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Athena's retinue: nineteenth-century scientists embedded in the army

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Abstract. Between 1860 and 1880, scientists in the United States, Argentina and Russia accompanied military expeditions on the northern Great Plains, in Patagonia, and in north-eastern Asia. The extent to which the scientists were able to remain at arm's length from the slaughter of war is seen in the publications resulting from their travels. In the context of consolidating or extending national territory during the modern age, military patronage did not invalidate the research findings of attentive naturalists, who adhered to transnational disciplinary norms. There is only weak evidence to suggest that local prejudice determined the form of natural knowledge stemming from the expeditions.

Are scientists in their moral life compromised by receiving money accumulated for immoral ends? Is the truth sought by scientists invalidated by how it was pursued? In research with human and animal subjects, the answer is clear. Certain kinds of research are excluded because they compromise the dignity or the body of the individual. But even if the knowledge is not directed toward inflicting pain and suffering, as it would be in the development of a monstrous weapon or a device of social control, may the ethical scientist accept lucre from unpalatable sources? Even if the scientist in question receives our censure, can we place credence in the findings? Should we reject calculations in general relativity, for example, because they were financed by the United States Air Force?[1]

The ethics of funding is particularly relevant in the context of military patronage. In the modern age, armies and navies have often financed scientific research, some of it with little direct connection to war. The following pages explore the extent to which scientific and military activity, conducted simultaneously, can be separated.

Paul Forman has offered that even if reliable and general results are obtained, the practice of science is compromised by military funding. That is to say, scientists adjust their agendas to obtain military funding, in the way that scientists today construct projects to suit protocols defined by other agencies. Scientists on the military payroll are often unaware of, or in denial about, the extent to which their goals and methods

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1 Lewis Pyenson, 'Cracking the Einstein code', *Journal of Interdisciplinary History* (2010) 41, pp. 274–276, reviewing a book about physicist Roy Kerr, who benefitted from Air Force support.

conform to what the military wants. Something may be achieved due to military patronage – an atomic clock or a maser – but the scientist, emphasizing his pure ends and rigorous means, inevitably shields himself from what makes his research possible.[2]

Scientific seclusion or shielding – the 'secret' history of science – follows directly from the claim by scientists that their activity is dispassionate.[3] Disinterestedness is indeed one of Robert K. Merton's four prescriptive scientific norms.[4] Merton followed the view of Anton Chekhov, who observed that there are no national multiplication tables. For Merton, by extension, science is transnational. Scientific results are not merely useful across political boundaries – that is to say, international; rather, to invoke another of his norms, they are universal. Merton's normative thesis has been challenged by a generation of writers who claim that personal interest and civil authority lie at the base of scientific activity. The critics observe that science has often been indistinguishable from rationalization. Are they correct in challenging the transnational nature of modern science?[5]

Anecdotal evidence (the so-called case study) is insufficient to answer the question, for deviance from the norm can be accommodated by special pleading. Comparison tempers anecdote. But traditional comparison has been criticized recently by partisans of *histoire croisée*, or entangled history. They observe that much of comparison, when it is directed to understanding the movement of ideas and techniques from one setting to another, is one-dimensional, whereas the general situation features a continual exchange between the context of origin and the context of reception. The entangled historians emphasize a multiplicity of levels, scales and directions, leading them to write about webs of individuals, crossed lines of communication, and multidimensional vectors of transmission. They recommend *histoire croisée* as a fruitful technique for studying transnational phenomena.[6]

2 Among relevant writings by Paul Forman: 'Truth and objectivity', *Science* (1995) 269, pp. 565–567, 707–710; 'Into quantum electrodynamics: the maser as "gadget" in Cold-War America', in Paul Forman and José M. Sánchez Ron (eds.), *National Military Establishments and the Advancement of Science and Technology: Studies in Twentieth Century History*, Dordrecht: Kluwer, 1996, pp. 261–326.

3 Lewis Pyenson, *The Passion of George Sarton: A Modern Marriage and Its Discipline*, Philadelphia: American Philosophical Society, 2007, pp. 343–344, for Sarton's view of science as a secluded endeavour.

4 Robert K. Merton, 'The ethos of science (1942)', in *idem*, *On Social Structure and Science*, ed. Piotr Sztompka, Chicago: University of Chicago Press, 1996, pp. 267–276. The presently unfashionable norms are usefully stated: communism (knowledge is the common property of all scientists), universalism (science is valid everywhere), disinterestedness (scientists pursue truth and accept new results regardless of the personal benefits attached to them), and organized scepticism (new results are accepted following rigorous testing and confirmation).

5 In modernity, science and art were held to derive from universal genius lodging in a national climate. Young George Sarton commented during the Belle Epoque, 'I see in Wagner all the traits of the German character, but alongside of these, the traits of genius, which have no nationality.' After the First World War, he contended, 'The cosmopolitan spirit is destructive of what is best in both the national and the international ideals.' Pyenson, op. cit. (3), pp. 17, 347.

6 Notable are publications by Michael Werner and Bénédicte Zimmermann: 'Beyond comparison: *histoire croisée* and the challenge of reflexivity', *History and Theory* (2006) 45, pp. 30–50; Werner and Zimmermann, 'Vergleich, Transfer, Verflechtung: Der Ansatz der Histoire croisée und die Herausforderung des Transnationalen', *Geschichte und Gesellschaft* (2002) 28, pp. 607–636; and Werner and Zimmermann's edited collection, *De la comparaison à l'histoire croisée*, Paris: Le Seuil, 2004.

The degree of entanglement or reflexivity in *histoire croisée*, however, seems to depend on the nature of the notions or the objects or the ideas moving from one place to another. In the modern age, astronomy seems less amenable to entanglement than homeopathy. Comparative history remains illuminating if the terms of the comparison do not determine its conclusions, a caution that is usefully applied to other historical techniques, such as prosopography.[7]

The following pages examine the extent to which the research of scientists working closely with the military is, as the scientists claim, disinterested and universal. I compare geologists and naturalists who accompanied the armies of the United States, Argentina and Russia as they fought, in the middle of the nineteenth century, to subjugate autochthonous peoples of the North American plains, Patagonia, and northern Central Asia.

The three instances merit treatment in one place because they are principal examples, between 1860 and 1880, of natural scientists embedded with the military of independent countries seeking to control contiguous territory through expeditions of conquest. The scientists include academics in the United States, founders of a national academy of science in Argentina, and members of the Imperial Russian Geographical Society of St Petersburg. Among the soldiers are General George A. Custer on the Great Plains, General Julio A. Roca in Patagonia, and General Nikolai Przhevalskii in Central Asia and East Asia. I begin with George Bird Grinnell, a Yale palaeontologist and an intimate of Custer's who became a vocal advocate for the rights of aboriginal peoples in the United States. I next consider four of Grinnell's Argentine counterparts, German-trained scientists associated with the National Academy of Sciences in Córdoba. Then I introduce Prince Peter Kropotkin, a man whose name is honoured by both anarchists and biologists.

Scientific expeditions chaperoned by the US, Argentine and Russian armies shared many attributes. The scientists worked in a regime of military discipline, which restricted the kinds of observation they could make. The scientists witnessed military violence. Although the scientists depended on the military for logistical matters, notions of imperial expansion find little place in the body of their scientific publications (a notable exception is assigning the name of a general to a species). That is to say, the geological, botanical and zoological monographs exhibit common form and content. In the following pages I investigate whether what one reads in the publications derives more from transnational forms than from a common pattern of daily life on the warpath.

At the outset, it is relevant to review the geopolitical situation of the United States, Argentina and Russia at the beginning of the last third of the nineteenth century. All three countries were 'pushing to the line'. They sought to apply pressure to the places where their borders were defined by little more than treaty or convention. The US pressed north – Alaska, the Northwest, and the Dakotas – as well as south – eventually

7 Lewis Pyenson, 'Comparative history of science', *History of Science* (2002) 40, pp. 1–33; *idem*, 'Cultural imperialism and exact sciences revisited', *Isis* (1993) 84, pp. 103–108; and *idem*, '"Who the guys were": prosopography in the history of science', *History of Science* (1977) 15, pp. 155–188.

Arizona and the Antilles. Argentina confronted Paraguay on the north and Chile on the west. Russia extended in all directions, notably against the Ottoman Empire and Great Britain in the south and against China and Japan in the east. Ethnic cleansing and resettling accompanied pressure on the line. The United States used concentration camps (reservations) for autochthones; Argentina employed wholesale genocide; Russia colonized Central Asia while exiling tens of thousands of dissidents and dreamers into thinly populated Siberia. In each instance, the state bureaucracy wanted to know about the new territory. Enter the scientists.

By 1860 Darwin's *Origin* was on everyone's lips. The old science of natural history, with its renovation by Linnaeus and Buffon, and the new sciences of geology and comparative anatomy, with Lyell and Cuvier, refracted through the lens of the synthetic romances of Alexander von Humboldt, had prepared the ground theoretically,[8] and the colonial aspirations of Great Britain, France and the Netherlands offered countless examples from around the globe. Most of the scientists in the following pages held Darwin in esteem: Midwest geologists and East Coast palaeontologists in the United States; German academics in Córdoba and Buenos Aires, Argentina (a notable exception is Germán Burmeister);[9] and Russian, Polish and German explorers in Asia. Young scientists kept Darwin in mind as they observed the land from the perspective of the cavalry engaged in conquering it.

With these points in mind, we turn to a desultory Yale graduate student, George Bird Grinnell. He grew up the son of Cornelius Vanderbilt's Wall Street broker, who was also the comptroller of the New York Central Railroad. In Manhattan, the Grinnells lived next door to J.J. Audubon's widow, whom George came to know as a boy. George Grinnell went to Yale University, where he was an indifferent student, more interested in outdoor activity than in indoor scholarship. Having devoured Thomas Mayne Reid's novels about the American West, Grinnell, upon receiving a BA in 1870, accompanied palaeontologist Othniel Charles Marsh on one of Yale's pioneering fossil expeditions to the northern Great Plains. Marsh and his Yale entourage rode around Montana and Wyoming, accompanied by a military escort.[10] Then Grinnell returned to work in his father's firm.

