

Nathan Sivin

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Medicine, Philosophy and  
Religion in Ancient China  
Researches and reflections

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VARIORUM  
1995

# VII

## TAOISM AND SCIENCE

中歲頗好道

Devoted to the Dharma (*tao*)  
in my middle years . . .

Wang Wei

### *The Problem*

Was Taoism in some sense responsible for—or did it at least further—the development of the sciences in China? Whether there was some such relationship will concern anyone trying to understand religion or thought about Nature in China. The character of this influence may also cast light on why the technical subcultures of China and Western Europe diverged so decisively in early modern times.

Attention in Chap. VI to the consistent vagueness in scholarship about Taoism was an unavoidable preliminary to historical questions. The purpose of this essay is raise some of them.

### *Points of Transition*

People who think about science without having practiced it often assume that it progresses by a steady accretion of knowledge. That this belief is so widespread testifies to the enduring influence of Francis Bacon, who argued in the days when modern science was being invented that people ought to do it bit by bit, in groups, according to a rational division of labor. But that is not an adequate description of what scientists do. There is a larger rhythm in which, as knowledge accumulates, it becomes more and more evident that old patterns are inadequate to encompass newly discovered phenomena. Eventually a new pattern makes sense of otherwise anomalous knowledge. Much previous knowledge may be quite irrelevant to this new pattern. After the transition, it sets the standard until the need for a still more comprehensive pattern can no longer be ignored.

A transition of this sort has taken place in studies of Taoism. The view of Taoism and its evolution prevalent among historians until the 1970's gave rise to a good many hypotheses and opinions about the relations of Taoism and science. As the old conventional wisdom has been replaced by a fundamentally different understanding of Taoism, no one has reassessed these claims about a link with science. It is time to ask whether they fit the emerging new framework, or are extraneous to it.

### *Two Histories of Taoism*

The first history of Taoism originated centuries ago among orthodox Chinese authors. Historians there and elsewhere continued to flesh out its structure until the late 1960's. The convulsions within China in the last century and a half, and metamorphoses in the rest of the world's relations with it, are reflected in the fine texture of this complex of interpretations, but it is not difficult to summarize in broad outline. Its view of Taoist practice was based on a few readily available texts that, as Anna Seidel put it, "enjoyed the esteem of Confucian schoolmasters." When tracing the vicissitudes of the religion it did not look beyond the prejudiced accounts in the official histories. Not surprisingly, it has been largely replaced by a second history that mines the enormous collections of Taoist scriptures and a far wider range of historic sources.

**History 1.** Very early attempts to placate Nature were shaped by the mystical practices of shamans to form a philosophy that sought "the union of the individual with an impersonal natural order," unlike Western mysticisms that strove for oneness with a personal deity. Taoism resembled Confucianism only in that calling it a religion was a matter of definition; those of philosophers and religious scholars tended to diverge sharply. The most prominent Taoists were Lao-tzu 老子, variously dated from the sixth to the third century, and Chuang-tzu 莊子, somewhat more closely placed between 399 and 295. Although a number of other authors were included in the "Taoist school," descriptions of key Taoist ideas were almost entirely based on the writings of these two.

Somehow out of this school, in the first and second centuries A.D., evolved more than one "secret society with strong Taoistic tendencies." They fomented a great peasant uprising in the first century A.D. Late in the second century Taoism metamorphosed, possibly under "barbarian" Buddhist influence, into "an organized popular religion." As the Han dynasty collapsed, this church even governed a large piece of West China as an autonomous theocracy. A leading British authority summed up the usual judgment: "It is hardly possible to dignify with the name of religion such a strange medley of magic, legend and gross superstition; and one cannot believe that its scriptures were regarded very seriously by any large section of the community."<sup>1</sup> Taoism was often at the root of rebellion, and some scholars

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1. Giles 1935-1937: 1. Since most of this essay is devoted to Joseph Needham's hypotheses, my usage of the words "Taoist" and "Taoism" reflects his own. When clarity is advisable I use other terminology. References in the form "II, 123" or "V.3, 76" are to Needham et al. 1954. I acknowledge with gratitude the counsel of Timothy Barrett, Derk Bodde, Kenneth J. DeWoskin, David Keightley, Terry Kleeman, G.E.R. Lloyd, Victor Mair, Joseph Needham, and Donald B. Wagner. This paper was written in Need-

affirmed that "we always find the Taoists with the party opposing the literati."<sup>2</sup>

Taoists borrowed monasticism from Buddhists, competed against them for imperial patronage, split into sects that competed with each other, but failed to build "an organized church." They remained sunk in degeneracy, the intellectual and moral standards of their communities low, until the last "Taoist pope" was ousted in 1927.

There was what one might call a last gasp of respectability in Neo-Taoism, a short-lived movement of the third and fourth centuries of brilliant intellectuals who devoted to the Taoist classics the deep study that in earlier centuries would have been channelled into those of the Confucians. Aside from that, the various enthusiasms of cultured gentlemen for immortality, alchemy, and escapist "pure conversation" were, if not perceptibly related to the popular tradition, at least "Taoistically inclined" in ways that no one felt the need to explain.

**The transition.** This first history was not at all coherent, and (in hindsight) could not have been maintained without large gaps. The lacunae existed because historians of late imperial China did not find the religions of the masses a suitable topic for exploration. Their overviews were cobbled together out of incidental accounts and biographies that had found their way into the Standard Histories for reasons that had nothing to do with a desire on the parts of ancient historiographers to document an organized religion.

The massive Taoist Canon (*Cheng-t'ung tao tsang* 政統道藏), printed ca. 1477 for the use of religious communities, was reprinted for commercial purposes in 1924-1926. It quickly found its way to centers of learning around the world (there were already incomplete copies in Japan and Paris). That is not to say that the nearly fifteen hundred treatises it contains, and still more scriptures in reprints of smaller scope, were promptly digested. With respect to the question of Taoism and alchemy, for instance, I believe that by 1950 there was only one person in the

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ham's East Asian History of Science Library. When the first version was presented at the Third International Conference of Taoist Studies, Unterägeri, Switzerland, in September 1979, he was commentator. That draft carried a dedication to Needham and his colleagues marking the twenty-fifth year since the first volume of *Science and Civilisation in China* was published. This final version commemorates three great explorers of Taoism who are no longer with us, Joseph Needham, Anna Seidel, and Michel Strickmann.

2. Weber 1922. This summary is drawn from the best textbook survey of East Asian studies before 1970, Reischauer & Fairbank 1958: 72-76, 122, 137-141, and the most authoritative anthology of philosophy, Wing-tsit Chan 1963: 138-177. These were unadmiring but benign accounts; those of European missionary scholars (on whom Weber and others depended) written in the days when imperialism was a good word were a great deal less tolerant. See, for instance, Wieger 1917.

world both trained as a scientist and widely and critically familiar with the collection, namely Ch'en Kuo-fu 陳國符.<sup>3</sup> By 1968, however, Japanese historians had accumulated a great deal of monographic research that implied new and complex patterns. A few French scholars, brought up in the Parisian sociological tradition, had begun looking at Taoist sources in new ways. Well before 1950 Edouard Chavannes, Paul Pelliot, and Henri Maspero were taking them seriously as religion, as varieties of individual self-cultivation, and as documents of a social history quite unlike that of conventional scholarship. The Japanese and French work had already rendered History 1 obsolete, but did not replace it. Writers on Taoism elsewhere largely ignored their publications.

Between 1968 and 1979 a series of three international conferences brought together a total of thirty or so scholars from Japan, China, Europe, and the United States, one of them an ordained Taoist master, a few of them specialists, and a majority who had been working on one or another margin (including two historians of science). This encounter of diverse research experience and insight realigned into new patterns a great deal of what earlier had never quite made sense. Taoist studies gradually became a new presence in Sinology, with the usual apparatus of specialities from journals to Internet sites. Since it normally takes at least twenty years for research breakthroughs to engender a real consensus, and to osmose from the conference site to the undergraduate survey, the old prejudices are still vigorous. But the contours of a quite different history have for some time been visible from the research frontier.<sup>4</sup>

3. Chen 1949 is a remarkably useful study of the history of the Taoist canons.

4. This overview does not express a consensus, but my own reading of one that is forming amongst those immersed in the primary sources. It is based on the post-1968 literature, on personal communications from most of the specialists in China, Japan, and elsewhere, and on my study of the primary sources. For histories of Taoism that reflect current scholarship see Seidel 1990 and Robinet 1991 (the latter up to the Yuan). There is no such history in English, although Seidel 1974 and Strickmann 1974 are excellent as early overviews of modern Taoist studies, and Baldrian-Hussein 1987 provides an up-to-date introduction. Seidel 1989–1990 is a thorough and magisterial essay on Western scholarship, updated by Verellen 1995. Boltz 1987 is a detailed guide to late Taoist literature. Teiser 1995 lists Western publications on popular religion, very broadly defined. Particularly useful monographic studies include Seidel 1969 for the Han, Fang Shih-ming 1993 for the second century, Mollier 1990 for apocalyptic movements, Mather 1979 for early court Taoism, Bokenkamp 1983 and Bell 1988 on the Ling-pao tradition, Strickmann 1981 and Robinet 1984 for the Shang-ch'ing movement, Verellen 1989 for the end of the T'ang, Chin Chung-shu 金中樞 1974 for the late Sung, Zürcher 1980 for the early influence on Buddhism, various papers in Strickmann 1981–1985 for the adaptations of Tantrism, and Sakade 1977 and Akizuki Kan'ei 1986 for recent Japanese studies (Fukui

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**History 2.** Although the philosophical and religious meanings of the *Lao-tzu* and *Chuang-tzu* are debated with as much gusto as ever, their historical significance has changed fundamentally. As I have noted in Chap. VI, in the first couple of centuries after their compilation readers did not take them to be exemplars of a single philosophy. There is no reason to believe that any part of either book was written much before 300 B.C. The *Lao-tzu* was probably compiled late in the third century, and the *Chuang-tzu* as late as the late second century.

The two books did not provide a philosophic basis for the early Taoist movements, which either ignored the *Lao-tzu*, reinterpreted it in terms of cult practices that had nothing to do with metaphysics, or were fixed on the mythical figure of Lao-tzu as a savior. Those groups that treated the book as a revelation revered it alongside a multitude of other revelations, some of them "revealed" by Lao-tzu after his transfiguration as a (not the) divine emanation of the Way (T'ai-shang Lao Chün 太上老君). Writings of the early Taoist movements likewise tend either to ignore or to scoff at the *Chuang-tzu*. It was rather the noble dabblers of the third century who concentrated their "studies of the mysteries" (*hsuan-hsueh* 玄學) on the *Lao-tzu*, the *Chuang-tzu*, the Canon of Supreme Mystery, and the Book of Changes. The canonic prestige of the *Lao-tzu*, the *Chuang-tzu*, and a few similar works rose later, primarily because of their official recognition by T'ang emperors. They claimed that the god Lao-tzu, whose surname was the same as their own, was an ancestor.

Finally, if we are simply interested in these two books as distinct presences in intellectual life, they had little traceable influence on philosophy before the first century B.C., and did not stand out afterward, except for their great literary influence. In the first place, few historians would place the compilation of either long before the Han. Between the mid third and the late second century, quietist ideas became part of a rich eclectic stew, reflected in a succession of books from *Lü shih ch'un-ch'iu* 呂氏春秋 on. The meat in this hodgepodge was a new theory of the state in which it became a replica of the cosmos and a simulacrum of the human body.<sup>5</sup> A new Confucianism, which discarded the humanism of the founder and his immediate successors for a broad range of doctrines cooked in that very stew, furnished the state with its first orthodoxy in 135 B.C. Important additions to it continued until the end of the first century (see Chaps. I and III).

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Kôjun 1983 offers a somewhat different group of themes). See the provocative discussion of current problems in Fukui Fumimasa 1995. Current Chinese views, still affected by official disapproval of Taoism as "superstition," are represented in the collective volumes edited by Jen Chi-yü (1990) and Ch'en Ku-ying (1992-).

5. Sivin 1995.

As that stew became the common diet, ideas derived from the *Lao-tzu* and *Chuang-tzu* were no longer the property of Taoists, but were simply part of what was in everyone's bowl. A few books of the time were partial to quietist ideas, and some, such as *Huai-nan-tzu* 淮南子, drew heavily on the two literary masterpieces. But even in the third century the label "Taoist" does not tell us very much. Han-fei-tzu 韓非子 displays similar affinities, but he was also in the direct line of teaching descended from Confucius, and served as a high minister of the Ch'in regime. Historians blithely call the book named after him Taoist, Legalist, eclectic, and so on, according to fad and personal taste. Such isms do more to invite confusion than to shed light.

In short, from the Han on one can identify certain ideas as Taoist to the extent that they echo those in books conventionally assigned to that bibliographic category, but embodying such ideas in some subclass of society called "the Taoists" is more likely than not to be a vacuous exercise. The best corrective for that misleading old habit is to ask "exactly what individuals does this proposition refer to?" When, as often happens, that question has no answer, rephrasing the proposition is the candid solution.

One of the most important new elements in this second history is the understanding that popular religion was the common stem out of which all religious phenomena grew. It was not a folk phenomenon, but was universal in the sense that it united elite and commoners as the form of local collective life. Officials were sometimes expected to persecute it, and ideologists despised it as a threat to the government's control of correct thought, but when they went back to their villages they were likely to take part in, and help pay for, the festivals they shared with everyone else.

Worship of local gods was a part of every community's shared activities. Officials distrusted the potential of communal organization for heterodoxy, and in didactic statements were unwilling to take seriously any culture but that of their own class. In their writing most of them simply ignored the religious character of popular rites, acknowledging them only as "vulgar practices" (*su* 俗), and their practitioners as "wizards" (*wu* 巫, a term we will explore below). The heirs of the old pedants, Nationalist and Communist party ideologues, tried to expunge it, and encouraged scholars to label it "feudal superstition" (*feng-chien mi-hsin* 封建迷信).

