CRITIQUES & CONTENTIONS

Science and Imperialism

By Paolo Palladino* and Michael Worboys**

In recent years the historian of science Lewis Pyenson has shifted his attention from the history of the “new physics” in Wilhelmine Germany to that of physics and astronomy in the outposts of nineteenth- and early twentieth-century colonial powers, chiefly those of Germany, the Netherlands, and France. It is very welcome that an increasing number of historians are now studying the relationship between science and imperialism, broadening the scope of the history of science from its traditional European and American focus. It is even more welcome that such a senior figure as Pyenson should have been so productive in this area, drawing attention to the place of science in empires other than the British. But Pyenson’s interest in the relationship between science and imperialism does not seem to stem from any concern about the problem of imperialism, of why and how one people dominates another. He believes that we should pay greater attention to this subject because it leads to a very different appreciation of the place of science in society than is common among those he terms “the radical relativizers and their epigoni the strong-program Cimmerians, whom historians of science do well to disregard.” This critical attitude toward post-Mertonian social historians and sociologists of science, who are interested in showing how economic, political, and social considerations shape the development of scientific knowledge and practice, is motivated by Pyenson’s desire to arrest what he sees as the steady disintegration of the program for the history of science set forth earlier this century by William Osler, George Sarton, and Max Weber. Following in their footsteps, and in those of neoconservative cultural critics like Allan Bloom and George Steiner, Pyenson wishes to draw attention

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to the value of the scientific mode of inquiry as one of the highest intellectual achievements of the Enlightenment.3

By chronicling the great “civilizing mission” of the “exact” sciences, Pyenson seeks to challenge the contextualist and relativist programs of social historians and sociologists. He believes that if the dominant historical movement of the late nineteenth and early twentieth century, namely “savage and ubiquitous” imperialism, can be shown to have had no influence on the physical and astronomical sciences he studies, then those programs are worthless. From a number of case studies—an approach he decries when it is adopted by others—Pyenson proceeds to confirm his doubts.4 He finds, first, that the practices in these “exact” sciences showed no evidence of any “transmutation” produced by imperialism; and second, that only the “exact” sciences had any significant social and political impact on life in the colonial dependencies, and this precisely because they were so patently free of any imperialist taint.

These bold claims, if they were as substantial as Pyenson wishes, would constitute a significant attack on some major achievements in the history of science of recent decades: the realization of the value of social historical and sociological approaches for understanding the development of science, and the increasing acceptance of the history of science as part of the broader discipline of history. History of science is no longer only about the great and the good and their “contributions” to the canons of what Pyenson regards as peculiarly Western forms of knowledge. It is now also about institutions supporting scientific work and about the place of science in changing social and economic structures and relations. It is also about how this social context in turn can influence the formation and validation of scientific knowledge.5

Besides being particularly fruitful methodologically, the examination of these issues has led historians of science to explore new areas like the relationship between science and imperialism, and this has expanded and enriched our community of practitioners.6 As the development and place of science in the world outside of Europe and North America receive more attention, many more historians from Africa, Asia,

3 Lewis Pyenson, “What Is the Good of History of Science?” History of Science, 1989, 27:353–389, on p. 353; and “Why Science,” p. 70. For Pyenson’s alignment with Bloom and Steiner see his references to them in “What Is the Good?” p. 353; and in Pyenson, Neohumanism and the Persistence of Pure Mathematics in Wilhelmine Germany (Memoirs of the American Philosophical Society, 150) (Philadelphia: American Philosophical Society, 1983), pp. 2, 6. Like Bloom and Steiner, Pyenson is committed to a strong form of intellectualism that verges on idealism; this intellectualist bias is clearly reflected in his unification of the disparate resources called upon by social historians and sociologists to explain the social origins of scientific discourse and practice under the term ideology.

