
Racialising the Virile Body: Eadweard Muybridge's Locomotion Studies 1883–1887

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In 1883, the photographer Eadweard Muybridge was invited to the University of Pennsylvania to conduct one of the first sponsored research projects of the modern American university. The investigations concerned the sequential photography of human and animal movement, resulting in over 100,000 images and 781 published collotype plates containing more than 20,000 figures of moving men, women, children, animals and birds.¹ Dr William Pepper, the University's provost, and others, including the American realist painter Thomas Eakins, were instrumental in bringing Muybridge to the university, a move that allowed Muybridge to continue the motion studies that he had completed with Leland Stanford in 1879. The university provided Muybridge with space, extensive equipment and assistants in order to undertake the project, which he conducted between 1884 and 1887.² Dr Pepper also created a commission to oversee Muybridge's research, consisting of nine professionals, seven of whom were doctors or engineers employed by the University of Pennsylvania (the other two were Thomas Eakins and Edward Coates, both of the Pennsylvania Academy of Fine Arts). As film historian Tom Gunning has recently remarked, Muybridge was a bit of a 'crazy uncle' whose project straddled 'intersections between photography, science, art and new forms of mass entertainment'.³

The Muybridge project's immense scope and complexity has been further documented in archival material concerning Muybridge's University of Pennsylvania work recently made available to scholars at the Smithsonian's National Museum of American History (NMAH). NMAH Photographic Specialist Michelle Delaney has helped to build scholarship on a group of 850 cyanotype, or 'blueprint', contact proof sets that Muybridge made from his Animal Locomotion negatives.⁴ The

original glass-plate negatives for these images have never been found.⁵ Most of the NMAH cyanotypes are sheets of blue, non-enlarged photographs, printed directly from the lost glass-plate negatives onto thin, off-white paper and cut to size. This process replicates the long, thin strips of glass-plate negatives, which are usually about 30 cm long and 1.2 cm wide. These blue-tinted contact prints are mounted on 850 separate thin sheets of cardboard and labelled using pre-printed sheets with blanks for the Animal Locomotion plate number, title, classification, as well as the negative series number and the number of views taken (Figure 1).

In Figure 1, we see a young woman, artist model Blanche Epler – paid for four hours of work on this autumn day of 25 September 1885 – walking up and down a short flight of stairs with a water vessel.⁶ The sequence of images here, which most Westerners would read from left to right, suggests a filmic narrative of small, incremental changes in time, captured through the instantaneous photography of Muybridge's multi-camera apparatus. But as Marta Braun has so brilliantly demonstrated, a close analysis of the printed plates reveals curious temporal gaps, usually ignored in the viewer's effort to render the series a narrative of discrete and temporally contained, motions.⁷ Here, for example, Miss Epler apparently turns about face in the third image; whereas the first two images show her moving up the stairs, in the third image she is darting down to the final step. Further viewing time reveals that perhaps these images are not a connected sequence after all; in the fourth image, an earthenware vessel, which had been on the ground in the first three images, has replaced the dish of water that Miss Epler obligingly carries before the camera. Below the top row of images, other contact prints show the results of rear and frontal views; Muybridge usually photographed each subject simultaneously from three different positions, using a battery of twelve cameras for the lateral view and another two cameras with twelve lenses for the front and rear views. The label on the top of the image shows additional information not available in the printed collotype plates. Most importantly, the inclusion of the series negative number (here, number 1419) allows the researcher to match the images to the remaining extant Muybridge workbooks, now located in the International Museum of Photography, George Eastman House in Rochester, New York. In this case, for example, we learn that immediately after this series of images Miss Epler disrobed, performing a related series in the nude. Although the printed plates reflect the cyanotype proofs in every detail, revealing that the negatives that made the cyanotypes were used for the final printed version, the inclusion of additional information in the cyanotypes allows for further research into the Muybridge project. The discovery of these

proofs has sparked a renewed interest in Muybridge's University of Pennsylvania work, for now scholars have new visual evidence for his working methods.⁸

Despite the complexity of this project as a site for competing discourses concerning science, art and mass culture, Muybridge straightforwardly declared his own interests in the University of Pennsylvania project. His studies of both human and animal movement would be of value, he claimed, to both 'the Scientist and the Artist'. Muybridge seemed especially interested in effectively bringing science and art into close dialogue with each other. In his press scrapbook from the project, the one theme that is consistently underlined, by what looks like Muybridge's hand, is the necessary interrelationship between science and art. A typical underlined sentence: 'Science can never furnish a substitute for the artistic sense. But there is no reason why the artist should not avail himself of all that science can teach him'.⁹

Some readers may be familiar with at least some of the historiography concerning this famous project, which has included arguments over the origins of cinema, the discourse of science and art, Muybridge's relationship to Eakins and nineteenth-century realism, feminist critiques of pornographic visuality and, more recently, pathological locomotion.¹⁰ The cacophony of scholarly voices here can be partly attributed to the complexities of the text. Despite Muybridge's central role in the project, others were also involved in the work; he cannot properly be understood as the project's sole 'author'.¹¹ The polysemic nature of the photographic text also opens the project to a number of readings, both historical and theoretical; these readings are informed, in part, by the tumultuous history of late nineteenth-century race and gender politics.

As a generation of photographic critics has argued, the history of photographic meaning is necessarily a history of institutions and of structures of power relations of dominance and subordination that have specific histories that shape the ways in which photographic meaning is produced. John Tagg, working within an Althusserian and Foucauldian framework, has argued that photography has no intrinsic identity, that what is real is not just the material item but more importantly 'the discursive system of which the image it bears is part'.¹² Allan Sekula, working with the assertion that 'photographic meaning depends largely on context', has sought to understand how photography 'serves to legitimate and normalise existing power relationships'.¹³ Tagg and Sekula, in particular, have shown how 'instrumental' photographic images, such as mug shots, anthropological records, medical images and even documentary photographs were central to managing the new forms of governance intrinsic to colonial expansion, the second industrial revolution and state formation in the late nineteenth century.¹⁴ Their efforts have

been joined by a generation of cultural and photographic historians who have become suspicious of modernism's allegiance to 'the thing itself' (the term is John Szarkowski's, former curator of photography at the Museum of Modern Art), instead focusing on how the photograph, in Abigail Solomon-Godeau's formulation, has been made subject to the 'grids of meaning imposed upon it by culture, history, language'.¹⁵

In this article I wish to attend, literally, to the photographic 'grid' by resituating Muybridge's University of Pennsylvania work in relationship to ideas concerning the gendered nature of racial progress in the late nineteenth century. Borrowing from Michael Omi and Howard Winant's work on racial formation, I want to think through the University of Pennsylvania work as a historically situated racial project in which 'human bodies and social structures are represented and organized' in order to create, inhabit, transform or destroy racial categories.¹⁶ Race and gender are not ontologically given; they are categories that signify and symbolise relations of power, categories that are articulated and contested in the realm of culture, in relationship to human bodies whose racial and gender specificity becomes knowable, in part, through visual representation. In this essay, I argue that the University of Pennsylvania Muybridge project reveals an investment in gendered evolutionary race science, an investment that we can retrieve through an investigation into three related sites, all connected to anthropometry. The first site concerns the anthropometric grid; the second site concerns scientists' investment in this research; and the third concerns the racialising and gendering of some of the male models engaged for this project.

The first site: anthropometry and the grid

A key aspect of an alternative reading of this project as inflected by nineteenth-century race science concerns the role of anthropometry in the University of Pennsylvania project. By the second half of the nineteenth century, measurement technologies of the body's external features had become increasingly standardised in an anthropological sub-discipline known as anthropometry, 'the technique of expressing quantitatively the form of the human body'.¹⁷ In the United States, the Civil War marked what one historian has called a 'watershed' in anthropometric developments, not only because of the widespread anthropometric examination of Union soldiers, but also because nearly all post-bellum theories of racial inferiority focused upon war anthropometry for scientific validity.¹⁸ While Samuel Morton's work in this field, which had been used as a justification for slavery, lost its influence

in the United States in the wake of the Civil War, his work took root and flourished in Europe, especially in the work of polygenist Paul Broca. As C. Loring Brace has argued, 'The techniques that Broca elaborated from Morton's beginnings were adopted in England ... and later, Hrdlička and Hooton [founders of American physical anthropology] saw to it that these returned to American anthropology as it grew in the twentieth century'.¹⁹ Anthropologists continued to pursue anthropometric methodologies throughout the nineteenth and into the twentieth centuries, avidly measuring bodily and facial characteristics, such as stature, arm length, head length and width and nose length.²⁰ Anthropologists were most likely to study either institutionalised or non-white populations, such as the 'feeble-minded', school children, Native Americans, blacks or colonised subjects. The idea was that the measurement of anatomical differences could help define racial types and that the isolation of these racial types could help (for some investigators) illuminate not only physical differences, but cultural, mental and moral differences as well. Through measurement, racial typologies and hierarchies – of both body and mind – were constructed and naturalised. This work continued through the 1920s among eugenicist scientists. As one concluded in 1928, 'the reason for using the stature-capacity index is fairly clear. The brain very evidently has something to do with intelligence and it would seem only reasonable to suppose the larger the brain relative to the size of the individual, the greater would be his or her intelligence'.²¹

Photography became central to this enterprise of constructing and mapping somatic difference.²² In physical anthropology, photography's principal contribution through at least the 1920s was the documentation of distinct racial types. Historians of physical anthropology, photography and empire have noted several of the major efforts to use photography as a means of taxonomising racial types. In 1850, the prominent American natural scientist Louis Agassiz arranged for Joseph T. Zealy to daguerreotype five South Carolina slaves in order to document somatic evidence of tribal difference.²³ In 1873, the year after Muybridge began his work with Leland Stanford in California, two photographic projects designed to chart racial difference got underway in Europe: the Hamburg photographer Carl Dammann's *Ethnological Gallery of the Races of Men* (published in English in 1875); and the British Lieutenant Colonel William Marshall's study of South Indians, entitled *A Phrenologist among the Todas*, which was illustrated by photographs of residents of Madras and Simla.²⁴ Whereas some of this work represented more fluid approaches that were dictated as much by moments of encounter as by systematic mapping, other efforts were underway to standardise photographic methodologies across subjects. In 1869, J. H. Lamprey proposed

the photographic incorporation of the metrological grid system, long used by artists seeking to accurately portray bodily proportions (Figure 2). Although some French systems predate Lamprey's approach, his grid system was published in the London-based *Journal of the Ethnological Society* and was thus made available to English-speaking professional