8 Recent reassessments of the last figure: Alexander von Humboldt and Aimé Bonpland, *Essay on the Geography of Plants*, ed. Stephen T. Jackson, tr. Sylvie Romanowski, Chicago: University of Chicago Press, 2009, pp. 1–46; Pablo Penchaszadeh and Miguel de Asúa, *El deslumbramiento: Aimé Bonpland y Alexander von Humboldt en Sudamérica*, Buenos Aires: Museo Argentino de Ciencias Naturales, 2010.

9 Irina Podgorny and María Margaret Lopes, *El desierto en una vitrina: museos e historia natural en la Argentina, 1870–1890*, Rosario: Editorial LIMUSA, 2008, for the most persuasive account of Argentine natural history, including Darwin. A recent, derivative account for English readers: Adriana Novoa and Alex Levine, *From Man to Ape: Darwinism in Argentina, 1870–1920*, Chicago: University of Chicago Press, 2010.

10 George Bird Grinnell, 'An old time bone hunt', *Yale Alumni Weekly*, 2 November 1923, pp. 167–168. Vertebrate palaeontology, Marsh's area of expertise, was one of the major achievements of science in the United States during the nineteenth century. Marsh's accomplishments and the controversy surrounding them receive a balanced assessment in Grinnell's éloge, 'Othniel Charles Marsh, Paleontology', in David Starr Jordan (ed.), *Leading American Men of Science*, New York: Henry Holt, 1910, pp. 283–312; and Charles Schuchert and Clara Mae LeVene, *O.C. Marsh, Pioneer in Paleontology*, New Haven: Yale University Press, 1940. Popular accounts of Marsh's Western expeditions, and of his rivalry with Edward Drinker Cope of

From his location in New York, Grinnell studied natural history and began supplying Marsh's collections. He secured skeletons and skins from P.T. Barnum's menagerie. He arranged for specimens from Florida hunters.[11] Marsh saw Grinnell's potential as a palaeontologist, and he encouraged Grinnell to resume his studies at Yale. 'I thank you very much for the encouragement you give me about going into science', Grinnell wrote to Marsh. 'I am more and more convinced that it is the best course for me to pursue, but I shall follow your advice and not decide hastily.' The Panic of 1873, which saw the liquidation of Grinnell's family business in New York, drove him back into Marsh's arms at New Haven.[12]

In his time, Marsh was notorious for a rivalry with Edward Drinker Cope, at the Philadelphia Academy of Natural Sciences, as the two palaeontologists raced to obtain choice vertebrate fossils for their museums and to elaborate the sequence of evolution. A lifelong bachelor, Marsh was solitary in his habits. In the field, he was not especially forthcoming with his students. Henry Farnum, a former student who accompanied Marsh into Kansas in 1873, recalled,

> We found it very difficult to get any information from Professor Marsh on what we were doing. I cannot recall that he ever gave us even a cursory lecture on the geological formations on which we were working or the possible significance of what we were finding. If we asked him questions, he was very apt to give a few of his characteristic grunts and return a noncommittal answer.

Another former student, George F. Eaton, put it this way: 'Slow to forgive acts of treachery and hostility, he was yet able to forgive and forget past injuries when convinced that his former enemy had buried the hatchet.'[13] The observations do not detract from the recent evaluation of one palaeontologist: 'His contributions to the

Philadelphia in acquiring Western fossils and classifying them: David Rains Wallace, *The Bonehunters' Revenge: Dinosaurs, Greed, and the Greatest Scientific Feud of the Gilded Age*, Boston: Houghton Mifflin, 1999; Mark Jaffe, *The Gilded Dinosaur: The Fossil War between E.D. Cope and O.C. Marsh and the Rise of American Science*, New York: Crown, 2000.

11 George Bird Grinnell to O.C. Marsh, 13 March 1873, where Grinnell has received George Robert Gray's *Hand-List of Genera and Species of Birds, Distinguishing Those Contained in the British Museum* (1869), sent by O.C. Marsh, and where Grinnell seeks a copy of Charles Lucien Bonaparte's *Conspectus generum avium* (1850–1857); Grinnell to Marsh, 19 March 1873, where Grinnell has received $150 from Marsh for specimens, waits for bird skeletons from Florida, and offers Marsh a rhinoceros skin, mounted, for $100; Grinnell to Marsh, 1 April 1873, billing $440 for emus, a flying fox, diverse cases, a buffalo head, a Sumatran rhinoceros with skin, a zebra, a caribou head and an African porcupine; Grinnell to Marsh, 11 November 1873, signalling that Barnum has agreed to give Spencer Fullerton Baird of the Smithsonian all the animals that die in Barnum's collection, and where Grinnell sends Marsh the remains of a female jaguar, a young kangaroo and a male black spider monkey. Yale University Archives, O.C. Marsh Papers, MSS Acc. 343, copies courtesy of Daniel L. Brinkman, Division of Vertebrate Paleontology, Yale Peabody Museum of Natural History.

12 George Bird Grinnell to O.C. Marsh, 4 December 1873, for career plans; Grinnell to Marsh, 11 November 1873: 'I suppose that you have been informed of the failure of our house.'

13 Henry Farnum, recollections of 1931; George F. Eaton, secretary of the Conneticut Academy of Arts and Sciences, to Donald Adams, editor, *New York Times Book Review*, 17 July 1940. Yale University Archives, O.C. Marsh Papers, MSS Acc. 343, Microfilm Reel 26.

understanding of extinct reptiles, birds and mammals are unequalled in the history of paleontology.'[14]

Marsh had been travelling west since 1868, when, guided by William F. Cody (Buffalo Bill), he found remains of the early horse *Equus parvulus*, at the bottom of a well. 'Recalling the old adage that truth lies hidden in the bottom of a well, I could only wonder, if such scientific truths as I had now obtained were concealed in a single well, what untold treasures must there be in the whole Rocky Mountain region.' Marsh was an accomplished game hunter, a passion he shared with Grinnell, and, instructed by Cody, he shot and skinned his first buffalo. He returned with Yale students, among them George Bird Grinnell, in 1870, in an expedition costing $15,000, covered in part by the federal treasury and guided by both Cody and Frank North. In 1872, while protected by the US Cavalry on the plains of Kansas, he found fossil birds with teeth. Two years later he was again in the West:

> Our party was a small one, – a few Yale students, and a small military escort from Fort Wallace, consisting of Lieutenant Pope, a sergeant, and about a score of soldiers. This escort I owed to General [Philip] Sherman, a faithful friend in all my Western explorations. I appreciated his kindness all the more, as just then the frontier posts had none too many troops to keep the Indians in check.[15]

The decades after the salvation of the Union saw a victorious army spending its political capital on a war against the nations of the Great Plains, who by 1873 had been pushed south into the desert and north into the Dakota Territory. A vast expanse, filling with settlers, became the Wild West. As Marsh and Grinnell learned when hunting fossils, it was prudent to approach strangers on the plains with a loaded gun. Henry Farnum recalled about the 1873 expedition, 'We were required to carry a Sharp's carbine, 50 caliber, as then used by the Cavalry, a Smith and Wesson's 36 caliber six shooter, and a large hunting knife.'[16] The US Army, while it could be contracted to protect a professor, would not intervene in civil matters – George Armstrong Custer's widow Elizabeth recalled that her husband was unable to protect Wild Bill Hickok from desperados who threatened him in Deadwood, near where the Custers were stationed.[17]

If economic uncertainty can make the purgatory of graduate school seem like paradise, it can also stimulate bending the laws of the land. By the Fort Laramie Treaty of 1868, the Sioux had been granted the Black Hills of the Dakotas as their kingdom.

14 Mark J. McCarren, *The Scientific Contributions of Othniel Charles Marsh: Birds, Bones, and Brontotheres*, New Haven: Peabody Museum of Natural History, 1993, p. 55.

15 O.C. Marsh, 'Thirty years' work on Rocky Mountain geology: a historical sketch', Yale University Archives, O.C. Marsh Papers, MSS Acc. 343, Microfilm Reel 26. The funding of the 1871 expedition in R.S. Lull, *The Yale Collection of Fossil Horses*, New Haven, *Yale Alumni Magazine, Supplement*, 1913, 12 pp. On Grinnell's travels: Michael Punke: Smithsonian Books/Collins, *Last Stand: George Bird Grinnell, the Battle to Save the Buffalo, and the Birth of the New West*, New York, 2007; Sherry L. Smith, 'George Bird Grinnell and the 'vanishing' Plains Indians', *Montana: The Magazine of Western History* (2000) 50, pp. 18–31.

16 Henry Farnum, recollections of 1931, in Yale University Archives, O.C. Marsh Papers, MSS Acc. 343, Microfilm Reel 26.

17 Elizabeth B. Custer, *Following the Guidon*, New York: Harper, 1890, p. 164.

At the time of the Panic of 1873, the Black Hills were rumoured to have gold.[18] Philip Sheridan, a Civil War general then in charge of pacifying the Great Plains, sent brevetted General George Armstrong Custer into the Black Hills to reconnoitre for mineral wealth. The Army, who knew enough about rocks to know that they did not know what they were looking for, assembled a scientific corps to accompany the expedition. Sherman invited Professor Marsh to join; Marsh delegated his assistant, Grinnell.[19]

Custer is popularly seen as a rash commander, but he planned the Black Hills expedition in detail. There were one thousand men equipped with the latest Remington firearms, accompanied by 110 wagons, three Gatlings and a three-inch rifle. A herd of cattle provided food. Six soldier–engineers were responsible for mapping (they carried two chronometers, a thermometer and a barometer) under William Ludlow, a West Point graduate and captain of the army engineers, and his civilian assistant William H. Wood.[20] The scientific party contained two senior academics. The first, Newton Horace Winchell, was one of the expedition's geologists. Winchell, who had graduated from the University of Michigan, was a professor at the University of Minnesota and head of the state geological survey; the second, Aris B. Donaldson, a graduate of Ohio Wesleyan University and founding professor of rhetoric and English literature at the University of Minnesota, was Winchell's assistant on the expedition (Donaldson resigned his professorship to become the expedition's botanist). The state of Minnesota paid for both Winchell and Donaldson. George Grinnell, Marsh's palaeontological representative and a junior geologist, was accompanied by the formidable scout Luther North; Yale paid both Grinnell and North. A St Paul, Minnesota photographer who was also considered a scientist, William H. Illingworth, rounded out the group.