4 Pyenson, “Why Science,” pp. 78 “savage and ubiquitous” imperialism, and p. 70: “Case studies (the term is redolent of hospital psychiatric wards) multiply, as unilingual young men and women with no historical or scientific training—and indeed, with no general humanistic background—set off to inventory scientific achievement with unsympathetic detachment and clinical prose.”

5 For Pyenson’s larger historical project see “What Is the Good?” See also the integration of medical and social history in Richard J. Evans, Death in Hamburg: Society and Politics in the Cholera Years, 1830–1910 (Oxford: Oxford Univ. Press, 1987); and, for the influence of social context on the formation of scientific knowledge, Charles E. Rosenberg, “Towards an Ecology of Knowledge,” in The Organization of Knowledge in Modern America, 1860–1920, ed. Alexandra Oleson and John Voss (Baltimore: Johns Hopkins Univ. Press, 1979), pp. 440–455. The increased scope of the discipline is evident from the contents of mainstream journals such as Isis, the British Journal for the History of Science, and the Journal of the History of Biology during the last decade or so.

and South America are encouraged to pay greater attention to science. Pyenson, in many ways, has led this expansion of our intellectual horizons and has gained a just and considerable reputation among the emerging group of historians of science in the third world and those with an interest in the history of third world science. But we think that Pyenson is offering them a model that will bring a return to a narrowly defined history of European achievements and that will simply continue to subjugate the history of, for example, Indonesia and Algeria to that of the West. It is based on a very narrow range of theoretical resources and is presented with a rhetoric that will do nothing to make history of science more attractive to new scholars. Pyenson’s program is therefore both intellectually impoverished and politically insensitive. It deserves close scrutiny.

In this essay we first discuss Pyenson’s fundamental distinction between the “exact” and “descriptive” sciences. After this we turn to the questionable notion of imperialism built into his argument, and then discuss the problematic dependency model of diffusion that underpins it. Finally, we consider the relationship between science and political power. In the conclusion we offer what we feel is a more open, ecumenical, and exciting historical agenda for the study of science and imperialism.

THE “EXACT” SCIENCES

A great number of historians of science may appreciate Pyenson’s overriding concern to highlight the special significance of the scientific mode of inquiry for the development of contemporary civilization, a concern that is shared even by some whom Pyenson would probably want to dismiss as relativists. However, the case he articulates against the contextualist and relativist program for the history of science is far from convincing.

Pyenson’s argument about the place of physics and astronomy in imperial expansion and the accompanying claims about the inadequacies of social historians’ and sociologists’ appreciations of the history of science rest on the traditional (and often unquestioned) division of the sciences into “exact” and “descriptive.” More precisely, Pyenson believes that as long as scientists are simply collecting data and there is no disciplinary consensus as to how these data should be assembled or given meaning, it is to be expected that they should be ordered quite differently by different groups and that preference for one or another ordering may be influenced by ideological—“external”—considerations. That a body of scientific knowledge in this primitive “descriptive,” “inductive,” or “qualitative” stage of life should be loaded with such unscientific baggage is for Pyenson totally unsurprising. However, in his view this baggage is displaced from scientific discourse as the empirical record becomes more complete and the theoretical framework in which it fits more articulate.
and mathematically precise or “exact.” Pyenson goes on to argue therefore that case studies showing how imperialism affected the development of any sciences other than the “exact” ones cannot be used to support any general claims about the social nature of scientific knowledge. A meaningful claim can emerge only from studies of the impact of “external” factors on the “exact” sciences. In fact, the only such claim that meets with Pyenson’s qualified approval is Paul Forman’s attempt to relate the birth of the “new physics” to peculiarities of German “culture” during the early twentieth century. There are, of course, many other interesting and convincing studies that could be cited, and their number is ever increasing.

Pyenson’s argument clearly echoes the historiographical discussions that followed the publication of Thomas Kuhn’s *Structure of Scientific Revolutions*. Today, however, growing numbers of historians of science view the distinctions between “internal” and “external” factors, and between “exact” and “descriptive” sciences, that were so crucial in the 1960s as specific to debates at that time and now superseded. Pyenson wishes to swim against this current.