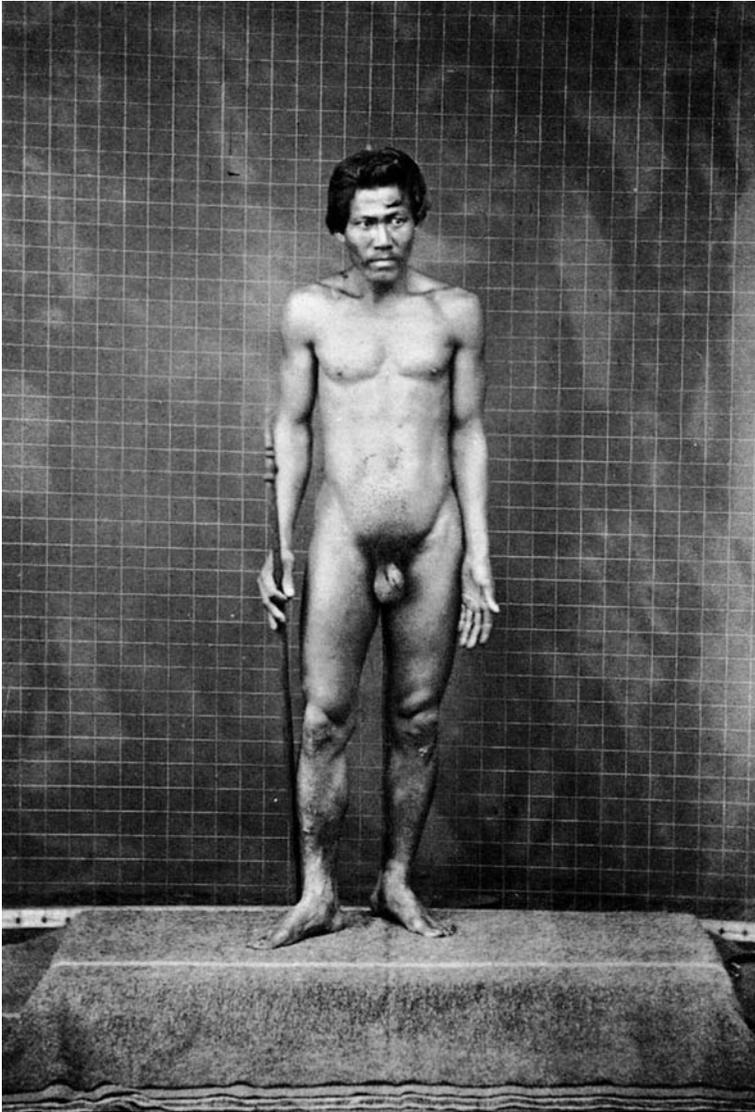


Figure 2: Front view of a Malayan male, photographed by J. Lamprey, c. 1868–9. Royal Anthropological Institute of Great Britain and Ireland (no. 2116).

audiences.²⁵ The system allowed some generalised comparisons across subjects and was widely followed.²⁶

The introduction of photography to the emerging discipline of physical anthropology helped define a new genre in visual culture, the anthropological photograph. Despite the variations in approach that continued to frustrate those scientists who sought a standardised methodology, the anthropological photograph emerged during the late nineteenth century with a recognisable set of visual signs. For example, the American polygenesis advocates J. C. Nott and George R. Gliddon urged those interested in 'ethnic iconography' that 'the same portrait should be photographed both in *front view* and in *profile* [emphasis in original]'. M. V. Portman, a colonial officer in the Andaman Islands, wrote that when photographing 'savages', the subjects should be 'stark naked, a full face and a profile view should be taken of each and the subject should touch a background painted in black and white chequers, each exactly 2 inches square'.²⁷ In Figure 2, for example, a Malayan male stands before the camera, his right hand holding a staff while his left palm opens towards the camera in a gesture of cautious vulnerability. As in many of these photographs of racial 'types', the subject avoids returning the camera's gaze. The power relations of looking that structure such photographs imply a nineteenth-century white viewer allowed to enact the colonising gaze without risking the confrontational gesture of the colonial subject's 'looking back'.²⁸ The subject's powerful legs are slightly parted away from the centre of his body, while his arms and hands are held away from the torso; the overall attitude of the model, slightly elevated on a fabric-covered platform, suggests a puzzled, though not necessarily hostile, reluctance. Behind him, the grid of silk threads at two-inch intervals helps construct an emerging iconography of visual empiricism, where signs of measurement signal the rhetoric of a disinterested scientific endeavour. Lamprey argued that the vertical silk lines would allow the comparison of height between, for example, a 'good academy figure or model of six feet' with 'a Malay of four feet eight in height' (the image of Lamprey's model in Figure 2, however, suggests a height of five feet, three inches). The horizontal lines would allow the comparative study of anatomical structure and contour.²⁹ As critics of photography, the state and empire have argued, however, the joining of photography and science, especially in this period, was central to the creation of instrumental images where state power was masked by the discourse of photographic objectivity.³⁰

That Lamprey's anthropometric grid shows up for the first time in American photography in Muybridge's University of Pennsylvania project suggests that a racialised narrative informed the project. Lamprey's system posed the body against a gridded backdrop divided into two-inch squares by means of silk threads; Muybridge's grid was composed of threads dividing the field into five-centimetre squares (Figure 3).³¹ Even

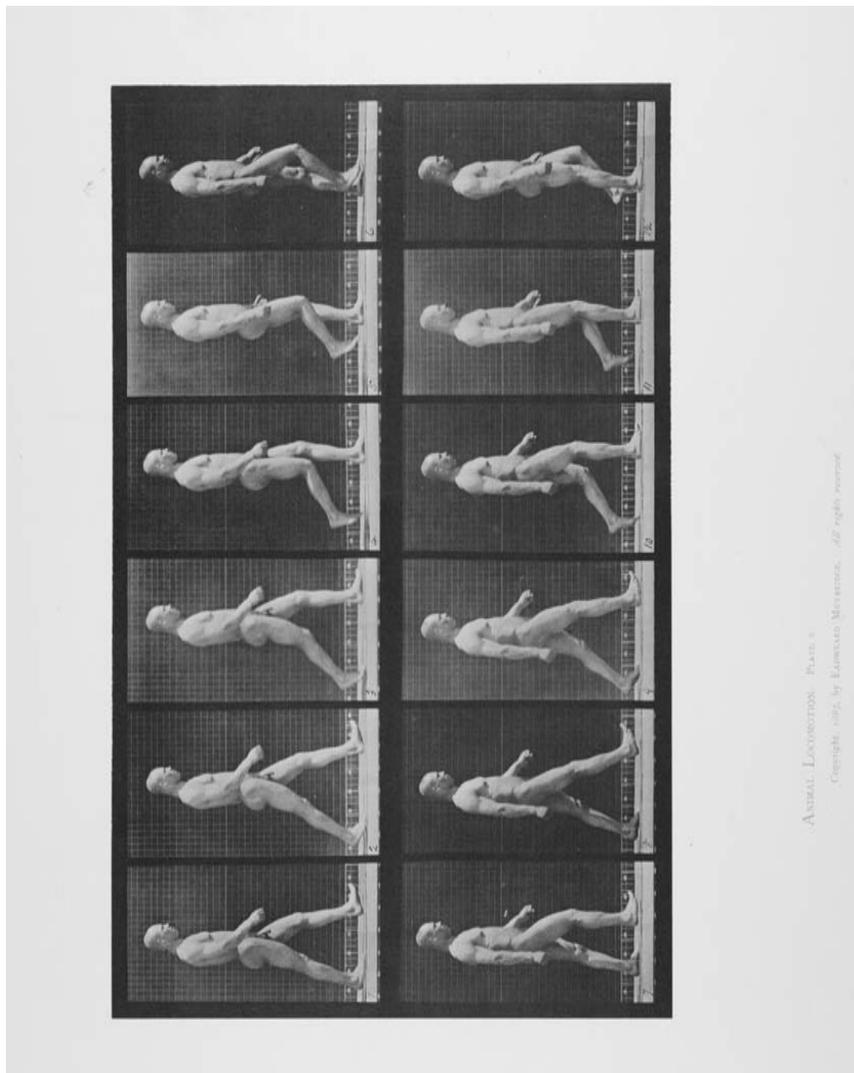


Figure 3: Eadweard Muybridge, PL 6 Walking (Ben Bailey) (1887). Photographic History Collection, NMAH (catalog no. 2430).

more relevant, Muybridge did not begin his work at the University of Pennsylvania using the metrological grid. As Marta Braun shows, his earliest images, taken in the spring and summer of 1884, were made on the University Veterinary Hospital grounds against a solid background, the same as he had used in California for his earlier motion studies (Figure 4).³² In Figure 4, we see a sequence of images of a woman spanking a child; unlike the later sequences, where human and animal models move in a direct course past a bank of cameras, in this case the models remain stationary while six cameras arrayed in an arc covering 180 degrees describe the models from six different points. This method of working was abandoned by the early summer of 1885, when Muybridge was finally able to perfect the system for which the series is best known, batteries of twelve cameras placed at three different angles to the model.³³ The unlined backdrop suggests that the implicit goal was the visual description of the models and their activity, rather than their measurement.

