

**POINTS EAST AND WEST:
ACUPUNCTURE AND COMPARATIVE PHILOSOPHY OF SCIENCE**

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Acupuncture, the traditional Chinese practice of needling to alleviate pain, offers a striking case where scientific accounts in two cultures, East and West, diverge sharply. Yet the Chinese comfortably embrace the apparent ontological incommensurability. Their pragmatic posture resonates with the New Experimentalism in the West—but with some provocative differences. The development of acupuncture in China (and not in the West) further suggests general research strategies in the context of discovery. My analysis also exemplifies how one might fruitfully pursue a comparative philosophy of science that explores how other cultures investigate and validate their conclusions about the natural world.

1. Introduction. When acupuncture first received widespread exposure in the United States in the 1970s, it was like a thorn in the side of Western science. Americans proudly paraded the success of their science. The landing of a man on the moon just a few years earlier, along with the recent introductions of the computer chip and a pocket calculator, seemed tangible proof of that success. Some philosophers had even argued that this success was one of the characteristic features, if not the distinctive hallmark of science. Yet here the Chinese had discovered, some two millenia earlier, a form of alleviating pain that had escaped notice in the West—and which Western researchers were at a loss to explain adequately.¹ U.S. physicians were dumbfounded watching a surgeon remove a tuberculosis-infected lung where the primary source of analgesia was a needle inserted and being gently twirled in the patient's forearm—all while the patient remained conscious, chatting with the surgeon. Westerners were particularly baffled by the sometimes remote relationship between the points where needles were inserted and the site of their apparent effect. The Chinese knowledge of acupuncture seemed like an arrow piercing an unsuspected Achilles heel of Western science.

The case of acupuncture and its reception in the U.S. is well suited for addressing several fundamental epistemic questions, which I discuss below. In addition, the case is an excellent occasion to consider the potential for a *comparative philosophy of science*.

In what follows, I first review acupuncture analgesia and Western and traditional Chinese conceptions of it. The contrasting views offer a particularly deep version of Kuhnian

incommensurability. I focus on one especially revealing contrast between Western and Eastern views—accounts about the specific location of acupuncture needling points (hence, "Points East and West") (§2). Second, I turn to the very conceptions of science and knowledge in China and how they compare with widespread Western conceptions (§3). There are some provocative parallels, as well as significant differences, between traditional Chinese conceptions of knowledge and the New Experimentalism. Next, I explore the history of acupuncture through another recent focus of interest, the context of discovery (§4). Finally, I turn to what philosophy of science may mean in a Chinese context (§5). Study of Chinese philosophy to date has focused primarily on ethics, religion, and social or political theory. I hope my analysis shows that philosophers of science might find fruitful the study of Chinese thought and practice beyond those boundaries—and of "science" in other cultures, as well.

2. Acupuncture Analgesia and Acupuncture Points. Acupuncture analgesia was somewhat paradoxical for Westerners. Sharp needles, rather than cause pain, appeared to alleviate pain.² There was, at least, agreement on the basic observations, here. Despite the wide cultural gulf in interpretations that was latent, the basic observation of phenomena was not so theory-laden that nothing was puzzling or served to mark diverging interpretations. Certainly, some Western skeptics doubted that the phenomenon was "real," claiming that the surgical "demonstrations" were fraudulent, having been staged merely to promote Mao's communist regime. But when Western physicians began to replicate the effects for themselves in their own hospitals, these voices were quickly silenced. Numerous controlled laboratory and clinical studies since the early 1970s have confirmed that acupuncture relieved both acute and chronic pain, in both humans and other animals (Pomeranz 1987; Baldry 1993; Liao, Lee and Ng 1994; Schoen 1994). The phenomenon of pain relief from needles was real—or real enough.