Pyenson’s case is based, first, on a misrepresentation of the contextualist and relativist program. He argues that if the general claims of this approach were sound, then one should be able to detect, for example, the “clear presence of imperialist ideology and practice in publications of physics and astronomy which are produced in imperialist settings.” He claims, however, that physics and astronomy were invariant across the political, economic, and social gap separating the imperial metropolis and its colonial periphery. Whether this is a valid empirical finding is a moot point, as Pyenson starts from the presumption that “because discourse in the exact sciences is insular, activity in physics, astronomy and mathematics is especially suited as a cultural probe.” But the whole point of the contextualist and relativist program is to take nothing about science as given or timeless. The aim instead is to explore how boundaries between scientific and social considerations arose and have changed historically. For example, no distinctions were made between the language of politics and that of science in early seventeenth-century England, but now these are very different. How did this happen? To answer this question one can begin, like Steven Shapin and Simon Schaffer, by studying rival theories of knowledge,


such as those championed by Robert Boyle and Thomas Hobbes, without assuming that ultimately there is only one that can truly capture the order of nature. Instead, when one of these theories of knowledge becomes dominant, the contextualist and relativist program seeks to explain how social processes and social forces determine that outcome. Thus, moving to another country, we find that in late seventeenth- and early eighteenth-century France a body of professional scholars enjoyed strong royal patronage because by building a theoretical system that unified all natural phenomena through the mathematical language of Newtonian mechanics they lent quasi-theological legitimacy to the efforts of the monarchy to undermine all independent centers of political power. Here the “exact” sciences played an explicitly ideological role.\(^{14}\) A century and a half later the position of the French state was quite different, but the intellectual orientations and the social organization of the “republic of science” established earlier were too strongly entrenched to be reformed for the new state: the scientists charged with the task of reform were so imbued with the culture of this republic that they could not envision any alternative organization.\(^{15}\) Not surprisingly, the nineteenth-century “exact” sciences seem to some historians of science to have been immune to social influences. But most social historians and sociologists of science would remember that this relative immunity of physicists and astronomers to political pressure, a major theme in Pyenson’s studies of the “exact” sciences in Algiers, Batavia, and Shanghai, was the consequence of intellectual orientations and institutional positions established through social negotiations under historical circumstances that no longer obtained in late nineteenth- and early twentieth-century society. Colonial physicists’ and astronomers’ relative immunity to the mundane politics of the Age of Empire may simply have been a reflection of the social and political position of metropolitan physics and astronomy; that immunity does not stand as evidence against the social history or sociology of science.\(^{16}\)

With regard to the second linchpin of Pyenson’s argument, the distinction between the “exact” and “descriptive” sciences, no one has yet defined the rites of passage from one to the other. Indeed, most historians seem to have followed Kuhn in regarding the distinction as specific to nineteenth-century physics, and perhaps inappropriate for other sciences at other times.\(^{17}\) Furthermore, that all forms of scientific discourse should have in fact aimed, and may still aim, toward a mathematically exact discourse provides no strong evidence against the historicist and sociological position. On the contrary, it has been argued that this tendency was socially deter-


\(^{17}\) Kuhn’s position on this is somewhat ambiguous, though we have taken what we believe to be the most appropriate historical reading.
mined, and that the very language of logic and mathematics that underpins this taxonomy of the sciences can be shown to be socially constituted.\textsuperscript{18}

It seems to us that the boundaries between “internal” and “external” factors and taxonomies of scientific disciplines should not be taken as timeless, fixed concepts, but should themselves become objects of inquiry. Why these objects should be defined and institutionalized quite differently by different communities of scientists in different social situations and in different periods of history is an exciting historical question that, we believe, can be understood only by means of the sociological observations so despised by Pyenson. In fact, social historians and sociologists of science have already put these analytical tools to work, in the very ways Pyenson recommends, in order to understand the place of science in modern “civilization.”\textsuperscript{19}