Taoism, a tradition of the literate minority, was, for those who drew the distinction, more respectable than popular religion. This was partly because of the high moral ideals that it professed, moving away from the popular view of gifts as central in asking favors of the gods. It was partly because Taoism did not threaten the state's authority to define what should be worshipped, unlike the creativity of

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ordinary people whose cults peopled the pantheon. It was also because, like Buddhism and the state cult, certain Taoist rites incorporated an elite fondness for display of wealth. As Erik Zürcher has put it with regard to the upper-class cults of the Six Dynasties, "the strict observance of the complicated rules governing the life of the Taoist adept, the very expensive drugs and the frequent and equally expensive banquets and purificatory ceremonies must, as far as laymen were concerned, have remained the privilege of the happy few who had both the leisure and the financial means to fulfil the demands of the Taoist way of life."<sup>6</sup>

Historians today use "Taoism" as a cover term for a number of religious movements with diverse aims: organization and maintenance of theocratic communities of believers (the Way of the Celestial Masters or T'ien-shih 天師, end of the second century), missionary activities to save people from the impending cataclysm (among other early traditions, the Divine Spell or Shen-chou 神呪 movements, recurrent from the fourth century on), collective access through ritual to the power of the Way (the Numinous Treasure or Ling-pao 靈寶 movement, shortly before 400), support for the state in return for patronage (the first theocracy in 215, and several exemplars from 425 on), individual self-cultivation leading to immortality and appointment to the celestial bureaucracy (the Supreme Purity or Shang-ch'ing 上清 movement, ca. 500), tantric "thunder magic" traditions that won imperial patronage in the eleventh century (Divine Empyrean or Shen-hsiao 神霄 Way), and quasi-Buddhistic monastic striving for spiritual perfection (the Way of Complete Perfection or Ch'üan-chen 全真, twelfth century), to mention only the best-known varieties.

These traditions were built atop and interacted with popular belief, but their ritualists distinguished themselves from those of local cults. Popular religion simply incorporated the ideals and social relations of a place; everyone belonged. Taoists were initiates, whether en masse or individually. In its first centuries the Celestial Masters movement trained and initiated whole populations, but by perhaps 500, only educated initiates had access to its canons, its liturgy, and its practices. While popular religion remained local in its focus even as the worship of certain gods spread widely,<sup>7</sup> each Taoist movement saw itself as universal. Taoists organized gods, local and regional, into a bureaucratically structured pantheon of which they themselves were a part. New movements tended to claim that their

6. This quotation comes from Zürcher 1959: 290. Appendix VI is a study of Buddhist-Taoist conflict considerably ahead of, and generally ignored in, its time. Strickmann entitled the analysis of initiation fees in his path-breaking study of the Supreme Purity movement "The Free Enterprise of the Spirit" (1977).

7. For this process of diffusion see, e.g., Dean 1993, Kleeman 1994.



heavens and their emanations of the Tao were superior to those previously known—all of them superior to those of the popular gods.

Taoist masters were hereditary and highly trained, and held registers of initiation (*lu* 籙). The highest of them were ordained. Popular masters were generally self-selected. Instead of the oral formulas by which operatives of popular religion implored the gods, Taoists ceremonially submitted written documents in the classical language, following forms derived from those of the imperial government. Taoist movements regularly defined themselves by reference to bodies of revealed scriptures, and like the government were much occupied with questions of orthodoxy and heterodoxy; none of this had any meaning for popular religion with its oral traditions. Some popular masters, particularly in late imperial China, were literate and owned books, but writing was not fundamental to their work. Such distinctions have blurred as part of the social tumult of the late twentieth century.

Popular belief was enmeshed in the ongoing reality of the everyday world. Taoist movements were born anticipating that an imminent catastrophe would end the world, and that only initiates would survive. Although the popular master's access to the divine world was often achieved through trance and possession, the Taoist master's rites did not depend on letting a god take over his body. The authority of the ordained master came instead from no less than membership in the bureaucracy of the gods, which implied immortality. He did not seek favors of the gods, as the popular master did; he was one of them, and could issue orders.

The Taoist maintained that authority by elaborate forms of self-cultivation that maintained communication between the outer pantheon and the thousands of gods within his own body. Many of these techniques that were oriented toward immortality, such as alchemy and ingestion of rare natural drugs, began as popular practices among the southern aristocrats. A precursor of the individually-oriented Supreme Purity movement adopted them in the fourth century. The Numinous Treasure movement later competed for believers by drawing on the ceremonial resources of Buddhism.

Taoist masters gave their reverence many liturgical forms, directing it through various intermediaries ranked above the popular pantheon to the unnameable and ineffable Way itself. Because that was its object, Taoism is often called "China's indigenous higher religion."<sup>8</sup>

Although the Taoist movements were millenarian, with the possible exception of their cloudy role in the uprisings of the second century, they remained politi-

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8. For further discussion, see Chap. VI, p. 307.

cally conventional. When their writings take up political issues, they consistently support the established order, and gratefully accept the state's support. Like Buddhist sects, when not drawing on the state's largesse, they absorbed their share of the government's recurring distrust for unofficial foci of popular esteem. Rebels generally appropriated symbology, as we would expect, from their own popular faiths rather than the specialists' scriptural religions.

The distinction between practitioners and liturgies cannot obscure the considerable integration of Taoist and popular worship for nearly two thousand years. From the T'ang on, as the autonomous Taoist communities disappeared, priests gradually became higher ritual specialists employed by local cults to perform essential ceremonies more powerful than those of the popular masters. In the Northern Sung, as the popular pantheon and the structures that Taoists had built on top of it began to merge, certain regimes extended their recognition not only to Taoist movements but to local gods. This was not a matter of popularizing Taoism, but, as Schipper has put it, of "the upgrading and emancipation of local power structures" on terms shaped by Taoist doctrines. By the Yuan, Taoism was furnishing "the organizational framework for all vocational and associational non-official bodies." These services made the movements of the time viable, but gradually moved the non-monastic Taoists out of their own physical institutions into popular temples and other public spaces.

Several important ingredients of the first history of Taoism play no significant role in the second. The most obvious are the imperial offerings to Lao-tzu recorded in A.D. 166, and the "studies of the mysteries" of "Neo-Taoism." The state cult was not linked in any perceptible way to any individual or group that can be called Taoist, although it reflects popular and imperial worship of the legendary sage not as a philosopher but as a god. What is original in "Neo-Taoism" has turned out mainly to be adaptations of Mādhyamika Buddhism. Some scholars believe that a new ingredient, the early Han Huang-Lao 黃老 intellectual fashion, tied together the philosophy of the *Lao-tzu* and the religious movements of later centuries in some unspecified way. This movement has inspired much vague discussion and tentative links to recently unearthed manuscripts, but testable hypotheses still await some concrete and systematic research.<sup>9</sup> The early influence of Buddhism has turned out to be limited in extent and type, generally mediated not by religious specialists but by laymen. Here too, as Zürcher once said, Taoism and Buddhism are "two branches springing from a single trunk."

Finally, as I have argued in Chap. VI, individual spiritual techniques of immortality, including alchemy, are not Taoist in any fundamental sense. They ori-

ginated in the popular milieu, and continued to be widely practiced by laymen. Immortality is an important theme in Taoist writings over the centuries, but no more so than in secular writings on occult topics. Again it is an accident of bibliography that the literature on various arts of long life and eternal life was most fully preserved in Taoist abbeys. To automatically prefix "Taoist" to "alchemy," a habit of many Sinologists, adds an increment of confusion but none of meaning.

**Findings.** For the purpose of this investigation, we need not pause over the vicissitudes of the Taoist movements, at least two of which survive, much changed through acculturation. Of the considerable differences between these two histories, three bear particularly on attempts to link Taoism and science:

1. Clarifying the differences between popular religion and the Taoist movements has dispelled confusion about what practices were peculiar to the latter.

2. Appreciating that the aims of Taoist masters were squarely religious rather than a degenerate form of philosophic inquiry obviates much speculation about whether Taoist masters were studying Nature, doing research, carrying out experiments, and so on. We are now attentive when they describe their methods in terms that have nothing to do with study or rational inquiry, much less systematic experimentation. Taking seriously their own assertions that they are striving for union with godhead, we can acknowledge that they used others' technical knowledge and practice toward that end, but rarely added to it. Because they kept written records and artisans did not, historians have given them credit for innovations that were more probably borrowed.

3. Understanding the First Neo-Confucianism allows us to recognize that many quietist ideas that were originally far from conventional became, from the Han on, part of the furniture of conventional minds. It is foolhardy to assume that they imply any unconventional conviction, or association with "the Taoists."

### *The Role of Joseph Needham*

Among the many claims posited for a linkage between Taoism and science, those by Joseph Needham stand out. He is the only scholar who has offered hypotheses substantial and rich enough in implications to serve as a starting point. If we are finally ready for a comprehensive look at how science and Taoism intersected, it is because, for the first time, Needham has imposed order on a large portion of the primary and secondary literature. The Taoist connection is a recurrent issue in a massive work that is, after all, not an attempt at a definitive history, but a preliminary reconnaissance published over forty years and still in process.<sup>10</sup>

It is salutary to remember, now that there are nearly a thousand historians of Chinese science,<sup>11</sup> how few of its sources had even been read outside China by

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1950. Beginning with the first volume of *Science and Civilisation in China* in 1954, Needham proposed a first comprehensive pattern connecting Taoism and science. My concern here is to explore his use of the words "Taoism" and "Taoist," to determine what his interpretations imply, and to assess their bearing on the evolution of science. His assumptions and hermeneutics were widely shared, although never set by others in so broad a framework. Thus when I discuss details of analysis or interpretation, "Needham" is shorthand for "Needham, his collaborators, the eminent authorities whose opinions he cites, and the many scholars who accepted his findings without testing them independently." I need hardly add that the present inquiry depends from start to finish on hindsight.

Needham's ideas about linkage were largely formed before 1960. Original though many of them were, they reflect the conventional wisdom about Taoism at the time he wrote. They also reflect the readership toward which he chiefly aimed his book, namely scientists with humanistic leanings like himself. They then formed the main audience for writing on the history of science. They expected technical sophisticated narratives of a grand march away from error toward objective knowledge. Needham was not alone in urging a nuanced but still positivistic view. Lynn Thorndike's massive *History of Magic and Experimental Science* (1923–1958), which argued that the two had grown up together, strongly influenced him. But most of the discipline-builders rejected such ideas, and dismissed the idea that non-European science was worth taking seriously. Needham's willingness to see religion as a positive force made his account additionally unconventional without challenging in principle the positivism of the time.

### *Science and Which Taoism?*

Needham's understanding of the relation between Taoism and science is not set out concisely or in one place. A large piece of the picture is found in the 1956 volume of *Science and Civilisation in China* devoted to the history of thought. He fleshed it out in subsequent volumes down to 1986 (when the last two he wrote for the series appeared), but did not alter it in any fundamental way.<sup>12</sup>

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9. Yates 1994: 144, studying MSS excavated in 1972, questions the identification of many Ma-wang-tui finds with "Huang-Lao Daoism."

10. Taoism is a rarer theme in volumes of *Science and Civilisation in China* by other contributors. The term does not occur in the indexes of vols. V. 9 and VI. 1, or in the part of vol. V. 6 not written by Needham.

11. See the worldwide survey of specialists in Sivin 1988.

12. II, 33–164. Needham also wrote part of vol. V. 6 long before it appeared in 1994.

Many of Needham's views cannot be compressed beyond a certain point without losing their essential texture. I will accept the risk of recapitulating them a little more amply than has been done before (although I cannot avoid oversimplification). I am asking where and when in Chinese society Needham finds Taoists whose "complex and subtle set of conceptions . . . lies at the basis of all subsequent Chinese scientific thought."<sup>13</sup>

This question devolves naturally into two others that call forth less vague replies: First, are these Taoist precursors of science related to each other by any plausible definition of "Taoist," or at least by a coherent range of definitions? This is tantamount to asking whether the label is being applied in a way that illuminates the origins of science, or whether conversely a range of definitions so wide as to convey no information is being used to back up an initial assumption that every shaper of science is a Taoist. Second, how conclusive is Needham's evidence that the thoughts and acts of these Taoists, whoever they may be, were essential to the evolution of science?

Needham's use of the designation "Taoist" is far from consistent. Indeed it would be gratuitous to assume that he is striving for consistency. I will demonstrate, however, that a coherent and testable general notion of Taoism, as it influenced science, emerges from his writings. I will argue that when his evidence is critically evaluated and reinterpreted in ways consistent with today's fuller understanding of Chinese religion, its bearing on the course of science is negligible. As a check on this conclusion, I will survey the careers of a number of great contributors to science, technology, and medicine, inquiring whether Taoism played a role in the sum of their achievement different from that played by other systems of belief. Finally it will be appropriate to ponder what the outcome implies for the history of science.

### *Various Taoists*

**The historical variety of Taoisms.** Needham's pro-scientific Taoists were agnostic naturalists, mechanists, materialists, experimentalists, empiricists who

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My discussion centers on the extended essay in Vol. II (1956) of *Science and Civilisation in China*, and on the conventional wisdom as exemplified in Needham's studies. In forming my argument, however, I have drawn on all his publications. I should acknowledge the extremely limited extent of my own understanding of Taoism before 1970; see, for instance, Sivin 1968: 157n26. I began research for this and the preceding chapter in the late 1970's to overcome the confusion in thinking about the subject that I detected in my earlier work. That this confusion was commonplace did not make it acceptable.