As Braun shows, the metrological grid appears for the first time in Muybridge's work on 2 June 1885 when, while working in the 524–31

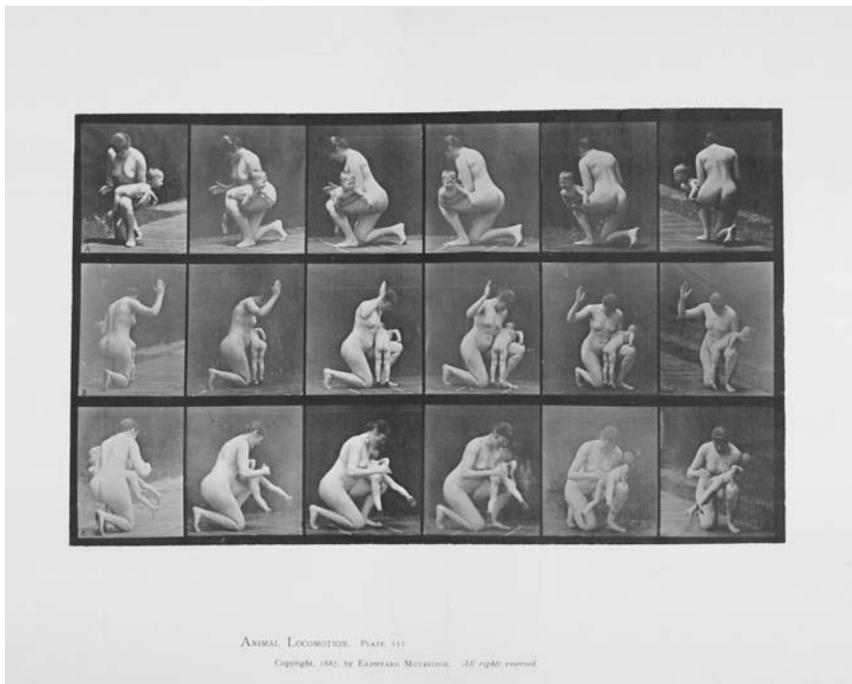


Figure 4: Eadward Muybridge, PL 527 Spanking a Baby (1887). Photographic History Collection, NMAH (catalog no. 2896).

negative series, Muybridge photographed Ben Bailey.³⁴ Ben Bailey, a 'mulatto' pugilist, was the only model of African descent among the ninety-five models photographed for Muybridge's work at the University of Pennsylvania; Bailey walked, ascended and descended stairs, struck a blow and threw a rock for Muybridge's cameras.³⁵ Bailey appears to have been one of the numerous black and mixed-race boxers in the Philadelphia area who made the city a centre for boxing during the period, fighting in athletic clubs and bars for whatever the spectators would donate (professional boxing was highly lucrative at the top, though still illegal).³⁶ With Ben Bailey, we have the introduction of the anthropometric grid into American photography; although the other ninety-four models were white, the anthropometric grid first appears behind the only model who was African American. It is as if the non-white 'other' cannot be understood, scientifically, without the anthropometric grid, a technology for mapping racial difference. The fact that Bailey was mixed-race raises the question of what role he may have played in addressing late nineteenth-century anthropological inquiries into racial hybridity and evolution.³⁷ Once introduced, Muybridge retained the grid for all of the series after negative number 524, where Bailey was first introduced.

Figure 3 represents the first activity that Bailey performed for Muybridge's cameras: walking. Maleness is clearly signalled by the genitalia, while masculinity is articulated through the absence of narrative that defines many of the female series. For example Miss Epler's task for 15 September 1885 was crossing a brook on stepping-stones. From the perspective of the 1880s implied white, male, middle-class viewer, Bailey's musculature would have seemed unusually developed. His powerful upper arms cast small shadows in the full sunlight, while his quadriceps muscles suggest a coiled power. The decision to include this plate early in the published series, as number six, suggests that Muybridge, or others, considered it to be exemplary – but of what, is unclear. Bailey's physique stands in marked contrast to that of the comparatively slight bodies of the male students, whose athletic accomplishments were also photographed as model movements (discussed below). Bailey's articulation of a muscled, racialised body represents, perhaps, an emerging model for a new embodied masculinity, marked by a cross-racial investment in musculature as a visible marker of masculine gender identity. As Gail Bederman has argued and as Martin Berger has discussed in relationship to Thomas Eakins's paintings during this same period, Victorian ideals of the male gender were shifting from older notions of 'manhood', characterised by inner virtues and adult responsibilities to emerging ideas of modern 'masculinity', where self-control became legible through the muscled body.³⁸ Bailey's

powerful physique signals an emerging masculine ideal that was, at the time, identified with both working class and African American male body types, but which would soon emerge as a white, middle-class ideal as well.

The hegemony of white cultural identity, as numerous historians and critics have argued, is grounded in its invisibility as a racial category, but, like all forms of difference, the consolidation of one aspect of the binary (for example, whiteness) is predicated on the identification of the other (for example, blackness). Ben Bailey's impressive display of physical prowess as – significantly – a boxer situates him as the object of desire and of admiration for the implied nineteenth-century white viewer. At the same time, the history of violence against American blacks in late nineteenth-century America, when an average of 188 lynchings occurred per year during the 1890s, suggests a violent affirmation of racial difference, reinforced by the official inequality of law and social practice, which these images quietly ignore. In the context of nineteenth-century race politics, the admiration of a physical embodiment of whites' corporeal ideal suggested by the photographs was strenuously contradicted by the racial hierarchies promulgated by the same emerging disciplines, further described below, that supported the Muybridge project. This is the 'dialectic of love and theft' detailed, for example, by Eric Lott in his work on nineteenth-century blackface minstrelsy: whites' fascination with an invented black vitality, always shadowed by a panicked, envy-laced disgust.³⁹ This splitting is constitutive of white racial identity in nineteenth-century American history. In a period of complex racial formation, where white racial identity was being redefined as 'Caucasian' to include the provisional whites of nineteenth-century immigration, while being consolidated against definitions of blackness integral to Jim Crow segregation, the anthropometric grid discursively situates Bailey as a racialised object of anthropological inquiry, against which narratives of racial progress can be mapped and measured.⁴⁰

The second site: anthropometry and the scientists

One could argue that the grid emerged at this point because of the project's link to realism in the visual arts, for example through Thomas Eakins. Eakins is unlikely to have been much concerned with the grid, however, because he appears to have ended his association with the Muybridge work well before June 1885, when the grid appeared. Another alternative might be seen in the involvement of Francis Xavier Dercum, who was interested in the documentation of

pathological locomotion. However, the project's second linkage to anthropometry, through the research interests of many of the scientists on the Muybridge advisory commission and their associates, suggests an alternative interpretation.⁴¹ These influential professors may have seen Muybridge's work as an evidentiary source for their own scholarly claims in the fields of comparative anatomy and physical anthropology.

A first clue concerning the relationship between the Muybridge project scientists and the study of comparative racial anatomy is the discovery that some of them were also founders of the American Anthropometric Society. The American Anthropometric Society was founded in 1889 – three years after the completion of Muybridge's project – by Harrison Allen, Francis X. Dercum, Joseph Leidy, William Pepper and Edward Charles Spitzka.⁴² Allen, Leidy and Pepper were all members of the Muybridge advisory commission. Francis X. Dercum, head of the neurological clinic at the university, was Muybridge's collaborator in photographing pathological locomotion as part of the Pennsylvania project; he also reviewed 20,000 of Muybridge's photographs in the fall of 1885 as part of the university's supervision arrangement.⁴³ These scientists all had various linkages to shifting ideas of race science in the nineteenth century.⁴⁴

Pepper, an important figure in the history of medical education in America in addition to his roles at Penn, was extraordinarily ambitious for the university. He asserted that he 'undertook the patronage of Muybridge, believing that it could promote the general recognition of the university' as well as produce 'an important piece of useful work being done under scientific control'. Both of these goals were realised in his estimation.⁴⁵ Pepper founded the first university teaching hospital in the United States in 1874 at Penn. As provost of the University of Pennsylvania from 1881–1894, Pepper was instrumental in shifting Penn towards the European model of a research university. During his tenure as provost, the university grew from a site of fifteen acres to fifty-two, while the number of students more than doubled from 981 to 2,180.⁴⁶ The development of a system of physical education and hygiene was one of Pepper's key goals; for him, the development of the white, male student body was directly linked to white racial progress, as manifested in the Anglo-Saxon and in what Pepper labelled a new American race. On the occasion of a University of Pennsylvania student winning the world record for the high jump in 1887, Pepper pronounced that physical education was nothing less than central to the 'cultivation of manly and courageous qualities ... among those two great branches of the English speaking races [Britain and America] that the world has most to hope for in the maintenance of peace

and in the ultimate triumph of liberty'.⁴⁷ Such rhetoric was not necessarily unusual at a time when 'race' was also used to refer to what would now be understood as cultural or social qualities of a nation or people.

Joseph Leidy was one of the more senior members of the scientific commission. Professor of anatomy for thirty-eight years at the university, he was a key founder of American vertebrate palaeontology, as well as the foremost anatomist of his time. Although some aspects of vertebrate palaeontology concerned the collection and classification of human fossils, including skulls, in an effort to map racial difference, Leidy's work focused for the most part on extinct vertebrate forms, including the ox, horse, and – most famously – the dinosaurs. Unlike his close colleague at the American Philosophical Society, Samuel Morton, Leidy generally avoided the mid-nineteenth-century investment in human skull collection and measurement as a scientific basis for racial hierarchies and for slavery. When given an opportunity to take over Morton's work after Morton's death in 1851, Leidy declined; as he later wrote, 'after the death of Dr Morton, it was proposed to me to take up the investigation of the cranial characteristics of the human races, where he had left it, which I omitted, not from a want of interest in ethnographic science, but because other studies occupied my time'.⁴⁸ Instead, Leidy was one of the earliest American supporters of Darwin's controversial ideas concerning evolution. As a result of Leidy's advocacy, the Academy of Natural Sciences in Philadelphia became the first American scientific society to recognise Darwin's work through admitting Darwin to membership in 1860.⁴⁹ In his role as anatomist Leidy became the director of the university's first Department of Biology in 1884, where his title changed to Professor of Comparative Anatomy and Zoology. His research in comparative anatomy rendered Leidy an ideal member of the Muybridge commission, even though he apparently did not take a direct role in the photographic work.

