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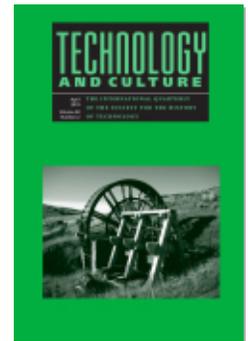
Reading Needham Now

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Technology and Culture, Volume 60, Number 2, April 2019, pp. 562-573 (Article)

Published by Johns Hopkins University Press

DOI: <https://doi.org/10.1353/tech.2019.0036>



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FORUM: HISTORY OF SCIENCE, TECHNOLOGY, AND MEDICINE: A SECOND LOOK AT JOSEPH NEEDHAM

Reading Needham Now

CARLA NAPPI and MCKENZIE WARK

ABSTRACT: What possible futures can be opened up by creatively reading an encyclopedic text not as a repository for information and historical facts but along two other lines instead: as an archive of concepts and of generative narrative detritus? This essay will reencounter Joseph Needham's *Science and Civilisation in China* (SCC) according to these two readings. Reading collaboratively, the authors proceed through the early, more general volumes of SCC. McKenzie Wark works with the main text, in connection with Needham's earlier writings, to explore conceptual tools he offered for understanding and living in our current moment. Carla Nappi reads the footnotes to think about voicing, context, and how we write the history of science. These contrasting approaches in a collaboratively written piece play with forms of writing and reading, taking Needham as an anchor and inspiration.

On the Historian as Paleontologist (Nappi)

If you look again at the first volume of Joseph Needham's *Science and Civilisation in China* (SCC) series, and you spend some time browsing through the pages, you will likely be struck by a premise that seems to inform all aspects of the work, however subtly: as a scholar, your life and experience significantly impact what you study and how you do so.¹ You can find this premise throughout the volume. Sometimes it takes the form

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From "Reading Needham Now" by Carla Nappi and McKenzie Wark (*Isis* 110, no. 1). © 2019 by The History of Science Society. Reproduced by permission from The University of Chicago Press.

1. Of course, this is true of all writing.

of the author invoking his family as part of his intellectual genealogy.² Or perhaps it's a moment of reflection on his experiences as a researcher.³ Or as a traveler in China who has personally witnessed its geological formations, heard the calls of its knife-sellers, tasted its fruit, seen its red-cheeked country people. Needham invites his readers to consider their whole self as a crucible for their scholarly work, as an instrument for making knowledge, and as matter to be assessed for the quality of the work it produces.

A second look at Needham, for me, is thus a look back not only at his own work but also (through that work, for the reasons articulated above) at myself. Once, I thought I was going to be a paleontologist, and I spent my undergraduate years training in that craft. In looking back at SCC, I found myself looking with a paleontologist's eyes.

Looking again at Needham, I was looking at sediment and stone, at foundations and their cracks and the life that can grow from them (whether quick or petrified), at soil and dust as rich substances with which to make stories. Looking again at Needham, I looked at the ground, at what had precipitated out of the main text. I looked, in other words, at the footnotes.

On Needham as Neglected Figure (Wark)

It may seem strange to posit Needham as neglected, given that for scholars in certain fields he looms as unavoidable, even oppressively so. However, there are a few areas where he might appear as a relatively fresh and novel voice rather than as an archival monument. One is within what came to be thought of as Western Marxism. Needham had a nuanced relation to Marxism, a topic on which I can say more later in this conversation. He was actively involved in the leftist political world of Cambridge between the wars.⁴ Together with J. D. Bernal and J. B. S. Haldane, he was one of a small num-

2. Writing of John Turberville Needham, he remarked: "This was the same Needham who had the controversy with Spallanzani on spontaneous generation, and whose reputation, as an epigenesist friend of Buffon's, I have tried to do something to uphold. . . . He discovered a vase bearing Egyptian (or Etruscan?) signs of hieroglyphic nature in the Museum at Turin and persuaded a Chinese librarian at the Vatican as well as himself that some of them bore a similarity to certain Chinese characters. At any rate J. T. Needham was a pioneer for his time and place in understanding the non-alphabetical structure of Chinese. Of course they had all been long anticipated by the 13th-century friar, William of Rubruck, who distinctly stated the case." Joseph Needham, *Science and Civilisation in China*, Vol. 1: *Introductory Orientations*, with Wang Ling (Cambridge: Cambridge Univ. Press, 1954) (hereafter cited as SCC, Vol. 1), p. 38, note d.