The final form of the expedition emerged only in June of 1874. Grinnell 'and his assistant L.H. North' obtained a pass from General Philip Sheridan to accompany Custer, 'on condition that there shall be no expense to the Government'. While he was in Chicago, Grinnell was 'horrified to learn that Custer has been telegraphing all over the country for a geologist'.[21] In St Paul, Grinnell obtained a commitment from Custer to 'furnish us with horses and with every facility for collecting and transporting specimens'.[22] Then, in Fort Lincoln, Custer informed Grinnell that Winchell and his assistant would join the expedition. From Custer, Grinnell obtained custody of all the

18 Hyman Palais, 'Some aspects of the Black Hills Gold Rush compared with the California Gold Rush', *Pacific Historical Review* (1946) 15, pp. 59–67.

19 Donald Jackson, *Custer's Gold: The United States Cavalry Expedition of 1874*, New Haven: Yale University Press, 1966, pp. 46–72, for a comprehensive discussion of the scientific corps. Ernest Grafe and Paul Horsted, *Exploring with Custer: The 1874 Black Hills Expedition*, Custer: Golden Valley Press, 2002, p. 15, for Donaldson and Wood. Grafe and Horsted's book is a masterful study of the expedition.

20 Ludlow and Wood favourably impressed another Yale scientist in 1875: 'Ludlow is a very pleasant man – 35 perhaps – all the people we meet join in praising him up so enthusiastically that I am beginning to think he must be something quite remarkable in the way of a military man. His assistant Wood, is an attractive fellow, and I doubt not will be a pleasant companion.' Edward Salisbury Dana to Henrietta Silliman Dana, 30 June 1875, Yale University Archives, Dana Family Papers, MS 164, Box 21, folder 204.

21 George Bird Grinnell to O.C. Marsh, 5(?) June 1874, citing Grinnell's letter of credentials from Sheridan. Yale University Archives, O.C. Marsh Papers (OCM), MSS Acc. 343, copies courtesy of Daniel L. Brinkman, Division of Vertebrate Paleontology, Yale Peabody Museum of Natural History.

22 Grinnell to Marsh, 7 June 1874, OCM.

fossils to be found, although 'we do not know how much he may change when Winchell gets at him … If there is a fight and the fossils are divided the trip will have been a failure'.[23] Grinnell lost the fight when Ludlow sided with Winchell, although Winchell agreed to cede the fossils to Yale if they could be analysed immediately for Ludlow's report on the expedition.[24]

Grinnell knew what would justify the expedition scientifically, and he was continually disappointed. 'You must see how it is yourself', he wrote to Marsh. 'The object of the expedition is to rush over as much ground as possible in the 60 days allowed', leaving little time to prospect for bones. Disappointment extended to the land itself: 'The whole country is the most dreary and depressing I have ever travelled through and if I once get out of it please God I'll never enter Dakota again nor go on a purely military expedition again.'[25] Grinnell managed to ship back two small boxes of fossils – Cretaceous invertebrates, Miocene and Pliocene bones and a rhinoceros jaw – although he reported that Custer seemed 'much disappointed at our failure to obtain vertebrate fossils'.[26] The expedition traipsed around the Black Hills and eastern Montana during the summer of 1874. It succeeded politically, if not scientifically. Winchell was sceptical about gold deposits; Custer, relying on the view of professional miners on the expedition, proclaimed a new Eldorado. Prospectors then flooded in.[27]

Winchell's and Custer's diverging opinions about gold suggest an independence of scientific spirit. So do the comments of the scientists, who attributed the disappointingly small number of fossils collected to the military discipline of a quick march. Winchell emphasized in his report, echoing Grinnell's lament to Marsh,

> In a military expedition, or one mainly military, the accompanying geologist can only be industrious in gathering facts, as they occur during the daily march. His opportunity for comparing his observations with the geology of a belt of country adjoining on either hand, or for following up a train of investigations to solve problems that arise to his mind from what he sees, is very meager.

Yet Grinnell did note hadrosaur bones and turtle remains, as well as shells. Grinnell wrote up his thin findings. As was usual for expeditions, sedentary collaborators helped with the results. The invertebrate shell fossils were identified by Robert Parr Whitfield, then professor of geology at Rensselaer Polytechnic Institute and later at the American Museum of Natural History. Donaldson's collection of plants went for identification to John Merle Coulter, an early visitor of Yellowstone who was then professor of natural science at Hanover College, Indiana.[28]

23 Grinnell to Marsh, 21 June 1874, OCM.
24 Grinnell to Marsh, 25 and 26 June 1874, OCM.
25 Grinnell to Marsh, 28 July 1874, OCM.
26 Grinnell to Marsh, 10 and 15 August 1874, OCM.
27 T.B. Walker *et al.*, *Memorial for Newton Horace Winchell, Last of the Founders and Charter Members of the Academy of Science*, Minneapolis, 1914 [*Bulletin of the Minnesota Academy of Science* (1914) 5(2)].
28 William Ludlow, *Report of a Reconnaissance of the Black Hills of Dakota Made in the Summer of 1874*, Washington, DC: Government Printing Office, 1875. In this volume: Winchell, 'Geological report', pp. 21–73; Grinnell, 'Paleontological report', pp. 75–78; Grinnell, 'Zoological report', pp. 79–104; Whitfield, 'Descriptions of new fossils', pp. 103–104, Winchell's quotation on p. 60. William Trelease, 'John Merle Coulter', *Biographical Memoirs of the National Academy of Sciences* (1929) 24, pp. 99–123.

The naturalists on the expedition went on to enjoy significant scientific careers. We may ask how their views cohered with or were formed by the association with Custer, who himself had a scientific bent. Custer's widow Elizabeth reports that he sent a live wildcat to the Scientific Board (presumably the Smithsonian), a stuffed elk to the Audubon Club of Detroit, and a collection of fossils to the University of Michigan. In his field camps, Custer would assemble an 'annual menagerie'; on the Black Hills expedition in 1874 it contained owls, an eagle, a rattlesnake, jackrabbits and two badgers, and the animals travelled in the ambulance wagon with the best springs. Elizabeth Custer viewed the military as stand-ins for the scientists: 'In geological research the officers of our army have been of incalculable use to their Government. They explored the Indian infested countries long before the colleges or Government sent out scientists for the purpose.'[29]

Elizabeth Custer's odious reference to aboriginal peoples finds a reprise in the reflections of Custer's brother-in-law, Lt James Calhoun, who accompanied the expedition:

> As I gaze upon this particular spot, I think that it is a great pity that this rich country should remain in a wild state, uncultivated and uninhabited by civilized men. Here the wheel of industry could move to advantage. The propelling power of life in the shape of human labor is only wanting to make this a region of prosperity … Man is the promoter of earthly happiness. He is the divine instrument, pre-ordained from primitive existence to diffuse this beneficence upon the earth. Man is the noblest work of God. In this wild region man will ultimately be seen in the full enjoyment of true pleasure, in the possession of happiness ordained by honest labor. For the hives of industry will take the place of dirty wigwams. Civilization will ere long reign supreme and throw heathen barbarism into oblivion. Seminaries of learning will raise their proud cupolas far above the canopy of Indian lodges, and Christian temples will elevate their lofty spires upward towards the azure sky while places of heathen mythology will sink and rise no more. This will be a period of true happiness.[30]

The sentiments are echoed in an early twentieth-century publication by Winchell about a painting by Douglas Volk depicting the discovery in 1680, by Louis Hennepin, of the Falls of St Anthony on the Mississippi River near St Paul, Minnesota:

> There is native, original Minnesota in all its untrod magnificence, pregnant with all its potential promise. There is the wild man, its sole occupant, with his feeble energy and superstitious faith. Conjoined to these in the same scene is the tread of the first European, with all that his civilization implies. In that footstep is the embodiment of geographic exploration promoted by commerce and Christianity, the intelligence and education of Hennepin contrasted with the degradation of the savage. All the art which has followed after that scene, all the manufactures, the science, all the education, all the improved methods of human livelihood are foreshadowed and concentrated in the discovery of the Falls of St Anthony. No single individual scene, no event in all our history, carries with it so much of the natural and so much of the possibility of the artificial in our history as the portaging of that canoe round the Falls of St Anthony by Father Hennepin and his companion Du Gay.[31]

29 Elizabeth B. Custer, *Boots and Saddles, or Life in Dakota with General Custer*, New York: Harper and Brothers, 1885, p. 301, for the menagerie; Grafe and Horsted, op. cit. (19), p. 21, for the comfort afforded the live animals. Elizabeth B. Custer, op. cit. (17), p. 71, for the quotation.