13. I, 95.

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avoided preconceived ideas, democrats and heterodox collectivists. They appear in Needham's overview of philosophy as the Confucians' "mortal enemies the *tao-chia* 道家 (Taoists), whose speculations about, and insight into, Nature, fully equalled pre-Aristotelian Greek thought, and lie at the basis of all Chinese science." "The philosophy of Taoism . . . developed many of the most important features of the scientific attitude . . . Moreover, the Taoists acted on their principles, and that is why we owe to them the beginnings of chemistry, mineralogy, botany, zoology and pharmaceuticals in East Asia."<sup>14</sup>

The ideal Taoists in the first half of the last quotation, then, are what Sinological custom has called philosophers, not priests: *tao-chia*, not *tao-chiao* 道教, to use a modern distinction. His discussion depends largely for evidence on the *Lao-tzu*, *Chuang-tzu*, its late imitation the *Lieh-tzu* 列子, and eclectic compilations such as *Lü shih ch'un-ch'iu*, *Kuan-tzu* 管子, and *Huai-nan-tzu*. In 1956, one must note in passing, the last three were still conspicuously ignored by most students of Chinese thought. There was even less agreement than there is today about what ism to assign them to.

After this initial flowering, a few additional "Taoist" philosophers emerge in the Wei and Chin periods: Wang Pi 王弼 (226-249) and other "revisionists," Pao Ching-yen 鮑敬言 (early fourth century?) as a representative of the "radicals,"<sup>15</sup> and Ko Hung 葛洪 (283-343), "the greatest alchemist in Chinese history," as a representative of the strengthened "experimental traditions of ancient Taoism."<sup>16</sup> Finally, "there was a second flowering of true Taoist philosophy" in the *T'ien-yin-tzu* 天隱子 of Ssu-ma Ch'eng-chen 司馬承貞 (ca. 700, mentioned but not discussed or cited), the *Book of the Gatekeeper* (*Kuan-yin-tzu* 關尹子), probably of

14. II, 33-164, esp. p. 162; p. 1; p. 161; "the physics of magnetism" joins this list on p. 493.

15. Needham calls Pao "the most radical thinker of all the medieval Chinese centuries," but gives no evidence that his critique of the segregation of power and wealth is wedded to proposals for fundamental change in the structure of government or society (which I gather is what "radical" means). A later discussion of Pao in terms of class struggle argues—on an inadequate foundation of evidence, I believe—that his ideas were anarchist (Uchiyama 1965). Pao is unknown except for the dialogue in *ch.* 48 of *Pao-p'u-tzu wai p'ien* 抱樸子外篇. Needham allows for the possibility that the dialogue and Pao himself may be fictitious, or that Pao may have lived much earlier than Ko Hung. Later Needham proposed tentatively that Pao was Ko's father-in-law Pao Ching 鮑靚 (V. 3, 76). I believe that the last two possibilities are ruled out by the fact that Ko refers to him at the beginning of *ch.* 48 as "Pao sheng 生 Ching-yen," not a term for a senior.

16. II, 432-441. For a more qualified estimate of Ko's alchemical achievement, and of the extent to which he can be considered an experimentalist, see Chap. VI, pp. 323-324.

the Southern Sung, and the Book of Transformations (*Hua shu* 化書) attributed to T'an Ch'iao 譚峭 (tenth century).<sup>17</sup> As for the Taoists who "acted on their principles," they are clearly not drawn from these *tao-chia*. I will return to them.

In later writing Needham considerably broadened the scope of proto-scientific Taoism. The hiatus between the early Taoist writers and those of the Wei and Chin has been filled with those who carried on an intrinsic Taoist "artisanal element . . . The *fang shih* 方士, of whom we hear so much between the -5th and +5th centuries, were certainly in general Taoist, and they worked in all kinds of fields (apart from divination and incantation) as star-clerks and weather-forecasters, men of farm-lore and wort-cunning, leeches, irrigators and bridge-builders, architects and decorators, metal-winners and smiths, above all, alchemists."

The distinction between alchemist and Taoist tends to blur, as in this elision: "If then we may take Ko Hung as fairly representative of all the early medieval Chinese alchemists, some clear conclusions may be drawn about their beliefs . . . The maintenance of weight on cupellation was therefore for the Taoists not the only, or the main property . . . which entitled a gold-looking substance to be called gold."

Needham finds the identification of alchemist and Taoist plausible because most alchemical literature either survives in the *Tao tsang* or has "Taoist connections." What connects alchemy, the saleable skills of the *fang-shih*, and Taoist philosophy is apparently not the propinquity of their literary remains but certain notions held in common: the naturalism, empiricism, anti-feudalism and related attitudes, and the willingness to take seriously magic and science, which he tells us repeatedly were inseparable in early times.<sup>18</sup>

Needham believes that both the "Taoist Church" founded in the second century A.D. and what used to be called the "Neo-Taoism" of the third and fourth centuries undermined the scientific attitudes bequeathed by their predecessors and negated the experimental impulse of the *fang-shih*. Here is how he puts it: "How could it have come about that the high philosophy (at one and the same time scientific and mystical) of the Taoist fathers . . . was transformed into a theist and supernaturalist religion, heavily laden with superstition, and not without an element of conscious mystification?" "The strangest transformation of all was that which converted Taoist agnostic naturalism into full-blown mystical religion and ultimately theist trinitarian theology, Taoist proto-scientific experimentalism into fortune-telling and rustic magic, Taoist primitive communalism into a way of per-

17. II, 442-454.

18. V. 2, 9, 70; V. 2, 1; e.g., II, 57.

sonal salvation, Taoist anti-feudalism into equalitarian secret societies of anti-foreign or anti-dynastic tendency." This change was not so much the doing "of the Taoists' complacent and conventional rival, social-minded Confucianism, as of the socio-economic system of feudal bureaucratism itself."<sup>19</sup>

In brief, "the entire development was fundamentally the working up of an indigenous opposition system to Buddhism. First, political Taoism was sent underground. . . . Then Confucian feudal bureaucratism allowed no outlet for the scientific energies potentially present in the Taoist philosophers and the shamanist magicians. Thought thus being sterilised and experimental techniques despised, the shamans, from the +1st century onwards, found their living being taken away from them by the new foreign religion of salvation from India. . . . But now, with half-conscious resource, the Taoists copied theology, sutras and discipline to such good effect that for many centuries they were able to hold their own in the form of an organised religious institution."<sup>20</sup> There is clearly a discrepancy between the scientific value of the great Taoist scriptural collections and the negative role assigned to the "shamanist magicians" who made them.

The transition was not only fateful but final, and reinforced by later history. The "Neo-Taoists" Wang Pi, Hsiang Hsiu 向秀 (ca. 221-ca. 300), and Kuo Hsiang 郭象 (d. 312) were probably not "quite so mystical as Feng Yu-lan represents them, since there is a tradition that Hsiang Hsiu at least practiced alchemy." As a result of their commentaries on the *Lao-tzu* and *Chuang-tzu* "the whole Taoist system was emasculated for continued existence in, and adaptation to, a milieu in which the Confucian conventions were dominant." Note the assumption that anyone who practiced alchemy was not very mystical.<sup>21</sup> Whatever "the whole Taoist system" may mean, the *Lao-tzu* and *Chuang-tzu* coexisted with a Confucian state orthodoxy for some time after 135 B.C. In the era of these "Neo-Taoists" the power of "Confucian conventions" was hardly in evidence, as emperors increasingly ruled under the aegis of Buddhist or Taoist movements.

Before returning to test the influence on science of Needham's "Taoism" as I have just summarized it, it is advisable to pause over two special characteristics of his historical account, namely the absence from it of popular religion, and his interpretations of imperial cults.

**Popular religion.** The word "Taoist" is conventionally used for a great variety of popular beliefs and practices— notions about gods and their relationships with

19. II, 154, 162.

20. II, 161.

21. II, 433. I have argued (1976) that the aims of alchemy were squarely mystical.



humans, liturgical rites, sacerdotal functions, disciplines for self-cultivation, magical and divinatory techniques, and so on. There is no reason to believe that *tao-chia*, *tao-chiao*, Neo-Taoists, etc., originated these aspects of popular culture. Nor did they use them more often than did masters untrained in the worship of the Tao and its emanations, pious but otherwise conventional gentlemen hoping for an appointment to the celestial civil service, honest businessmen who followed the trade of physiognomy or geomancy, or itinerant rainmakers. Rolf Stein has described the "ceaseless dialectical movement of coming and going" by which Taoism, like the other high traditions of China, drew upon and contributed to the forms of popular culture (1979).

Some Sinologists, especially in Japan, are aware that these cultural artifacts far transcend the organized religious movements. They speak of them as manifestations of "popular Taoism," which they treat as an entity distinct from "popular Buddhism." This species of Taoism, for good reason, has not been adopted by critical scholars elsewhere. It implies that the masses, incapable of creating their own religion, depended upon Chang Tao-ling 張道陵 and his progeny for it. The notion that everything worthwhile began as a grant to the commons from a legendary founder is so entrenched in traditional culture that this form of it lingers on despite the historical evidence accumulated against it.

Needham usually avoids the term "popular Taoism" and the cast of mind behind it.<sup>22</sup> He belongs instead to the larger company of those in the West for whom any generally diffused belief or practice that cannot readily be sorted into such categories as "Confucian" or "Buddhist" must be Taoist without further qualification. A few examples from *Science and Civilisation in China* illustrate this point. The universal themes depicted in the renowned silk painting from Tomb 3 of Ma-wang-tui (crow in the sun, toad and rabbit in the moon, etc.) are "Taoist myths and legends." A court lady is said to have been "a specialist in Taoist sexual techniques," although the Ming source does not mention Taoism, but merely speaks of the sexual "techniques of the Yellow Lord and the Pure Girl" (*Huang-ti su-nü chih shu* 黃帝素女之術).<sup>23</sup> In the *Pao-p'u-tzu nei p'ien* 抱樸子內篇 "strong Taoist influence on alchemy is apparent from the use of charms and amulets,

22. For an exception see V.6, 231.

23. V. 3, 21-22; see also IV. 1, 31, 91; V. 3, 39; V. 2, 260. The idea of Huang-ti beliefs as in some sense particularly Taoist apparently accounts for the mental leap, but a few pages later Needham judiciously uncouples the two rubrics: "... the study of Huang (Ti) and Lao (Tzu), which can mean either Taoism or the art of immortality..." (p. 52). The name of Huang-ti was not a monopoly of Lao-tzu, Chuang-tzu, the *fang-shih*, or the various sects that worshipped the Tao.

Taoist magic and ceremonies," and so on.<sup>24</sup> Finally a discussion of "how far Taoist ideas penetrated into Japan" is concerned with such matters as "the Taoist theory of the 'three corpses (*san shih* 三尸)' in the body, . . . the Taoist respiratory exercises (*fu ch'i fa* 服氣法)," and "*pai shu* 白朮, that characteristically Taoist longevity medicine."<sup>25</sup> All of these examples are drawn from the popular milieu. The terms were as familiar to literari with a taste for the occult as to Taoist initiates. "Taoist magic and ceremonies" is another matter, but when their components are identified, they too regularly turn out to be parts of popular religion.

Even being Confucian in various senses does not rule out being Taoist, even though the two were "mortal enemies." A section on conduits and canals in the "K'ao kung chi 考工記" section of the canonical *Chou Li* evokes the remark "One should not fail to note the extremely Taoist character of these maxims."<sup>26</sup> A passage in which Mencius uses an astronomical example is "of distinctly Taoist flavour" because "he is criticising the scholars of his time for forcing facts and going against nature."<sup>27</sup> In 1959 Needham described the inscription on a stele erected in Fukien by Cheng Ho 鄭和 and his admirals in 1432, although composed by a civil servant on behalf of a "Confucian" state cult at imperial behest, as "an inscription of sailors' gratitude to a Taoist goddess." Twelve years later he called it a votive offering "to the Buddhist-Taoist goddess of the sea."<sup>28</sup> Here too the issue, I suggest, is popular belief.

24. V. 3, 106.

25. IV. 1, 91; V. 3, 175-177. Sinologists often make the first two links. The last is not obvious, but atractylis is a macrobiotic plant established in conventional medicine long before the cited works were compiled. Atractylis, it seems, is Taoist without qualification because immortality is Taoist without qualification. This is not the only case in which a drug used universally is considered Taoist because it figures in immortality legends, alchemical practice, etc. For examples, see III, 642, and below, p. 18.

26. IV. 3, 256, note a. This usage has hoary antecedents. For instance, in his translation of the *Li chi* 禮記, James Legge says of Confucius' reference to "*ta tao chih hsing* 大道之行 (lit., 'the practice of the great Way')," "this sounds Taoistic," and he speaks of "the Taoistic period of the primitive simplicity" (1885: I, 364-365).

27. III, 196. In this passage (4B.26) Needham reads *ku* 故 first as "cause and effect" and then as "phenomena." The "Taoist flavour" and concern with scientific reasoning disappear in the more literal translation of D.C. Lau: "In talking about human nature people in the world merely follow former theories [*ku*]. They do so because these theories can be explained with ease. . . . In spite of the height of the heavens and the distance of the heavenly bodies, if one seeks out former instances [*ku*], one can calculate the solstices of a thousand years hence without stirring from one's seat" (Lau 1970: 133).