3. "I shall always remember the long and enjoyable days I spent during World War II, while waiting for plane transport, culling what seemed necessary for my purpose from [Cordier's *Bibliotheca Sinica*] in the library of the Royal Asiatic Society in Calcutta. The only other reader at the time was the Librarian of the King of Cambodia." *Ibid.*, p. 50, note d.

4. The standard work on this is Gary Werskey, *The Visible College* (New York: Holt, Reinhart & Winston, 1979).

ber of prominent scientists who articulated and practiced a new kind of citizen-scientist role. Needham was never a member, or even a fellow traveler, of the Communist Party of Great Britain. His nonspecialized writings of this period aimed less at articulating a Marxist worldview to scientific practice than at putting Marx in dialogue with a range of other ways of thinking and acting in the world.

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Some of the most influential accounts of the formation of Western Marxism in the Anglophone world omit Needham entirely. One key source of this marginalization is the work of another Anglophone historian, Perry Anderson. In the 1960s, as an editor of the influential journal *New Left Review* and in a series of influential books, Anderson launched an ambitious project to renew Anglophone Marxist thought by drawing on continental European sources. Of course, there were Anglophone Marxists, but they had tended to arise out of the intellectual fields that were particularly strong in British universities, such as the study of classics.⁵ Anderson had another reason to want to minimize their achievements. Many were or had been close to the Communist Party, and Anderson sought to open up an intellectual space at considerable distance from it. Hence his marginalization of figures such as Bernal and Haldane. He and his colleagues freed the intellectual project of a Western Marxism in English from the constraints of Communist Party life. But in the process, they rather limited it to a political, philosophical, and aesthetic project that knew very little about science and technology.

This was the price to be paid for dismissing figures like Bernal and Haldane from the conversation. Downplaying the more general contributions of Needham to a vital and open-ended Marxist thought also meant ignoring his deep and abiding engagement with China. Anglophone Western Marxism remained rather Western-centric. This no longer seems tenable.

On Figuring Neglect (Nappi)

See, this is exactly why writing this together was better than writing alone: sometimes you need someone else's perspective to help you hear a fresh voice in something familiar. (We can understand the collaborative nature of the SCC series in the same spirit.) It's helpful to look again at Needham to ask what we've neglected to notice and to try to put a form to that absence.

This is why I'm so interested in the detritus and precipitates of SCC. When I visited Needham's library of texts at Cambridge University some years ago, I was fascinated by the scraps and notes making up the obverse sides of the notecards in his card catalogue: old recipes, visiting cards, invi-

5. Perry Anderson, *Considerations on Western Marxism* (London: New Left, 1976); and Edwin Roberts, *The Anglo-Marxists* (New York: Rowan & Littlefield, 1996).

tations to dinner, postcards. I wanted to make something with that accidental archive. It was a collection of quotations, a repository of utterances by others—directions given, requests made, statements asserted. Here was a library made up of things said by other people, whether read from the front side (this recipe for cake) or the back (this placeholder marking a classical quotation about the medicinal uses of pangolin in a sixteenth-century Chinese text). It was an archive of quotations.

We find an ambivalence about quotation in the footnotes to *Introductory Orientations*: “All reliance on quotation is bad,” Needham asserts, “even if sometimes unavoidable.”⁶ In order really to understand a statement in a work, he seems to be saying, one must go to the original text rather than relying on a second- or third-hand image of it. Something about the importance of an origin. Something about the reliability of the first voicing of an assertion. Something about taking context seriously.⁷ Understanding context is how we tell the story that gives a quotation its meaning.⁸ He makes this point often, in the footnotes. To quote, then, is to take out of context, to remove a statement from its story.

But remember the kind of work that this first volume of *SCC* is: much of its flesh congeals around textual quotations and remembered conversations and not-yet-forgotten images (as all stories ultimately do). And Needham was a storyteller. In these new stories, a quotation becomes a kind of fossil, an image we recognize as belonging elsewhere but that nonetheless tells us something important about where we happen to find it.

On Needham as Biologist (Wark)

Needham was a storyteller, but he was also a theorist—and of a recognizably Marxian stripe. The threads connecting Needham with Western Marxism are real if sometimes faintly etched. One could make a similar case for Needham and Western science studies. Needham was a scientist before he was a historian. His work in his original field of embryology may in some ways have been eclipsed, but how he thought his way through it would later be an influence on Donna Haraway—and thus, indirectly, on science and technology studies (STS). Needham is one of three biologists Haraway studied in her first book, *Crystals, Fabrics, and Fields*.⁹ There, she charts how his

6. *SCC*, Vol. 1, pp. 43–44, note d.

