Kapil Raj, *Relocating Modern Science: Circulation and the Construction of Knowledge in South Asia and Europe, 1650-1900*, London: Palgrave MacMillan, 2007, 285 pp.

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This is an unchanged paperback release of a book published several years ago. The focus of the book is on the "contact area" between Europeans and non-Europeans in India and south Asia mainly in the eighteenth century. Although the author raises big questions about the history of modern science and its origins, the materials dealt with are far from adequate to the task. He seeks an "alternative vision" of the generally understood view that modern science was almost completely a Western creation. He mentions mathematical reasoning but does not mention the Hindu-Arabic numeral issue according to which important benefits allegedly accrued to the pioneers of modern science.

While setting the stage for this foray, Kapil Raj introduces a number of straw men such as the idea of "immutable" scientific rules of procedure, solely "logical step-by-step reasoning" along with the notion that the major discoveries leading to modern science took place in "enclosed" places such as laboratories, observatories, or possibly museums. These are juxtaposed to other spaces, such as coffee houses, pubs, breweries, or trading companies in south Asia. These caricatures miss the fact that Galileo and others used telescopes at home but mostly *en plein air* as the instrument was in fact a portable laboratory. Likewise, pioneers of microscopy in the middle of the seventeenth studied insects, plants, animals, and human specimens in a great variety of places, many of them on location.

These unhelpful allusions to putative scientific methods distract the author so that he does not ask just which scientific advances really do mark the rise of modern science. I should think that anyone who gave this question serious attention would have to consider that the revolution in astronomy starting with Copernicus lies at the heart of the great advance of

modern science. That path leads through Tycho Brahe, Galileo, Kepler, perhaps Descartes and some others but culminates in Newton's new science of mechanics. That nonpareil achievement unified celestial and terrestrial physics, governed by universal gravitation, and gave us modern physics. It would be exceedingly difficult to find Arab, Indian, or Chinese scholars who contributed directly to that revolution. The telescope was available especially in India by 1615, slightly later in China and the Middle East, but no indigenous scholars sought to use it to advance astronomy in the seventeenth century. Likewise the science of motion was neglected outside of Europe.

Further thought about this would reveal the extraordinary advances in human, plant and animal anatomy, as well as the discovery of bacteria made possible by the invention of the microscope, all absent outside Europe in the seventeenth century. To this we can add the advances in pneumatics and hydraulics leading to the discovery that *air has weight*, an indispensable discovery on the way to the invention of the atmospheric steam engine. Nor can we overlook the discovery of electric charge by William Gilbert in 1600 which gave birth to the whole area of electrical studies, the laboratory demonstration of electric lighting in 1706, and eventually the invention of electric motors, the telegraph, telephone, and radio waves.

Instead of acknowledging those paths of discovery that made possible microbiology and modern medicine as well as the modern mechanical world and the electronic society, Kapil Raj looks at studies of natural history, surveying, map-making, legal inquiries, and linguistics mainly in the Indian subcontinent. Unfortunately, Raj focuses mainly on Western sources and the European writers who were able to extract from indigenous sources useful information once it was recast in the framework then well-established in various European sciences. Microscopes had been in use in Europe since the 1620s but this book contains no hint of such use in the following century in India.

For example, the author discusses a major work by the French writer, Nicholas L'Empereur (known as L'Empereur). He is credited with a major botanical volume called *Jardin de Lorixa*, apparently completed on site in Chandernagore, India in 1725, but neglected thereafter. Raj points out that L'Empereur's project (a wholly European initiative) was based on interviews with native medicinal workers and the "translation" of an indigenous *materia medica* text. However, it was not a strict translation and the result was a *hybrid botanical work*, "recognizably European" (p. 44). Raj points out that L'Empereur was highly versed in European conventions of botanical research, and that his descriptions were put into "standard format starting with physical descriptions of each plant, its roots, its flower, fruit, and seed, its habit, and finally it properties and uses." In other words,

this was based on European, not Indian conventions. Furthermore, the Indian *materia medica*, Raj points out, "do not describe the plants, but enumerate their properties and uses and, above all, *had no illustrations* [my italics]" (p. 43). All of this suggests that from beginning to end, this potentially useful knowledge was first organized and illustrated by European draftsmen, although in some cases it appears that native painters were trained up to the task. In other words, L'Empereur's product is his invention based on reading some native accounts and then interviewing *fakhirs* and other medicinal workers to flesh out the account. There were many similar European works prior to this. Instead of providing examples of indigenous advances, Raj tells us how Europeans needed to conduct additional research and thus to reorganize otherwise incomplete native accounts in order to contribute to the ongoing work outside India.

The vast difference in artistic skills between Europeans and natives in the seventeenth century is illustrated by the native-authored frontispiece (p. 33) and the later botanical illustrations on p. 47f. Anyone who compares European artistic realism from the thirteenth century forward with seventeenth century Mughal and/or Persian miniatures would see that even seventeenth and eighteenth century Indian works are not on the same level of detailed realistic representation and perspective as the European painters of the fourteenth and fifteenth centuries. There is need for a major look at how and when Indian painters or illustrators were trained in the European style.

It is most unfortunate that this book has been so strikingly mistitled, turning it into an ideological wedge rather than an interesting account of mutually beneficial encounters between European naturalists and those of India in the eighteenth century. Indeed, had the book been titled something like, *Interesting Encounters Between European Naturalists and Indigenous Indian Populations in the Eighteenth and Nineteenth Century,* the reader would be prepared to benefit from Raj's research and discussions. In addition to the subjects mentioned above they would include the difficulties of "institutionnalizing European learning in India," the difficulties of communication between Western religionists and natives, as well as the *introduction* of "modern science" to India (pp. 171 and 175). Raj gives the reader a copious list of all sorts of scientific instruments and lab devices presented to a Calcutta School, shipped and paid for by the East India Company in 1823 (pp. 176-78). An attentive reader would also notice that all sorts of new scientific perspectives and devices were being introduced into India in every chapter of the book. Nevertheless, the author is completely wedded to his unworkable scheme as his concluding chapter on "Relocations" makes clear.