28. III, 557; IV. 3, 523.

**State Cults.** A number of important imperial cults were based on Taoist structures of meaning and legitimation. Needham mentions many of them, alongside others more doubtfully Taoist. A general view of the relations of imperial Taoism to science, medicine, and technology, and to other Taoisms, does not emerge. Here are a few examples:

1. The Han Martial Emperor (Wu-ti), we are told, was in contact with "the shamanistic strain of Taoism" but, because he was "active and ambitious," brought about "the very triumph of Confucianism." Eight years later Needham writes of "the time of Taoist dominance under Han Wu Ti."<sup>28</sup>

Lack of clarity about the ideological commitments of the Martial Emperor and his immediate predecessors is universal in modern studies. Historians in the Han and after emphasized the conflicts between Confucian and Taoist philosophic doctrines. They were not inclined to consider how easily these doctrines (and rituals related to them) could be, and how frequently they were, used side by side as adjuncts to state power. Needham's reconnaissance of science and material culture has encouraged interest in the Western Han. Perhaps it will motivate someone to take a fresh look at the promiscuous use of ideology by the Martial Emperor and his predecessors—not only that derived from the *Lao-tzu* and the search for immortality, but the assortment of conceptions, slogans, symbols, and rites that historians by force of habit label Confucian.

2. Needham notes that in 401 the Grand Progenitor of the Northern Wei (T'ai-tsu, first emperor, r. 386–409) "established a professorship of Taoism (*hsien jen po shih* 仙人博士) . . . and a Taoist workshop for the concoction of medicinal preparations." The primary source does not mention Taoism, although it remarks that the emperor "was fond of the words of Lao-tzu, and recited them without tiring." The Erudite, or professor, taught a number of texts on attaining immortality through taking drugs. The workshop was for preparing them. The imperial enthusiasm, the source tells us, soon ebbed and the project ended. We cannot decide on the basis of this evidence that the emperor's employment of specialists in immortality techniques was in any way related to his fondness for chanting the *Lao-tzu* (more often admired as a source of salvation than of mysticism). These two Taoisms in turn do not imply his involvement in any other Taoism, such as the religious movement that briefly turned the rule of his successor into a "Taoist theocracy" under the master K'ou Ch'ien-chih 寇謙之.<sup>29</sup>

3. Needham's survey of alchemy discusses the Taoist involvements of the Per-

28. I, 106, 108; III, 581.

29. II, 441; *Wei shu*, 114: 3048. Needham quotes Ware 1933: 224. See *Wei shu*, 113: 1973, for the date. On K'ou and court Taoism see Mather 1979, esp. p. 107, and Yamada 1995.

fectured Ancestor (Emperor Chen-tsung of the Sung, r. 997–1022). This emperor's attempts to attract recluses from 998 on, and the series of revelations vouchsafed to him beginning in 1008, are "nonsense" that "may seem as meaningless as it is amusing" unless "one realizes that it was exactly at this juncture that a number of important military inventions were made." In an otherwise carefully documented summary, Needham explains this by "his Taoists . . . consulting with their military colleagues," but backs this with no evidence at all.

He suggests further that the court fabricated messages from heaven as an alternative to "military might." Imperial use of Taoism was based on a policy of "theocratic mystification." Needham's monograph on astronomical clockwork declares that "Chen Tsung was particularly devoted to Taoism, so it is not surprising that he took a great interest in the astronomical equipment made by Han Hsien-fu" (and paid for it). Needham does not suggest that Han was connected with any Taoist movement, so this must be another instance of Taoism as enthusiasm for technology, quite compatible with Taoism as mystification.<sup>30</sup>

4. Finally there is the intricate case of the Excellent Ancestor (Emperor Hui-tsung, r. 1101–1125), who inaugurated the Divine Empyrean cult. Orthodox historians of the last thousand years have not explained this grand act of patronage as mystification. After all, they see sincere Taoism as merely one more sign of self-indulgence in the ruler they hold morally responsible for the fall of the Northern Sung. Strickmann, who unlike them has studied the primary sources in the Taoist Canon, sees it in part as an expression of Chinese religiosity counterposed to the Buddhism of the Khitans who threatened the empire from the north.<sup>31</sup>

Needham has taken a particular interest in this period, and his work has already played a part in prompting more specialized research. The issue is broader than religion alone. ". . . Hui Tsung . . . consistently supported the reformers . . . except between 1107 and 1112 . . . Now one of the most striking features of the period was the alliance between the reformers and the Taoists, counterbalancing the strict Confucian orthodoxy of the conservatives. . . . The reforming party of the Sung were bureaucratic scholars who broke away from the typical Confucian ideas and were prepared to ally themselves with Taoist science and technology. It was highly significant, for example, that Wang An-shih 王安石 (1021–1086), and again in 1104 Ts'ai Ching 蔡京 (1046–1126), included mathematics and medicine among the subjects which could be offered in the imperial examinations." Exactly what tie Needham had in mind between Taoism and these examinations, offered as qualification for specialized but in no sense unorthodox civil service functions,

30. V. 3, 183–184; Needham, Wang & Price 1960: 70. For the context of the revelations see Wu Yiyi 1989.

31. Strickmann 1978.

he did not explain. Thanks to the historical survey of medical qualifying examinations by Needham and Lu we know that they were not new in the Sung period, and that association with Taoism (unless one makes physicians "Taoists" by definition) had not previously distinguished their use. A footnote in a different volume mentions another strikingly pertinent point—that "the Reforming Party became associated with Taoism" only after Wang An-shih's lifetime!<sup>32</sup>

The relation between Taoism and science was not merely a matter of social and political expediency. In discussing the elevated status of Taoism Needham asserts an intellectual link: "All this should be viewed in conjunction with the background of interest in natural phenomena and mechanical invention which led us at an earlier stage to call Hui Tsung's court an 'entourage of virtuosi.'" He is inspired to compare the Excellent Ancestor to Charles II, founder of the Royal Society. Earlier he likens the ambience of the court to that of Rudolf II at Prague, the great patron of astrologers and alchemists.<sup>33</sup>

The claim, then, is that scientists, mechanicians, and Taoist adepts (explicitly related to the Divine Empyrean movement) were allied against the orthodox Confucians. This union was not a mere marriage of convenience between the heterodox, but was based on a genuine overlap of convictions.

Now what evidence does Needham offer for this view? He lists the characters he considers central to the Taoist side of the alliance. All are familiar from older conventional accounts, which present them as living testimony of the Excellent Ancestor's Taoist leanings. The orthodox historiographers often thought of this enthusiasm as (to quote Kracke's paraphrase) a "tendency toward mental instability" that "led to definite unbalance in his later years."<sup>34</sup>

Neither in those discussions nor in others I have cited earlier do particulars of cooperation between the reform group and Taoists against "strict Confucian orthodoxy" appear. A single anecdote bears the main burden of illustrating a working alliance. It deserves examination.

The great escapement-regulated astronomical clock that Needham and his colleagues have reconstructed was designed, built, and documented under the supervision of Su Sung 蘇頌 over the years 1086–1094. The political circumstances of this project were in many respects diametrically opposite to those depicted for a similar feat proposed a quarter-century later, in the Excellent Ancestor's time.

32. Needham, Wang & Price 1960: 124; Needham & Lu 1963; Strickmann 1978: 335n15; Needham 1954- : I, 138. On Hui-tsung's Taoist associations see also Miyakawa 1975 and 1976.

33. V. 3, 190–191; IV. 2, 501, note d.

34. Needham, Wang & Price 1960: 124–125; Kracke 1953: 25.

Su was one of the several unprecedented polymaths of his century. By 1094, when he presented to the Emperor his book on the clock, he had risen to the top of the civil service to become Vice Director of the Secretariat and Chancellery (i.e., Grand Councilor, 1092). This was the period in which the more extreme enemies of Wang An-shih were extirpating his adherents (1085–1093). Su was thus the tool of a group that most principled conservatives avoided. He himself seems to have held no factional grudges. No one has argued that he was in league with Taoists of any sort.<sup>35</sup>

Now for the anecdote. In the Excellent Ancestor's time, Wang Fu 王黼 (1079–1126), a powerful official remembered mainly for his sycophancy and his complicity in the fall of the Northern Sung, proposed building an astronomical clock to replace that of Su. This was a technological step in the campaign of Wang, the prime minister Ts'ai Ching, and other remnants of the reform period, to wipe out every trace of the faction which had wrecked their careers a generation earlier. Whether Wang's clock was superior to its predecessor has yet to be determined; it is interesting that the only contemporary evaluation we have likens its design to one built three and a half centuries earlier.<sup>36</sup>

Needham counterposes the two projects: "Su Sung's clockwork was associated with the Confucian Conservatives—Wang Fu was one of the Taoistic Reformers." He explains in a note that Wang "was closely associated with a number of Taoist adepts and certainly acquainted with some of their arts, but this did not prevent him from making an adventurous, and somewhat unscrupulous, career in the official bureaucracy." In *Heavenly Clockwork*, published five years earlier, the nuance is a little different: "It is quite clear that he disposed of the talents of certain more obscure Taoist technologists . . ."

To back this claim Needham cites Wang's memorandum of 1124. The only relevant portion says "In [1102] I chanced to meet a wandering unworldly scholar at the capital, who told me his family name was Wang and *gave me a Taoist book* which discussed the construction of astronomical instruments in detail."

The phrase the translation of which I have italicized is "*mien ch'u su shu i* 面出素書一," more literally, "he took out in front of me one book written on unbleached silk."<sup>37</sup> Nothing in the story hints that a Taoist produced it. With due

35. See Franke 1976: 969–970 and, for more detail, Weng Fu-ch'ing 翁福清 1986.

36. There is a great deal of information on the mechanized astronomical instruments of the Sung period in the *Sung hui yao* 宋會要 that has not yet been used by historians of science. This source states definitely (LIII, 2: 15a, p. 2151b) that the Wang Fu clock was completed, a matter that is not resolved in *Heavenly Clockwork*, 2: 15a.

37. Needham 1954: IV, 2, 500–502; Needham, Wang, and Price 1960: 118–119, 125. The anecdote is found in *Sung shih*, 80: 1906.

sagacity, Needham does not *assert* that the unworldly scholar was either a Taoist or the author of the book.

In Wang Fu's statement, then, we are left with his chance meeting with a man of unknown allegiances who gave him a book of ideologically undetermined character more than twenty years before he based his proposal on it. This is not an unusual tale, but rather the most common way of suggesting that a book is of more than mortal origin.

Where was Wang's obscure band of Taoists in 1124? This question can be answered on the assumption that, here as so often elsewhere, Needham is using the word "Taoist" to mean "technician."<sup>38</sup> Wang's association with Taoists would thus amount to making use of mechanics to design his clock. That workers skilled in manual arts would be essential to this job hardly needs to be proven. In this view, the generalization about reformers and Taoists becomes a statement that Wang and others of his faction used technicians when technicians were needed, as indeed civil servants—orthodox, heterodox, reforming and reactionary—had usually done before them. The weight in this equation of other Taoisms—of "Taoists" who were not just technicians—remains unknown.

One can make a case, although it has nothing to do with science, and Needham did not make it, for a political alliance between individuals in the "New Policies" group and the most powerful representatives of orthodox Taoist movements in the Excellent Ancestor's court. The latter included Liu Hun-k'ang 劉混康 of Supreme Purity, and Lin Ling-su 林靈素 with his epochal Divine Empyrean revelations. The emperor supported them—at least up to a point. When Lin arranged the downfall and execution of the previous Taoist favorite, Wang Tzu-hsi 王仔昔, no infusion of imperial grace saved the latter.<sup>39</sup> At the same time, the leading members of the emperor's government were adherents of what had once been Wang An-shih's faction. These two groups (both riven by internal rivalries) were thus joined in access to power, and we know that they cooperated to secure

38. Wang Fu's long memorial, excerpted above, is accorded only a one-sentence summary in *Sung hui yao*, *loc. cit.*: "Previously Fu memorialized that he had obtained a *fang-shih's* book on armillary spheres." The historiographic official (an occupational group not fond of drawing fine distinctions among the heterodox) is equating *fang wai chih shih* 方外之士 and *fang-shih* 方士.

39. On Liu, see *Mao shan chih* 茅山志, S 304, TT 153-158, 3: 3a-4: 7a; on Lin, Strickmann 1978; and on Wang Tzu-hsi, *Sung shih*, 462: 6a, *T'ieh wei shan ts'ung-t'an* 鐵圍山叢談, 5: 9b-10a, and Chin Chung-shu 1974: 301. Needham has linked Lin with medicine by calling *Su Shen liang fang* 蘇沈良方, a collection of prescriptions and theoretical discussions by Shen Kua and Su Shih 蘇軾 (1037-1101), "a conflation of their writings under the supervision of the Taoist Lin Ling-su" (V. 3, 193). Lin did not perform this service. Lin's preface (to *Liang fang*) merely says that he paid for printing an MS in his possession.

it. What else joined them—principle, vision, intentions toward the use of science—we do not know.

Neither of these perfectly plausible types of association—administrators' use of technicians for engineering tasks, and the sharing of imperial favor by Taoist favorites and Ts'ai Ching's feuding clique—casts light on our central issue, namely the consequences for science of Taoism as an imperially sponsored cult.

Was either alliance opposed to Confucian orthodoxy? Recent studies of the New Policies (*hsin fa* 新法) generally differ from the perspective of the 1950's in two pertinent respects:

1. Critical historians have abandoned "Confucian orthodoxy" as a criterion for distinguishing the enemies from the adherents of the New Policies. The reasons are both general and specific.

Considered generally, the term has scant inherent meaning. Through most of political history both sides of a power struggle usually flaunted their orthodoxy, freely redefining it. "Confucian orthodoxy" was a necessarily amorphous area of discourse *because* groups competing to hold, control, or define legitimate access justified their opposed claims by reference to established usage.

In the New Policies period, assertions of orthodoxy were frequent and fervid on both sides. Both factions represented, and of course modified, trends founded in the formal Confucian schools of the time. Wang An-shih was one of the greatest shapers of orthodoxy in Chinese history. He requiring those preparing for the examinations to master a single set of classical interpretations, namely those in his own commentaries.<sup>40</sup> Wang's reforms gave the bureaucracy enhanced authority; in return he expected more conformity from civil servants. This combination of authority and orthodoxy became part of his enduring legacy (see Vol. I, III 3-4).