7. On understanding the meaning of a term, Needham asserts that “everything depends on the context” (*ibid.*, p. 33, note a). In the next footnote he explains: “For example, the sound *shih*, pronounced in the second tone, may mean ten, time, food, eclipse, to pick up, stone, hen roost, erect, shad-fish, or a stone shrine” (*ibid.*, note b).

8. “For all story, without the knowledge of the places wherein it is performed, as it wanteth a great part of the pleasure, so it in no way enricheth the knowledge and understanding of the reader” (Sir Walter Raleigh) (*ibid.*, p. 6, note a).

9. Donna Haraway, *Crystals, Fabrics, and Fields: Metaphors of Organicism in Twentieth-Century Developmental Biology* (New Haven, Conn.: Yale Univ. Press, 1976).

work on embryos pushed him to revise the mechanistic metaphors that organized his earlier work in the direction of a kind of *organicism* that nevertheless precluded any recourse to vitalist special pleading.

The problem with vitalism—then as now—is that it invokes a special, nontestable hypothesis to account for the specificity of living things. Mechanist approaches avoided this extrascientific shortcut but were frustrated in their attempts to account for certain features of living systems, particularly their capacity for self-regulation. Like vitalism, organicism maintains that the study of the parts does not explain the whole. Like vitalism, organicism sees goal-directed behavior in organic systems. Hence biology cannot be reduced to physics, as it has unique phenomena to explain. Needham insisted, however, that organicism deals only in testable theories.

Organicism had to clear two conceptual hurdles. The first was to reject any teleology, any hint of a final cause that drew development toward it. The other was to avoid the problem of immanence, of just saying that a form results “because emergence”—as if that was an explanation, rather than that which had to be explained. Needham’s solution was to try to think the gap in scales between developmental morphology and biochemistry. His program was a biochemistry of development. He stressed the *chemical geography* of the embryonic cell.

Needham abandoned the Aristotelian view of a higher power or final form that drew the elements together into itself—the root of most vitalist theories of form. Instead, he developed the image of the *field*. In a field theory, development is determined by *proximity effects*. The form and function of the part depend on relations with adjacent parts within the whole. But rather than reducing biology to physics, this implied the introduction into physics of a problem from biology, the problem of how proximity in a field causes certain kinds of forms to assemble.

The autonomy of biology as a science had to do with this level of organization. The unity of science derived from articulating the relation between levels of organization. This was not a kind of reductionism, nor was it a general systems theory. The question of form has to be studied in its specificity at each level or scale of organization. Biochemistry provides an understanding of how molecules can align in patterns and structures that can be folded and shaped into a larger scale of much more diverse forms.

Haraway notes the influence of Marx on Needham’s biology, but not so much the influence of his biology on his Marxism. What Needham may have taken conceptually from his scientific work is a sophisticated approach to questions of form. He was not a reductionist. He thought each level or scale of organization had its own formal principles, discoverable by the research methods applicable to that scale, whether physics, chemistry, biology, geology, or human history. However, having come up against the complexity of form at the biological scale, he was not about to settle for the

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received ideas about form that were present in the human sciences of his time, including any doctrinaire approach to “dialectical materialism.”

On Histories and Scale (Nappi)

Form and scale are critical to the paleontologist-storyteller. Looking at Haraway’s reencounter with Needham’s work encourages us to ask: What happens if we take Needham’s approach to the significance of form and scale and apply it to a rereading of *SCC* now? By engaging the different levels of organization of the work—at least in the first volume—as different worlds to explore and from which to draw stories and interpretations that are relevant now, that seems to be just what we’re doing.

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We might follow Needham and look at what’s happening at the level of the human in *Introductory Orientations*. If we listen among the footnotes, he seems to be pointing us repeatedly to phenomena that emerge at the scales of the individual person and the larger human collectivities that grow from it. Specifically, he seems to assume that the qualities of both individual and collective are influenced by their experiences, and this has implications for how we responsibly understand the world. We have already seen that Needham constantly points the reader back to his own experiences as an individual and to the presence or absence of relevant experiences on the part of his fellow scholars. And we have also seen that, for Needham, context is crucial. It is incumbent on individual scholars to shape their experiences such that they’re in a position to appreciate the context of the texts or ideas they study: the footnotes repeatedly invoke the importance of context for understanding a term, a text, or a historical object or event. Placing something in context is a matter of the effort and intention of the author, and that effort succeeds or fails on the basis of proper experience. Needham also repeatedly invokes the collective experiences of “the Chinese” or the Romans or other social groups, which is another way of talking about individuals. (Here, the group is an individual.)