Acupuncture also puzzled Westerners because the place where acupuncturists inserted the needle (or needles) was sometimes quite distant from the site of its (their) intended effect. For example, one inserts a needle between the thumb and forefinger—a well-known point called *hegu* (also romanized as *'ho-ku'*)—to treat either a headache or abdominal cramps. For coughing or a fever, one uses a point above the third toe. The Chinese did not insert needles haphazardly, but at specific points, as prescribed by centuries of practice in China. For Westerners, the pattern of the points posed penetrating anomalies. The correlations between cause and effect made no anatomical sense. The lack of adequate Western interpretation of the points, coupled with the traditional Chinese interpretation of the same phenomenon, prompts several questions about "science" in the two cultural contexts, East and West.

Westerners have not been wholly without explanations for acupuncture. Even in the early 1970s, when the mechanisms and perception of pain were still relatively little understood, suggestive ideas appeared. Melzack and Wall (1965) had proposed several years earlier that pain impulses to the brain could be regulated where different types of nerve fibers entered the spinal cord and converged in the substantia gelatinosa. Impulses along large fibers (type II and III, that mostly respond to tactile changes) could, they suggested, switch a figurative gate, blocking the further transmission of pain impulses towards the brain along the thin (pain) fibers. This might explain why the gentle stimulus of a twirled needle could block a pain impulse in the same segment of the body. Since the early 1970s Western knowledge has deepened substantially, most notably through the discovery of endorphins, natural opiate-like molecules that fit into receptors on nerve cells and suppress the cell's ability to transmit impulses. According to current models,

there are numerous ascending and descending nerve pathways that regulate one another, both through promotion and inhibition. Acupuncture apparently triggers many of these regulatory pathways (Pomeranz 1987, 2-16; Baldry 1993, 56-65).

Despite these explanations for the underlying mechanism of acupuncture, neither the nature of acupuncture points nor their distribution with respect to their sites of effect are adequately understood in Western terms. Americans certainly looked for unique anatomical structures at traditional acupuncture points—yet with no success. Some researchers claimed that acupuncture points correlate with areas of the skin with low electrical resistance (impedance)—and many veterinarians, for example, now use electrical "point finders" to identify points in treating animals with acupuncture. Others, however, have recently challenged these findings (Pomeranz 1987, 22-24; Liao, Lee and Ng 1994, 36).

Shortly after acupuncture was introduced in the U.S., a few physicians noted that acupuncture points corresponded to (Western) 'trigger points', hypersensitive points that stimulate sensations of pain when touched (Liao 1973; Melzack, Stillwell and Fox 1977). Various other studies have strengthened specific features of this correlation. Acupuncture also seemed related to the Western concept of 'referred pain', sensations of pain on the skin linked to tissue damage deep in a visceral organ. A familiar example is the pain of angina pectoris that seems to travel across the left chest and down the left arm, though originating in the heart. Current explanations of referred pain based on the regulatory networks described above, however, account for interactions only within dermatomes, or segments of the body defined by the branching of nerves at each vertebra (Baldry 1993). Both trigger points and referred pain are reminiscent of acupuncture, but in neither case is there a way to explain the sometimes distant effects of needling at a particular point. In short, the West cannot adequately explain why acupuncture points are where they are, nor how they relieve pain at distant locations.

The case of acupuncture might represent only another curious anomaly in Western science were it not for the existence of traditional Chinese accounts of the phenomenon³ (*Outline* 1975; Lu and Needham 1980). Traditionally, the Chinese conceived the body with an entirely different "geography" than in the West (Moyers 1993). For the Chinese, traditionally, the body is maintained by a primordial life energy or quality, *qi*, that gives substance to all matter (not unlike the Greek *pneuma*). The *qi* flows through the body along several channels. Twelve major meridians, each designated by a major internal organ (liver, stomach, spleen, gall bladder, etc.), correspond to the twelve yearly cycles of the moon. Some treatises identify 365 points, corresponding to the days of the year (though this varies considerably historically). The flow of *qi* maintains a balance between *yin* and *yang*, the two complementary principles according to Daoist philosophy. Chinese accounts of acupuncture are thus fully embedded in a "cosmology" or system of organizing the world.⁴

The Chinese accounted for health and disease in terms of the flow of *qi* along the meridians. (I use the term 'account for', rather than 'explain' or 'theorized about', as these later terms, from a Chinese perspective, may be inapplicable, appropriate only in a context of Western philosophical discourse—see §3). When the flow of *qi* was impeded or imbalanced, disease, malfunction or pain resulted. To restore the balance, needles were inserted at specific points along the appropriate meridian. The needles either promoted or impeded the flow of *qi*, re-establishing the balance of *yin* and *yang*.

