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Introduction: Orienting American science

Like other forms of knowledge, scientific traditions are only fully comprehensible when they are placed in their proper social and cultural contexts. But the mutual interdependence of tradition and context cannot be fully brought out unless we are able to envision the ideas and institutions in question as developing under conditions other than those that produced and sustained them. Comparative judgments of this sort are implicit in even the most narrowly focused historical studies. However concerned we may be with the individual components of specific courses of events in particular places and times, the interpretations we place on them are necessarily informed by our sense of how they relate to other processes of change and continuity. The question is not whether comparisons and contrasts are to be drawn, but how systematically and with regard to what different combinations and circumstances.

This book is an essay in comparative history. My subject is American science and its introduction into late nineteenth- and early twentieth-century China. I describe the ways in which Americans and American-educated Chinese tried to promote modern science in China, I examine their views of science's place among the forces for change in China, and I set their plans and programs against sufficiently detailed backgrounds to make them intelligible. A comprehensive account of modern science in China would range far beyond the individuals and organizations that figure in my study – the Medical Missionary Association of China, the Rockefeller Foundation and its China Medical Board, the architects of the Boxer indemnity fellowship program, and an association of largely American-trained Chinese scientists, the Science Society of China. But I am interested in the transfer of scientific ideas and institutions to China primarily for what it shows about the United States, and only secondarily because of its bearing on Chinese scientific development.

Viewed from this perspective, the transmission of American science to

China reveals a complex network of shifting conflicts and tensions in American social and scientific life. Faced with the task of rooting their scientific traditions in Chinese soil, Americans found it necessary to define the essential cognitive structures and social dimensions of science. But in adjusting their ideas and ambitions to Chinese circumstances, they also found themselves arriving at contradictory conclusions. They disagreed about the character of the intellectual and institutional matrices that sustained science, and they disagreed about the social and cultural consequences of scientific progress.

The main theme of my study concerns those disputes, why they arose in connection with the problem of exporting science to China, and how they relate to the social history of American science. In the first instance, they were disagreements about how China differed from the United States and how the disparities between the two societies had to be taken into account in programs for the transfer of scientific traditions and institutions. But in answering those questions, Americans were taking sides in unresolved debates about the significance of divisions in their own society. They anticipated that the lives and ways of knowing of all the Chinese would be uniformly changed with the development of science, because they believed that nothing less than that had already happened in America. Yet their expectations about China's future also reflected their sense that the transformations worked by science in the United States had left the country still fragmented along ethnic, ideological, and class lines. The tension between these two salient features of American society and culture was inescapable. How it was mediated determined the course of scientific development in the United States, as well as the strategies Americans pursued in attempting to export their scientific traditions to the rest of the world. The changing fortunes of American science in China therefore present us with a special view of the conundrum of our past and present: Abroad and at home, social divisions have been accentuated rather than reduced with the growth of a body of knowledge whose imperatives have always seemed universally compelling.

My study begins with a time when Americans were confident of science's power to illuminate the sources and consequences of social diversity. Missionary physicians and educators in late nineteenth-century China assumed that the principles of sound social order were concurrent with the laws of nature. They attributed the chief differences between China and the United States to the failure of the Chinese to structure their lives in accord with those principles and laws. As disease was the inevitable consequence of aberrant behavior, they concluded that

the science most relevant to Chinese conditions was medicine. Accordingly, the institutional arrangements they made for science in China were predominantly medical: hospitals, medical schools, and a professional organization for medical missionaries and the Chinese doctors they were training.

At the end of the nineteenth century, the future of modern science in China appeared to lie with these undertakings. In fact the future lay elsewhere, not because of anything happening in China, but on account of broad changes underway in American society. There the conditions for scientific and medical success were radically altered in directions set by the problems confronting an increasingly industrial, urban, and ethnically diverse nation. Those problems cut the ground out from under the science that missionary physicians had presented to the Chinese. As the United States became more socially heterogeneous, it became harder to gain even an ideological hold on variations in social experience, expectations, and conduct by describing them as directly remediable departures from the order of nature. The divisions in American life seemed more deeply entrenched than was allowed for in such a vision. Whether in order to accommodate, ameliorate, or transcend those divisions, Americans moved to construct a more socially and intellectually complex scientific edifice than they had previously envisioned.