But if we look beyond human scales, some phenomena cease to be salient—influence or intention, for example, and possibly experience—and other phenomena emerge instead. This is one of the ways that STS and the history of science are changing how we understand the contribution of *SCC*, making it possible (perhaps even demanding) that we read Needham’s work for insights at nonhuman levels of organization.¹⁰ Because Needham’s focus on human scales was so clear and pervasive in this work, in order to move beyond them the reader needs to find a way to eschew individual intention altogether and read a text otherwise—in a way that the

10. Throughout this essay, I intend “history of science” as shorthand for an expansive field that includes the histories of technology, health, and healing.

author did not intend it to be read—and to look beyond standard models of causality, matters of influence, and conceptions of “context.” (This is one way in which reading the footnotes successively as a text is useful: it’s necessarily a process of reading a text otherwise, since the footnotes were not intended to be read successively as a narrative on their own. Doing so thus forces a reorientation.) The reader must instead attempt to think toward other ways of reading and understanding texts and other entities in the world. The questions remain: How might we do this? And what kind of history does that leave us with, if the normal building blocks of history at human scales (context, causality, intention) cease to operate in recognizable ways? And if we manage this, how might reencountering SCC in turn change how we practice science studies and the history of science?

On Needham’s Organicism (Wark)

The social and historical organicism evident in *SCC* had several sources, as we can see in the book he put together at the end of the 1930s, *Time, the Refreshing River*. One source was the Epicurean philosophers of the ancient world. “In the modern world, Epicurus and Lucretius have come into their own.”¹¹ Interestingly, Needham seems to have read Lucretius as a metaphysics not of separate atoms but of the relations that bind them, through which atoms commune.

Another source was a deepening of his interest in Marx and Engels. Still, Needham’s Marxism appears more as an ethics and a politics than an ontology. As a practicing scientist, he knew that philosophy, no less than science, deals with real external events only through the “optic glass” of human limitation. Marxism offered him a language for thinking between domains of knowledge, a practice that, unknown to Needham, was actually closer to that of the Machist-Marxist Alexander Bogdanov than to Lenin, his nemesis.¹²

Rather than a dogmatic metaphysics of the real, Marxism for Needham is just one example of a practical, engaged, open-ended theory and practice: “No more shall we take Gautama and Plato for our guide, but rather those determined men who from Confucius to Marx were vehicles of the evolutionary process, working through them to implement the Promise occluded in the very beginning of our world.”¹³

Contradictions are to be resolved in this world, although never finally. “Sir Thomas Browne was wrong; ‘the great Mutations of the world’ are not yet all acted, and time will not be too short for the development of human

11. Joseph Needham, *Time, the Refreshing River* (London: Allen & Unwin, 1943), p. 71.

12. *Ibid.*, p. 22; and Alexander Bogdanov, *The Philosophy of Living Experience* (Chicago: Haymarket, 2017).

13. Needham, *Time, the Refreshing River*, p. 27.

society that is to come.” Needham thinks this a generalization that can hold for different levels, across the natural and social worlds. “We cannot consider nature otherwise than as a series of levels of organization, a series of dialectical syntheses.”¹⁴

This is a strange kind of dialectics. Needham’s thought is *monist*: there is one substance, even if there are plural forms in which it is organized. There is a continuity running from the natural and social worlds, and hence from knowledge of one to the other. “Karl Marx and Frederick Engels have adumbrated the idea of levels of organization in setting the Hegelian dialectic actually within evolving nature.”¹⁵ Consciousness does not confront nature from without. “Dialectic” in Needham’s sense refers to the nesting of levels of organization and their relation.

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On an Ethics and Politics of SCC (Nappi)

As part of an effort to look for histories at nonhuman scales, digging into the footnotes of *Introductory Orientations* starts getting us to an ethics and politics of the text that’s useful to think with now.

Insofar as he was operating from a concern with the level of the human (at the individual and collective scales), Needham’s work is also concerned with issues of identity, and often that identity manifests in terms of the nation or the empire. The Chinese language is more “subtle” than other languages.¹⁶ The Chineseness of dynasties and cultures could be more or less “pure.”¹⁷ “Traditional Chinese culture” is treated as a coherent object and evaluated with respect to a largely European idea of modernity.¹⁸ Types of scholars are often characterized by their nationality (Indian, Chinese, etc.) or by area of specialty (Arabists, etc.). In this first volume individual identity is determined by association with a particular type. And so the ethics and politics of Needham’s project are fundamentally rooted in a concern with the level of the human actor, taken singly or in groups.