2. Specialists in the politics of the Northern Sung period see the group around Wang An-shih as heterogeneous. Its members ranged from sincere and innovative reformers to unscrupulous conventional careerists taking what for a time was the obvious route to power. As they diverged, the New Policies ceased to be an effective program of reform by the time Wang retired in 1076. The restoration of its promoters in the Excellent Ancestor's time was so completely under the control of those avid for power that it is often called the "post-reform period."

The dominant figure of the Excellent Ancestor's reign was Ts'ai Ching. "Under him the political persecution intensified, corruption increased, and the

40. J. T. C. Liu 1959: 24-29, 88-89. These mandatory interpretations, which were promulgated in the schools, were composed by Wang, a son, and a disciple. See the references in Liu and the prefaces in *Lin-ch'uan chi* 臨川集, *wen chi* 文集, 15: 147-149.



government administration deteriorated in many ways." Ts'ai, as prime minister, was deeply involved *ex officio* in the Excellent Ancestor's Taocratic extravaganzas, and was involved in distaff politics in which enthusiasm for Taoists played a role.<sup>41</sup> The evidence has yet to appear that, during the last quarter-century of his life, reform meant more to him than a slogan useful in accumulating power and personal wealth.

To sum up the case of the Excellent Ancestor, Needham's picture of an alliance between Taoism and political reform blurs as we scrutinize the evidence. Taoists did not support reform in this instance any more than in the earlier ones.

### *Labels for Taoists*

A necessary last step before examining the links between Taoism and scientific attitudes is to look at terminology. The Sinological faith of the 1950's in the clear distinction between *tao-chia* and *tao-chiao* as philosophy and religion has turned out to be mistaken. Those terms, and others that routinely have been translated "Taoist," turn out to have much more diverse meanings in the historical sources.<sup>42</sup> I will summarize the results of research on several such terms, and on *fang-shih* and *wu*, two words that scholars often relate to Taoism without considering their meaning in context. Each discussion begins with a literal translation of the term. "*Tao*" may refer, in various contexts, to "the Way" or "a way, an art or method."

**Tao-chia** 道家, "masters of the Way (*or* with a way)." This term in early writing consistently refers to books rather than people.

Ssu-ma T'an's 司馬談 (d. 110 B.C.) "On the Essentials of the Teachings of the Six Schools" (discussed in Chap. IV) first associated this term with philosophy. He argued at length that the doctrines of the *tao-chia* were best because they included the best points of the others. Ssu-ma's Taoism was much more comprehensive than that of the *Lao-tzu* and *Chuang-tzu*, because he drew the boundaries of his description from the Springs and Autumns of Master Lü (ca. 239) or some other eclectic work like it.

In the "Treatise on Bibliography" of the History of the Former Han, *tao-chia* is a bibliographic rubric. We can assess its historical value from the assertion that the Taoists, like the proprietors of nine other classifications, were descended from bureaus of the royal Chou government. This class of books comprises thirty-seven

41. Liu 1959: 10; Chin Chung-shu 1974, esp. p. 296.

42. The most useful summary is Sakai & Fukui 1977, with an English summary in Fukui 1995. See also Chap. VI above.

works. The titles of the lost majority do not reveal what they had in common.

Over the centuries the *tao-chia* class of books also came to incorporate an indiscriminate range of treatises on religious, occult, and legendary topics. This was not the result of a sustained, conscious effort to define *tao-chia* as an ideal type and collect books accordingly. Books became "Taoist" because conventional people often read them, or because imperial patronage of one sect or another had enriched a palace library.

Ko Hung, that great enthusiast of immortality (ca. A.D. 335), contrasts the contents of two of his books, Inner Writings and Outer Writings. The first, which "belongs to *tao-chia*," includes not philosophy but "immortality, medicine, spirits and prodigies, transformations, self-cultivation, longevity, exorcism and the avoidance of calamity." The Confucian (*ju* 儒) content of the second is far from classical: "success and failure in human relations, good and bad in worldly affairs." The same use of "*tao-chia*" without philosophical overtones for those practicing occult disciplines can still be found in a twentieth-century treatise on charm healing written for anyone who cared to buy it.

Beginning in the Six Dynasties, members of Taoist organizations used "*tao-chia*" to distinguish themselves from their Buddhist counterparts. As late as the Ming it referred to those who practiced techniques, i.e., to what had earlier been called *fang-shih*.<sup>43</sup>

In short, when modern historians went hunting for Chinese parallels to European philosophy, they were bound to find them. They read Ssu-ma T'an's partisan argument carelessly and ignored large ranges of meaning elsewhere that did not suit such a high-minded enterprise.

**Tao-chiao** 道教, "teachings of the Way." Every philosophic tradition had a Way of its own. This term, like those that follow, was available to anyone. In *Motzu* 墨子 39 (fourth century B.C.) and many later historic sources, it refers to the teaching of the Confucians. It was not much used in the Han. Buddhists used it rather widely beginning just after the Han to refer to the teachings of their own *dharma*. Authors associated with Taoist movements, engaged in anti-Buddhist polemics from ca. 480 on, began using it to distinguish their doctrines from those of their rivals. "Before modern scholarship," as Seidel puts it, the term "was never used to distinguish Taoist philosophy from Taoist religion but to differentiate the Taoist tradition from Confucianism and Buddhism." That, we have seen, was also the case for *tao-chia*.<sup>44</sup>

43. *Shih chi*, 130: 7-14; *Han shu*, 30: 1729-1732; *Pao-p'u-tzu wai p'ien*, 50: 9b; Anon. 1930: 16; Ch'en Kuo-fu 1949: 259.

44. Seidel 1989-1990: 229. Sakai & Fukui 1977: 432-433 cite a number of Buddhist

**Tao-jen** 道人, "man of the Way (or with a way)." Hsun-tzu 荀子 (ca. 250 B.C.) a successor of Confucius, in a passage concerned with the foundations of good government, uses the term for people who abide by his version of the Confucian Way. In the *Chuang-tzu*, two occurrences mean "a person who has attained oneness with the Tao" and one means "a sycophant." In the *Lun heng* the word means "one who follows a discipline," a *fang-shih* (five occurrences). With the advent of Buddhism, as a simple extension of the Han meaning, *tao-jen* often designated Buddhists. By the first half of the third century, it was used for that purpose in translating Indian sutras.<sup>45</sup>

**Tao-shih** 道士, "gentleman with a way." Beginning with a famous passage from the mid second century B.C. in which "an ancient *tao-shih*" advises on nourishing the vital principle, this term simply meant someone who followed a way, a discipline. From the Chin period on, this broad sense of *tao-shih* to some extent replaced *fang-shih*. Thus Ko Hung writes of "dilettantish practitioners" (*ch'ien-po tao-shih* 淺薄道士), homeless "vulgar practitioners" (*su tao-shih* 俗道士) and "common practitioners" (*fan-yung tao-shih* 凡庸道士) of low-grade esoteric disciplines. Like *tao-jen*, the term was used for Buddhist monks until the Southern Dynasties. Then, again via polemics, *tao-shih* came to mean Taoist masters in contradistinction to Buddhist *tao-jen*.<sup>46</sup>

**Tao-shu** 道術, "techniques of a way or discipline." The passage that begins the final chapter of the *Chuang-tzu* equates "those who cultivate some method" with "those with a *tao-shu*," and uses "*tao-shu*" for all the "hundred schools." Sakai and Fukui have shown that, by the Han, conventional authors were commonly using *tao-shu* for "the methods of the former kings and sages." Thus the skeptical Discourses Weighed in the Balance (completed A.D. 70/80) speaks of Tung Chung-

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examples of *tao-chiao* from the early third century to the beginning of the fifth. Ku Huan's 顧歡 biography quotes the first extant Taoist usage from his lost *I hsia lun* 夷夏論 (a polemical treatise, ca. 480); *Nan Ch'i shu*, 54: 932, 934. It is interesting that both treatises in the *Tao tsang* that include the word *tao-chiao* in their titles, the *Tao-chiao i shu* 道教義樞 (ca. 700?), and the *Tao-chiao ling yen chi* 道教靈驗記 (after 905), also borrow heavily from Buddhist literary forms in order to argue for the superiority of Taoist religion. Recently some Japanese specialists have argued that we cannot speak of a Taoist religion until initiates began using this term to designate themselves in the fifth century (Fukui 1995: 8; Kobayashi 1995: 26-27). I would prefer to define it by its doctrines, practices, and organization rather than by its polemical stances.

45. *Hsun-tzu*, 21. 31-34, trans. Knoblock 1988-1994: III, 103-104; *Chuang-tzu*, 12. 86. On Buddhist usage, Sakai & Fukui 1977: 446.

46. *Ch'un ch'iu fan lu* 春秋繁露, 16. 7: 23b; *Pao-p'u-tzu nei-p'ien*, 15: 4a; 4: 1a; 15: 7a; Ch'en Kuo-fu 1949: 258-259. On Ko Hung see Chap. VI, pp. 323-327.

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shu's outline of neo-Confucian orthodoxy as a "treatise on *tao-shu*, in which he repeatedly spoke of portents as due to failures of government," at the same time affirming that "in Chung-shu's book he neither turned his back on the Confucians nor contravened Confucius." Sakai and Fukui find Huang-Lao enthusiasts, like those of other schools, using the term. Stein has demonstrated that after the Han it still often referred to conventional literati and Buddhists.<sup>47</sup>

**Fang-shih** 方士, "gentleman who possesses techniques, technician." When Ch'en Kuo-fu argues that "*fang-shih*" is equivalent to "*fang-shu shih*" 方術士 and Yü Chia-hsi 余嘉錫 equates it with *fang-chi chih shih* 方技之士, they are substantially agreeing. Both phrases might be translated literally "gentleman who possesses techniques." Wang Ping 王冰, the eighth-century annotator of the Plain Questions of the Inner Canon of the Yellow Lord, glosses *fang shih* literally as "a gentleman who clearly comprehends an art (*ming wu fang-shu chih shih* 明悟方術之士).<sup>48</sup>

I have discussed the movement in and out of fashion of various terms that used to be uniformly translated "Taoist." Discussions of technicians also use a shifting vocabulary. The treatises devoted to *fang-shih* in the Standard Histories refer to their arts as *fang-chi* 方伎, *fang-shu* 方術, and *i-shu* 藝術. All the technicians (*fang-chi*) mentioned in the first "Treatise on Bibliography," that of the Han History, are physicians. Other masters of technical arts are scattered under such designations as "diviners of propitious days" (*jih-che* 日者) and "recluses" (*yin-i* 隱逸).

The chapters on technicians of the later Histories include wonder-workers, astrologers, physiognomists, diviners, imperial favorites, initiated Taoists, a Buddhist patriarch, a man famed for his wealth, architects and other artisans, and an assortment of doctors in and out of the Imperial Medical Service.<sup>49</sup> This diversity affirms the ambiguous but generally low status of the *fang-chi* label. There is no reason to consider it more than a catchall for people who made their mark in arts of which gentlemen were not encouraged to know more than a smattering.

47. *Chuang-tzu*, 33.1. Watson 1968: 362 renders *chih fang shu che* 治方術者 as "those who apply themselves to doctrines and policies," which is not translation. Graham 1981: 274 renders it as "who cultivate the tradition of some formula." The context does not validate so narrow a sense for *fang*. Sakai & Fukui 1977: 441-443; *Lun heng*, 29: 7a, 4a. For the contexts see Forke 1907-1911: I, 466 and 84. Forke translates *tao-shu* as "magical arts," but the issue is plainly omens. Unlike Forke, I accept Sun I-jang's 孫詒讓 emendation of the phrase *pu-chi K'ung-tzu* 不及孔子 to *pu-fan K'ung-tzu* 不反孔子, cited by Huang Hui 黃暉 1938: 29: 1163-1164 and Liu P'an-sui 劉盼遂 1957: 571. Stein 1963: 39.

48. Ch'en 1949: 258-259; Yü 1958: 682; *Huang-ti nei ching su wen* 黃帝內經素問, 3: 67. 2.

49. Sakade 1978: 627-628.

One can only agree with Yü Chia-hsi that *fang chi* is a general term for technical skills, which need not involve magic—even, I would add, in the broad acceptance of “magic” that includes divinatory powers.

Unlike the terms discussed above, there is a more elusive dimension to *fang-shih* and *wu*, which requires further scrutiny. For our purpose I will pay attention mainly to the use of the term *fang-shih* by historiographers. No two used it identically, and other sorts of writers used it in other ways. Despite considerable evolution, to a first crude approximation several criteria for the use of “*fang-shih*” appear general from the Han at least through the Sung:

1. The *fang-shih* usually belonged to the tiny privileged segment of the population who could read books and leave records. The writings we have, not a random sample, are of high literary quality. Early stories about technicians often have them confounding philosophers. The *fang-shih* usually came from a family that we know held official rank, even in periods when such rank was normally hereditary.

2. The *fang-shih* himself did not usually hold high rank in the regular civil service. If he did, it tended to be obtained irregularly, most often as an imperial gesture. Someone who reached a high post through a conventional career, although he might have considerable mechanical skill, scientific knowledge, or mastery of the occult, was not often called a *fang-shih*. Chang Heng 張衡 (78–139), astronomer, cosmologist, inventor, “patron of the art of yin and yang,” was, in the words of Ngo Van Xuyet, essentially a *ju literatus*, and so merited a biographical chapter all his own in the History of the Later Han.<sup>50</sup>

3. The *fang-shih* did not strive for the personal goals that the well-born expected of their own kind. He usually held conventional moral and political opinions, if we can rely on the record, but the stigma of inappropriate technical enthusiasms, however faint, is commonly visible. Someone in a conspicuous position of orthodoxy, regardless of technical expertise, was not considered a *fang-shih*.