\section*{ON THE NATURE OF IMPERIALISM}

That Pyenson’s characterization of the different sciences is inadequate to support his case against contextualists is only one of the problems besetting his discussion of the relationship between science and imperialism. Pyenson has acknowledged in one comparative study that imperialism comes in different forms—sometimes cultural, sometimes economic, or political, or social, or scientific—and that it comes in changing combinations of any of these.\textsuperscript{20} No single meaning can be attached to imperialism. However, interest in diversity is for Pyenson more a matter of words than of historiographical practice: apart from this single broad comparative study, he has focused exclusively on “cultural imperialism” and on the “civilizing mission.” He fails to explicate these terms, and others that are usually associated with imperialism, such as \textit{exploitation} and \textit{domination}, find no place in his history. There is no recognition of the links between military, economic, or technological dominance and cultural hegemony; the “higher” motives of the “civilizing mission” are treated as quite different from “baser” economic, political, military, and social ones. That the “civilizing mission” was in fact often experienced in the same way as these other forms of domination is also consistently ignored.\textsuperscript{21}

More significantly, in the Age of Empire the relationships between colonial policy and science, as Pyenson himself recognizes, were far from uniform across imperial boundaries. Not all colonies were the same, and neither were the scientific efforts in them. There were great differences between the German physical and astronomical endeavors in tiny Samoa and the large British scientific enterprise in the Indian subcontinent or developments in a country like Australia. Pyenson’s focus on the “exact” sciences and “cultural imperialism” in places like Samoa means that he is study-


\textsuperscript{20} Pyenson, “\textit{Pure Learning}” (cit. n. 12).

\textsuperscript{21} Another feature of Pyenson’s work is that he looks for the impact of imperialism on individuals, essentially a few scientists, mostly in small institutions. This biographical approach has been his trademark and is typical of a positivistic tradition that tends to marginalize social, economic, and institutional factors.
ing an extremely small aspect of imperial science, as measured in terms of personnel, institutions, spending, or publications. This is an extremely unrepresentative base from which to offer a model of imperial strategies in science or major insights into science and imperialism. Most of the science practiced in and for European colonies was intended to support and service economic and political objectives. The British, French, German, and other imperial powers established large scientific and technical departments in the colonies, and most had major metropolitan institutions devoted to research on colonial problems and the training of colonial scientific personnel. In India, for example, there were universities, research institutes, scientific and technical services, and voluntary scientific organizations. Interestingly, educational policy in the early part of the nineteenth century concentrated on the moral and mental education of Indian elites, and science was not a chosen vehicle for any “civilizing mission.” Scientific and technical education was introduced there later in the century, and then only to prepare technicians to assist their British masters in subjects of immediate economic value—surveying, botany, medicine, and geology.

The biological, environmental, and medical sciences, in the British Empire as elsewhere, were the main ones deployed in the effort to harness science to the imperial wagon because they were the most useful (as were those branches of chemical, physical, and astronomical research relevant to meteorology and surveying). Thus the first, and until 1900 the most important, imperial scientific institutions were the botanical gardens. They were set up to facilitate the collection, exchange, and cultivation of economically valuable plants; later, often as the research stations of agricultural departments, they housed research on plant genetics, pathology, and physiology, not to mention entomology. In medicine, the concern to control diseases such as malaria and other tropical fevers, which acted as impediments to the settlement and development of certain areas, led to research initiatives and the elaboration of new etiological models of disease. In every case the imperial context was crucial to the instigation of research, provided the resources used to solve the problem, and shaped the form of the knowledge produced. When it came to programs to improve health in the colonies, colonial scientists and administrators often found parasites and vectors more convenient to work with than the indigenous population. The choice between strategies, and their supporting research programs, knowledge, and prac-