Harrison Allen, a member of the Muybridge commission and president of the American Anthropometric Society after his teacher and colleague Joseph Leidy's term, was Professor of Comparative Anatomy and Zoology, as well as (at various points) Physiology, at the University of Pennsylvania from 1865–96. Allen was more involved in the project than Leidy and contributed an essay entitled 'Materials for a Memoir on Animal Locomotion' to the volume on the project published in 1888.⁵⁰ Allen's own research concerned comparative racial and vertebrate anatomy and physical anthropology. He produced a number of scientific papers on bats as well as on human anatomy and, especially in his later years, crania and the classification of skulls.⁵¹ According to his contemporary, anthropologist and University of Pennsylvania professor

Daniel Brinton, Allen was especially interested in the anatomical differences 'between races or varieties of the human species' and sought to understand these differences, in part, through an investigation of animated structures – through movement. His investigations into the lower jaw, as a 'test character of race', Brinton argued, 'should be committed to memory by every student of racial anatomy'.⁵² For Allen, anatomical characteristics could be traced to evolutionary development of racial types, the study of which was known as comparative racial morphology. In the assessment of physical anthropologist Aleš Hrdlička, Allen stood, after Samuel Morton and another nineteenth-century colleague, as 'the foremost American representative of our branch of science before the end of the nineteenth century'. Allen's interest in cranial measurements and comparative racial anatomy, Hrdlička reported in this laudatory assessment of 1919, stemmed primarily from 'the works of [Samuel] Morton and J. Aitken Meigs, the latter of whom he knew personally'.⁵³ Allen attributed distinctions in anatomy to diversity in nutrition and other environmental conditions and, like other contemporary anthropologists, his work represented the post-bellum rapprochement between Neo-Lamarckian ideas of the inheritability of acquired characteristics and an environmental determinism that provided morphological evidence for Spencerian notions of racial hierarchy.

As Lee Baker has argued, Philadelphia, and the University of Pennsylvania in particular, played an important role in the 'Faustian bargain' made between anthropology and race in the late nineteenth century. In 1886, a few years after he had invited Muybridge to the university, Provost William Pepper hired Daniel G. Brinton as the first professor of anthropology at a US university. The hiring of Brinton was designed to support Pepper's interest in creating a museum of ethnology on the campus and Brinton was appointed Professor of American Archaeology and Linguistics; once at Penn, he quickly became the head of the emerging field of anthropology in the Philadelphia area.⁵⁴ Brinton, like other neo-Lamarckian anthropologists, argued that all human beings had a common psychic heritage, but that differences in environment produced, over time, different races, which could be clearly charted in a hierarchy from savage at the foot to civilised at the head. In 1884, Brinton became Professor of Ethnology and Archaeology at the Academy of Natural Sciences of Philadelphia (ANSP). In his popular, fee-based lectures to Main Line (elite) Philadelphians, most of whom were women, Brinton contrasted the perfect development of the 'Aryan American woman' to her over-sexed 'savage' sisters. His influential books *Races and Peoples* (1890) and *The American Race* (1891) grew out of the ANSP lectures.⁵⁵ For Brinton, ethnography was the science of mapping and classifying races and peoples; the physical differences

measured by comparative anatomists such as Harrison Allen were the means through which these racial taxonomies could be constructed. According to Aleš Hrdlička, although Brinton's personality was 'widely different' from Harrison Allen's, the two associated 'as friends and each doubtless exercised an influence on the other's thought and scientific production'.⁵⁶ He popularised the scientific investigation of comparative racial anatomy using an explicit discourse of racial hierarchy that placed the European or white race at the top and Africans and American Negroes at the bottom. Brinton's arguments did not prevent *Races and Peoples* (1890) from being positively reviewed on both sides of the Atlantic, including by the young Franz Boas, who reviewed the work for *Science* in 1890.⁵⁷

The racial assumptions of the emerging field of physical anthropology, known during the period as 'somatology' or 'comparative racial anatomy' were legitimised through technologies of measurement and visualisation. By 1883, the year that University of Pennsylvania scientists extended the invitation to Muybridge, still photography was widely accepted as a key technology in mapping somatic difference and classifying the static body on scales of racial hierarchies. Muybridge's work in documenting motion, however, corresponds with a new direction in physical anthropology where movement emerged as a key indicator of racial evolution. Late nineteenth-century French anthropology became especially interested in mapping movement, particularly human locomotion, as an index of racial types. Felix-Louis Regnault, the French anthropologist who pioneered ethnographic film in the 1895, turned to film as a means of recording racial difference; for Regnault, the still camera could not capture the body in motion, which he believed provided essential clues concerning racial typologies. As Fatimah Tobing Rony persuasively argues, '[i]n searching for an index of race – the unfashioned clue – Regnault chose to explore *movement*, that which is "in between" culture and nature, acting and being'.⁵⁸ Each race, Regnault argued, had a particular posture while in motion and only studies of sequential movement could capture what the eye failed to detect unaided. Might Muybridge, long disputed 'father' of the motion picture, be an influence in ethnographic film, where kinesiology, as well as physiology, was seen to index racial difference?

The third site: anthropometry and Penn athletics

The third appearance of anthropometry in the project concerns the fourteen male university student models who performed many of the athletic feats for the University of Pennsylvania work. The students were part of a broader category that included Penn student record-holding athletes, professional athletes, mechanics who were 'experts in their

particular trades' and labourers; the female models, Muybridge claimed, 'were chosen from all classes of society'.⁵⁹ In general terms, Muybridge wanted the female models to demonstrate what he considered to be everyday activities accomplished with grace and poise, whereas the male models were intended to represent the perfect, or champion, motions of a given athletic or work-related activity.⁶⁰ The gendered representation of some of these quotidian tasks trafficked in the visual discourse of the erotic.⁶¹ Just one of numerous examples was Catherine Aimer, an artist's model whom Muybridge paid for five hours on 18 July 1885 to bathe and pour water over her head, dry herself, step out of the bath and put on stockings. These performed activities could be read simultaneously as mundane and pornographic, depending upon the reading practices of the viewer.⁶² Although Muybridge paid the artist models to disrobe, he was frustrated that their working-class origins prevented them from producing the class-inflected poise that he sought from his female locomotion studies. 'I have experienced a great deal of difficulty in securing proper models. In the first place, artists' models, as a rule, are ignorant and not well-bred', he complained to a reporter in the summer of 1885. 'As a consequence, their movements are not graceful and it is essential for the thorough execution of my work to have my [female] models of a graceful bearing'. The working-class male models, however, could not be induced to remove their clothing at any price, according to Muybridge.⁶³

Muybridge was more successful at getting the male student models to disrobe. Most of the male Penn models were students in the mechanical engineering programme or in the medical school; outside class, they were often team mates on a variety of amateur athletic teams at Penn, including baseball, cricket, track, football, rowing and cycling. For example, the Penn athletic model and student Randolph Faries graduated with a BA in 1885 and received an MD in 1888. During these years, he became prominent in athletics and held the championship for the mile run in 1884, 1885 and 1886; he was also on the baseball team for four years. In 1890, he was made Director of Physical Education at Penn, a post he kept until 1897.⁶⁴ Percy C. Madeira, the model for Plate 59, 'Starting for a Run' and Plate 60, 'Running at a Half-mile Gait', among other plates, was the 1884 amateur one-mile champion of America for 1884. In addition to modelling running for Muybridge, Madeira also high-jumped, long-jumped, ran hurdles and participated in other physical activities.⁶⁵ Many of the other athletic models were also champions or record holders of their various sports: for example, Albert Cline, who received his BS in 1887 and ME (post-graduate engineering degree) in 1888, set a college record for the pole vault in 1886. During the same meeting, classmate and fellow Muybridge model Randolph Faries won



Figure 5: Eadward Muybridge, PL 64 Running at full speed (Randolph Faries) (1887). Photographic History Collection, NMAH, (catalog no. 2480).

the mile (Figure 5), while Thomas Grier, another Muybridge model and a project assistant, won the mile walk.⁶⁶

When Muybridge arrived at the university in 1883, the university was at the start of a rapid process of modernising its athletic programme. Led primarily by Penn alumni, the Athletic Association ran Penn's teams; because these alumni no longer had a formal relationship to the school, sports became a way to maintain loyalty. They recruited players from local athletic clubs and other colleges and then enrolled the athletes in a Penn course in order to make them eligible to play football, for example.⁶⁷ In 1884, this long-standing practice was curtailed by the passage of new regulations from the Intercollegiate Athletic Sports association, to which Penn belonged. In the 1880s, the university, led by Provost Pepper, modernised its athletic facilities, which were seriously underdeveloped in comparison to those of Penn's athletic rivals, especially Harvard, and established a new department of physical education.⁶⁸

In December of 1885, just after Muybridge had completed the bulk of his photos, the new gymnasium was formally opened.⁶⁹ The facilities and programmes were directed by White, with Robert Pennell, a well-known

trainer from the New York Athletic Club, in charge of the gymnasium. Founded in 1866, the New York Athletic Club established the standard rules for amateur athletics, including the American innovation of barring paid athletes from membership, thereby preventing competition from working-class athletes, who might pursue athletics as a form of paid labour.⁷⁰ The goal of the new University of Pennsylvania gymnasium was not principally to build strength, a concern of later athletic programmes, but to build physical health and vigour. As the *Regulations for Intercollegiate Athletic Sports* argued in 1884, 'the object of physical training is to confirm health, correct morbid tendencies, strengthen weak parts, give a symmetrical physical development and secure as far as possible a condition of perfect physical vigor'.⁷¹ D. Hayes Agnew, a professor at the university and the subject of Thomas Eakins's well-known painting of his surgical theatre, argued before a university meeting that the intellectual capacities of many students were limited by their feeble bodies, a problem that the proposed Department of Physical Culture would address.⁷²

The university's new department was inspired by the developments at Harvard, where Dudley Allen Sargent had been hired in 1879. Sargent designed and built, with Harvard's support, advanced versions of the mechanical fitness machines he had pioneered in his previous position at Bowdoin College. Sargent designed his fifty-six exercise machines to mimic movements from everyday life, especially those concerning manual labour. Thus, a student could 'chop wood' with a pulley exercise, or saw wood by moving the weights from front to back.⁷³ These exercises were designed to give an even overall muscular development, rather than the overdeveloped muscles of a worker engaged in regular manual labour, such as a blacksmith or lumberjack. Although motions of these workers could provide useful models for exercise form, their muscular development was not to be emulated. The advent of exercise machines in college athletics introduced a new trained body, a body whose *even* development signalled the class status of someone with the time to devote to building muscles effectively removed from productive labour.

This evenly developed, trained white male body emerged as an ideal type for enervated middle-class professional men during the 1880s. As the Committee formed to raise the funds to create Penn's athletic programme in 1883 argued concerning the merits of the Harvard approach, through Dudley's system 'the ideal student has been transformed from a stooping, weak and sickly youth into one well-formed, robust and healthy'.⁷⁴ The medical professors who were behind the move to physical culture in the Ivy League schools had long noticed that the most accomplished academic students were often the most physically underdeveloped. At Yale, for example, anthropometric

measurements had revealed that the highest-ranking students had more than their fair share of spinal curvature. The medical directors of the athletic facility there responded by requiring that all scholarship students submit to physical examinations and they acquired a set of Muybridge photographs of University of Pennsylvania athletes for comparison study. Eventually, the directors began making their own photographs of physical deformities, which they exhibited at the International Hygiene Exhibition at Dresden in 1911.⁷⁵ Using the Muybridge photographs as guides, Yale advocates of physical culture sought to blend the over-developed musculature of the manual labourer with the mental acuity of the sunken-chested scholar to create a new, vigorous upper-class body, immune from neurasthenia and over-civilisation.