30 Grafe and Horsted, op. cit. (19), p. 19, Calhoun on 20 July 1874.

31 Winchell, 'Hennepin at the Falls of St Anthony', 1908, in Walker *et al.*, op. cit. (27), p. 106.

Winchell, who identified the iron deposits in the Mesabi Range, also wrote about early humankind in North America. That work, appearing at the end of his life, bears no trace of his racism.[32]

Grinnell's intellectual progress is more sanguine. In 1875, he participated as a naturalist, along with Yale geology tutor Edward Salisbury Dana, on an expedition led by William Ludlow (and protected by the Cavalry) to Yellowstone. Grinnell's companion on the expedition was the son of Yale's Silliman Professor of Natural History and Geology, James Dwight Dana. E.S. Dana was in fact in Grinnell's class at Yale, although by the time of the Yellowstone expedition, Dana had studied at Vienna and Heidelberg and had been appointed tutor in mathematics, physics and chemistry at Yale. In letters to his parents, Dana was circumspect about the expedition. Even though the scientists were, he emphasized to his mother, 'not allowed to stray off very far from camp, and not at all unless fully armed', he was impressed with the country. To his father:

> We have seen a great deal that was interesting geologically during the month we have been in the field and have learned a great deal that could hardly have come in any other way. In the way of detailed observations we can do very little while we are marching 25 and 30 miles a day. At the same time I think on the whole we pick up more than I would have supposed possible.[33]

To his mother:

> I had to laugh at myself several times as I was engaged in pounding out fossils at some ledge of rock – hammer in one hand and rifle in the other. It seemed rather absurd but I noticed that those who had had most experience were those who were most cautious, and most careful not to be caught unprepared.[34]

On the Yellowstone expedition, Grinnell and Ludlow grew alarmed at civilized intrusions into the pristine wilderness.[35] The beauty of the mountains made a strong impression on them. Art historians have signalled the nineteenth-century identification of the North American landscape with the sublime, Immanuel Kant's superlative of beauty and harmony.[36] The theme is recovered by Edward Salisbury Dana, who generally expressed only admiration for the Cavalry and alarm at the Indians, when describing Yellowstone to his mother:

> We all agreed that the Grand Cañon with its waterfall of 300 feet and more was the one thing longest to be remembered – and it is something which the photograph entirely fails to

32 Newton Horace Winchell and Alexander N. Winchell, *Elements of Optical Mineralogy*, New York: D. van Nostrand, 1909, for another side to Newton H. Winchell's science. The book, written with his son Alexander (with a doctorate from Paris and a professorship in mineralogy and petrology at the University of Wisconsin), is based on the work of Michel Lévy, Fernand André Fouqué and Alfred Lacroix.

33 E.S. Dana to Henrietta Silliman Dana, 18 July 1875; E.S. Dana to James Dwight Dana, n.d., Yale University Archives, Dana Family Papers, Box 21, Folder 204.

34 E.S. Dana to Henrietta Silliman Dana, 1 August 1875, Yale University Archives, Dana Family Papers, Box 21, Folder 204.

35 John F. Reiger, *The Passing of the Great West: Selected Papers of George Bird Grinnell*, New York: Scribner, 1972, p. 109.

36 François-Marc Gagnon, 'The forest, Niagara and the sublime', in Hilliard T. Goldfarb (ed.), *Expanding Horizons: Painting and Photography of American and Canadian Landscape 1860–1918*, Montreal: Montreal Museum of Fine Arts and Somogy, 2009, pp. 33–36.

reproduce. The picture shows you well enough the form of the Cañon, with its steep sides worn into fantastic buttresses, turrets and pinnacles and the river, looking like a [–?] ribbon far down below – but it fails to give you the slightest idea of the coloring, which is the most wonderful feature of it all. You expect something dark and somber, and instead you find a brilliancy of coloring which you can hardly believe is real as you look at it. Some of the sharp-pointed towers are bright red, others yellow, others white, with all shades between, and the same colors belong to the mass of the walls as far as you can see. It is something which no amount of word-painting could give any idea of and which would seem impossible on canvass.

The scenery all through the Park is such as belongs to high mountain regions, much of it very fine indeed, and the Lake is not the least attractive feature of it all. Scientifically the Geyser Basins offer the most that is interesting and the exhibition of power in throwing up those great streams of water to a height of one and two-hundred feet is very grand, while the beauty and variety in the material deposited by the geysers and hot springs never cease to excite admiration.

It is a very pleasant way of traveling – with a pack-train, instead of wagons – and one to be enjoyed by all concerned with the exception of the poor mules who have a hard time indeed. We had a pretty distinct trail to follow and it took us up and down steep hills, through the dense pine forests where your horse must be guided well or he would bang your knees against the trees for you, over fallen timber, and through the rich meadows brilliant with an endless variety of wild flowers. There is so much variety in such a mode of traveling that the day's march never becomes wearisome, even if it stretched out to nearly 40 miles. It was a most striking contrast to the life on the plains – not the least in the big camp fires which the cold at night makes very pleasant. You might hardly appreciate that for the first month we were out we never had that luxury, and even the little wood needed for cooking purposes must often be carried along with us.[37]

By 1876, Grinnell was a seasoned plainsman. Custer asked him to join the expedition that ended in the Cavalry's defeat at the Little Big Horn. Grinnell declined, pleading more urgent tasks with Marsh at Yale's new Peabody Museum. More collecting and a brief time as a Wyoming rancher followed. In 1880 Grinnell returned to Yale, defended a doctoral dissertation on the osteology of the bird known as the roadrunner, and promptly took over direction, with his father, of the magazine *Forest and Stream*. Grinnell used it to promote his views about preserving the wilderness. He founded the Audubon Society in 1886, befriended Theodore Roosevelt in the Boone & Crockett Club, and, in his mature years, became a prominent defender of aboriginal rights.[38] We shall find his like in Russia.

As a defender of the dignity of the indigenous peoples of America, Grinnell followed his Yale professor, O.C. Marsh. For his 1874 expedition to the Dakotas, Marsh obtained permission from the Oglala Sioux, persuading them that his interest was not gold but fossils. He promised the Sioux chief, Red Cloud, to bring complaints about exploitation and corruption to the attention of the administration in Washington. Marsh made the deputation in 1875, speaking directly to President Grant. The complaint punctuated an ongoing investigation of the Indian Bureau and received wide notice in

37 E.S. Dana to Henrietta Silliman Dana, 10 August 1875, Yale University Archives, Dana Family Papers, MS 164, Box 21, Folder 204.

38 Frank Graham Jr, with Carl W. Buchheister, *The Audubon Ark: A History of the National Audubon Society*, New York: Knopf/Random House, 1990; William T. Hagan, *Theodore Roosevelt and Six Friends of the Indian*, Norman: University of Oklahoma Press, 1997, for Grinnell's Indian advocacy. Also Reiger, op. cit. (35), pp. 124–143.

the press. Red Cloud came to Washington and made his case in the company of Marsh. Before the end of the year, the secretary of the Interior Department was replaced. In 1883 Red Cloud spent three days in New Haven, hosted by Marsh.[39] The Sioux war bonnet currently on display in Yale's Peabody Museum is said, by staff, to have been a gift from Red Cloud to O.C. Marsh.

Words do not fail us when we confront racism and genocide. Rather, there are too many words. The words extend to the beginnings of history in antiquity. Study Thucydides, as General Colin Powell may have done, and you will see rivers of blood, whole cities razed and peoples killed or enslaved.[40] The Athenians, so proud of their democracy, did not share with others what they held dear. In a well-known passage, Thucydides recounts how the Athenians overwhelmed the Melians. The Melians, desperately negotiating in the face of overwhelming Athenian power, tried to shame the Athenians into spreading democracy, rather than devastation. Ha! said the Athenians, you are nothing to us but a resource. Read Henri Pirenne's histories of the medieval world. Pirenne, the patron of revolutionary socialists, the father of the craft that we hold dear, in describing the triumph of the bourgeoisie, takes violence and depravity as a given – Europe's background radiation.[41] (Does not similar violence and depravity characterize the great Mesoamerican civilization contemporaneous with medieval Europe, the Aztecs?) It is there, in early American literature, about the eradication of peoples (the Acadians, the Mohicans). It is there, in the great works of European fiction at the dawn of the industrial age (*Candide*, *The Last Man*). And yet Longfellow, Cooper, Voltaire and Shelley wrote, in their study, and their books issued from presses. Modernity carries this tradition forward into our own time. Banquo increasingly makes himself felt. It's enough to drive you crazy.

We have still not come to terms with the slaughter on the Great Plains of North America in the 1860s and 1870s. But the remarkable fact is that it was repeated, at the same moment, by the mirror-image twin of the United States in the southern hemisphere. Over these two decades, Argentina, like the United States, became a centrally unified republic and pushed its aboriginal peoples out of its great plains, the Pampas. The railways and intensive farming came to Argentina, as they came to the United States. Europeans arrived by the millions to populate the expanse. Buenos Aires, by 1900, was an austral New York.[42]

39 Schuchert and LeVene, op. cit. (10), pp. 139–168.

40 Charles Stewart, 'No culture without history', *Anthropological Quarterly* (2005) 78, pp. 269–277, for Powell's appeal to Thucydides.

41 Christophe Verbruggen and Lewis Pyenson, 'History and the history of science in the work of Hendrik De Man', *Belgisch Tijdschrift voor Nieuwste Geschiedenis* (2011) 41, pp. 487–511, for Pirenne.

42 A concise and reliable survey of science in nineteenth-century Argentina may be found in Marcelo Montserrat, 'La ciencia', in Miguel Angel de Marco (ed.), *Nueva historia de la nación Argentina*, tomo VI, tercera parte: *La configuración de la República independiente 1810–c.1914*, Buenos Aires: Planeta, 2001, pp. 403–427. Montserrat's text provides a notable discussion of the impact of Italian savants on science in Argentina and also of the reception of Darwin's *Origin of Species*. Montserrat's contribution, 'The evolutionist mentality in Argentina: an ideology of progress', in Thomas F. Glick, Miguel Angel Puig-Samper and Rosaura

Jens Andermann has written movingly about the Argentine genocide. The consistent justification for it, he emphasizes, was the outward extension of civilization and the eradication of barbarism. Catholicism allied, sometimes uneasily, with Argentine civilization, although South American religion did not exhibit the bewildering variety of North American religion.[43] A trope common to both settings was the notion of exploiting the land to generate wealth. As has often been noted, steam and steel were the tools for exploitation. Remingtons made the unitary Argentine republic, just as they made the continent-spanning United States of America. The 1870s, in both countries, saw a scientistic belief in mechanical progress.[44] Both countries sought to produce more scientists, along the lines of German universities. Both countries set up structures to inventory the natural world following European norms.