Chapters 3 and 5 describe the result: an array of professionalized, specialized, and laboratory-centered sciences allied to state power and corporate wealth. The development of those sciences transformed but did not resolve the problem of relating the presumably universal imperatives of scientific knowledge to the varied practical requirements of diverse groups of people. In the early twentieth century, Americans looked forward to a time when the lines of specialization in their science would correspond to the lines of differentiation in their society. They anticipated that the correspondence could be achieved by embedding science in distinctive organizational frameworks in which the laboratory would have pride of place as the primary locus of scientific inquiry. They expected that this would place professionally trained research scientists in a position to cooperate freely among themselves and to provide scientifically trained professionals in government and industry with the expert knowledge they required to coordinate the activities of an increasingly heterogeneous population.

These new visions of social and scientific life led Americans to expand their plans for transmitting science to China. But the institutional and intellectual structures they fashioned for that purpose were socially and scientifically incoherent. The contrasting ambitions embodied in the

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Boxer indemnity fellowships and the Rockefeller Foundation's China Medical Board suggest the depth of the incoherence. Both programs were designed to provide China with the resources necessary for the development of specialized, professional, and laboratory-based sciences. But what those resources were, and what the growth of those sciences would entail, turned out to be questions that did not admit of consistent answers. Aspirations that seemed inseparable in the United States proved mutually irrelevant, even contradictory, in China. The Boxer scholarships were established on the theory that, once China was outfitted with a corps of professionally trained scientists and scientifically trained professionals, the country's future progress would be secure and orderly; for the China Medical Board, it was precisely because there was no foreseeable end to disorder and insecurity in China that provision had to be made for centers of laboratory research, like the Peking Union Medical College.

That the American synthesis of professional science and laboratory research could not be sustained in China was neither adventitious nor evidence only of the power of an alien culture to put asunder what would otherwise have remained conjoined. The axes along which American science fragmented as it was exported were determined in the United States, not in China. They mirrored wider patterns of conflict and consensus whose dimensions were fixed by distinctively American experiences of industrialization. In Chapter 3 I trace the differences between the China Medical Board and the Boxer fellowship program to divergent conceptions of social strife in industrial societies: Whereas the Rockefeller Foundation and its advisers ascribed the divisions in American society to an inevitably disruptive factory system, the indemnity scholars' most articulate proponents believed that social conflict was an atavistic residue from a preindustrial era and, consequently, was soon to disappear.

These competing perspectives on the consequences of industrialization in the United States grew out of a broader American debate regarding industrial, bureaucratic, and evolutionary models of the division of labor in society, which I describe in Chapter 5. The debate shows, again, how far Americans were and are from being able to reconcile their recognition of persistent divisions within and among different societies with their confidence in the universality of scientific knowledge. It also shows how dependent all putative resolutions of the tensions were and are on usually hidden judgments about the role of governments in industrial societies. Insofar as the projected conjunction of scientific specialization and social differentiation had any prospects for being realized, it entailed subordi-

nating the dynamics of both scientific progress and social change to the imperatives of state power.

So far I have been talking exclusively about Americans and their conceptions of science's place in China's future. But roughly a third of my study is concerned with Chinese students in the United States and one of their organizations, the Science Society of China. Their views of America and its science take us into a different world, both scientifically and socially. So long as we attend only to Americans reflecting on the problem of transmitting their scientific traditions, what we see are lines of cleavage in American science, contrasting visions thrown into sharp relief by the fact that China seemed so homogeneous to the men expounding them. Predictably, Chinese students of American science, sensitive to the divisions in *their* society, returned the compliment and with little apparent difficulty managed to find coherence and cohesion among the traditions they encountered abroad. They never seriously doubted the essential unity of American science; they were not at all uncertain about what the varied scientific enterprises presented to them had in common. In their view, the unity and the universality of modern science flowed from its methods.

American historians have long celebrated the power of foreign observers to descry features of our society and culture whose significance we ourselves miss. It may seem that in the Science Society of China and its members we have another set of witnesses to our past to place alongside such old acquaintances as Tocqueville and Bryce. Their preoccupation with the scientific method was firmly grounded in the particular mix of social concerns, ideals, and experiences they brought to their studies. But it was also an accurate reflection of just how central methodological claims were to American judgments of scientific knowledge and its social significance. By World War I public images of science in the United States had shifted decisively, from those emphasizing its substantive content and, especially, the implications to be drawn from the laws of nature, to others focused on the power of its methods. A clear sense of prior agreement on methodological principles allowed American scientists to carry on their arguments about the issues dividing them.