In the eleventh century we see emerging the label of “literatus-physician” (*ju-i* 儒醫), which elevated doctors given it far above the *fang-shih*. For instance, Sun Ssu-mo 孫思邈 (alive 673), although not related to any Confucian lineage, eventually became one of the models for aspiring scholar-physicians because of his emphasis on philosophic studies and ethical standards as preparation for medical practice. In his own dynasty he was a mere *fang-chi*. That is how he was listed, at least, in the Old History of the T'ang (945), a book rather faithful to the contemporary record. When the New History was compiled in the interest of better coverage and stylistic improvement (1060), Sun was promoted to “recluse.” Finally, in the famous sixfold classification of early doctors in the Introduction to Med-

50. *Hou Han shu*, ch. 59; Ngo 1976: 71.

icine of 1575 he figured prominently among the scholar physicians.<sup>51</sup>

4. The *fang-shih* had powers only rarely seen in the orthodox literatus—to foresee the future, to arrogate to himself the shaping and transforming powers of natural process (*tsao hua* 造化), and so on. At the same time descriptions of him never limn the full humanity, the mastery of the social Way, of the more conventional great.<sup>52</sup>

What pattern do these criteria reveal?

This is a category that originates not in some set of objective criteria but in the eye of the beholder. Ingenious craftsmen, diviners, physicians, thaumaturges, seekers after immortality, monks: I have found none who says "I am a *fang-shih*."<sup>53</sup>

*Fang-shih* is not a social grouping toward which people align themselves, but rather an imputation of aims, powers, or behavior that the literatus biographer may admire or despise, but does not share. People become *fang-shih* in the eyes of others because of what they have done, not where in society they were born. Outside of technical skills and an identity that is nonconformist in a specific way (while usually conformist in other ways) they may or may not have anything in common with other *fang-shih*.

In what way, then, are they nonconformist? Here we benefit from the systematic and thoughtful researches of Ngo Van Xuyet into *fang-shih* in the Later Han. Ngo points out that "just as Confucian literati were more or less imbued with esoteric literature . . . the *fang-shih* were versed in the canonic books. No clear demarcation can be established in this period." Texts had long been the basis of claims to authority and, for the elite, livelihood. The state orthodoxy of the Former Han based on the Confucian writings aimed precisely to enforce the boundaries between respectable and disreputable texts, that is, those that furthered, and those that potentially obstructed, careers. The platitude always used for this purpose is "The master never spoke of marvels, prodigies of strength, anomalies, or

51. *Chiu Tang shu*, 191: 5094–5097; *Hsin Tang shu*, 196: 5596–5598; *I hsueh ju men* 醫學入門, *shou chuan* 首卷, pp. 54a–80b; Hsieh Kuan 1935: 51a–51b.

52. Ngo 1976: 66.

53. The opening section of T'ao Hung-ching's 陶弘景 preface to his *Pen-ts'ao ching chi chu* 本草經集注 (ca. 500) seems to use *fang-chi* as a self-reference. This preface is universally accepted as genuine, and indeed the later part appears to speak with T'ao's voice. But the first four characters, "*Yin-chü hsien-sheng* 隱居先生, the Hermit Master," are not the way a Six Dynasties author would have referred to himself. At least the initial thirty-nine graphs (including the phrase about *fang-chi*) are a prologue by someone else, perhaps a disciple. This curious point might be easier to resolve were it not that what corresponds to the beginning is missing from the very early Tun-huang MS (p. 1).

spirits." *Fang-shih* were those whose authority was based on the wrong books.<sup>54</sup>

By the Later Han that orthodoxy had crumbled, and any sort of text might be useful to anyone. Those who hoped to preserve the dying order, marginal in a new society, needed such labels to mark those who should have remained on their side but had given in.

Ngo's insights suggest a pattern in the use of "*fang-shih*" in conventional historiography. The word acknowledges that someone claims exceptional skill in a technique or discipline, which implied spiritual penetration of the cosmic order. This claim might or might not be true. In either case it denies his entitlement to the conventional status for which his birth or rank would otherwise qualify him. "*Fang-shih*" is thus an epithet that denies social authority based on skill, although the latter may imply cosmic power.

This description only holds for one kind of author. The few early writings that come from the popular milieu indicate that *fang-shih* could be a positive term. An interpretation of a revelation in the Canon of Great Peace, for instance, says that the word refers to the leader of the community who will carry its message to "a lord who has virtue and power."<sup>55</sup> Without further multiplying distinctions, we can move on to the corollary.

The patterns outlined above tell us nothing about the concrete data that led someone at a certain time and place to decide that someone else was a *fang-shih*. The word does not express a fact, not even a fact about behavior. I have demonstrated for Sun Ssu-mo that even the most soberly stated accounts of *fang-shih* tend to resolve under close scrutiny into scattered crystals of history in a matrix of legend. As DeWoskin puts it with understatement, the term typically "was somewhat akin to 'others,' and did not attach to any readily definable tradition."<sup>56</sup>

What facts underlie a given use of this epithet can only be determined case by case through the study of evidence. Some of those labeled *fang-shih* were no doubt members of politically marginal groups, while others (T'ao Hung-ching, Sun Ssu-mo, and I-hsing 一行 among them) passed their lives as pets of monarchs. Some *fang-shih*, we already know, were initiated masters of an orthodox sect. Some were brilliant technicians with average political and religious beliefs. But what little we know with fair certainty, once we have teased the facts away from the biases and stereotypes, does not support the assumption that a *fang-shih* was a proto-scientist, and at one with the masses.

54. Ngo 1976: 64; Analects 7. 21.

55. *Tai-p'ing ching* 太平經, 39. 50: 68-69. Cf. Kaltenmark 1979: 40.

56. Sivin 1968: 81-144; DeWoskin 1983: 6. On sources for the study of *fang-shih* see also DeWoskin 1981.

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Wu 巫, "mediums." Lin Fu-shih's 林富士 thorough study of *wu* in Han dynasty records and artifacts reminds us that, although the character appears in the oracle script of the second millennium B.C., experts on the period do not agree on what it meant then. In the philosophical writings of the late Chou some *wu* served rulers and others pursued occupations allied to divination and exorcism, but all seem to have served the gods. They continued to be possessed by gods in the Han.<sup>57</sup>

The senses that "*wu*" has accumulated over the centuries—a dancing ritualist who brings the gods down to earth, a medium of either sex, a curer, one who behaves wantonly, and so on—are related closely enough to suggest not scattered meaning but sparing and fitful curiosity about a single phenomenon. In view of the scant detail in the documents about who *wu* are and what they do, I submit that the word, like "*fang-shih*," is an epithet, not the name of an occupation. Its linguistic function is like that of the English word "superstition," which labels beliefs that the speaker doubts are religious and is not interested in understanding.

*Wu* is a garden-variety literary term, patronizing or disapproving, for mediums and other sorts of ritualist that the author could not be bothered to distinguish from them. Men of letters and officials most often applied it to the masters who performed the priestly functions of popular religion, often as mediums. They also imposed the word indiscriminately on the much rarer shamans (who instead of being possessed take spirit journeys on behalf of their clients), trance healers, Taoist priests, and others. Its use generally reveals less about the person it points to than about the attitudes of him who points.<sup>58</sup> To take a statement about a *wu* as evidence that someone was a specialist spirit medium, or belonged to another particular occupational category, misses the point.

**Application to science.** For Needham and most of his secondary sources of a generation or more ago, a Taoist is a Taoist. He does not need to keep several species distinct, since all embody a single ideal with clear positive consequences for science. I will give a few examples in which one or another hallmark of a Taoist evokes the wider complex of ideas (naturalist, empiricist, etc.) conducive to technical endeavor.

1. In his discussion of flood control Needham tells us that Chia Jang 賈讓 (fl. 6 B.C.), a great engineer, "was in fact an advocate of the channel expansion theory, a Taoist in hydraulics, who believed that the great river should be given plenty of

57. Lin 1988: 14–22. Lin seems to consider servants of the gods a separate category, but is not clear on this point. Chow 1978 is much more limited in value.

58. Historical and anthropological studies of popular religion in a few localities indicate that its rituals are commonly mediumistic, but the breadth of this generalization remains untested.



room to take whatever course it wanted." Chia was a "Taoist" because he did engineering. Needham reasons that Chia's reluctance to confine the river was an instance of "non-interference," *wu-wei* 無爲, a notion that harks back to the *Lao-tzu*. By perfectly analogous reasoning he could be labelled "anti-Taoist," "Confucian," or "Legalist," according to taste. His preferred plan, involving "the wholesale resettlement of the populations of prefectures bordering the river," was anything but *laissez-faire*.

2. That is not the only leap from technology to high philosophy. Another example appears in the section on the fenestrated rudder: "the device was probably quite empirical in origin . . . but it is not at all too fanciful to suppose that some medieval Taoist sailor, finding that his work was eased and that his ship sailed better, was fully content to follow the principle of *wu-wei*, and letting well alone, recommended the arrangement to his friends" (p. 656).

If Taoist necessarily implies *wu-wei*, however, *wu-wei* need not imply Taoist. Elsewhere Needham reminds us that "although the concept of *wu-wei* was emphasized particularly by the Taoists, it was part of the common ground of all ancient Chinese systems of thought, including the Confucians." This excellent point, unfortunately, does not recur often enough to avoid frequent confusions.<sup>59</sup>

3. A group of Taoists turns up in a palace laboratory at the end of the first century B.C.: "the *Han Kuan I* 漢官儀, a book on the Han bureaucracy written or published by Ying Shao 應劭 in +197, says that Wang Mang's coins were called *Pai Shui Chen Jen* 白水真人, i.e., 'White-Water Adepts', a distinct indication of the role of his Taoist alchemists in the 'adulteration' of the bronze." Is "Taoist" meant to convey more than "alchemist" alone would do?

The Chinese text says nothing about Taoism or alchemy. It merely remarks that Wang changed the coinage, and that the new coins carried the words *huo ch'üan* 貨泉 (specie currency). The *Han kuan i* continues, "these words when dissected yield *pai shui chen-jen* [lit., 'white water immortals']. This was an omen that [the Han] would be restored under Shih-tsu [i.e., Emperor Kuang-wu]." In other words, Wang's enemies, intent on restoring the Han dynasty, used "dissection" (*fan* 反), a popular method of divination, to forecast success. They split the character *ch'üan* into its component parts, which can be read separately as the words *pai* 白 (white) above and *shui* 水 (water) below. Similarly, but more arbitrarily, they divided *huo* more or less diagonally into *jen* 人 (man) and *chen* 眞 (real, realized). *Chen-jen*, literally "realized immortal," was a most propitious word. The point of this exercise in dissection is that the restorationists identified the "white-water immortal" with the future emperor. Wang's own coinage, they asserted, was

59. IV. 3, 234-235, 656; II, 563.

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predicting his defeat. The passage is about political propaganda, not alchemy.<sup>60</sup>

4. Needham observes that Taoists made instruments "for bringing the rays of the sun to a focal point," that is, burning lenses. He quotes two passages from Discourses weighed in the Balance. One says "that the *Chi Tao chih Chia* 伎道之家 (Taoist technicians) do it," and the other "this is the climax of Taoist learning and a triumph of their skill."

One might retranslate the first phrase to reflect the syntax. According to Han word order, "*tao*" cannot describe the type of technician. "*Chi*" (skill, technical), which comes first, tells what kind of *tao*. The phrase means nothing more specific than "masters who possess technical ways," i.e., "technicians."

Needham took the English of the second phrase directly from Alfred Forke, half a century earlier. Forke read into the text the idea that the learning was Taoist. One might read the text (about a marquess who made artificial pearls) literally as "[the success of the technique is due to] the perfection of acquired skill on the part of those who practice this art (*tao-shih*), the application of ideas by ingenious people."<sup>61</sup>

5. Needham's tendency to link technical skills to Taoism without evidence (echoing Forke and many others) is not confined to discussions of the Han.

In reviewing the social backgrounds of technologists, he observes that "in view of the close association between Taoism and technical arts in ancient China, one would expect to find more Taoist inventors in the middle ages than have so far made their appearance . . . on the whole the Buddhists were more illustrious as technicians in these times." Among the exceptions to this most significant assessment is the "Taoist swordsmith" Ch'i-wu Huai-wen 蔡毋懷文 (mid-sixth century). His identification with the co-fusion method of steelmaking, according to Needham, provides the clearest link of Taoism to ferrous metallurgy. The source states only that Ch'i-wu "put at the service of the Exalted Progenitor (Emperor Kao-tsu) the arts that he commanded."<sup>62</sup> No evidence indicates that Ch'i-wu was a Taoist. "*Tao-shu*" implies nothing more than Ch'i-wu's technical arts. The only ones mentioned are swordmaking and reasoning according to the color associations of the Five Phases, both of which were widely practiced among those uneducated in the *Chuang-tzu* and uninitiated into the worship of the Tao.

Needham describes a carriage of ca. 340 with a mechanism that animated "a

60. V. 2: 218; *Tai-p'ing yü lan* 太平御覽, 835: 6b-7a.

61. 道士之教至，知巧之意加也。IV. 1, 111-112, repeated IV. 3, 677. Lun heng 論衡, 16. 47: 694, 2. 8: 71, tr. Forke 1907-1911: II, 350 and I, 378. For *chiao* as "acquired skill" see *Kan-Wa daijiten* 漢和大辭典, item 13212, sense 1.2.