While a Westerner may be inclined to dismiss the notions of meridians and *qi* as relics of an antiquated and discredited cosmology, the concepts are still essential from the perspective of

acupuncture practice. Even now, acupuncturists use the meridians or channels to assess where needles should be placed. Indeed, part of an acupuncturist's skill is diagnosing which channels have been affected in a sick patient and where along those channels to place needles. Furthermore, Western clinical studies of pain perception support the Chinese notion of channels. Patients report that sometimes the site of felt pain moves and that when it does, it traces lines described by the Chinese meridians (Macdonald 1982; see also Cooperative Group 1980; Baldry 1993, 81-83).

The Chinese thus account for why the points and their effects can sometimes be so distant from each other: they are connected by the *qi* flowing along the meridians. This view is clearly incommensurable (ontologically) with Western views about cells, nerve pathways, and energy in biological systems. Philosophically, how should one interpret the divergent interpretations? Does one ideally try to resolve the incompatibilities? If unsuccessful, must one choose between the two accounts? The task becomes more challenging when one considers how the very approaches to characterizing or validating "scientific" knowledge differ in China and the West.

3. Explanation and the New(?) Philosophy of Experiment. The strategy for resolving the divergent interpretations of acupuncture points typical among Westerners, of course, was (and still is?) to dismiss the Chinese accounts as inadequate explanations, even though there is no available alternative. Western physicians and medical researchers did not regard the traditional Chinese accounts as credible. But my aim is not to dwell on possible cultural prejudices or failure to follow rules of social objectivity or symmetry in discourse (as discussed by Longino 1990; Gieryn 1994; Shapin 1994; among others). Rather, the predominant Western position is a valuable foil for understanding an Eastern, or Chinese, perspective. Here begins an exercise in comparative philosophy of science.

The typical Chinese posture towards this apparent conflict is quite different and reveals, I suggest, an important alternative in characterizing "scientific" knowledge. The Chinese do not, in their turn, reject Western explanations. Neither do they abandon their own traditional accounts. Rather, they fully embrace the incommensurability. For example, Western medicine and traditional Chinese medicine (including acupuncture) can be found in the same Chinese hospitals, with some patients pursuing both styles of treatment simultaneously (Moyers 1993). Since the 1960s, Chinese researchers have investigated the (Western) physiology of pain and acupuncture, as well as the flow of *qi*—for instance, examining the possibility of blocking *qi* along the channels. Researchers from both traditions present their findings at the same conferences (c.f., Zhang 1986).

Philosophically, this seems untenable. Someone guided by a semantic view of scientific theory or imbued with a spirit of pluralism might well accept a certain amount of *limited* inconsistency or *local* incommensurability among disparate models. But the problem here strains even such generous tolerance. The two accounts of acupuncture seem to involve fundamentally different ontological commitments about both the structural and functional components of the body, as well as the basic forces at work in the world.

Yet the inconsistent commitments do not disturb the Chinese. Why not? The primary answer, I believe, is the thoroughgoing pragmatism of the Chinese culture. Historically, at least, the Chinese have been far more concerned about efficacy in practice than about explanation. In the West, of course, explanation has long been considered central, even critical, to science (e.g., Hempel 1966; Kourany 1987; Boyd et al. 1991; Salmon et al. 1992). Now, however, some

emphasize instead the central significance of practice or experimental demonstration (e.g., Hacking 1983; Franklin 1986) and, more recently, the 'performative' idiom (Crease 1993; Pickering 1995). These "new" Western approaches echo a long-standing tradition in China.