22 Lewis Pyenson, “Science and Imperialism,” in Companion to the History of Modern Science, ed. R. C. Olby et al. (London: Routledge, 1989), pp. 920–933, esp. pp. 928–929. In this essay, supposedly a review of current work in the field, Pyenson makes a single remark about the “significant research now undertaken on the descriptive sciences,” and then cites only Susan Sheets-Pyenson’s work on colonial natural history museums as an example (p. 922, n. 4).


tices, was dictated by tangible social considerations. Attention to this “ecology” of knowledge is absent from Pyenson’s work. For example, he contends that “even colonial climatology is lacking in imperialist inspiration.” But in actual fact, during the nineteenth century meteorological observatories served quite admirably the strategic aims of the French Empire: its settlement, the movement and health of imperial agents, and the development of cash-crop agriculture.

An important component of imperialism that is almost absent from Pyenson’s writing is the reaction of the local subject populations. Given his espoused interest in the “civilizing mission” of science, this ought to have been a prime concern. One of his few observations on this component shows little empathy with the “colonized”: “If scientific knowledge had ceased to issue from a crenellated, fortress-like observatory in the Sahara, the men inside would have become indistinguishable from foreign legionnaires; if geophysicists touring the Asian littoral by automobile had failed to take significant measurements, they would have been little different from commercial spies.” But most of the geoscientists in Asia and Africa were, in fact, the “commercial spies” of European companies or imperial governments. They were looking for natural resources that could be exploited, and their observations were no less accurate or significant for that. Also, since the military supported geophysical research, local populations could hardly make the distinction between scientist and legionnaire. Pyenson does mention the destruction of an observatory in Madagascar and notes that indigenes “occasionally did see abstract knowledge as part of their oppressor’s baggage.” But in this particular case the observatory was not just seen as part of the baggage. Rather, it was the very agency that produced maps of the region for the French forces and enabled them to subdue and govern a subject people. The reason more observatories were not attacked is that there were so few of them. At the time of Ghanaian independence colonial agricultural science was criticized for failing to deal with a disease affecting the important cocoa crop in any manner satisfactory to the local farmers. The whole subject became highly politicized and resulted in attempts to create an alternative science that would solve the problem in ways that were not detrimental to the producers. The modern historical researcher may be able to make fine distinctions about the nature of work in a particular institution and its functional neutrality, but historically, and from the perspective of a subject people, military, political, commercial, and scientific colonial personnel were all potential agents of domination. This indigenous perspective is nowhere found in Pyenson’s work; all he cares for is the work of scientific missionaries exporting metropolitan civilization to the colonial periphery.


Pyenson claims to show that unlike work in the “descriptive” biological and environmental sciences, the endeavors in physics and astronomy that he has examined were not segregated into products of intellectual metropoles and peripheries. He believes that the work of physicists and astronomers in the colonial outposts of the French, German, and Dutch empires spoke to a spirit that transcended “the all too human conditions of life,” a spirit that lifted them above the mundane problems besetting their social environment. The work was therefore valued equally with that of their colleagues in Paris, Berlin, or Amsterdam, and they were fully integrated members of a single, universal citadel of exact sciences. Pyenson claims that, thanks to this solidarity, research institutes and educational establishments for physicists and astronomers in imperial outposts acted as constant and indelible reminders of the unity of the colonial periphery and its ties to the diverse imperial metropoles.

We agree that to discuss the relationship between, for example, physics in Sydney and London in terms of the now-outmoded concept of metropolitan cores and colonial peripheries is fruitless. This is one of the reasons to appreciate Pyenson’s work. However, his conclusion that the site of production is therefore irrelevant is unwarranted. There is little support for it in the example of physics in India, where theoretical studies dominated experimental ones for pragmatic reasons. Pyenson’s assumption of an extraordinary degree of agreement between physical scientists in London, Paris, Berlin, Amsterdam, Washington, and Tokyo is also questionable. Current work in the history of modern physics shows a great deal of cognitive dissonance—dissonance that may be the product of different cultural traditions—even between metropolitan centers.