62. 以道術事高祖。IV. 2, 34; *Pei ch'i shu*, 49: 3b; cf. Needham 1958: 26.

large wooden figure of a Taoist . . . with its hands continually rubbing the front of the Buddha” as well as “ten wooden Taoists . . . continually moving round the Buddha.” A footnote is undecided “whether there was religious syncretism here, or whether the Taoists were supposed to be paying homage to a superior religion, or whether even the phrasing does not simply mean followers of the Buddhist Tao.” Since the text reads “*mu tao-jen* 木道人” and speaks of the Hunnish patron’s surpassing devotion to the Buddhist teachings, the third alternative is the only plausible one. I have noted that “*tao-jen*” routinely referred to Buddhists at the time. The passage is not evidence for a Taoist presence in technology.<sup>63</sup>

In Needham’s writing the hiatus between the *tao-chia* of ca. 300 B.C. and the *tao-chiao* that began nearly five hundred years later is solidly filled with Taoist activity in relation to early technology, medicine, and science, especially in the technical efflorescence of the Han. Some of the actors are “Taoist *fang-shih*.”

*Fang-shih* enter this picture because they both personify the Chuang-Lao philosophies and complement them. Taoism as an organized religion unites the “Taoist school of ancient philosophers” with “magic-scientific accretions . . . around a nucleus of primitive shamanism.” On the one hand, the interest of the *fang-shih* in techniques puts them on the Taoist side of the Confucian-Taoist antinomy. On the other, their magic connects Taoism with “the most primitive sorcery of the North Asian peoples.” This sorcery is of course shamanism. “The Chinese had a word of their own for shamanism, . . . namely, *wu* 巫.” Needham’s extensive discussion of “Shamans, *Wu*, and *Fang-shih*” devotes only one sentence to the latter: “The only remaining important term is *fang-shih* 方士, which some like to translate as ‘gentlemen possessing magical recipes’—we think they were just straight magicians.” Since Needham also consistently describes the *wu* as magicians and thaumaturges, “*wu*” and “*fang-shih*” appear, in the absence of a conclusive assertion to that effect, to be synonyms or close to it. But does *fang* always imply magic? We have seen that it does not.<sup>64</sup>

In considering anyone called a *wu* from the Middle Period of history on to be Taoist, Needham follows his chief source, the turn-of-the-century pioneer J. J. M. de Groot, for whom “Taoism may . . . be defined as Exorcising Polytheism, a cult of the gods with which Eastern Asiatic imagination has filled the Universe, con-

63. IV, 2, 159–160; *Tai-p’ing yü lan*, 752: 3a.

64. I, 117; II, 132, 134. It is pertinent that the distinction between magic and religion, after close scrutiny by cultural anthropologists, has proved to be indefensible. Tambiah 1968 is the classic demonstration. Anthropologists increasingly use the rubric “symbolic behavior” to cover rites of all kinds, whether the appeal to the gods is explicit or tacit. My own research into popular healing in traditional China fully supports this view. There is no point in splitting hairs over, e.g., whether magic includes divination.

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ected with a highly developed system of magic . . ." Both scholars believe that the *wu* were gradually "incorporated in the Taoist system." Needham paraphrases de Groot to the effect that "the *wu* were by no means always on good terms with the ruling authorities, . . . so that the magical as well as the political-philosophical aspects of the Taoist system drove it inevitably into general opposition to the government." Finally "the *wu* aspect of Taoism was driven underground, and tended to take the form of those secret societies among the people which in later centuries played such an important part in Chinese life."<sup>65</sup>

Finally Needham, even in his latest writings, follows Sinological habit in finding Taoists in two other unconventional corners of Chinese society. First, he typically translates a sentence in T'ao Hung-ching's 陶弘景 preface to the Canon of Materia Medica with Collected Annotations (ca. A.D. 492): "There are also things mentioned in the writings of the Taoists (*hsien ching* 仙經) as necessary for their techniques . . ." *Hsien ching* means nothing more than "canons of immortality," and immortality was a very general pursuit at the end of the fifth century.

This elision misses an important point. T'ao is one of the few indubitable Taoists we have considered. He also practiced alchemy, and studied techniques of immortality. But what he did in his edition of the Canon was to *reject* the traditional arrangement of drugs by their use in seeking immortality, and to arrange them by origin instead. He contrasts those who use drugs for immortality with those who use them primarily for therapy, the aim of his book.

Needham also enumerates, among authors of sixteenth-century books on edible wild plants, Chou Lü-ching 周履靖, "a Taoist naturalist," and Kao Lien 高濂, "another Taoist naturalist." Chou edited a collection of works for high-minded gentlemen living in retirement, but an autobiographical sketch does not indicate involvement in any Taoist activity. Kao was a Hangchow poet, and compiled several tractates on cultivation of the vital *ch'i*. Elsewhere Needham qualifies his description, writing of Kao as one of "a group of scholars, largely of Taoist inspiration, who sought no office and lived in seclusion, cultivating plants and writing about them in order to console the heart in bad times and nourish the spirit." Needham presents no evidence that the "Taoist inspiration" consisted of anything more specific than seclusion. What does probing the influence of seclusion on the evolution of natural history tell us about the relation of the latter to Taoism?<sup>66</sup>

Let me sum up this necessarily extensive look at "Taoists" who neither contributed to philosophic Taoism nor were members of a Taoist movement. They,

65. II, 137-138; de Groot 1892-1910: VI, 931.

66. VI, 1, 246, 349-350; *Pen-ts'ao ching chi chu* 本草經集注, p. 4. See the biographic data on Chou in Goodrich 1976: 658b, 1279b, and on Kao in Ch'ang Pi-te 1976: 892a.

rather than the philosophers and priests, are the central *actors* in the concrete interplay between Taoism and science exemplified in *Science and Civilisation in China*. The book depicts their contribution as strong and positive, in contrast to the obstacles posed by the Taoist religion. It explains such Taoists' contributions to science by their magic, which in early times was supposedly akin to science, and by their manual operations, contrasted to the prejudice of Confucians against using their hands. These two themes are intimately related: "If I believe that by taking a wax statue of [someone] and sticking pins in it I can cause him evil, I am adopting a belief for which there is no foundation, but I do at any rate believe in the efficacy of manual operations, and science is therefore possible."<sup>67</sup>

This classic British empiricist stance can lead to odd conclusions. Is the wizard conducting his own rituals, a Taoist in the abstract, a better scientist because he dirties his hands than the imperial astronomer, a Confucian at the office, working out new algorithms to compute events in the sky? And what sort of history of science will emerge from generalizations based on abstract Taoists while ignoring all but a handful of initiated ones?

**Residual Taoists.** I have argued so far that Needham conceives of Taoism in relation to science largely in three ways: first, as a set of attitudes toward Nature and its apprehension derived from the *Chuang-tzu* and other early classics, without reference to scientific inquiry; second, as the work of "technicians" (*fang-shih*, *tao-jen*, etc.) without, in most cases, reference to their individual attitudes; third and less frequently, as popular beliefs and rites. Most of the variety of undefined references to Taoism and Taoists scattered through Needham's voluminous writings can be understood with reference to one or the other of these senses. Others do not clearly fit any identifiable species of Taoism, so that their bearing on the Taoism-science relationship is especially nebulous. I will give a few examples.

1. Of several "Taoist authors" writing on the formation of minerals from *ch'i* 氣 exhalations, the only one about whom anything whatever is known was King Chien-p'ing 建平王 (fl. 444) of the Liu Sung Dynasty. His biography does not hint at a connection with the *Chuang-tzu*, Taoist sects, popular observances, etc.<sup>68</sup>

2. Learning from experienced artisans and craftsmen "had been a long tradition in Taoism, as witness the story of Pien the Wheelwright . . . and Liu Tsung-yuan's old gardener . . . In Thang, Han Yü 韓愈, though so Confucian a scholar, had written a famous essay on what he had learnt from the mason Wang Chheng-fu 王承福." Of the three "Taoists" who learned from artisans in these anecdotes, one

67. Needham 1969: 162.

68. III, 638-639; *Sung shu*, 72: 2a-6a.

was an unimaginative ruler in the familiar *Chuang-tzu* story. The wheelwright was the "Taoist," and the lord his straight man. The second and the third can hardly be called Taoists. Han (768-824) was the most ostentatiously orthodox Confucian of his time. William Nienhauser remarks of Liu Tsung-yuan 柳宗元 (773-819) that "although he took an interest in Buddhism, especially in the Ch'an school, which was then popular in South China, he was a servant of the state at heart." Elsewhere Needham describes him merely as "a Thang writer of naturalistic interests." None of the three who learned from technicians is linked to Taoism.<sup>69</sup>

3. In pre-Han legends of taming the waters, "the unsuccessful, or at any rate disapproved, irrigation engineers are identical with the corps of legendary rebels . . . It was therefore quite natural that some of them should have become heroes for the Taoists in later ages, since the Taoists opposed feudalism root and branch, urging a return to the collectivist golden age. Consequently it is of great interest that Chhü Yuan, in the *Li Sao* and especially the *Thien Wen* odes (c. -300), strongly takes the part of Kun," saying that he "met with failure through no fault of his own."<sup>70</sup> No "Taoist" other than Ch'ü Yuan 屈原 is mentioned in this connection. Needham does not present Ch'ü's otherwise unknown credentials as a Taoist. This association may be a matter of Ch'ü's unconventionality, or of his fascination with mythical cosmography.

4. Yang Hsiung 揚雄 (53 B.C.-A.D. 18) "was devoted to astronomy and used to discuss it with the Taoists. He made an armillary sphere himself. An old artisan once said to him . . ." Needham evidently understood *huang-men* (literally, "yellow gate") as "Taoist." Taking the word in its established Eastern Han sense of "the gates to the private quarters of the emperor and his women," one might read ". . . was devoted to astronomy. He asked an old artisan about it who was making an armillary sphere at the Yellow Gates. He said . . ."<sup>71</sup>

**Summary of Findings.** Despite a few cases such as the examples just given that do not fit any pattern, Needham portrays Taoism as an essentially threefold influence on science:

1. The "Taoist" literary works shaped science because they embodied a set of attitudes which prefigure, or are in principle identical to, those of the modern sci-

69. IV. 3, 85 note a; II, 577; Nienhauser in Liu & Lo 1975: 569.

70. IV. 3, 250; also II, 115ff.

71. 揚子雲好天文。問之于黃門作渾天老工。曰。 *T'ai-p'ing yü lan*, 2: 11a-11b, or *Ch'uan Hou Han wen* 全後漢文, 15: 2a; Needham, Wang & Price 1960: 129; Bielenstein 1976: 24 for *huang-men*; for a translation of the whole passage, Pokora 1975: 114-115, item 114.

entist. They are distinctive because they were opposed to attitudes encouraged by Confucians.

2. "Taoist" popular religion shaped science through its immortality disciplines, magic, etc. (to which Needham gives more attention than communal rituals): "since in their beginnings magic, divination and science were inseparable, we cannot be surprised that it is among the Taoists that we have to look for most of the roots of Chinese scientific thought."<sup>72</sup>

3. The "Taoist" *fang-shih* shaped science because they contributed to technical inquiry.

We have seen that once Needham has identified an individual in principle with any of these three Taoisms, a concrete linkage with Taoist activity becomes unnecessary.

### *Taoism and Scientific Attitudes*

I have argued that the least ambiguous linkage of science asserted by Needham is to the tradition of the *Chuang-tzu*, the *Lao-tzu*, and other books customarily shelved with them. How are the links formed? How strong and clearly articulated are they? In other words, can one assume that all early philosophic Taoist authors were agnostic naturalists, mechanists, materialists, experimentalists, empiricists who avoided preconceived ideas, democrats and heterodox collectivists?

**Empiricism.** In the interest of concision I will sample only two of these characteristics, namely empiricism and its corollary, the observation of Nature without preconceptions. These are central, but the reader will do well to keep in mind that they are closely tied to the others. In a more rigorous discussion it would be necessary to examine them all.

We are told that "Cognoscere causas' [understand the cause] . . . became the motto of the Taoists. Through all the convulsions caused by the substitution of feudal bureaucratism for feudalism at the time of the unification of the empire by Chhin Shih Huang Ti, they continued to pursue it." In the sources, curiously, this motto remains unrecorded. Needham sees a consistent message running through the philosophical writings enumerated earlier: that correct Taoist practice requires regard for "what may be ascertained about causes and intrinsic principles in Nature." This is how he puts it: "*Wei* 爲, then, was 'forcing' things, in the interests of private gain, without regard to their intrinsic principles, and relying on the authority of others. *Wu-wei* 無爲 was letting things work out their destinies in accordance with their intrinsic principles. To be able to practise *wu-wei* implied learning from Nature by observations essentially scientific." Needham considers

72. II, 57. Here Needham follows Thorndike 1923-1958.

Taoists opposed in this respect to Confucians. Of the latter he asserts that "their rationalism was limited to human society and did not even admit that the world of Nature was worth theorising about at all."<sup>73</sup>

This strongly stated opposition will be discussed later with respect to individual careers of scientists (pp. 49-56 below). First it is necessary to weigh the evidence for the idea that, as an aspect of *wu-wei*, Taoist philosophers urged their readers to learn about principles, to theorize through observation of Nature.

Needham's discussion of empiricism is not documented from the *Chuang-tzu* or *Lao-tzu*. Chuang-tzu's contemporary Shen Tao 慎到 (ca. 300 B.C.) provides the earliest statement: "As regards the people who protect and manage the dykes and channels of the nine rivers and the four lakes, they are the same in all ages; they did not learn their business from Yu the Great, they learnt it from the waters."

Different authorities classify Shen Tao as a Legalist, a Taoist, and an Eclectic. His work has survived only in fragmentary form. Since we have no context for this sentence, both its relation to Taoist thought and its bearing on empiricism are murky. For instance, although the fragment speaks clearly to one empiricist theme, learning from experience of Nature, it appears to contravene another, the cumulative and progressive character of experiential knowledge.