Many scholars working in science and technology studies and history of science today, however, are trying to move away from an anthropocentric focus in their work—and also from nationalistic modes of determining, characterizing, and judging identity. Some of us are aiming to create more humane fields characterized by a plurality of scholarly voices and approaches, at the same time diversely human and inclusive of the nonhuman.

If we surf Needham’s footnotes, we find glass vases and sea urchin

14. *Ibid.*, p. 15.

15. *Ibid.*, p. 31.

16. *SCC*, Vol. 1, p. 40, note a.

17. *Ibid.*, pp. 78, 119, note 1.

18. *Ibid.*, p. 72, note b. We might replace “European” with “Euro-American” here, or go one step further and simply use “white.” There’s an assumption throughout the text that seems to conflate modernity with whiteness.

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gonads and crabs and medicinal drugs and pieces of tree resin and bodies of water. The footnotes seem to enclose a cabinet of natural curiosities emerging out of the textual world. And on that level, we also find a concern with individual identity. But here, rather than being identified in terms of synchronic type or kind, objects are identified in terms of likeness to each other across historical time. (For example: that thing then is like this thing now; that thing over there is like this more familiar thing.) In this respect, reading Needham's cabinet of footnoted objects evokes a concern with community, sameness, and building relations across disparities that is similar to what we find in his footnoted cabinet of people as described above. Here, the ethics (a sense of care for and responsibility toward others) and the politics (a sense of relationality within and among groups) are still fundamentally human, based in notions of identity determined by similarities across time and space. This is unsurprising: a cabinet is a collection produced by human intention.

If we instead consider the note space as an ecology in its own right, and if we explore that ecology looking for phenomena emergent at nonhuman scales, what might we find? What kinds of relations do objects have with each other in the notes, beyond what Needham says about them? What kinds of work do they do together? And what kinds of politics and ethics beyond the human (with implications for the art of reading in the STS and history of science fields) might emerge from reading this way?

On *Science and Civilisation in China*, Volume 1, as Synthetic Marxist Historiography (Wark)

The synthetic and indeed political character of *Science and Civilisation in China* can easily be overlooked. And yet I think it motivates and shapes the whole into more than its parts. Needham writes: "We are living in the dawn of a new universalism, which, if humanity survives the dangers attendant on control by irresponsible means of sources of power hitherto unimaginable, will unite the working peoples of all races in a community both catholic and cooperative. The mortar of this edifice is mutual comprehension."¹⁹ The first and second volumes of SCC outline a recognizably Marxist approach to history, distinctive in its breadth. The level of abstraction at which such a theory of history works usually holds only modest appeal for working historians. For Needham, historical study was a component of a larger praxis, that of world history itself, a praxis in need of a self-understanding not always lost in the weeds of empirical detail.

As Carla notes, SCC starts with geological and geographical conditions, or "geotectonics," that shape possible social and technical forms of organization, which in turn give rise to distinctive cultural superstructures.²⁰

19. *Ibid.*, p. 9.

20. *Ibid.*, p. 63.

Chinese civilization emerged in a geography bounded by mountains to the west, which are the headwaters for rivers that twist and turn and run toward the coast in the east and which divide China into separate parallel agricultural zones. Needham assigns a central importance to hydraulic engineering and agricultural output in the formation of a succession of states. When a Chinese state is unified, it is because there is one region with an extensive granary that dominates the others; when disunified, it is because the separate hydraulic-engineered agricultural areas are more or less equivalent and sustain rival states.

Volume 1 sweeps through Chinese archaeology and ancient history. Needham used the Marxian base and superstructure understanding of historical dynamics, where extracting a surplus from a rural population was the dominant factor.

Unity and centralization of State power simply meant that . . . the control of an economic area where agricultural productivity and facilities of transport permitted a supply of grain-tribute so superior to that of any other areas, that the group which controlled the key area controlled China. But in the San Kuo period [220–280] there were in fact three areas of comparable resources. It therefore openly reveals to us, as if by a dissection, the geopolitical muscular system normally hidden by the subcutaneous fat and skin of constitutional and military history as it is generally written.²¹

The unification of the Qin and Han dynasties was based on the superior development of the northern region around the Yellow River. That fell apart at the end of the Han period because the lower Yangtze area had caught up and could support a separate superstructure. While his is not a history from below, Needham is not all that interested in dynastic succession.