More significantly, Pyenson denies the value of the “core and periphery” model for explaining the development of the “exact” sciences, yet relies on it in a more general and crucial way: he sees only a one-way traffic of culture and civility from imperial metropolis to colonial periphery. This approach is contrary to the modern understanding of imperialism, which considers the interactions between metropoles and peripheries and sees an active role for the cultures of subject populations. If we look at the colonies through these different eyes, we see that Western methods and knowledge were not accepted passively, but were adapted and selectively absorbed in relation to existing traditions of natural knowledge and religion and other factors. For example, Indian researchers produced scientific knowledge highly valued in the metropolis which was influenced by indigenous, Indian traditions of natural knowledge. They did not need to be civilized, and often they resented the assumption that India needed “civilizing.” This sentiment fed Indian nationalism and...
undermined imperial unity; scientific meetings in the 1930s were an important forum for the discussion and advancement of Indian independence. In this context we might also note European scientists practicing in India, such as Robert McCarrison and Albert Howard, whose researches were creatively shaped by the indigenous culture.34

If we turn our attention toward the metropolis, we see that imperialism also affected the development of metropolitan scientific institutions and knowledge. The importance of empire to the development of the biological sciences in Britain and to specific disciplines like entomology is clear. As Michael Osborne has shown recently, the same can be said for mid-nineteenth-century Parisian medical theory. Other studies have demonstrated the influence of imperialism on the physical sciences. In geology, Robert Stafford has shown the importance of empire to the work and ideas of Roderick Murchison and mid-Victorian geology in general. Crosbie Smith and M. Norton Wise have argued that the fundamental contributions of William Thomson and other British physicists and engineers to the development of electrodynamics were profoundly influenced by both utilitarian and imperial considerations.35 In sum, we should take seriously Roy MacLeod’s views on the inadequacy of the core-periphery model; his preferred view is captured by the phrase “the moving metropolis,” which highlights the importance of seeing scientific relations as changing, variable, and polycentric. We should also follow the advice of Nathan Reingold and Marc Rothenberg, who, after reviewing a number of studies of colonial science, proposed that “to understand science fully requires an understanding of the ecology of its environment.”36

THE SCIENCES AND POLITICAL POWER

One last problem raised by Pyenson’s thesis is how to evaluate the relationship between different sciences and political power. As we have seen, Pyenson bases his views on this matter on the following reasoning. Physics and astronomy were, and always will be, immune to ideological bias by reason of their advanced state of intellectual development (not to mention their supposed worthlessness in the eyes of government officials seeking to make science serve imperialism). By virtue of this immunity to political contamination, these sciences were able to play a far more powerful and lasting imperial role than the biological and environmental sciences ever did. What is the evidence for this conclusion? Presumably, to answer this question one would need to know how to judge the effectiveness of the various links between the different forms of imperialism and the various sciences. Pyenson provides no criteria to guide us here, only an unelaborated notion of the “civilizing mission.” While sometimes recognizing that the relationships between imperialism and science were quite varied in different imperial contexts, Pyenson mostly ignores

36 MacLeod, “Visiting the ‘Moving Metropolis’” (cit. n. 31); and Reingold and Rothenberg, eds., Scientific Colonialism (cit. n. 31), p. xii.
the possibility that the different links may be due to culturally and historically specific attitudes toward the proper place of science in society. Except in one programmatic paper, he simply glides over the possibility that the different social place of science and scientists (not to mention the different justifications for supporting science articulated in London, Paris, Berlin, Amsterdam, Washington, and Tokyo) resulted in different links between science and the imperial vision being articulated in the various metropoles, regardless of the disciplines involved. Instead Pyenson champions the view of science embedded in the rhetoric of science for empire that prevailed in late nineteenth- and early twentieth-century Germany (and Prussia in particular), a view that was strongly influenced by idealism and the related importance attached to mathematical studies for the pursuit of "truth." Eugene Cittadino’s recent work on late nineteenth-century German botanists’ researches in Africa and Asia, which were largely supported by the Berlin Academy of Sciences, suggests however that the “descriptive” and scarcely mathematical endeavors of these botanists could serve to advance the cause of imperialism just as well as those of their colleagues in the “exact” sciences.37 Much of Pyenson’s work is therefore about the peculiar place of certain sciences in German society and its implications for German imperial expansion. Such work highlights only one among many possible roles of science in such expansion.