Andermann cites one Argentine naturalist and science fiction writer from this time, Eduardo Holmberg, who explicitly screened out aboriginal peoples from the world he surveyed:

> There are human forms moving about this stunning solitude. Do not ask who they are, for the very rocks and mountains, the extinguished life forms and the icebergs, the plants and the rivers, the living animals and the rains and the ice shells, the moss and the volcanoes, will tell you their names. Their arms are the sextant and the barometer, the chisel and the compass, the gunpowder and the mountain knife, the chronometer and the chain, the thermometer, the lead and the hoist.

For Holmberg, scientists affixed their names to species in the book of eternity; in a sense, they owned a part of the natural world. To achieve this glory, they worked with the military.[45]

Ruiz (ed.), *The Reception of Darwinism in the Iberian World: Spain, Spanish America and Brazil*, Dordrecht: Kluwer, 1999, pp. 1–28, is a model of sophistication and grace.

43 Jens Andermann, 'Entre la topografía y la iconografía: mapas y nación, 1880', in Marcelo Montserrat (ed.), *La ciencia en la Argentina entre siglos: textos, contextos e instituciones*, Buenos Aires, 2000, pp. 101–125. *Idem*, 'Argentine literature and the 'Conquest of the Desert', 1872–1896', www.bbk.ac.uk/ibamuseum/texts/Andermann02.htm.

44 Marcelo Montserrat, *Ciencia, historia y sociedad en la Argentina del siglo XIX*, Buenos Aires: Centro Editor de América Latina, 1993, pp. 31–82, on evolution, progress, and positivism. Also Solomon Lipp, *Three Argentine Thinkers*, New York, 1969, notably pp. 16–26, on the same theme; Marcelo Montserrat, 'La mentalidad evolucionista: una ideología del progreso', in Gustavo Ferrari and Ezequiel Gallo (eds.), *La Argentina del ochenta al centenario*, Buenos Aires: Sudamericana, 1980, pp. 785–818.

45 Irina Podgorny, *El sendero del tiempo y las causas accidentales: los espacios de la prehistoria en la Argentina, 1850–1910*, Rosario: Prohistoria, 2009; Podgorny and Lopes, op. cit. (9), pp. 159–178; in 1889, the naturalist Estanislao Zeballos, founder of the Sociedad Científica Argentina and in that year minister of foreign affairs, donated to the Museum of La Plata skulls that he had collected from the battlefields of Patagonia (pp. 164–165, 239). Also Máximo Farro, *La formación del Museo de La Plata*, Rosario: Prohistoria, 2009, pp. 63–79. Andrés Di Tella, 'Ruins in the desert: field notes by a filmmaker', in Michael Lazzara and Vicky Unruh (eds.), *Telling Ruins in Latin America*, New York: Palgrave Macmillan, 2009, pp. 87–94, for a discussion of the controversy about the skulls, p. 90 for novelist David Viñas's identification of the autochthonous genocide with the *desaparacidos* of the military regime in 1976–1983. Irina Podgorny, 'La derrota del genio: Cráneos y cerebros en la filogenia argentina', *Saber y tiempo* (2006) 20, pp. 63–106. In 1912, the great reforming educator and architect of Argentina's scientific pre-eminence in Latin America, Joaquín V. González, affirmed that Argentina's mission was to spread civilization by vanquishing indigenous peoples. Irina Podgorny, *Arqueología de la educación: textos, indicios, monumentos*, Buenos Aires: Sociedad Argentina

Andermann and other writers cite postmodernist speculators to make their case that the inventory of minerals and biota along with the generalizations deriving from them are fundamentally unclean. But words are not invalidated simply because they are uttered in halls bearing the name of a man who despoiled the wilderness and underpaid his workers. At the high-water mark of the modern age, critic George Steiner resigned himself to affirming that high culture could coexist with inhuman atrocity. Depending on the direction of the wind, the great composer Richard Strauss, apolitical in the manner of physicist Max Planck, could smell the ovens of Dachau from his residence in Munich.[46]

Let us return to Argentina's conquest of its desert. The word 'desert' signals desolation.[47] The land is uncultivated. The rivers irrigate no fields. The autochthones are nomads. The wind, Gabriela Nouzeilles has emphasized, blows everything this way and that. Nouzeilles explores, with this and other tropes, the specificity of Patagonia.[48] Here, however, it is relevant to emphasize a homology between the Badlands of South Dakota, the terrain of southern Siberia, and the stark land that, for a generation, Argentines sought to master.

The conqueror of the land in Argentina had an early career resembling George Armstrong Custer's.[49] Julio A. Roca occupied a pivotal role in late nineteenth-century Argentina. A young man from Tucumán in the northern interior, he joined the army of the Argentine Confederation in 1858, served in a war of conquest (against Paraguay) and wars of unification (in Argentina), and rose in 1877 to become minister of war. Over the next two years, he extended Argentine dominance over Patagonia by conducting a savage war. Victorious, he then suppressed a revolution by the City of Buenos Aires. Elected president in 1880, he nationalized Buenos Aires and moved the provincial government to nearby La Plata. In 1898 he began a second, six-year, term as president. If Custer had mastered his ego, he might have followed Roca's path.

Roca rose on a tide of positivism, which, from the time of Domingo Faustino Sarmiento, became a national mantra. Sarmiento and his successors were awed by the

de Antropología, 1999, pp. 123–124. Noteworthy is the centenary memorial of the Conquest of the Desert, published in four volumes by the Academia Nacional de la Historia, under its president Enrique M. Barba: *Congreso nacional de historia sobre la Conquista del Desierto*, Buenos Aires: Academia Nacional de la Historia, 1980.

46 George Steiner, *In Bluebeard's Castle: Some Notes towards the Redefinition of Culture*, New Haven: Yale University Press, 1971, p. 87: 'The accomplishments of art, of speculative imagining, of the mathematical and empirical sciences have been, are, will be, to an overwhelming extent, the creation of the gifted few … The immense majority of human biographies are a gray transit between domestic spasm and oblivion. For a truly cultured sensibility to deny this, under pretexts of liberal piety, is not only mendacious but rank ingratitude.' Dachau on p. 63. Shall Steiner's quotation be engraved over the gates of Yale, Cambridge and Geneva universities, where Steiner gratefully spent much of his scholarly life?

47 For example, Giacomo Puccini's Manon Lescault, dying in the green desert of Louisiana. An exhaustive look at the word 'desert' in Argentina in Angel A. Castellán, 'Nacimiento historiográfico del termino "desierto"', in Academia Nacional de la Historia, op. cit. (45), vol. 4, pp. 293–305.

48 Gabriela Nouzeilles, 'The iconography of desolation: Patagonia and the ruins of Nature', *Review: Literature and Arts of the Americas* (2007) 40, pp. 252–262.

49 There is a large literature on the Conquest of the Desert. Néstor Tomés Auza, 'La ocupación del espacio vacío: de la frontera interior a la frontera exterior, 1876–1910', in Gustavo Ferrari and Ezequiel Gallo (ed.), *La Argentina del ochenta al centenario*, Buenos Aires: Sudamericana, 1980, pp. 61–89.

industrial expansion of the United States, which they attributed to the application of science. Populating the interior of Argentina, and especially the desolate southern cone, was a way of assimilating European immigrants and achieving the status of a great nation. Indian raids on Argentine settlers resulted in Roca's mission, confided by the Argentine president, to pacify the land in the southern area of Rio Negro. As formulated by Roca's late predecessor as minister of war, Adolfo Alsina, it was an operation to push the Indians out and construct a defensive line against their incursions; securing Argentina's borders against Chile would come as a fillip. In 1876, two months before the Battle of the Little Big Horn, Roca emphasized in a letter to a newspaper that Sarmiento, in the last months of his presidency, had entertained the idea of establishing a permanent frontier with the help of an expedition of 'competent professors from the diverse fields of science, who were indispensable for determining the positions and the division of the land, for carrying out hydrographical and geological and other investigations of natural history in these regions'.[50] Three years later Roca set out on his 'great crusade, inspired by the most pure patriotism, against barbarism'.[51] With six thousand troops, he rode over Neuquén and Rio Negro, pushing governmental control south to the rain-shadow desert around the fortieth parallel. A corps of scientists worked diligently as Roca 'cleansed' the desert for colonization; an informed estimate of the number of Indians killed in battle or by disease (largely smallpox) is 18,000.[52]

The estimate appeared in a historical account of the scientific corps, published in 1961 by Guillermo V. Stuckert, a member of the Córdoba Academy of Sciences, dean of the Faculty of Medical Sciences in Córdoba, and sometime legislative deputy for the Anti-Peronista Unión Cívica Radical. Following in the tradition of Roca's scientific corps, Stuckert intended his monograph to affirm how science secures human dignity and liberty. Having experienced a life of authoritarian politics, Stuckert urged readers to recover the energy and self-reliance of scientists like those on Roca's expedition. He emphasized that mathematics, physics and chemistry 'direct human destiny'. An effort had to be made to point young people back to these 'abstract demonstrations'. Stuckert

50 Manuel J. Olascoaga, *Estudio topográfico de la Pampa y Rio Negro*, vol. 1, Buenos Aires: Comisión Nacional Monumento al Teniente General Roca, 1939, p. 44, Roca to the editor of *La república*, 24 April 1876.

51 Olascoaga, op. cit. (50), p. 154, Roca addressing his troops on 26 April 1879; Manuel J. Olascoaga, *Estudio topográfico de la Pampa y Rio Negro*, vol. 2, Buenos Aires: Comisión Nacional Monumento al Teniente General Roca, 1940, p. 204, Lt Col. Enrique Godoy's diary of 1 May 1879, concerning the activities of his division 'in this crusade of civilization against barbarism'.