Acupuncture emerged from this tradition of practice. Thus, while the concepts of *qi* and channels on the body may seem constitutively cosmological—or even pseudoscientific—they largely summarize empirical experience. The history of acupuncture is telling, here. The origins of acupuncture are uncertain, but the first texts that mention needling itself (some time between the eleventh and second century B.C.E., probably in the fifth century B.C.E.) do not refer to *qi*. The earliest explicit mention of the *qi* channels (second century B.C.E.), by contrast, are primarily in the context of moxibustion, a related practice in which dried leaves are burned on the skin at points now used for acupuncture. The use of needling appears to have been grafted onto this earlier practice. The relationships of channels to lunar cycles and points to days were introduced still later (third century C.E.). The notion of channels might have been inspired, of course, by the sensations that spread over the surface of the body during treatment at certain points (see Cooperative Group 1980). No cosmological reasons, at least, dictate the *specific* meridian pathways, which sometimes take abrupt turns, or zig-zag their way, say, around the side of the head. The cosmological schema, though present, underdetermines the practice. Hence, we must consider the meridian point-maps as empirically (or perhaps semi-empirically) derived. Finally, even after the *Jing-Luo* system of channels was formalized (268 C.E.), other needling points were added, sometimes along with new "collateral" channels. The Chinese adopted new points even when they did not fall on defined channels and, hence, ostensibly contradicted the *Jing-Luo* system. The number of points has continued to increase, even in the past few decades. The implicit aim has always been effective practice or performance, though the cosmological organization remains. Thus, although the "cosmological" schema (see note 4) has dramatically shaped the development of acupuncture, the Chinese also repeatedly modified practice based on experience. The actual system described by *qi* and channels thus hybridizes cosmology and empiricism, combining Daoist world-view with a rich tradition of performance-driven practice.

Note that while the Chinese are strongly pragmatic, they do not share popular Western commitments to causality. The elaborate accounts of acupuncture certainly reflect Chinese concern for systematized knowledge—and, indeed, for knowledge that can map practice reliably. Their view of systematicity, however, exhibits pattern or correlation more than underlying causation. They would tend to interpret *qi* in (crudely) descriptive terms, rather than in the strongly causal terms that provoke such sharp criticism from Westerners. For the Chinese, one need not isolate and identify exclusive causes, nor develop or select a single (or single best) explanation. Hence, in this case, the Chinese can adopt two incommensurable models of acupuncture, while making no overt effort to reconcile them or accommodate them within some more encompassing theory. The implicit challenge to Western philosophers is to articulate why (or when), according to their models of science, such conflicts must be resolved.

Traditional Chinese are also relatively indifferent to (Western) questions about (metaphysical) realism. Their perspective is neither distinctly realist nor anti-realist, but rather regards the "problem" of realism as itself either misframed or irrelevant—perhaps as embodied in the spirit of Arthur Fine's critiques (e.g., Boyd et al. 1991, 261-77). The Chinese have no strict ontology, no concept of 'being'. Existence is measured, at best, by a 'having-at-hand'. Hence, they do not question whether something 'is' or 'is not'. Recent arguments about realism based on views of experimental intervention or performance (e.g., Hacking 1983; Franklin 1986; or even

Latour, 1987, in adapting Bachelard's concept of 'phenomenotechnique') are, of course, not integral to Chinese views. In this particular, at least, the Chinese conception of "science" or systematized empirical knowledge is distinct from, and offers a provocative counterpoint to, the "New" Experimentalism in the West.

4. Discovery. Perhaps the most penetrating question in the acupuncture case is: why did acupuncture develop in China, and yet escape attention during the same 2000 years in the West (notwithstanding the description of trigger points and referred pain)? Such a question is complex, of course (see Lu and Needham 1980), but it raises problems about the nature of discovery that have enjoyed renewed interest among philosophers of science in recent years (e.g., Schaffner 1993; Bechtel and Richardson 1993; Darden 1991; Thagard 1988). How was acupuncture discovered? Did it occur due to any special features of what we might characterize as a Chinese philosophy of research?