Since, as is suggested by Pyenson, much of the literature on science and imperialism has focused on the experience of the British Empire, a brief look at the cultural specificities of British science and their implications for the use of science to advance imperial goals will confirm the difficulties of Pyenson’s model. There is no evidence that physics or astronomy played any significant role in British imperial policy or colonial rule. In the British Empire influence (political power is too strong a term) went to those scientists and sciences whose activities served or promised to serve the direct economic and political goals of imperialism. It was such linkages that enabled major institutions like the Geological Survey of India, the schools of tropical medicine in Liverpool and London, and the discipline of social anthropology to grow.38 In the 1920s the British scientific elite did participate in discussions about the emerging concept of Commonwealth, though it was the scientific community as a whole rather than any particular discipline that was used as a model for imperial federation. However, the main thrust of British imperial policy after 1918 was to create research and technical assistance agencies in individual territories where they could be guided by and best serve local economic and political interests. The relative influence wielded by scientists in Britain and in Africa who advised on the groundnuts scheme in Tanzania during the late 1940s is particularly illuminating.39 Advances in methods for exploiting colonial resources brought metropolitan botanists, geologists, and medical researchers greater rewards and professional security than

the pursuit of the more esoteric goals of any physicists and astronomers. Viewed from this perspective, the relationship between the different sciences, “exact” and “descriptive,” and the politics of imperial control appears refractory to any simple explanation.

CONCLUSION

The histories of the different sciences in the race to build empires during the nineteenth and early twentieth centuries were undoubtedly very different. However, these differences were not necessarily products of the greater or lesser “exactness” of different disciplinary discourses. The contribution expected of the different disciplines in expanding imperial control during the Age of Empire was contingent on different metropolitan cultural and social traditions and on divergent imperial policies and structures. The impact of science in the colonial and postcolonial history of the different indigenous societies was in turn a product of the encounters of indigenous and metropolitan cultures, encounters that are totally absent from Pyenson’s vision of what empire meant in the late nineteenth and early twentieth centuries.

In place of the limited view offered by Pyenson, we want to offer historians interested in the relationship between science and imperial domination an agenda that is much wider and more rewarding. First, however, we want to emphasize that for most of humanity, the history of science and imperialism is the history of science. Seen from this perspective, the whole subject takes on a far greater importance; it is through the growing number of historians of science from third world and former colonial countries that the subject will be developed. Science and imperialism is far too important to be regarded only as a test bed for the power of Western civilization or the defense of arcane historiographical distinctions. Second, we would suggest that the distinction between “exact” and “descriptive” sciences be abandoned in this context as it has been elsewhere and that historians study those sciences and scientific enterprises that were most important for imperial power. Attention should also be focused on the development of regional and national scientific communities and on the reasons for their different places in international science. In the course of our comments we have indicated how the history of science can be placed squarely in the political, economic, and social history of both the imperial powers and the colonial possessions. This shift is important because to understand the interactions between science and empire we must pay greater attention to the historical and cultural heritage of both the imperialists and the indigenes, and to how the latter first interacted with and then reshaped various forms of knowledge. Our own understanding will be enriched because our scientific heritage was not unaffected by this process. To follow Pyenson and do otherwise is to perpetuate in a very unwelcome and unjustified manner the submission of the history of former colonial peoples and societies to that of the West.