52 Alvaro Fernandez Bravo, *Literatura y frontera: procesos de territorialización en las culturas argentina y chileana del siglo XIX*, Buenos Aires: Editorial Sudamericana, Universidad de San Andres, 1999, pp. 170–171. For the deeper background to the Conquest of the Desert: Mónica Quijada, 'Repensando la frontera sur Argentina: concepto, contenido, continuidades y discontinuidades e una realidad especial y étnica (siglos XVIII–XIX)', *Revista de Indias* (2002) 62, pp. 103–142. Guillermo V. Stuckert, *La campaña del General Roca al desierto y la Academia Nacional de Ciencias*, Córdoba: Academia Nacional de Ciencias, Miscelanea no. 40, 1961, p. 21, for the estimate. The estimate is about the same number as casualties in the Falklands War of 1982. By way of comparison, the Dirty War in Argentina (1976–83) had thirty thousand *desaparecidos*, the Battle of Gettysburg in 1863 during the US Civil War resulted in more than fifty thousand casualties, roughly equivalent to the Battle of Waterloo; the Third Battle of Ypres in 1917 produced more than half a million casualties. It is hard to internalize these statistics.

believed that scientific instruction would defend 'our civilization, Christian and liberal'.[53]

Stuckert cast his account of the Conquest of the Desert in neo-Darwinian language. Roca's extension of state authority over Patagonia was 'inevitable … the supremacy of the strongest or most intelligent. It was and it remains today the destiny of men'. The war heralded a new era of 'cultural work and progress'. Roca's times were not those of the mid-twentieth century, 'our humanizing epoch', with its desire to 'raise underdeveloped peoples to higher cultural levels, without branding them with the stigma of "savages."' Rather, the result was what took place in North America, where the 'extirpation of the Indians' eliminated serious discussion of aboriginal rights. Stuckert cast Roca's war as the final campaign in a conflict that had endured for generations, in which autochthones and bandits had preyed on citizens of the new republic. He noted that the war succeeded in repatriating 117 citizens and more than ten thousand animals captured in raids by the Indians, and that a sustained effort was made to avoid atrocities.[54]

When the war was already under way, the interim president of the National Academy of Sciences in Córdoba, the old, intellectual city of the north-west, Oscar Doering, in a letter of 1879, offered a group of scientists to the expeditionary force, an offer accepted within days by General Roca. Doering, a physicist educated at Göttingen under Wilhelm Weber, directed an institution that had been planned for nearly ten years by Germán Burmeister, a Humboldtian-inspired entomologist who in 1861 left a professorship of zoology and an unhappy marriage in Halle for the Museo Público in Buenos Aires, and who worked with Sarmiento and his presidential successors in promoting scientific research at Córdoba.[55] The kindest assessment of Burmeister's planning (the first foundation of the Córdoba academy occurred in 1870) is to say that things proceeded unevenly; his controversial role in the affairs of the academy is recorded in a science fiction novel by Holmberg.[56]

The group eventually proposed to General Roca had two senior scientists, Pablo G. Lorentz and Oscar Doering's brother Adolfo Doering, a Göttingen-educated chemist and zoologist, along with two junior members, Gustavo Niederlein and Federico

53 Stuckert, op. cit. (52), p. 39.

54 Stuckert, op. cit. (52), pp. 4, 19, 24; the captives are memorialized in the epic poem by Esteban Echeverria, 'La cautiva' (1837), and in the painting by Angel Della Valle, *La vuelta del malón* (1892).

55 Luis Tognetti and Carlos Page, *La Academia Nacional de Ciencias: etapa fundacional, siglo XIX*, Córdoba: Academia Nacional de Ciencias, 2000; Luis Tognetti, 'La introducción de la investigación científica en Córdoba a fines del siglo XIX: La Academia Nacional de Ciencias y la Facultad de Ciencias Físico-matemáticas (1868–1878)', in Marcelo Montserrat (ed.), *La ciencia en la Argentina entre siglos: textos, contextos e instituciones*, Buenos Aires: Ediciones Manatial SRL, 2000, pp. 345–365; idem, *La Academia Nacional de Ciencias en el siglo XIX: los naturalistas, publicaciones y exploraciones*, Córdoba: Academia Nacional de Ciencias, 2004; Telasco García Castellanos, *Sarmiento: su influencia en Córdoba*, Córdoba: Academia Nacional de Ciencias, 2004. The constitution of the scientific commission, as well as its antecedents, in Francisco Cignoli, 'La comisión científica agregada al estado mayor de la expedición al Rio Negro (1879); sus propositos; sus logros', in Academia Nacional de la Historia, op. cit. (45), vol. 4, pp. 71–80.

56 Eduardo L. Ortiz, 'On the transition from realism to the fantastic in the Argentine literature of the 1870s: Holmberg and the Córdoba Six', in Evelyn Fishburn and Eduardo L. Ortiz (eds.), *Science and the Creative Imagination in Latin America*, London: Institute for the Study of the Americas, [2005], pp. 59–85; Marcelo Montserrat, 'Holmberg y el Darwinismo en la Argentina', *Criterio* (1974) 47, pp. 591–598.

Schultz.[57] Lorentz, a botanist with a doctorate from the University of Munich, and Adolfo Doering both participated in refounding the National Academy of Sciences in 1878. In 1874, Burmeister forced Lorentz to resign from the University of Córdoba and accept a post as professor at the Colegio Nacional de Concepción del Uruguay (an early secular and free school in Argentina, where Julio Roca had received his education) while continuing as a corresponding member of the academy (Adolfo Doering ended his career in the twentieth century as both a professor of zoology in the university and president of the academy). Schultz, an ornithologist who worked with the academy's collection of preserved animals, served as an assistant on the expedition, as did Niederlein, a botanist. The German naturalists accompanied Roca, collected specimens, and then worked with sedentary authorities to publish their results, as Grinnell and Winchell had done in the United States.[58]

In publishing his findings, Adolfo Doering thanked his military captains for allowing the scientists to conduct their investigations.[59] Lorentz was more circumspect: 'The expedition was a campaign, not a scientific expedition. We were almost constantly on the march and had the night to prepare the collected plants and write up our notes … Always there was the uncertainty that things would end with the bugle signalling that we had to move on'.[60] Yet Lorentz was clear to drape General Roca in the mantle of having brought 'civilization and industry, as well as science, to these vast areas'. Along with the civic crowns garnered by this conquest, Lorentz continued, there was also 'the laurel of science', awarded to Roca by naming some of the most interesting new species in his honour.[61] The laurel appears on the illustrated plates of the scientific report. The military patrons received more panegyric. In his report on geology, Doering wrote about the circumstances that united the scientists and the soldiers 'under the same tent … Everlasting and unfading are the laurels that the Argentine State has conquered on the field of battle. Our fervent hope is that the resplendence of Mars and the radiance of Minerva shall increasingly form one inextinguishable halo'.[62] Doering and his colleagues wanted to stay on good terms with their patron.

57 Stuckert, op. cit. (52), p. 21. Doering was the expedition's geologist because his academy's geologist, Göttingen-educated Luis Brackebusch, was then devoting his attention to producing a geological map of the northern part of the country, where its proven mineralogical wealth lay. Tognetti and Page, op. cit. (55), p. 52, for Brackebusch's focus on the north.

58 Stuckert, op. cit. (52), p. 37; Tognetti, *La Academia … los naturalistas*, op. cit. (55), for a summary of the expedition.

59 Adolfo Doering, with Carlos Berg and Eduardo L. Holmberg, *Informe oficial de la comisión científica agregada al Estado Mayor General de la expedición al Río Negro (Patagonia) realizada en los meses de Abril, Mayo y Junio de 1879, bajo las ordenes del general Julio A. Roca*, Pt. 1: *Zoología*, Buenos Aires: Ostwald y Martínez, 1881, p. 6.

60 Pablo Lorentz and Gustavo Niederlein, *Informe oficial de la comisión científica agregada al Estado Mayor General de la expedición al Río Negro (Patagonia) realizada en los meses de Abril, Mayo y Junio de 1879, bajo las ordenes del general Julio A. Roca*, Pt. 2: *Botánica*, Buenos Aires: Ostwald y Martínez, 1881, p. 174; Stuckert, op. cit. (52), p. 37 for an abridged excerpt.

61 Lorentz and Niederlein, op. cit. (60), p. 175.

62 Adolfo Doering, *Informe oficial de la Comisión científica agregada al Estado Mayor general de la expedición al Rio Negro (Patagonia) realizada en los meses de Abril, Mayo y Junio de 1879, bajo las ordenes*

None of the scientists sought a commission in the army, which could have led to a successful political career. They understood their supernumerary status. The scientists were indeed included in the grand canvas of 1892 by Uruguayan painter Juan Manuel Blanes, *The Military Occupation of the Río Negro by the Expedition Led by General Julio A. Roca*, which depicts the main figures of the Conquest of the Desert. In the painting, Roca and his officers are mounted in the foreground. Toward one side of the painting, in the middle distance, stand the four scientists, their instruments boxed at their feet. Significantly, the scientists have been entirely excised from the reproduction of the painting that graces the verso of the present one-hundred-peso note in Argentina.[63] This treatment lends support to the interpretation of Doering's military allusion, just mentioned, as an obligatory introduction, in the order of Islamic invocations at the beginning of medieval treatises on astronomy, or indeed the prominent invocation of a patron on the title page of Newton's *Principia*.