Clearly, many things were discovered in the West that were not also discovered in China. Thus it would be overstating the case to make any broad conclusion about one system of science versus another. My objective here, then, is simply to identify the factors that likely contributed to the process of developing acupuncture, and to examine whether the Chinese case highlights any productive general strategies, especially—in the spirit of a comparative philosophy of science—where they may contrast with Western strategies.

As noted above, the history of acupuncture is somewhat checkered, even haphazard. One may infer, then, the significance of contingency in originally *noticing* the phenomenon without a theory, paradigm or search schema. This raises again the question, perhaps largely for cognitive science, of how someone is sensitized to *notice* a new phenomenon and its potential relevance. The numerous cases of "chance" discovery documented by historians of science, of course, are ripe for such analysis by philosophers. In the acupuncture case, the *noticing* of one point was surely supplemented by (or perhaps prompted by) *noticing* another point or points. We may surmise that the documentation of even one effective acupuncture point could sensitize someone to *notice*, or even to look for, another—in a sense, generalizing or projecting (inducing) tentatively from only one case. Given the incomplete history, here, we can only speculate that the Chinese philosophical emphasis on particulars and the relationships among them may have fostered such observational skills or *noticing*.

Based on history, the most acupuncture points were discovered in the centuries following the linking of needling points to the *qi* meridians (Liao, Lee and Ng 1994, 58-60, 145). This proliferation of points first appeared in 268 C.E. in the work of Huangfu Mi, who presented them in the "cosmologically" organized system that has dominated ever since. Indeed, he may well have used the grand correlative framework in collating and synthesizing many points himself. It is plausible—and again, one must speculate based on incomplete historical records—that the schema gave greater meaning to the existing points, and offered a structure for accommodating potential new points, thus promoting discovery. This would follow Kuhn's claim that a paradigm or conceptual structure aids discovery. It would also support Wimsatt's (1987) claim that even potentially false models can serve as productive probes. Thus, the Chinese model of acupuncture may have been a generative tool in research (in the context of discovery) as well as an organizational tool (in practice).

Note again that the "cosmological" framework (or "theory") that guided practice since the third century did not preclude the discovery of additional acupuncture points that did not fit that

particular framework. In this case, the potentially 'anomalous' points did not precipitate, so far as we can tell, any major upheaval or "revolution." Did this result from the Chinese (highly pragmatic) style of thinking or their casual posture towards "theory"? The acupuncture case invites us to (re-)analyze investigators in the West to determine how their orientations—strongly pragmatic versus theoretical—guided productive responses to anomalous results.

Again, while one might expect the elaborate conceptual structures surrounding acupuncture to quell invention or discovery, this seems not the case for acupuncture analgesia, a relatively recent development. As part of Mao's "Great Leap Forward," researchers were urged to capitalize on the strengths of traditional Chinese medicine and develop them further. In 1958, doctors at a Shanghai hospital conjectured that acupuncture—used for centuries to control long-term, or chronic, pain—might also be applied to short-term pain. At first, they tested needling on pain relief while changing surgical dressings. Based on their success, they then tried acupuncture as an analgesic during tonsillectomies. Shortly thereafter, again buoyed by their practical successes, they tested acupuncture during major surgery—with spectacular results. The blade of the surgeon's knife was perceived as no more than a pencil being drawn across the skin (Lu and Needham 1980, 220-21). The U.S. physicians amazed by acupuncture analgesia a mere decade and a half later thus witnessed a particular variation of a centuries-old practice that was relatively new. Discovery on this occasion was clearly motivated, or propelled psychogenically, by deliberate search (itself politically "inspired"). Yet the achievements themselves resulted from reasoning wholly within the acupuncture tradition. In this case, the Shanghai doctors focused on expanding scope. Through analogical reasoning, they were able to expand the boundaries of the former domain in a way that has since proven enormously fruitful (compare Darden 1991, 244-48, 269-70). The strategies exemplified in the discovery of acupuncture analgesia do not bear any strong marks of the Chinese context. But the episode does show dramatically that an ancient tradition of knowledge can still be a living tradition, when coupled with an active imagination.