The Sui completed the grand canal between the Yellow and Yangtze rivers, finally linking the productive south with the political north. The Tang sponsored a more humanistic culture, the Song a more technical one. Restraint of the merchant class was, however, something of a constant. “Confucian officialdom was always in fear of a ruination of the agricultural basis of production by the speculative activities of merchants.”²² Needham pauses over some of the glories of Song technics: surveying instruments, gunpowder, compass, algebra, and paper money—all topics to be explored in rich detail in subsequent volumes. The Ming intermittently sponsored maritime exploration. The Indian Ocean, in the end, was left to the Portuguese and the Arabs. Needham sees the Ming as a time of restoration.

Needham writes: “Whoever might rule, it was always the scholar-gentry who had to be called in to administer. They alone possessed the necessary mastery of the written language, of official procedures, and of essen-

21. *Ibid.*, p. 115.

22. *Ibid.*, p. 129.

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tial techniques such as hydraulic engineering.” This seems to me a key point, not about Needham’s understanding of China, but about his understanding of the politics of intellectual life itself. What he shares with Bernal and Haldane is a curious version of Marxism that shifts historical agency from the *industrial* working class to the *scientific* working class.²³ As in biology, so too as a historian, Needham is a materialist but not a reductionist. Historical agency is constrained by, but not reducible to, geography. The possibilities of social and historical form are constrained by geography, but within those limits various forms of a proto-scientific knowledge-worker class push history forward.

Volume 1 of SCC posits a geotectonic as a prior level of which the historian needs a working knowledge. The historian’s task is to account for the forms that emerge within those constraints. What is the organizer of those forms? Agency is located in the main with various forms of a class of knowledge worker. Volume 2, *History of Scientific Thought*, elaborates on the class basis of classical Chinese worldviews. It takes a more volunteerist approach to history. In this, it curiously parallels developments within Chinese Marxism in the time period.²⁴

Needham had rather more sympathy for some traditions than others, and at least a little of his own intellectual formation may show through in this. Needham had three commitments: to politics, to religion, and to science. His favorable engagement with aspects of the Confucian, Daoist, and Mohist schools reflected these three commitments. As in his own everyday life, he did not see the necessity for them ever to merge into some grand synthesis or sovereign philosophy. Each practice of life generates its own worldview; these can overlap but need not merge.

On the Historian as Paleontologist, Again (Nappi)

And so I’m left with an approach to SCC as its own universe with its own geology, a paleontologist once again digging in the strata of the text itself, trying to read the sedimentary layers there, paying attention to the structure and the texture of the elements. And perhaps that’s what it is to reread Needham now, as a historian: to understand that there are different histories that emerge at different temporal scales and that tell different kinds of stories. And I’m left with a question (as I often am): How do our conversations (our training, our fields) need to change so that we can hear and tell those stories better?

23. *Ibid.*, p. 119; J. B. S. Haldane, *The Marxist Philosophy and the Sciences* (London: Allen & Unwin, 1938); and J. D. Bernal, *Science in History*, 4 vols. (Cambridge, Mass.: MIT Press, 1971).

24. Adrian Chan, *Chinese Marxism* (London: Continuum, 2003).

On the Historian and the World-Historical Project (Wark)

One can decompose SCC into a fascinating array of smaller and alternative projects. Or one can see it not only as one vast project but as a component of an even larger one. Needham wanted to contribute to the creation of a global society that was attuned to nature, that was cooperative and egalitarian, and in which science could advance beyond the limits set for it by capitalism as a mode of production and the blindness as well as insight it afforded. He thought that the People's Republic of China had a world-historical role in such a project—a role derived in part from its cumulative cultural and scientific legacies. “An unexpected vista thus opens before our eyes—the possibility that while the philosophy of fortuitous concourse of atoms, stemming from the society of European mercantile city states, was essential for the construction of modern science in its nineteenth century form; the philosophy of organism, essential for the construction of modern science in its present and coming form, stemmed from the bureaucratic society of ancient and medieval China.”²⁵ In order to take three steps forward, history had to take two steps back.

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25. Joseph Needham, *Science and Civilisation in China*, Vol. 2: *History of Scientific Thought*, with Wang Ling (Cambridge: Cambridge Univ. Press, 1956), p. 339.