At the University of Pennsylvania, the new department and facilities were directly modelled on the anthropometric systems in place at Harvard, Amherst and other elite colleges. As at Penn, these modern athletic departments were directed by medical doctors, who sought to introduce new scholarship in physiology and the physical sciences into college athletics. Edward Hitchcock of Amherst College, the founder of the first college department of physical education, advocated new corporeal standards; he researched Francis Galton's anthropometric work in England and published in 1888 the widely used *Anthropometric Manual*.⁷⁶ As the first president of the Association for the Advancement of Physical Education in 1885, Hitchcock helped to make anthropometric measurement a major methodology of the new profession.

At Penn, White introduced required anthropometrical measurements as a key element of his athletic system. As he described in his remarks at the opening of the gymnasium in 1885, 'each student is stripped and carefully examined as to his weight, height, the circumference of his chest, the size and condition of his legs, thighs, arms and forearms'.⁷⁷ The student engaged in a series of tests: a dynamometer, for example, measured back and loin strength, while a spirometer tested lung capacity. While the doctor was making the measurements, 'the physical peculiarities are observed and the special weaknesses, if any exist, are noted'.⁷⁸ The sum of these measurements was the quantified index of a student's 'development', which White used, along with the student's detailed personal and family medical history, to diagnose weaknesses that an athletic programme could address. Students were then directed to the 'chest weights, chest expanders, high and low pulleys' and other exercise machines that Harvard's Dr Sargent had personally arranged for the new facilities.⁷⁹

The athletic models' participation in the University of Pennsylvania Muybridge project was part of a larger nineteenth-century endeavour to engender manliness in upper-class white men. Social commentators as

well as young men themselves felt that their generation had become excessively refined; they longed for the manly challenges that their fathers had faced during the Civil War. Indeed, as sport historian Steven A. Reiss has observed, 'upper-class young men looked to sport as a means to prove their manliness'.⁸⁰ The 1880s interest in athletics and the training of the upper-class male body also stemmed from the American adaptation of British ideals of 'muscular Christianity', elaborated in 1850s Britain as part of the rise of empire and popularised in the United States by Protestant ministers such as Thomas Wentworth Higginson and Henry Ward Beecher.⁸¹ In the United States, the 'strenuous life' advocated by Teddy Roosevelt became part of prep school and college athletics as a prophylactic against the gender and sexual degeneracy of an excessive intellectualism, a decline that within the period's discourse of civilisation and progress meant a racial regression as well.⁸²

American advocates for physical education in American colleges and universities drew on European biometrics, including Galton's anthropometric work, to argue for the importance of sport in battling male neurasthenia, the 'American nervousness' that Charles Beard, S. Weir Mitchell and other prominent physicians argued was threatening to overwhelm America's 'brain workers' – the college educated, professional managerial class.⁸³ Although hysteria is often associated with women, as the Greek etymology of the word would suggest, in the last quarter of the nineteenth-century American nervous disease doctors diagnosed neurasthenia as being on the increase among 'the business and professional men who were most committed to the competitive ethic'.⁸⁴ The illness was a difficult one to diagnose, because it lacked a definitive pathology in an era when doctors required predictable, physical aetiologies in order to prescribe treatment. But most specialists, including the well-known Philadelphia physician S. Weir Mitchell, followed George Beard's analysis that the disease was caused by the shock of modernity: the advent of new technologies, such as steam-power and electricity; the frenzied increase in the pace of life; and the overwork of an accelerating market economy. Neurasthenia, in this analysis, was a badge of civilisation, a sign of racial progress. According to Beard, the prevalence of neurasthenia among America's brainworkers was an indication that American civilisation was the most advanced in the world.⁸⁵

Neurasthenia was also a difficult malady to cure and many doctors, including Francis Dercum, followed the Weir Mitchell rest cure, developed during the Civil War for soldiers suffering from battle fatigue. The rest cure consisted of complete, isolated bed rest for six to eight weeks, passive exercise in the form of massage or electrotherapy and a strict diet that emphasised protein and dairy.⁸⁶ Male neurasthenics were

rarely prescribed the full rest cure; the doctors' assumptions about class and gender privilege prevented them from prescribing treatment that would fully cut off their male patients from their work. Instead, male neurasthenics were often prescribed healthful forms of exercise, along with a reduced work schedule. Mitchell, whose 'rest cure' prompted Charlotte Perkins Gillmann to write the short story 'The Yellow Wallpaper', was sufficiently involved in the Muybridge project at the University of Pennsylvania to be thanked by Muybridge in the preface to his 1899 book on animal locomotion.⁸⁷ As Rachelle A. Dermer has shown, Plates 556 and 557 document the case of Robert Connelly, a male patient of Dr Mitchell's who suffered from the 'functional spasms' that Mitchell understood to be a 'typical example of hysteria in the male'.⁸⁸

Anthropometry, like photography itself, was an instrumental technology marshalled to legitimise a variety of truth claims over the course of the late nineteenth century. Its appearance in three sites central to the Muybridge work at the University of Pennsylvania suggests its centrality in efforts to enact and stabilise late nineteenth-century racial and gender hierarchies in the age of colonial expansion, Jim Crow segregation and white middle-class women's increasing engagement with the public sphere. The Muybridge project's complexity, with its 100,000 images, ninety-five models and numerous personnel, eludes – once again – any one scholar's claim to a definitive reading. The period's racialised discourse of anthropometry, joined with Gilded Age redefinitions of white, middle-class masculinity, overdetermines the Muybridge University of Pennsylvania work, yielding a new reading of the research as an imperfect racial project in which human bodies are represented and organised in order to consolidate historically situated racial formations specific to the late nineteenth-century discourses of manliness and civilisation.

Notes

I would like to express my thanks for the important contributions of Marta Braun to my thinking in this work; we have engaged in countless discussions as this project takes shape as part of each of our research. I owe an enormous debt to her fine scholarship, visual acuity and intellectual companionship. Many thanks to Michelle Delaney of the National Museum of Photographic History; the American Philosophical Society, which funded my stay in Philadelphia as a Fellow at APS; and audiences at the Muybridge symposium at Stanford University in May 2003, the Institute for Historical Studies at the University of Maryland (College Park), as well as the University of Manitoba conference on 'The Photograph' in March 2004, for their comments. Lastly, I would like to express my appreciation for the anonymous readers for *Gender & History*, who have helped to make this a stronger article.

1. In 1887 Muybridge offered Eadweard Muybridge, *Animal Locomotion: an Electrographic Investigation of Consecutive Phases of Animal Movements, 1872–1885* (Philadelphia:

- University of Pennsylvania, 1887) as a selection of 100 plates, held in a leather portfolio, or as individual prints. The full series of images is reprinted in Eadweard Muybridge, *Muybridge's Complete Human and Animal Locomotion* (New York: Dover, 1979). The collotype was a preferred method for high-quality mechanical printing of photographic images in the 1880s. The resulting commercially printed images were lush, with great tonal gradations. Collotypes were expensive and were associated with luxury publications such as *Animal Locomotion*. Visually, the published collotype plate was difficult to distinguish (for most observers) from the original photograph.
2. Eadweard Muybridge, 'Original Prospectus and Catalogue of Plates' (1887), reprinted in Muybridge, *Muybridge's Complete Human and Animal Locomotion*, vol. 3 (New York: Dover, 1979), pp. 1585–97, here p. 1585. Muybridge's assistants, paid by the university, were students, all but one of whom were also models for the project. For further details on the assistants and their work, see Thomas G. Grier to G. E. Nitzsche, 4 March 1929 and H. L. Bell to G. E. Nitzsche, 7 December 1923, UPA 9 Box 2, FF26, University of Pennsylvania Archives, (UPA).
 3. Tom Gunning, 'Never Seen this Picture Before: Muybridge in Multiplicity', manuscript in author's possession, p. 3. Muybridge's zeal in documenting motion has led another researcher, a psychologist by training, to suggest that the project provides evidence for an obsessive-compulsive disorder. See Arthur P. Shimamura, 'Muybridge in Motion: Travels in Art, Psychology and Neurology', *History of Photography* 26 (2002), pp. 341–50, here p. 349.
 4. Michelle Delaney, with Marta Braun and myself as guest co-curators, also curated an exhibition focused on this collection: 'Freeze Frame: Eadweard Muybridge's Photography of Motion', Smithsonian's National Museum of American History (NMAH), 7 October 2000 – 15 March 2001: <<http://www.americanhistory.si.edu/muybridge/index.htm>>.
 5. Thus, the cyanotypes at NMAH represent the closest thing we have to the original negatives for the project. Muybridge's correspondence with Erwin F. Faber, the Philadelphia artist who drew the elongated animals for Muybridge's zoopraxiscope plates, describes the shipment of the negatives to Glasgow for the purpose of making lantern slides. This late correspondence (March 1901) suggests that further detective work might be in order. See Eadweard Muybridge to Erwin L. Faber, 16 June 1899 and 11 March 1901, Eadweard Muybridge Papers, UPT 50, M993, Box 1 Folder 37, UPA.
 6. Muybridge Notebooks, Notebook 3, negs. 1322–1540, 15 September–28 October 1885, International Museum of Photography, George Eastman House, Rochester, New York (IMP).
 7. Marta Braun's 1984 article on the Pennsylvania work redefined Muybridge scholarship. Working with the published plates alone, she convincingly argued that despite 100 years of arguments to the contrary, Muybridge's Pennsylvania work, as compared to that of Marey, was more concerned with narrative than it was with scientific accuracy. See Marta Braun, 'Muybridge's Scientific Fictions', *Studies in Visual Communication* 10 (1984), pp. 2–21; Marta Braun, *Picturing Time: The Work of Etienne-Jules Marey (1830–1904)* (Chicago: University of Chicago Press, 1992).
 8. The newly discovered archive is especially important to historians. In 1896, Muybridge made an agreement with William Pepper of the University of Pennsylvania to transfer the remaining 33,000 collotype plates and negatives to the University. For discussion of the transfer of material concerning the project from New York to the University of Pennsylvania in 1896, see H. G. Ward to William Pepper, 25 June 1896 and Eadweard Muybridge to William Pepper, 24 June 1896, in William Pepper Papers, Annenberg Rare Book and Manuscript Library, University of Pennsylvania, (Annenberg). For a description of the NMAH collection (Acc. No. 98743), see Marta Braun, 'Muybridge's Animal Locomotion: The Director's Cut', *History of Photography* 24 (2000), pp. 52–4; as well as an undated, untitled document in the Muybridge 'Outline of Collection' vertical files, Division of Photographic History, National Museum of American History, Smithsonian Institution, Washington, DC.