Taken as a whole, the history of acupuncture highlights several elements of discovery—the possible role of particulars in *noticing*; the potential of inducing from single examples; the role of models (interpreted flexibly) in highlighting new cases; a pragmatic posture towards anomalies; and the search for expanded scope or new domain through analogy. All may potentially apply as strategies more generally. At the same time, these features—emerging from an analysis of discovery in another culture—also exemplify the potential value in developing more fully a comparative philosophy of science.

5. Beyond Traditional Chinese Medicine. The case of acupuncture illustrates, I trust, important philosophical questions regarding both Chinese "science" and comparisons of Chinese and Western conceptions of knowledge and research. I surely have not resolved all the tensions between Western and Eastern interpretations of acupuncture, let alone those implicit in traditional Chinese medicine or Chinese "science" more generally. I hope, however, that my conclusions are significant enough to inspire interest in considering the remaining tensions further. Comparative analysis of this type has the potential, as indicated by my examples, I trust, to contribute deeply to our understanding of science—or to understanding of "our" science.

I hope also to have demonstrated that our understanding of Chinese conceptions or practice of acupuncture are incomplete without also understanding the epistemic context from which they emerged and in which they function. I contend that we need such contextual understanding when considering the "scientific" results of other cultures, as well. If so, then

there are strong implications for research in ethnobotany (including the ethnopharmacology now in vogue), ethnoecology, and other cross-cultural studies of 'native science'. Research that merely documents what the culture knows (or knew), while failing to understand the methods by which such knowledge was developed and secured, I contend, is critically incomplete. It may be worth noting, for example, that some Native American cultures guard their knowledge of the natural world from inquiry by modern (Western) scientists, precisely on the grounds that these individuals do not appreciate the epistemic structure or context of such knowledge. Philosophers of science, in my view, can fill an important role as interpreters in the exchange of scientific knowledge across cultures. But first, we need to develop more expertise in comparative philosophy of science.

NOTES

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¹Acupuncture had been introduced into the West as early as the 17th century and was being practiced in many "Chinatowns" in major U.S. cities. The discussion here focuses on mainstream scientific discussions and research in the United States ensuing from efforts to re-establish diplomatic ties with China in the early 1970s.

²Traditionally, the Chinese also used acupuncture for a variety of medical conditions, including hiccups, insomnia, asthma, muteness, ulcers and vitamin E deficiency and, more recently, drug addition and smoking. But the striking short-term effects on pain attracted the most attention. For simplicity, I focus on acupuncture analgesia—though the case becomes all the more interesting when one considers these other therapies and the closely related practice of moxibustion.

³One may distinguish "traditional" from other "modern" Chinese accounts that are basically Western. In my analysis 'Chinese' refers to the traditional accounts unless explicitly noted otherwise. 'Traditional' itself can be variously interpreted. I follow the popular *Jing-Luo* system, formalized in 282 A.D. by Huangfu Mi's in his *Jiayi Jing* (see Lu and Needham 1980). For a more detailed view of debates *within* China, see Zhao (1991).

⁴'Cosmology' is a grossly inadequate term to describe the fundamental Chinese approach to the world, which consists of many layers of correlative patterns, yet does not draw on a clear ontology. I retreat to using the term as the closest equivalent in Western terms for conveying the fundamental and organizational nature of the schema.

REFERENCES

- Baldry, P. E. (1993), *Acupuncture, Trigger Points and Musculoskeletal Pain*. 2d ed. Edinburgh: Churchill Livingstone.
- Bechtel, W. and Richardson, R. C. (1993), *Discovering Complexity: Decomposition and Localization as Strategies in Scientific Research*. Princeton, NJ: Princeton University Press.
- Boyd, R., Gasper P., and Trout, J. D. (eds.) (1991), *The Philosophy of Science*. Cambridge, MA: MIT Press.
- Cooperative Group of Investigation of Propagated Sensation along a Channel (1980), "A Survey of Occurrence of the Phenomenon of Propagated Sensation along Channels (PSC)", in *Advances in Acupuncture and Acupuncture Anaesthesia*. Beijing: The People's Medical