Samuel Johnson contended that only a blockhead would write for anything except money.[64] The observation is relevant here, because one source for Russian expansion in Asia is the autobiography of the anarchist prince, Peter Kropotkin, which was written in English, for money (the penniless prince gave most of the profits to his political cause). In his autobiography, Kropotkin recalls that he was groomed for imperial service, attending an elite preparatory school, the Corps of Pages in St Petersburg. There he experienced the stupidity of the imperial court and the depravity of boys' academies. At school, he was strongly attracted by the natural sciences and Alexander von Humboldt's evocative presentation of their unity; he studied Darwin's *Origin* soon after it appeared. Science, in his view, would become the servant of humanity. He wrote about one Luddite, 'William Morris's hatred of machines only proved that the conception of the machine's power and gracefulness was missing in his great poetical genius.'[65] Upon graduation, at age nineteen, he wanted to study science at the university, but his father would not finance his studies. Kropotkin opted for active military service.[66]

Kropotkin was taken with Humboldt's descriptions of the great rivers of the Americas, notably the Mississippi. Russia had just acquired rights on the Amur River in eastern Siberia. The young officer declined an appointment under the tsar in favour of a commission with a regiment of Cossacks in Siberia. He served for five years, most of it centred in Irkutsk, near Lake Baikal, but also at Chita, near the border with the Qing Empire. The territory was filled with internal exiles, most recently more than ten

del general d. Julio A. Roca: Geología (1879), Buenos Aires: Ostwald y Martínez, 1881–1882, pp. 299–530, 301–302.

63 Stuckert, op. cit. (52), detail facing p. 24.

64 Johnson's stricture turned on its head by Adam Gopnik, 'Writing and winning', *New Yorker*, 18 October 2010, pp. 23–24.

65 Kropotkin, *Memoirs of a Revolutionist*, London: Smith, Elder, 1899, p. 119.

66 The principal source for Kropotkin's life in Russia is his *Memoirs*. Recent, derivative accounts may be found in Kenneth Hewitt, 'Between Pinochet and Kropotkin: state terror, human rights and the geographers', *Canadian Geographer* (2001) 45, pp. 338–355; Gerry Kearns, 'The political pivot of geography', *Geographical Journal* (2004) 170, pp. 337–346, with a list of Kropotkin's articles on geography in English. Also Haia Shpayer-Makov, 'The reception of Peter Kropotkin in Britain, 1886–1917', *Albion* (1987) 19, pp. 373–390.

thousand Poles. Like the four German naturalists in Argentina and like George Bird Grinnell, Kropotkin had the advantage of youth. He quickly received a mission from the Geographical Society of St Petersburg to explore Manchuria.

Kropotkin's patron society was emerging from a period of Baltic tutelage to advance a national, Russian agenda.[67] When General Nicholas Muraviev floated down the Amur in 1855 to assert Russian sovereignty over Sakhalin, he brought with him a group of scientists: L.E. Schwarz, for mathematical topography, and the naturalists Gustav I. Radde and Richard Maak. (Radde, a young pharmacist, had attracted the attention of a natural-history society, which had earlier sent him to the Crimea and southern Russia, where he stayed for three years.[68]) Their results, published in German and in Russian, led to a further expedition by F.B. Schmidt and two assistants in 1860–1862. Schmidt returned to St Petersburg and produced a map in 1863.

Kropotkin's first expedition into Siberia followed, where he used a map on birch bark given to him by a hunter.[69] It led to a second, more detailed, mapping expedition in the north-eastern Qing territories, essentially an intrusion of military espionage, undertaken with astronomer Theodore Usoltzeff. The original results of the latter expedition appeared in 1876 when Kropotkin was in prison for sedition; the publication proposed a new model for mountain formation in Central Asia.[70] During his time in Siberia, Peter Kropotkin undertook, in all, five scientific expeditions, including a major northern voyage. Eric Gautier has emphasized that, in addition to his work on mountain formation, Kropotkin elaborated a picture of Central Asian glaciation. The receding ice sheet created a vast inland lake, of which the Caspian and Aral seas are remnants.[71] As for Kropotkin's incarceration, it was an imprisonment, he noted in retrospect, originating in an appreciation of the communistic Dukhobors, who had been exiled to the Amur region, and also in his contempt for state discipline, which he saw at work in the suppression of a revolt of Polish exiles in 1866.

Science, for Kropotkin, was a greater good. He and his brother Alexander pursued it in Siberia as an anodyne for their frontier life as Cossack officers:

> There are not many joys in human life equal to the joy of the sudden birth of a generalization, illuminating the mind after a long period of patient research. What has seemed for years so

67 Mark Bassin, 'The Russian Geographical Society, the "Amur Epoch," and the Great Siberian Expedition, 1855–1863', *Annals of the Association of American Geographers* (1983) 73, pp. 240–256; Eva-Marie Stolberg, 'The Siberian frontier between "White Mission" and "Yellow Peril," 1890s–1920', *Nationalities Papers* (2004) 32, pp. 165–181.

68 Peter Kropotkin and Douglas W. Freshfield, 'Obituary: Dr. Gustav Radde', *Geographical Journal* (1903) 21, pp. 563–565; Rudolf Blasius, 'Gustav Radde', *Journal für Ornithologie* (1904) 52, pp. 1–49.

69 Kropotkin, op. cit. (65), pp. 214–215.

70 Peter Kropotkin, 'Russian explorations in Manchuria', *Geographical Journal* (1898) 11, pp. 62–65; Pierre Kropotkine, *Orographie de la Sibérie*, Brussels: Veuve F. Larcier, 1904, published in 1876 in Russian in the memoirs of the St Petersburgh Geographical Society. Also Tatiana K. Ivanova and Vyacheslav A. Markin, 'Piotr Alekseevich Kropotkin and his monograph *Researches on the Glacial Period* (1876)', in Geological Society of London, *History of Geomorphology and Quarternary Geology*, Special Publication no. 301, 2008, pp. 117–128.

71 Eric Gautier, 'Pierre Kropotkine: scientifique et anarchiste', University of Nantes, Centre François Viète, mémoire de D.E. A., 2000, pp. 26–40.

> chaotic, so contradictory, and so problematic takes at once its proper position within an harmonious whole. Out of a wild confusion of facts and from behind the fog of guesses, – contradicted almost as soon as they are born, – a stately picture makes its appearance, like an Alpine chain suddenly emerging in all its grandeur from the mists which concealed it the moment before, glittering under the rays of the sun in all its simplicity and variety, in all its mightiness and beauty. And when the generalization is put to a test, by applying it to hundreds of separate facts which had seemed to be hopelessly contradictory the moment before, each of them assumes its due position, increasing the impressiveness of the picture, accentuating some characteristic outline, or adding an unsuspected detail full of meaning. The generalization gains in strength and extent; its foundations grow in width and solidity; while in the distance, through the far-off mist on the horizon, the eye detects the outlines of new and still wider generalizations.
>
> He who has once in his life experienced this joy of scientific creation will never forget it; he will be longing to renew it; and he cannot but feel with pain that this sort of happiness is the lot of so few of us, while so many could also live through it, – on a small or on a grand scale, – if scientific methods and leisure were not limited to a handful of men.[72]

This great intoxication Kropotkin offered to everyone.

In a pamphlet of 1880, 'An appeal to the young', Kropotkin addressed young scientists. Was their devotion to science, he asked, different from the drunkard's devotion to spirits? No, the scientists say, they work for humanity. A 'charming illusion', Kropotkin retorted. Science was the property of a select group of people. The teachings of science remained only 'the bitterest irony to nine-tenths of mankind'. In Kropotkin's view, it was more important to disseminate known quantities than to discover new things. Science, when taken up by large numbers of people, would experience 'a new bound forward'.[73] Kropotkin repeated in his memoirs, when he described how he declined an invitation to become secretary of the Geographical Society in St Petersburg, 'All those sonorous phrases about making mankind progress, while at the same time the progress-makers stand aloof from those whom they pretend to push onwards, are mere sophisms made up by minds anxious to shake off a fretting contradiction.'[74] It is fair to conclude that Kroptkin, like Grinnell, reacted profoundly against the depredations of imperialism, as directly experienced.

Kropotkin returned to Western Russia, surveyed Finland for the St Petersburg Geographical Society, and became a confirmed anarchist.[75] Science remained, in his view, the realm of precision and generalization, as in his early twentieth-century modification of Darwinism, mutual aid. It is a vision grounded in the military support of his geological work. Kropotkin was aide-de-camp to the young commander in Irkutsk, Kukel, whose library contained the London editions of the revolutionary Alexander Herzen. As president of the Geographical Society in Irkutsk, Kukel encouraged and financed Kropotkin's expeditions.

72 Kropotkin, *Memoirs of a Revolutionist*, Boston: Houghton Mifflin, 1930, p. 226.

73 Kropotkin, 'An appeal to the young' (1880), originally in French, in *Kropotkin's Revolutionary Pamphlets*, ed. Roger N. Baldwin, New York: Vanguard, 1927, New York: Dover; 1968, pp. 264–267.