9. L. F. Rondinella, 'More About Muybridge's Work' (July 1929), quoting Muybridge's 'Descriptive Zoopraxography' (1893), in Eadweard Muybridge Papers, UPT 50 M993, Box 2 Folder 6, UPA. Muybridge scrapbook, p. 139/157, Kingston Museum, Kingston-upon-Thames, Britain (KM).
10. For the arguments concerning Muybridge and the origins of cinema, see Kevin MacDonnell, *Eadweard Muybridge: The Man Who Invented the Moving Picture* (Boston: Little Brown, 1972); Gordon Hendricks, *Eadweard Muybridge: The Father of the Motion Picture* (New York: Grossman Publishers, 1975); Anita Ventura Mozley, 'Introduction to the Dover Edition', *Muybridge's Complete Human and Animal Locomotion*, pp. vii–xxxviii; for the competing discourses of science, narrative and academic art, see Braun, 'Muybridge's Scientific Fictions'; Braun, *Picturing Time*; and Janine A. Mileaf, 'Poses for the Camera: Eadweard Muybridge's Studies of the Human Figure', *American Art* 16 (2002), pp. 30–53; for the relationship between Thomas Eakins, Muybridge and nineteenth-century realism, see Elizabeth Johns, *Thomas Eakins, The Heroism of Modern Life* (Princeton: Princeton University Press, 1983); Susan Danly and Cheryl Leibold (eds), *Eakins and the Photograph: Works by Thomas Eakins and his Circle in the Collection of the Pennsylvania Academy of the Fine Arts*, (Washington, DC: Academy by the Smithsonian Institution Press, 1994); for a reading of the female nude as pornographic visuality, see Linda Williams, *Hard Core: Power, Pleasure and the 'Frenzy of the Visible'* (Berkeley: University of California Press, 1999); for pathological locomotion, see H. L. Gibson, 'The Muybridge Pictures of Motion', *Medical Radiography and Photography* 26 (1950), pp. 18–24; Michael Rogers McVaugh, 'Francis X. Dercum and Animal Locomotion', *Caduceus: A Museum Quarterly* 3 (1987), pp. 1–35; Marta Braun and Elizabeth Whitcombe, 'Marey, Muybridge and Londe: The Photography of Pathological Locomotion', *History of Photography* 23 (1999), pp. 218–24; Rachele A. Dermer, 'Photographic Objectivity and the Construction of the Medical Subject in the United States', PhD dissertation (Boston University, 2002).
11. For more on the others involved in the project, see Rondinella, 'More About Muybridge's Work'.
12. John Tagg, *The Burden of Representation: Essays on Photographies and Histories* (Amherst: University of Massachusetts Press, 1988), p. 4; John Tagg, 'Power and Photography: Part One, A Means of Surveillance: The Photograph as Evidence in Law', *Screen Education* 36 (1980), pp. 17–27. See also Elspeth H. Brown, *The Corporate Eye: Photography and the Rationalization of American Commercial Culture, 1874–1929* (Baltimore: Johns Hopkins University Press, 2005), p. 15.
13. Allan Sekula, 'Photography between Labour and Capital', in Leslie Shedden, *Mining Photographs and Other Pictures, 1948–1968: A Selection from the Negative Archives of Shedden Studio, Glace Bay, Cape Breton*, ed. Benjamin H. D. Buchloch and Robert Wilkie (Halifax: Press of the Nova Scotia College of Art and Design, 1983), pp. 193–268, here pp. 193–4; Allan Sekula, 'The Body and the Archive', *October* 39 (1986), pp. 3–65; Allan Sekula, *Photography against the Grain: Essays and Photo Works, 1973–1983* (Halifax: Press of the Nova Scotia College of Art and Design, 1984).
14. This work has sparked a number of compelling projects including Sandra S. Phillips, Mark Haworth-Booth and Carol Squiers, *Police Pictures: The Photograph as Evidence* (San Francisco: Chronicle Books, 1997); Shawn Michelle Smith, *American Archives: Gender, Race and Class in Visual Culture* (Princeton: Princeton University Press, 1999); Laura Wexler, *Tender Violence: Domestic Visions in an Age of U.S. Imperialism* (Chapel Hill: University of North Carolina Press, 2000).
15. Abigail Solomon-Godeau, *Photography at the Dock: Essays on Photographic History, Institutions and Practices* (Minneapolis: University of Minnesota Press, 1991), p. xxviii. Solomon-Godeau, in the same passage, is also the source for the attribution of the phrase to Szarkowski. For a classic collection of essays in postmodern photographic criticism, see Victor Burgin, *Thinking Photography* (London: Macmillan, 1982). For a recent

- rapprochement between postmodern photographic criticism and modernism's allegiance to the object, see Geoffrey Batchen, *Burning with Desire: The Conception of Photography* (Cambridge: MIT Press, 1997), pp. 4–21. See also Sarah Bassnett, 'Photography, Instrumental Discourse and City Planning in Early Twentieth Century Toronto and Montreal', PhD dissertation (Binghamton University, 2003).
16. Michael Omi and Howard Winant, *Racial Formation in the United States: From the 1960s to the 1990s* (London: Routledge, 1994), pp. 55–6.
 17. Charles Davenport, *A Guide to Physical Anthropometry and Androscopy* (New York: Cold Spring Harbor, 1927), p. 7. Anthropological measurement practices began their route to international standards in 1874 with the publication of *Notes and Queries on Anthropology*, a traveller's guide designed to promote standardised measurements of the human form. British Association for the Advancement of Science, *Notes and Queries on Anthropology, for the Use of Travellers and Residents in Uncivilized Lands* (London: E. Stanford, 1874). The more generalised study of body proportions, especially for the purposes of art, has a much older history; see, for example, Albrecht Dürer's works on human proportion in Albrecht Dürer, *Von menschlicher Proportion* (1528; repr. Nördlingen: A. Uhl, 1980).
 18. John S. Haller, Jr, *Outcasts from Evolution: Scientific Attitudes of Racial Inferiority, 1859–1900* (Urbana: University of Illinois Press, 1971), especially pp. 3–40.
 19. C. Loring Brace, 'The Roots of the Race Concept in American Physical Anthropology', in Frank Spencer (ed.), *A History of American Physical Anthropology* (New York: Academic Press, 1962), pp. 11–30, here p. 19.
 20. This (partial) list of measurements is drawn from Louis Sullivan, 'Anthropometry of the Siouan Tribes', *Anthropological Papers of the American Museum of Natural History*, 23 (New York: American Museum of Natural History, 1920), p. 89. Sullivan conducted measurements of 1,431 individuals from various Sioux tribes at the World's Columbian Exposition in Chicago, 1893. See Louis Sullivan, *Essentials of Anthropology: A Handbook for Explorers and Museum Collectors* (New York: American Museum of Natural History, 1923).
 21. G. H. Estabrooks, 'The Relation between Cranial Capacity, Relative Cranial Capacity and Intelligence in School Children', *Journal of Applied Psychology* 12 (1928), pp. 524–9, here p. 529. For the relationship between eugenics, racism and the 1924 Immigration Act, see Daniel Kevles, *In the Name of Eugenics: Genetics and the Uses of Human Heredity* (New York: Knopf, 1985), pp. 96–112.
 22. Sekula, 'The Body and the Archive'; Smith, *American Archives*.
 23. On the 'Zealy daguerreotypes', see Elinor Reichlin, 'Faces of Slavery', *American Heritage* 28 (June 1977), pp. 4–12; Melissa Banta and Curtis M. Hinsley, *From Site to Sight: Anthropology, Photography and the Power of Imagery* (Cambridge, MA: Peabody Museum Press, 1986), pp. 57–8; Alan Trachtenberg, *Reading American Photographs: Images as History, Mathew Brady to Walker Evans* (New York: Hill and Wang, 1989), pp. 54–6; Brian Wallis, 'Black Bodies, White Science: Louis Agassiz's Slave Daguerreotypes', *American Art* 9 (1995), pp. 39–62.
 24. Carl Dammann and F. W. Dammann, *An Ethnological Photographic Gallery of the Various Races of Men* (London: Trübner, n.d.); William E. Marshall and George U. Pope, *A Phrenologist among the Todas, or, The Study of a Primitive Tribe in South India: History, Character, Customs, Religion, Infanticide, Polyandry, Language* (London: Longmans Green, 1873). Martin Kemp, '"A Perfect and Faithful Record": Mind and Body in Medical Photography before 1900', in Ann Thomas (ed.), *Beauty of Another Order: Photography and Science* (New Haven: Yale University Press, 1997), pp. 120–49, here p. 129. See Paul S. Landau, 'Empires of the Visual: Photography and Colonial Administration in Africa', in Paul S. Landau and Deborah D. Kaspin (eds), *Images and Empires: Visuality in Colonial and Postcolonial Africa* (Berkeley: University of California Press, 2002), pp. 141–71.
 25. J. Lamprey, 'On a Method of Measuring Human Form for Students of Ethnology', *Journal of the Ethnological Society* new series 1 (1869), pp. 84–5.