Were I concerned only to follow the filiation of ideas from American scientists to their pupils in the Science Society of China, nothing more would be required than this report of a common apprehension of methodological consensus. But because I am also and more fundamentally concerned to explore the varied development of scientific ideas in relation to different patterns of social organization and social action, the matter cannot be left there. This is only partly a question of observing that there

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can be no thought of resurrecting the so-called myth of method – the notion that scientific discoveries are made by following some readily specifiable set of procedural rules. The more serious issue has to do with the nature of comparative studies in the history of modern science.

We should not be misled by the apparent ease with which Chinese science students discerned a methodological foundation underlying American science. As outsiders looking in, they were well positioned to identify the shared assumptions that allowed scientists in the United States to see themselves as engaged in a common undertaking. But precisely because they were outsiders with concerns of their own, they were also poorly placed to assess the validity of those assumptions or, more importantly, to trace the social and political configurations that sustained them. Even historians cannot expect other people to do their thinking for them, and the pictures Chinese scientists constructed of the scientific method and of the United States need have no special claim on our attention. Looking at American science in relation to China is not the same as looking at it from a Chinese perspective; we deceive ourselves if we imagine that it is or if we believe that, having mastered an intractable language and thereby apparently having gained entry into an alien society and culture, we are in a position to see ourselves as others see us. Excursions into foreign territory are no less useful for that; they leave us with changed views of our social and intellectual landscape. But those views necessarily remain ours. As historians and social scientists, we read our own categories and assumptions into the materials we study; if we are to be understood by our contemporaries, we have to translate the conceptual systems of other peoples into our own cognitive idiom, according to our own principles of transposition.

These are not points to be lamented, evaded, or ignored. To set them aside for later consideration, after we have proceeded with our empirical investigations of other cultures and societies, will only mislead us further. It will encourage us to continue misapprehending the status of the various grand distinctions – between traditional and modern societies, for example, or between scientific and humanistic cultures – that have long defined the aim and structure of comparative historical and sociological studies. Such pairings may lend an aura of objectivity to our presumption that the only differences among peoples worth recording are those that distinguish all of “us” from all of “them.” We may even discover some of “them” taking a parallel view: Early twentieth-century Chinese scientists were as beguiled as we are by the contrast between their society and ours; they too saw the world as essentially bifurcated, into scientifically advanced and scientifically backward parts. But this

happy consensus does not enhance the logic of the argument. We are still simply confounding the fact that other cultures and societies are not quite like ours with the arbitrary inference that they must all have something else important in common besides that.

Whether in addition to being arbitrary, this inference is warranted depends, obviously, on the further judgments we make about what is universal to all social and cultural arrangements, and what separates one from another. But the answers we have given to these questions have varied substantially over time and doubtless will continue to change, as they depend in turn on our shifting sense of what is peculiar to our own corner of the world. We are, in other words, back to the matter of how we see ourselves. But the circularity is not vicious. To see that the images we construct of others are informed by our self-conceptions does not preclude but rather invites the further observation that the exercise might increase our insight into the essential singularities of our own way of knowing, were we to recognize the process for what it is.

Taking this possibility seriously entails redefining the proper focus of comparative studies. Knowledge, like charity, turns out to begin at home. We must look first to the domestic sources and consequent evolving shape of our intellectual constructs if we are to understand variations in the organization of knowledge and social life across major temporal and cultural divisions, or comprehend why we see those variations as we do. The project is not wholly forbidding. Although it may seem excessively paradoxical, we need only do for ourselves what we are so ready to do for others: Explain people's ideas as products of their social life.

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Social diseases and contagious disorders: missionary science and medical missionaries

Explaining how the ideas men and women hold are related to the societies in which they live is never easy. It is doubly difficult in the case of American missionary physicians in late nineteenth-century China, because their scientific and medical ambitions had unusually diverse social referents: the China they sought to change, the America they had experienced directly, and the America they observed from China. Yet, this added complexity gives missionary science and missionary medicine a special power to illuminate the changed contours of social, scientific, and medical life in a society markedly different from our own.

The society I have in mind is not Imperial China in its last years but the United States after the Civil War. As social, scientific, and medical commentators, missionary observers moved easily from assumptions about the American past to descriptions of China and back again to judgments about the American present. Being in China served to focus their attention on the problems that arose when American aspirations were separated in time and space from the society that had nurtured them. But the distance between ideal and reality that most concerned them was a distance measured on a map of American history. The way they tried to transform China was determined by the widening disparity between the United States they remembered and the one they could see emerging.