- Publishing House, pp. 258-60.
- Crease, R. (1993), *The Play of Nature: Experimentation as Performance*. Bloomington: Indiana University Press.
- Darden, L. (1991), *Theory Change in Science: Strategies from Mendelian Genetics*. New York: Oxford University Press.
- Franklin, A. (1986), *The Neglect of Experiment*. Cambridge: Cambridge University Press.
- Gieryn, T. E., (1994), "Objectivity for These Times", *Perspectives on Science 2*: 324-49.
- Hacking, I. (1983), *Representing and Intervening*. Cambridge: Cambridge University Press.
- Hempel, C. (1966), *Philosophy of Natural Science*. Englewood Cliffs, NJ: Prentice-Hall.
- Kourany, J. (1987), *Scientific Knowledge: Basic Issues in the Philosophy of Science*. Belmont, CA: Wadsworth.
- Latour, B. (1987), *Science in Action*. Cambridge, MA: Harvard University Press.
- Liao, S. J. (1973), "Acupuncture Points and Trigger Points", presented at the American Congress of Rehabilitation Medicine Eastern Section Annual Meeting, Washington, D.C.
- Liao, S. J., Lee, M. H. M. and Ng, L. K. Y. (1994), *Principles and Practice of Contemporary Acupuncture*. New York: Marcel Dekker.
- Longino, H. (1990), *Science as Social Knowledge*. Princeton, NJ: Princeton University Press.
- Lu, G. D. and Needham J. (1980), *Celestial Lancets: A History and Rationale of Acupuncture*. Cambridge: Cambridge University Press.
- Macdonald, A. J. R. (1982), *Acupuncture: From Ancient Art to Modern Medicine*. London: George Allen and Unwin.
- Melzack, R., Stillwell, D. M., and Fox, E. J. (1977), "Trigger Points and Acupuncture Points for Pain: Correlations and Implications", *Pain 3*: 3-23.
- Melzack, R. and Wall, P. D. (1965), "Pain Mechanisms: A New Theory", *Science 150*: 971-81.
- Moyers, B. (1993), *Healing and the Mind*. New York: Doubleday.
- An Outline of Chinese Acupuncture* (1975). Beijing: Foreign Language Press.
- Pickering, A. (1995), *The Mangle of Practice*. Chicago: University of Chicago Press.
- Pomeranz, B. (1987), "Scientific Basis of Acupuncture", in G. Stuz and B. Pomeranz, (eds.), *Acupuncture: Textbook and Atlas*. Berlin: Springer-Verlag, pp. 1-34.
- Salmon, M. H., Earman, J., Glymour, C., Lennox, J. G., Machamer, P., McGuire, J. E., Norton, J. D., Salmon, W. C., Schaffner, K. F. (1992), *Introduction to the Philosophy of Science*. Englewood Cliffs, NJ: Prentice-Hall.
- Schaffner, K. F. (1993), *Discovery and Explanation in Biology and Medicine*. Chicago: University of Chicago Press.
- Schoen, A. M. (1994), *Veterinary Acupuncture: Ancient Art to Modern Medicine*. Goleta, CA: American Veterinary Publications.
- Shapin, S. (1994), *A Social History of Truth*. Chicago: University of Chicago Press.
- Thagard, P. R. (1988), *Computational Philosophy of Science*. Cambridge: MIT Press.
- Wimsatt, W. C. (1987), "False Models as a Means to Truer Theories", in M. Nitecki and A. Hoffman, (eds.), *Neutral Models in Biology*. New York: Oxford University Press.
- Zhang, X. (H. T. Chang), (ed.) (1986), *Research on Acupuncture, Moxibustion and Acupuncture Anesthesia*. Beijing: Science Press and Berlin: Springer-Verlag.
- Zhao, H. (1991), "Chinese versus Western Medicine: A History of their Relations in the Twentieth Century", *Chinese Science 10*: 21-37.