26. See Frank Spencer, 'Some Notes on the Attempt to Apply Photography to Anthropometry during the Second Half of the Nineteenth Century', in Elizabeth Edwards (ed.), *Anthropology and Photography, 1860–1920* (New Haven: Yale University Press, 1992), pp. 99–107; David Green, 'Classified Subjects', *Ten/8 Photographic Journal* 14 (1984), pp. 30–37; Elizabeth Edwards, 'Photographic Types: The Pursuit of Visual Method', *Visual Anthropology* 3 (1990), pp. 235–58; Russell Roberts, 'Taxonomy: Some Notes Towards the Histories of Photography and Classification', in Chrissie Iles and Russell Roberts (eds), *Invisible Light: Photography and Classification in Art, Science and the Everyday* (Oxford: Museum of Modern Art, 1998), pp. 9–52; Elizabeth Edwards, *Raw Histories: Photographs, Anthropology and Museums* (London: Berg, 2001); Shawn Michelle Smith, *Photography on the Color Line: W. E. B. Du Bois, Race, and Visual Culture* (Durham: Duke University Press, 2004), pp. 49–50.
27. Josiah C. Nott and George R. Gliddon, *Indigenous Races of the Earth* (Philadelphia: J. B. Lippincott, 1857), p. 612; M. V. Portman, 'Photography for Anthropologists', *Journal of the Anthropological Institute of Great Britain and Ireland* 25 (1896), pp. 75–87, quote on p. 76.
28. For a discussion of the politics of 'looking back' at the camera, see bell hooks, 'The Oppositional Gaze: Black Female Spectators', in *Black Looks: Race and Representation*, pp. 115–31 (Boston: South End Press, 1992); Coco Fusco and Brian Wallis (eds), *Only Skin Deep: Changing Visions of the American Self* (New York: International Center of Photography Harry N. Abrams, 2003); see also Alan Trachtenberg's reading of the Zealy daguerreotypes in Trachtenberg, *Reading American Photographs*, pp. 52–6.
29. J. Lamprey, 'On a Method of Measuring Human Form for Students of Ethnology', pp. 84–5; see also Elizabeth Edwards, 'Ordering Others: Photography, Anthropologies and Taxonomies', in Iles and Roberts (eds), *Invisible Light*, pp. 54–68, here p. 56.
30. See for example, Tagg, *The Burden of Representation*; David Green, 'Veins of Resemblance: Photography and Eugenics', *Oxford Art Journal* 7 (1985), pp. 3–16; Sekula, 'The Body and the Archive'.
31. Edwards, 'Ordering Others', p. 55; Robert Taft, 'An Introduction to Eadward Muybridge and his Work', in Muybridge, *The Human Figure in Motion*, pp. vii–xiv, here p. x.
32. The original arrangements stipulated that the work would take place in the enclosure of the Veterinary Department of the University of Pennsylvania during the spring and summer of 1884. Eadward Muybridge to William Pepper, 3 September 1883. William Pepper Papers, Annenberg; Marta Braun, 'Leaving Traces', in Nancy Mowll Mathews (ed.), *Moving Pictures: The Un-Easy Relationship between American Art and Early Film* (New York: Hudson Hills Press, 2005).
33. Although there are some inaccuracies in Gordon Hendrick's chronology (for example, he incorrectly argues that the published plates contained up to twenty-four, rather than thirty-six photographs), his discussion remains an important grounding for a close analysis of the period when Muybridge was working at the University of Pennsylvania. He reconstructs in detail the technical changes made during the summer of 1884 and the university's frustration with the resulting slow progress. Muybridge finished most of the photography by 15 December 1885, though he did continue to re-shoot motion studies until May 1886. Gordon Hendricks, *Eadward Muybridge*, pp. 167–72.
34. Muybridge Notebooks, Notebook 2 Negs. 524–1084, 2 May–4 August 1885, IMP. The notebook covering the negative series 1–523 is missing, but Marta Braun 'Leaving Traces', has shown that as late as series negative number 520, which was of pathological locomotion, there was no grid. We have not been able to match/find nos. 521–3, which are detailed in the missing notebook.
35. The category of 'mulatto' was dropped from the census in 1920 as the 'one drop' rule of the Jim Crow era eradicated mixed-race legal identities. On mulattoes during this period, see Joel Williamson, *New People: Miscegenation and Mulattoes in the United States* (New York: Free Press, 1984); for the antebellum era see Howard Bodenhorn, 'The Mulatto Advantage: The

- Biological Consequences of Complexion in Rural Antebellum Virginia', *Journal of Interdisciplinary History* 33 (2002), pp. 21–46. For a listing of Bailey's activities, see 2 June 1885 entries for negative series numbers 524–31 in Eadweard Muybridge, Lab Notebook Number 2, 2 May–4 August 1885, IMP. It does not appear that Bailey was photographed after this date. Muybridge referred to Bailey (model 22) as 'a mulatto and professional pugilist'; he does not note the racial status of any other model. See Eadweard Muybridge, *Animal Locomotion Prospectus and Catalogue of Plates* (Philadelphia: J. B. Lippincott, 1887), p. 12.
36. For black boxing in late nineteenth-century Philadelphia, see Roger Lane, *The Roots of Violence in Black Philadelphia, 1860–1900* (Cambridge: Harvard University Press, 1986), pp. 118–19. Philadelphia city directories and census for 1880–5 reveal a large number of men named Ben Bailey, some listed as mulatto, in occupations such as waiter, plasterer, brick-maker; it is impossible to tell which might have been the Muybridge model. Bailey was apparently not a particularly well-known boxer, historically; he is not mentioned in Nat Fleischer, *Black Dynamite: The Story of the Negro in the Prize Ring from 1782 to 1938* (New York: C. J. O'Brien, 1938).
 37. The question of racial 'hybridity' was central to the formation of physical anthropology as a discipline in both the United States and Europe, as scientists debated the relative fecundity of mixed-race offspring as a measure of civilisation or degeneration. For example, Nott and Gliddon credited Philadelphia's Samuel Morton for showing that 'the mulatto would seem to fall into that condition of hybrids, where they continue to be more or less prolific for a few generations, but with a constant tendency to run out ... mulattos are less prolific than either pure race; suffer much from tubercular affections; their children die young; and ... their average duration of life is very low'. Nott and Gliddon, *Indigenous Races of the Earth*, p. 367; see also Brace, 'The Roots of the Race Concept in American Physical Anthropology'.
 38. Gail Bederman, *Manliness and Civilization: A Cultural History of Gender and Race in the United States, 1880–1917* (Chicago: University of Chicago Press, 1995); Martin A. Berger, *Man Made: Thomas Eakins and the Construction of Gilded Age Manhood* (Berkeley: University of California Press, 2000).
 39. Eric Lott, *Love and Theft: Blackface Minstrelsy and the American Working Class* (New York: Oxford University Press, 1993).
 40. Matthew Frye Jacobson, *Whiteness of a Different Color: European Immigrants and the Alchemy of Race* (Cambridge: Harvard University Press, 1998); Grace Elizabeth Hale, *Making Whiteness: The Culture of Segregation in the South, 1890–1940* (New York: Pantheon Books, 1998).
 41. It is worth stressing that there can be more than one reason for the introduction of the grid in the summer of 1885. While this essay stresses its racial meanings, the grid may have other instrumental purposes. For further discussion of Eakins, Muybridge, Marey and the development of photographic apparatuses at the University of Pennsylvania, see William Dennis Marks, 'The Mechanism of Instantaneous Photography', in University of Pennsylvania, *Animal Locomotion: The Muybridge Work at the University of Pennsylvania* (Philadelphia, J. B. Lippincott company, 1888), pp. 9–33; William I. Homer, 'Eakins, Muybridge and the Motion Picture Process', *Art Quarterly* 26 (1963), pp. 194–216. Dercum helped Muybridge in two successive summers, probably 1885 and 1886. The Dercum letter is cited in Hendricks, *Eadweard Muybridge*, pp. 162–3.
 42. Edward Anthony Spitzka, 'A Study of the Brains of Six Eminent Scientists and Scholars Belonging to the American Anthropometric Society ...', *Transactions of the American Philosophical Society* new series 21 (1908), pp. 175–308, here, p. 176.
 43. Mozley, 'Introduction to the Dover Edition', p. xxvi; see also Rogers McVaugh, 'Francis X. Dercum and Animal Locomotion'; Braun and Whitcombe, 'Marey, Muybridge and Londe'.
 44. Haller reports that the American Anthropometry Society was organised for the preservation of the brains of its members. Haller, *Outcasts from Evolution*, p. 37.

45. William Pepper to H. Galbraith Ward, 15 June 1896, William Pepper Papers, Annenberg.
46. Joshua Lawrence Chamberlain, William Torrey Harris, Edward Potts Cheyney and Ellis Paxson Oberholtzer, *Universities and their Sons: University of Pennsylvania, its History, Influence and Characteristics* (Boston: R. Herndon Company, 1901), pp. 135–72.
47. Newspaper clipping of remarks that Pepper made on the occasion of student Page setting the world record for the high jump (dated 17 October 1887), vol. 3, p. 466. William Pepper, MD Collection, Van Pelt Library Special Collections, University of Pennsylvania.
48. As quoted in Aleš Hrdlička, 'Physical Anthropology in America, an Historical Sketch', *American Anthropologist* 16 (1914), pp. 508–54, here p. 516.
49. Leonard Warren, *Joseph Leidy, The Man who Knew Everything* (New Haven: Yale University Press, 1998); Martin Meyerson and Dilys Pegler Winegrad, *Gladly Learn and Gladly Teach: Franklin and his Heirs at the University of Pennsylvania, 1740–1976* (Philadelphia: University of Pennsylvania Press, 1978), pp. 89–97.
50. Harrison Allen, 'Materials for a Memoir on Animal Locomotion', in University of Pennsylvania, *Animal Locomotion*, pp. 35–102.
51. 'Harrison Allen', in American Association of Anatomists, *Proceedings of the Tenth Annual Session, Ithaca, N.Y., December 28–30, 1897* (Washington, DC: Beresford, 1898) pp. 12–26. See also Harrison Allen, 'Crania from the Mounds of the St. John's River, Fla. A Study Made in Connection with Crania from Other Parts of North America', read 12 June 1894, *Journal of the Academy of Natural Sciences of Philadelphia* new series 10 (1896), pp. 367–448; Harrison Allen, 'A Study in Hawaiian Skulls', *Proceedings of the Wagner Free Press Institute of Science* (1898), p. 55.
52. Daniel G. Brinton, 'Dr. Allen's Contributions to Anthropology', American Association for the Advancement of Science, Springfield meeting, August 1895, *Proceedings of the American Association for the Advancement of Science* 44 (1897), pp. 522–9, quote from pp. 523–4. For further information about Daniel G. Brinton, a key figure in the history of American anthropology, see Lee D. Baker, 'Daniel G. Brinton's Success on the Road to Obscurity, 1890–99', *Cultural Anthropology* 15 (2000), pp. 394–423. Baker argues that Brinton's work provided a modern foundation for the reciprocal relationship between race and anthropology in the period after the flourishing of the 'American School' of anthropology, whose central figure was Samuel Morton, in the mid-nineteenth century.
53. Aleš Hrdlička, *A History of American Physical Anthropology* (Philadelphia: Wistar Institute, 1919), pp. 59–60; see also Aleš Hrdlička, 'Physical Anthropology in America, an Historical Sketch'. J. Aitken Meigs, also associated with Philadelphia-area scientific establishments, wrote a number of works in early American physical anthropology, including an essay in a racist anthology by Nott and Gliddon. J. Aitken Meigs, 'The Cranial Characteristics of the Races of Men', in Josiah C. Nott and George F. Gliddon (eds), *Types of Mankind: or, Ethnological Researches, Based upon the Ancient Monuments, Paintings, Sculptures and Crania of Races and upon their Natural Geographical, Philological and Biblical History* (Philadelphia: Lippincott, 1854). Meigs took over Morton's skull collection when Joseph Leidy demurred.
54. Lee D. Baker, 'Daniel G. Brinton's Success on the Road to Obscurity', pp. 395, 399. Pepper succeeded in establishing the Department of Archaeology and Palaeontology and its museum in 1891; the museum is now the University of Pennsylvania Museum of Archaeology and Anthropology. Edward P. Cheyney, *History of the University of Pennsylvania* (Philadelphia: University of Pennsylvania Press, 1940), p. 351; Steven Conn, *Museums and American Intellectual Life, 1876–1926* (Chicago: University of Chicago Press, 1998), pp. 75–114.
55. Daniel G. Brinton, *Races and Peoples: Lectures on the Science of Ethnography* (New York: N. D. C. Hodges, 1890); Daniel G. Brinton, *The American Race: A Linguistic Classification and Ethnographic Description of the Native Tribes of North and South America* (New York: N. D. C. Hodges, 1891).
56. Hrdlička, 'Physical Anthropology in America', p. 539.