Missionary physicians gauged the distance separating American ideals from American realities in medical units. They started from the premise that in the good society individuals conducted themselves in accord with the laws of nature, the penalty for doing otherwise being disease. They presumed further that those laws were universally intelligible, yet were in fact only understood by enlightened individuals, principally doctors and ministers, whose insights gave them the right and the responsibility to exercise power and authority in their society. With this

pair of axioms in hand, the American shortfall from sound social practice could be estimated in two ways: first by the incidence of disease itself, and second by the degree to which interpreters of nature were displaced from their rightful positions of influence in their communities. The two indices were obviously related, but the disorders they measured were not reducible, one to the other.

Until the last decades of the nineteenth century, missionary doctors took it largely for granted that the first index was adequate for assessing the prospects for social reform in the United States. They affirmed an essential coincidence between the principles of social order and the actual structure of American society. Confident of their social position at home, they turned to foreign fields expecting to be able to treat the sick and the deviant where and how they found them. The medical missionaries who went out to China in the 1880s and 1890s were substantially less certain that the place of physicians in the United States was secure. They measured the disordered state of American society by the manifest disarray of their profession, and they posited a causal connection between the two, running from the second to the first. Transposed to China, their pessimistic judgments about medicine in the United States had the paradoxical effect of suggesting more ambitious programs for medical development than their predecessors had contemplated. Having relocated the sources of social disorder in America, they found it reasonable to think of creating wholly artificial institutional frameworks in China as substitutes for social resources conspicuously absent in the country. Hospitals could be sustained as islands of cleanliness and order in an unregenerate society; physicians could be trained to staff them; and a professional organization could be established to enforce claims to authority and influence that China had proven unable or unwilling to grant naturally to doctors.

Reform-minded physicians in the United States during the latter part of the nineteenth century were similarly committed to clinical work, more rigorous educational programs, and strengthened professional institutions. But in America these ventures intersected with and were transformed by new conceptions of health and disease grounded in laboratory and experimental science. Our own understanding of the proper interrelationship of cognitive and institutional structures in medicine has its origins in this transformation. But as late as the turn of the twentieth century, few medical missionaries had grasped its implications. Their sense of new opportunities to be seized grew instead out of a rearrangement of medical ideas in which natural theology and observational natural history, rather than laboratory research, continued to occupy central

positions. As a consequence, their achievements stand not as starting points for the subsequent development of modern science and medicine in twentieth-century China, but as monuments to ambitions, social and scientific, almost as alien to us as Imperial China was to them.

Understanding those achievements and ambitions requires that, like missionary physicians, we move from the United States to China and back again. We need to explore how the conditions of missionary work in China allowed men and women there to find continued meaning in ambitions that their contemporaries at home no longer found compelling, yet would have recognized as distinctively American. But to exploit the accounts left behind by missionary teachers and doctors, to use them to clarify our past, we must also describe the United States in ways that they did not. We need to explore how the circumstances of scientific and medical work in America brought men and women there to abandon aims that continued to inspire their counterparts in China.

*Missionary science: social influence, natural theology,
and medicine*

In 1890 the future of modern science in China seemed secure to American missionaries. With a new China “soon to be born out of the old,” wrote Devello Z. Sheffield of the American Board mission, “the exact sciences” and the “mechanical arts” were “certain to be accepted.”¹ As the American Presbyterian mission’s Calvin Mateer remarked, “western science” was “coming into China,” whether his colleagues would “will it or not”; the country was “slowly but surely opening her gates to western knowledge.”² Mateer and Sheffield were so convinced of impending Chinese scientific and technological success that they were prepared to tie the fortunes of Christianity to them. In the language of W. A. P. Martin’s essay of 1897, Western science was the most promising “auxiliary to the spread of the gospel” available; its development in China was so certain that Christian missionaries could only help their cause by allying themselves with it.³

Looking back, we may wonder how Martin, Mateer, and Sheffield could have been so sanguine about science’s prospects in Imperial China. The explanation lies in their view of what its successful transfer required. Their expectations about science had been formed in an America that had effectively disappeared by 1890. In that year Sheffield was forty-nine years old, the youngest of the three, and having been in China for only twenty-one years, he was also the most recent arrival among them. Mateer was fifty-four and Martin sixty-two; they had been in China