. (1987). *Lægen Ole Worm*. Århus: Århus Universitetsforlag.
Ihde, D., & Selinger, E. (2003). *Chasing technoscience: Matrix for materiality*. Bloomington: Indiana University Press.
Ingold, T. (2007). Materials against materiality. *Archaeological Dialogues, 14*, 1–16.
Knudsen, S. (2004). *Guide to analysis of DNA microarray data* (2nd ed.). New York: Wiley.
Lorimer, H. (2005). Cultural geography: The busyness of being 'more-than-representational'. *Progress in Human Geography, 29*, 83–94.

MacGregor, A. (Ed.). (1983). *Tradescant's rarities: Essays on the foundation of the Ashmolean Museum*. Oxford: Oxford University Press.
McCormack, D. (2003). An event of geographical ethics in spaces of affect. *Transactions of the Institute of British Geographers, 28*, 488–507.
Moore, W. (1995). Blood and gore tour. *Independent on Sunday*, *15 January*. (Quoted in Arnold, 1996, p. 1)
Mordhorst, C. (2003). Medical use and material matters. *Ethnologia Scandinavica, 33*, 84–98.
Mordhorst, C. (2009). *Genstandsfortællinger: Fra Museum Wormianum til de moderne museer*. Copenhagen: Museum Tusculanum Press.
Obrador-Pons, P. (2007). A haptic geography of the beach: Naked bodies, vision and touch. *Social and Cultural Geography, 8*, 123–141.
Olmi, G. (1993). From the marvellous to the commonplace. Notes on natural history museums. In R. G. Mazzolini (Ed.), *Non-verbal communication in science prior to 1900* (pp. 247–249). Firenze: Leo S. Olschki.
Olsen, B. (2004). Momenter til et forsvar av tingene. *Nordisk Museologi*, *2004*(*2*), 25–26.
Porter, R. (1997). *The greatest benefit to mankind*. London: Fontana Press.
Rhodes, L. A. (1996). Studying biomedicine as a cultural system. In C. F. Sargent & T. M. Johnson (Eds.), *Medical anthropology: Contemporary theory and method* (pp. 165–180). Westport, CT: Praeger.
Rose, N. (2007). *The politics of life itself: Biomedicine, power and subjectivity in the twenty-first century*. Princeton: Princeton University Press.
Runia, E. (2006). Spots of Time. *History and Theory, 45*, 328–336.
Seel, M. (2005). *Aesthetics of appearing*. Stanford: Stanford University Press.
Sloterdijk, P. (1999). *Regeln fur den Menschenpark*. Frankfurt am Main: Suhrkamp Verlag.
Star, S. L., & Griesemer, J. R. (1999). Institutional ecology, 'translations' and boundary objects: Amateurs and professionals in Berkeley's Museum of Vertebrate Zoology, 1907–39. In M. Biagioli (Ed.), *The science studies reader* (pp. 503–524). New York; London: Routledge.
Thrift, N. (2004). Intensities of feeling: Towards a spatial politics of affect. *Geografiska Annaler, 86*, 57–78.
Thrift, N. (2007). *Non-representational theory: Space, theory affect*. London: Routledge.
Turkle, S. (2007). *Evocative objects: Things we think with*. Cambridge, MA: MIT Press.
Vergo, P. (1989). *The new museology*. London: Reaktion Books.