57. My discussion of Brinton is indebted to Lee D. Baker, 'Daniel G. Brinton's Success on the Road to Obscurity'. For the Boas review, see [Franz Boas], 'Review of *Races and Peoples*', *Science* 16 (1890), pp. 276–7.
58. Fatimah Tobing Rony, 'Those Who Squat and Those Who Sit: The Iconography of Race in the 1895 Films of Felix-Louis Regnault', *Camera Obscura* 28 (1992), pp. 262–89, here p. 267.
59. Muybridge, *Animal Locomotion Prospectus*, p. 12.
60. Muybridge, *Animal Locomotion Prospectus*, p. 13.
61. Williams, *Hard Core*.
62. See the 18 July 1885 entries for negative series numbers 937–42, as Muybridge described them in his workbooks. Eadweard Muybridge, Lab Notebook Number 2, 2 May–4 August 1885, IMP. For a further reconstruction of what the models were doing when, see Marta Braun, 'Muybridge le Magnifique', *Études Photographiques* 10 (November 2002), pp. 34–50.
63. 'Animal Motion', *The Times*, Philadelphia, 2 August 1885.
64. See vertical file on Randolph Faries at the UPA, including clippings from *Philadelphia Inquirer*, *Philadelphia Evening Bulletin* and other sources.
65. Percy C. Madeira, 'Not So Fast', *Saturday Evening Post*, 11 July 1936, pp. 16–17, 77–78, 80. Madeira seems not to have been a Penn student.
66. George W. Orton, *A History of Athletics at Pennsylvania, 1873–1886* (Athletic Association of the University of Pennsylvania, n.d.), pp. 25–7. For the list of models, see Eadweard Muybridge, Lab Notebooks, IMP; for information about the students, see the UPenn Master Alumni List and vertical files, UPA.
67. Dan Rottenberg, *Fight on Pennsylvania: A Century of Red and Blue Football* (Philadelphia: University of Pennsylvania, 1985), p. 27; Athletic Association of the University of Pennsylvania, *Fortieth Anniversary, 1873–1913 (Franklin Field May 17, 1913); An Illustrated Account of what the University of Pennsylvania Achieved in all Branches of Sport* (Athletic Association of the University of Pennsylvania, 1913).
68. For Pepper's key role in Penn's athletics, see note from Pepper, 4 April 1882, seeking to help organise University athletics; letter from Pepper to John C. Sims, 12 April 1882; letter from Pepper to John C. Sims, 25 April 1882; John C. Sims clippings books, vol. 1 (1 January 1883–31 December 1886); General Administration Records, 1749–1930, Box 19, 1883 'Physical Culture', UPA. 'Physical Education: The New Department at the University of Pennsylvania', 1885 clipping, in John C. Sims Clipping Books, vol. 1; William M. Stewart to Samuel Dickson, Esq., 1 December 1884, General Administration Records, 1749–1930, Box 19, 1884 'Athletic Department', UPA. 'A University Gymnasium', *Inquirer*, 23 November 1883; *Telegraph*, 23 November 1883. According to Mr Pennell, the person in charge of the athletic grounds, Harvard's Dr Sargent oversaw the arrangements concerning the gymnasium's equipment. 'Athletics at the University', 27 August 1885 clipping, John C. Sims clipping books, vol. 1, UPA; see also 'Athletic Development', *Evening Telegraph*, 23 April 1885.
69. 'A University Gymnasium', *Inquirer*, 23 November 1883; *Telegraph*, 23 November 1883.
70. Steven A. Reiss, *Sport in Industrial America, 1850–1920* (Wheeling, IL: Harlan Davidson, 1995), p. 51; see also Benjamin Rader, *American Sports: From the Age of Folk Games to the Age of Televised Sports* (Upper Saddle River: Prentice Hall, 2004).
71. 'Regulations for Intercollegiate Athletic Sports', 7 February 1884; see also printed circular beginning 'Dear Sir', dated March 1884, John C. Sims clipping books, vol. 1, UPA.
72. 'Important Project', newspaper clipping, 22 March 1884 and 'Local Affairs', newspaper clipping, 22 March 1884, John C. Sims clipping books, vol. 1, UPA.
73. Carolyn Thomas de la Peña, *The Body Electric: How Strange Machines Built the Modern American* (New York: New York University Press, 2003), p. 57; see also Donald J. Mrozek, *Sport and American Mentality, 1890–1910* (Knoxville: University of Tennessee Press, 1983), pp. 36–7, 69–71.

74. Circular of the building committee of the Athletic Association of the University of Pennsylvania, 20 November 1883, John C. Sims clipping books, vol. 1, UPA.
75. For more information about Sargent's career, as well as his role in bringing his system to Yale, see George W. Pierson, 'Apostles of Physical Culture', *Yale Alumni Magazine* (1973), pp. 11–17.
76. Edward Hitchcock and H. H. Seelye, *An Anthropometric Manual, Giving the Average and Mean Physical Measurements and Tests of Male College Students and the Method of Securing Them* (Amherst, MA: Williams, 1887); Roberta J. Park, 'Healthy, Moral and Strong: Educational Views of Exercise and Athletics in Nineteenth-Century America', in Kathryn Grover (ed.), *Fitness in America: Images of Health, Sport and the Body, 1830–1940* (Rochester: Woodbury Strong Museum, 1989), p. 142. For a report on Galton's Anthropometric Laboratory's measurement of 9,337 visitors in seventeen different ways, see Francis Galton, 'On the Anthropometric Laboratory at the Late International Health Exhibition', *Journal of the Anthropological Institute of Great Britain and Ireland* 14 (1885), pp. 205–21.
77. 'The University Gymnasium: Prof. White on College Athletics', *Evening Telegraph*, 3 December 1885.
78. 'The University Gymnasium', *Evening Telegraph*, 3 December 1885.
79. 'The New Gymnasium', *Inquirer* clipping, 4 December 1885; see also 'The University Gymnasium', *Press*, 3 December 1885, John C. Sims clipping books, vol. 1, UPA; see also 'Athletic Development', *The Evening Telegraph*, 23 April 1885, J. William White scrapbooks, 5 April 1883–2 August 1884, UPA.
80. Reiss, *Sport in Industrial America*, p. 47.
81. Clifford Putney, *Muscular Christianity: Manhood and Sports in Protestant America, 1880–1920* (Cambridge: Harvard University Press, 2001), pp. 23–4; Harvey Green, *Fit for America: Fitness, Sport and American Society* (New York: Pantheon Books, 1986), pp. 181–216.
82. Theodore Roosevelt, *The Strenuous Life: Essays and Addresses* (New York: Century Company, 1901); see also Bederman, *Manliness and Civilization*; E. Anthony Rotundo, *American Manhood: Transformations in Masculinity from the Revolution to the Modern Era* (New York: Basic Books, 1993); Green, *Fit for America*, pp. 219–58.
83. Green, *Fit for America*, p. 138; T. J. Jackson Lears, *No Place of Grace: Antimodernism and the Transformation of American Culture, 1880–1920* (Chicago: University of Chicago Press, 1994).
84. Francis G. Gosling, *Before Freud: Neurasthenia and the American Medical Community, 1870–1910* (Urbana: University of Illinois Press, 1987), p. 10.
85. George M. Beard, *American Nervousness, Its Causes and Consequences* (New York: G. P. Putnam's sons, 1881), p. 176; see also Tom Lutz, *American Nervousness, 1903: An Anecdotal History* (Ithaca: Cornell University Press, 1991), p. 7.
86. Gosling, *Before Freud*, p. 110.
87. Jayne Morgan, 'Eadweard Muybridge and W. S. Playfair: An Aesthetics of Neurasthenia', *History of Photography* 23 (1999), pp. 225–31. According to Dermer, 'Photographic Objectivity', p. 43, Mitchell was one of the attending physicians for the work on abnormal movement, concerned primarily with the physical manifestations of hysteria.
88. S. Weir Mitchell and William G. Spiller, 'A Case of Uncomplicated Hysteria in the Male Lasting Thirty Years, with Post-Mortem Examination', *Transactions of the Association of American Physicians* 19 (1904), pp. 433–45, here p. 433, as cited in Dermer, 'Photographic Objectivity', p. 57.