74 Kropotkin, op. cit. (65), p. 240.

75 Kropotkin, op. cit. (65), p. 238.

Shortly after Kropotkin returned west, Kukel patronized another military explorer, Nikolai Przhevalskii (a Central Asian horse bears his name), who is known, in the words of one scholar, by his 'enthusiasm for conquest, his certainty in the superiority of the white man over the darker-skinned savage, his utter contempt for other civilisations, and the aggressive virility that permeate his prose'.[76] Or, in Kropotkin's measured words:

> He made his first journey with only three comrades, and always kept on excellent terms with the natives. However, as his subsequent expeditions took on more of a military character, he began unfortunately to rely more upon the force of his armed escort than upon peaceful intercourse with the natives, and I heard it said in well-informed quarters that even if he had not died at the very start of his Tibet expedition, – so admirably and peacefully conducted after his death by his companions Pyevtsoff, Roborovsky, and Kozloff, – he very probably would not have returned alive.[77]

The generals who prosecuted wars of conquest in the deserts on three separate continents during the 1860s and 1870s were not untutored. Custer, last in his graduating class at West Point, taught the children at his post, and, while fighting Indians on the plains, he studied Napoleon's campaigns.[78] Roca, in Argentina, remained in the forefront of public life for a generation. He served a number of presidents, from Sarmiento into the twentieth century. Kropotkin's sometime commander in Siberia, Nicholas Muraviev, was an admirer of literature and an advocate for a United States of Asia, to be affiliated with the United States of America; he was a cousin of the anarchist Michael Bakunin (the intelligentsia in Russia made up a tight weave: Kropotkin belonged to the subversive circle organized by the brother of the composer Pyotr Ilyich Tchaikovsky). Fervent in their desire to spread the civilization of western Europe, the soldiers negotiated around a Babel of languages. German and French were givens, and the crusading armies had a group of translators for dealing with the peoples to be conquered. And at least one man did sleep with the enemy. Custer, whose marriage with his wife Elizabeth was barren, had, it is alleged, a child with a native American woman.[79]

Military general staff everywhere in the middle of the nineteenth century studied their rivals; they paid close attention to conflicts in distant parts. The US Civil War, for example, was a classroom for European strategists.[80] We should not be surprised, then, that the form of a military campaign on the Great Plains resembled one in Patagonia. This is so for the army, and it is so for the prosecution of science. Men

76 David Schimmelpenninck van der Oye, *Toward the Rising Sun: Russian Ideologies of Empire and the Path to War with Japan*, DeKalb, IL: Northern Illinois University Press, 2001, p. 37, for quotation; Donald Rayfield, *The Dream of Lhasa: The Life of Nikolay Przhevalsky (1839–88), Explorer of Central Asia*, Athens: Ohio University Press, 1976, p. 20, for Kukel.

77 Kropotkin, op. cit. (72), p. 230.

78 Jackson, op. cit. (19), p. 21, for Custer as a schoolmaster; Elizabeth B. Custer, op. cit. (29), p. 145, for Napoleon.

79 David Humphreys Miller, *Custer's Fall: The Indian Side of the Story*, Lincoln: University of Nebraska Press, 1957, pp. 63–65.

80 Jay Luvaas, *The Military Legacy of the Civil War: European Inheritance*, Chicago: University of Chicago Press, 1959.

of learning insisted on their superior status, read books and kept up with the latest discoveries.

Expeditionaries in the United States, Argentina and Russia were keenly aware of their relatively modest place in the world of learning. The institutions they reported to – variously the Smithsonian Institution, the Córdoba academy and the Buenos Aires museums, the Siberian and the St Petersburg geographical societies – were junior homologues of the great scientific academies at London and Paris. Because, furthermore, the travelling scientists corresponded with mentors at unheralded universities, importance attached to writing up their results convincingly. This circumstance, more than the uniform requirements for military expeditions, helps account for the interdiscursivity of the publications that issued from their hand.

So, too, do forms of intimacy in the life of the scientists. I have contended elsewhere that the most neglected place in history of science is the bedroom, where the scientist can be in closest intercourse with another person.[81] A picture of the daily life of the expeditionary scientists, in and out of the bedroom, has not yet been constructed, just as it is unconstructed for scientists in our own time; evidence suggests that, for men and women of science in the modern age, patterns of intimacy can cross nations and continents.[82] It is also important to look into the habits of scientists in collecting and filing specimens. Here again the picture is comparable in the United States, Argentina, and Russia.

Grinnell's patron and doctoral adviser, Othniel Charles Marsh, was himself an Eli who in 1866 became, at Yale, the first United States professor of palaeontology – once Marsh's rich uncle, George Peabody, had endowed, for the use of his nephew, the museum at Yale which bears his name. Peabody's legacy to the museum, in 1869, supported Grinnell's trips west. The demands of opening the museum to the public, in 1876, likely constitute the reason why Grinnell did not perish at Little Big Horn. The Russian Geographical Society, Kropotkin's patron and his publishing outlet, had been founded in 1845 to promote knowledge of greater Russia. The Crimean War persuaded the imperial authorities to look east rather than west, and in 1854 they sent a military expedition down the Amur. A second expedition in 1855, which resulted in annexation of a good deal of real estate, included the society's geographers, as well as the naturalists Gustav I. Radde and Richard Maak. Radde, who collected, classified and published on a great deal of biota, saw his enterprise in a Humboldtian vein: 'Pure science', he wrote in 1859, 'has no goal other than to determine certain truth', and his labour was for the benefit of all humankind.[83] Finally, in Argentina, the Córdoba academy became an archive for natural-history collections and a nursery for the German professors who accompanied General Roca in the desert; the academy published the findings. Other institutions arose in Argentina for the same purpose. Estanislao Severo Zeballos, who was exploring Rio Negro when Roca was conquering it, founded the Instituto

81 Lewis Pyenson, 'Revisiting the history of relativity', *Metascience* (2011) 20, pp. 53–57.

82 Lewis Pyenson, 'The enlightened image of Nature in the Dutch East Indies: consequences of postmodernist doctrine for broad structures and intimate life', *Historical Studies in the Natural Sciences* (2011) 41, pp. 1–40.

83 Radde, quoted in Bassin, op. cit. (67), p. 254.

Geográfico in 1879 and the Sociedad Científica Argentina in 1871. Francisco Moreno, at the La Plata Museum of Natural History, beginning in the 1880s put together an extensive collection of mammalian fossils. (Moreno explored Rio Negro, discovered the beautiful Lake Nahuel Huapi in 1876 and later toured it with Theodore Roosevelt, founded the Argentine Boy Scouts, and ended his life as a political reactionary.)

All these institutions had a common hierarchy and social structure. Director, professor, curator, assistant, preparer, secretary, taxidermist, engraver, typesetter, pressman, servant. The hierarchy extended to the field. Argentine and Russian expeditionaries travelled with servants, and Custer's Black Hills expedition was served by an African American cook.[84] No unions here, no benefits and no democracy. The men at the top were authoritarian to the point of irascibility. The institutions of science resemble a military command structure, reason enough to imagine an affinity between scientists and military officers, and reason enough for imagining that the military, as such, gave no explicit direction to what the scientists published.

At the beginning of the *Odyssey*, Athena tells us that her heart is broken over Odysseus, 'the master mind of war' who devised the stratagem of the Trojan Horse. He is a castaway under the spell of the daughter of Atlas, a victim of Poseidon's wrath. Zeus, too, wants Poseidon to relax his punishment of Odysseus and allow the traveller, twice as wise as any mortal, to return home. Athena, who appears in the *Odyssey* a number of times disguised as the wise Mentor, was the *genius loci* of the cultural capital of classical Greece. She defended the city of Athens symbolically by promoting culture and by giving strength to the troops.[85]

In 1967, Martin Heidegger identified Athena as the goddess of the *technites*, 'the men who produce the equipment, vessels, and decorations'.[86] They are the artists and the engineers who command the beaux arts, on the one hand, and the mechanical arts, on the other hand. The artifice produced by those under Athena's protection is variously an instrument of enlightenment and an agent of oblivion. That is, golden Athena presides over the drama of Periclean Athens just as she guides the hand of Odysseus in avenging the audacity of the suitors in Ithaca.

In the middle of the nineteenth century, the military hoped that scientists might help explain the land to be conquered, but, appearances to the contrary, military objectives did not intrude on scientific scruples. The scientists, indeed, expressed a wide range of opinion about the aims of their patrons. In this regard, Przhevalskii and Kropotkin, Paul Lorentz and Francisco Moreno, George Bird Grinnell and Newton Horace Winchell, seem to stand in opposite corners of the room.

84 Olascoaga, op. cit. (50), p. 143, for servants; Stuckert, op. cit. (52), p. 30, for the anonymity of the scientists' three servants; Kropotkin, op. cit. (65), p. 133, reports having a 'soldier servant' when he was in the Corps of Pages; Grafe and Horsted, op. cit. (19), p. 5, for Sarah Campbell, the cook.

85 Joel Mokyr, *The Gift of Athena: Historical Origins of the Knowledge Economy*, Princeton: Princeton University Press, 2002, is silent about Athena's destructive side. The book identifies ingenuity in artifice – technology – with Athena's science. A more appropriate appeal for Mokyr would be to Hephaistos, the ugly, crippled metallurgist who, Book Eight of the *Odyssey* tells, fabricated a mechanical device to catch his wife *in flagrante*.

86 Andrew J. Mitchell, *Heidegger among the Sculptors: Body, Space, and the Art of Dwelling*, Stanford: Stanford University Press, 2010, pp. 58–61.

The observations of Peter Kropotkin about science form a thread in the modern age, which featured the relentless advancement of practical training for the labouring classes. For this reason, Socratic truth-seeking, as represented in the university research ethos, maintained an uneasy and unstable presence in industrial societies. The research ethos emerged in Germany before the Industrial Revolution took shape there, and it is exemplified by Benjamin Franklin's pre-industrial attitude toward pure learning. Today, pure learning is ridiculed by the sophistical *bricoleurs* of postmodernity.[87]

Guillermo V. Stuckert lamented early in the 1960s that the disciplines of modernity – physics, chemistry and biology – had mutated almost beyond recognition to serve industrial needs. As the present discussion shows, the modern age tolerated the isolation of scientific research – the ivory tower of Charles Augustin Sainte-Beuve that made it possible for scientists to remain at arm's length from their patrons in a wide variety of settings. That distance supported the integrity of research conducted in the midst of modern wars.

87 Paul Forman's writings are seminal for the modern/postmodern break: 'The primacy of science in Modernity, of technology in Postmodernity, and of ideology in the history of technology', *History and Technology* (2007) 23, pp. 1–152; *idem*, '(Re)cognizing Postmodernity: helps for historians – of science especially', *Berichte zur Wissenschaftsgeschichte* (2010) 33, pp. 157–174. A short elaboration: Lewis Pyenson, 'Technology's triumph over science', *Chronicle [of Higher Education] Review*, 11 March 2011, pp. B4–B5.