A close translation would differ in detail from Needham's free paraphrase: "Those who control the waterways, shoring up with bundles of sticks, dredging and closing ruptures, even among the barbarians, [use techniques] so much alike that they are practically identical. They learned them from the water, not from Yü the Great," the legendary king who tamed the universal flood. This laconic utterance would seem to be about methods, not principles. In reflecting on whether it is Taoist, a preamble to this passage in the earliest ample collection of the fragments, that of 1578, provides food for thought: "Hsu Fan inquired of Master Shen 'Where do laws originate?' Master Shen said 'Laws do not descend from heaven, or emerge from the earth. They issue from the human realm, in harmony with human hearts and minds. That's all.'"<sup>74</sup> We can hardly take that bit of dialogue as a verbatim recording, nor can we be sure it is ancient. It tells us how readers in the Ming or earlier understood the original fragment. It is anything but a philosophical Taoist reading. No ancient reading of the passage in the style of

73. II, 55, 10, 71, 94 (also 395).

74. [許犯問於慎子曰。法安所生。慎子曰。法非從天下，非從地出，發於人間，合乎人心而已。] 治水者，茨防決塞。雖在夷貊，相似如一。學之於水，不學之於禹也。II, 73; Thompson 1979: 271, fragment 68. See on the same page of Needham the quotation from *Kuan-yin-tzu*, 5. 20b, similarly paraphrased to speak of "those who can think."



Chuang-tzu is recorded.

The extended citations from pre-T'ang works that bear Needham's burden of proof are also not quite about empiricism. One, from the *Huai-nan-tzu*, is part of a long passage that argues for remaining aware of the origins of social order in deeply-rooted human tendencies that even the harshest punishments cannot overcome. It criticizes "the draconic Legalists" for turning their backs on these foundations and thus inventing disastrous methods of government. Needham reads the conclusion as "So therefore, rather than begging or borrowing fire, you had better take a burning mirror, and rather than drawing water from other people's wells, you had better dig one yourself."<sup>75</sup> He then remarks by way of interpretation "finally, go to Nature and not to Authority, make your own fire and dig your own well." A more literal translation would read "therefore begging for fire is not as good as using a firemaker, and depending on someone else to draw water is not as good as digging a well." The point of the passage is not observing while undistracted by authority, but building institutions on the basis of what is inherent in human beings. The fire one starts oneself and the water one draws from one's own well are not more natural than those received from other people. Rather, they represent direct access to the sources of fire and water.

The second text, from the Springs and Autumns of Master Lü (ca. 239 B.C.), "may be considered one of the finest affirmations of the ancient Taoist technologists against the politicians and sophists of their time," but it mentions neither Taoists nor politicians. Its theme is the need to recognize the limits of one's knowledge, and especially to avoid false analogies, a matter stressed as much by Confucius as by Chuang-tzu. It ends, in Needham's translation, "the Sage follows (Nature) in establishing social order, and does not invent principles out of his own head." There are no principles, no Nature, and no technologists in the Chinese.<sup>76</sup> It might be translated literally and in context as "the sage accords [with the actual circumstances] when creating institutions, rather than conforming to his own inclinations."<sup>77</sup>

As these examples indicate, one may venture to question the significance and Taoist credentials of the pre-T'ang evidence Needham brings to bear on the issue of empiricism.

In view of the crucial role that Needham allots to scientific observation in

75. 是故，乞火不若取燧，寄汲不若鑿井。A *sui* can be a mirror, lens, or drill.

76. 聖人因而興制，不事心焉。

77. *Huai-nan-tzu*, 6: 10b; *Lü shih ch'un-ch'iu*, 25: lun 5. 2. 1643; II, 73, translates the whole chapter.

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Taoist philosophy, one is surprised to find him saying that "the Taoists never developed a systematic theoretical account of Nature, analogous to that of Aristotle. The Yin and the Yang, the various forms of *chhi*, the Five Elements [i.e., the Five Phases], were insufficient for the task assigned to them," so that the Taoists' progress was mainly in "all practical technology." These two sentences appear to be asserting that certain Taoists attempted to construct a systematic theoretical account of Nature on the basis of inadequate concepts, and failed. At the same time, Needham does not identify Taoists who were making such an attempt.<sup>78</sup>

Nor does he consider obvious objections. First, systematic theoretical accounts of Nature did appear in the last three centuries B.C., not from Taoists but from literati. Second, how are we to judge adequacy "for the task assigned to them" without specifying what that task was, and perhaps who assigned it? If we are to insist on the criteria of modern science, Aristotle's account, devoid of mathematical abstraction, is just as inadequate. If we are prepared instead to take seriously the expectations of *Chinese in the last three centuries B.C.*, we must admit that they did not find these concepts at all inadequate. We also find them, not only in philosophic treatises but in the emerging technical literature, able to deal abstractly with deep theoretical issues. They did not attain a single, tightly organized consensus, although we find their modes of explanation converging in such matters as Five Phases associations and their articulation with yin-yang explanation. If we move back from Aristotle and look at all of Greek natural philosophy in the same period (before he drowned out his rivals), we find among the schools at least equal diversity.

Nor apparently is Needham convinced that such a failure would prevent the transition to modern science. He notes that "failure to develop adequate scientific terminology was characteristic of medieval European science, and this was one of the limiting factors which the upsurge of the Renaissance swept to one side."<sup>79</sup> Note that Chinese and Greek "limiting factors" were not things or phenomena, but rather *failures* of something to happen. Pondering that logical difficulty, we are left with the unanswered question of why the Chinese "limiting factor" was not "swept to one side" as well.

**Avoidance of Preconceptions.** The scientific empiricist not only observes Nature, but does so without the preconceptions that blind others to the actual phenomena. In this respect too Needham considers Taoism and Confucianism opposite: "the observation of Nature, as opposed to the management of society, requires a receptive passivity in contrast to a commanding activity, and a freedom

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78. II, 84.

79. IV. 3, 403, note d.

from all preconceived theories in contract to an attachment to a set of social convictions." Now "what was the main motive of the Taoist philosophers in wishing to engage in the observation of Nature? There can be little doubt that it was in order to gain that peace of mind which comes from having formulated a theory or hypothesis, however provisional, about the terrifying manifestations of the natural world surrounding and penetrating the frail structure of human society. . . . This distinctively proto-scientific peace of mind the Chinese knew as 'ching hsin 靜心.'"<sup>80</sup>

Needham then quotes the Writings of the Gatekeeper (*Kuan-yin-tzu*) on the sage's freedom from the obsessions that lead others to be possessed by demons: "for every day the sage faces the facts of Nature, and his mind is untroubled."<sup>81</sup> A literal translation might be "for every day the sage is responsive to the totality of phenomena (*wu* 物), his mind stilled," i.e., in a state of incipience.

On the same folio of the source, an epigram reminds us that for the Gatekeeper *wu* are not facts: "When one recognizes that there are no *wu* in the mind one knows that there are no *wu* in *wu*. Recognizing this, one knows there are no *wu* in the Way. Thus one is neither moved to emulate exceptional conduct nor to admire subtle and penetrating discourse [and so on]." In another place the book tells us that "of the myriad phenomena (*wu*) in sky and earth, not one is my own *wu*. Although *wu* are not my own self, I have no choice but to respond to them. Although I am not my own self, I have no choice but to cultivate my self. Although [I] respond to *wu*, there is no such thing as *wu*. Although [I] cultivate my self, there is no such thing as my self . . . The Way is one; that is all there is to it. It cannot be approached by ordered progression."

*Wu* in this late book, obviously much influenced by Buddhism, are phenomena in the mystic's sense, mere appearances, individually of no greater interest to the sage than images are to the mirror. Sage and mirror are "responsive" in the sense that they reflect phenomena. The presence or absence of theoretical preconceptions is not an issue.

Another key passage that Needham cites from Writings of the Gatekeeper to illustrate "the old theme of the necessity of being without partiality or preconceptions" turns out to be equivocal evidence. He translates ". . . the sages were taught by the myriad things, and in their turn taught the worthies, who taught the people. But only the sages could understand the things (in the first place); they could unify themselves with natural principles, because they had no prejudices and pre-

80. II, 57, 446-448, 63.

81. 日應萬物。其心寂然。

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conceived opinions." A plain English version of the phrase after the semicolon might be "only the sages were at one with the phenomena, and therefore devoid of self."<sup>82</sup> There is nothing in the Chinese about natural principles, prejudices, or preconceived opinions. It is about not rational inquiry, but the intuitive oneness with the world around them that furnished sage rulers with patterns for social institutions. What sages have overcome is not presuppositions but the illusions of selfhood.<sup>83</sup>

Needham presents a short passage from *Huai-nan-tzu* as an injunction to seek a unitary principle in Nature: "He who is of an intelligent nature is not terrified by any of Nature's operations; he who is wise by experience is not disturbed by any strange phenomena. The sage infers the far from the near, and concludes that the myriad things are based upon a single principle." More literally, the part of the source that corresponds to the last sentence says "Thus one who has attained sagehood understands what is distant from what is close at hand, so that all the diversity (of the phenomena) becomes one."<sup>84</sup> Again the word "principle" has no Chinese counterpart. Again the sage ruler seeks, not to draw a conclusion from study, but to merge himself with the world in all its particularity, social and physical, by a leap of intuition or illumination. He does so, this chapter asserts, in order to create a balance in the political order that can be achieved only by harmony with the cosmic balance.

Needham sees meditative activities as perfectly compatible with investigations aimed at the public welfare: "Thus 'emptying the mind' did not mean emptying it of that true natural knowledge which Chuang Tzu contrasted with the false knowledge of feudal social distinctions, but rather emptying it of distorting memories, prejudices and preconceived ideas, so that true practical knowledge might flourish and all abundance come in its train. The absolute justification of this complex of thought is seen in the great inventions of ancient China, as, for example, the use of water-power." But where do we find promises of material abundance and exhortations to hydraulic innovation in the *Chuang-tzu*?

The closest Needham comes to giving an answer is in the famous *Chuang-tzu* story of the old man who carries water out of his irrigation well by hand, refusing to use a simple dipping machine because "those who have cunning devices . . .

82. 唯聖人同物，所以無我。

83. II, 67, 447; *Kuan-yin-tzu* 5. 18b-19a; 9. 31b-32a; 3. 10a. For *chi-jan* see the Great Commentary to the Book of Changes, A. 9. This literal translation cannot convey the metaphysical depths of this passage, e.g., the distinction between the "I" and the "self," both written with the same Chinese word. Cf. Steininger 1953: 40.

84. II, 66; *Huai-nan-tzu*, 8: 4a-4b. 故聖人者由近知遠，而萬殊爲一。

have cunning hearts." This and similar anecdotes elsewhere Needham explains by "the popular feeling that whatever machines or inventions might be introduced it would be only for the benefit of the feudal lords; they would either be weighing-machines to cheat the peasant out of his rightful proportion, or instruments of torture with which to chastise those of the oppressed who dared to rebel." How a swape (*kao* 槲) could be used in either way is not obvious. Chuang-tzu's "anti-technology complex" sits uncomfortably with Needham's claim that the philosopher advocates "emptying the mind" as a means to prosperity for all.<sup>85</sup>

Needham acknowledges the contradiction when he translates two excerpts from Writings of the Gatekeeper that mix "magic, experimentation, bodily culture, and the invulnerability complex...suggesting that techniques should be used for the understanding of Nature *rather than* for benefiting human society." But these passages too are about attaining spiritual power and charisma rather than with either scientific investigation or social benefits of technology.<sup>86</sup>

What I have discussed in this section is the picture of Taoist empiricism sketched by Needham in 1956. It does not change noticeably in later volumes (see, for instance, p. 35 above).<sup>87</sup>

**Summary of findings.** Let me sum up the results of this discursive inquiry into linkages of Taoist philosophy and scientific attitudes. Needham's case for empiricism is not built on the *Chuang-tzu* and *Lao-tzu*, but on works of a more eclectic nature. His evidence for the constituents of empiricism—recourse to experience of Nature rather than to authority, avoidance of preconceptions that interfere with experience—consistently refers instead to the responsive and creative stilling of the mind practiced by mystics in more than one religious tradition. Its aim is not science. More than that, it is not knowledge.

One must agree with Needham that the indigenous Chinese forms of mysticism did not rule out acceptance of the natural order, or curiosity about it. But early Chinese sources do not say that "to be able to practise *wu-wei* implied learning from Nature by observations essentially scientific." The most famous Taoist master of the T'ang period expressed quite the opposite view.

85. II, 89, 124–125; *Chuang-tzu*, 12: 55, one of the "outer chapters."

86. II, 449, my italics.

87. One finds an occasional reflection concerned less with philosophical attitudes and more with practice. For instance, on optics, "The Taoists might talk about the wonders and beauties of Nature, the Naturalists might bring forward their generalised explanations of her phenomena, the Logicians might argue about the proper way of discussing, but only the Mohists actually took mirrors and light-sources and carefully looked to see what happened" (IV, 1, 78).

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In 711 "the emperor summoned Ssu-ma Ch'eng-chen, the Taoist master of Mt. T'ien-t'ai, and asked him about yin-yang and the disciplines based on study of regularities (*shu-shu* 數術)." This term refers to both quantitative and qualitative methods of prediction, from computational astronomy to fortune-telling. Ssu-ma replied "One devoted to the Way does less and less until he reaches the stage of no purposive action (*wu wei*). Why should he be willing to tax his mind with the study of regularities?" When the emperor went on to ask whether one can govern a state that way, he went on "The state is just like the self. If you go along with the spontaneity of phenomena, and you have nothing selfish in your mind, the state will become ordered." The story ends with Ssu-ma receiving the emperor's permission to return to his mountain.<sup>88</sup>

Three other components of the empiricism argument call for further thought:

1. Needham asserted in 1959 that Taoists failed to construct a systematic theoretical account of Nature because their concepts were inadequate. Since then, Needham and many others have demonstrated that there were systematic theories and that they used just those concepts. They are not concentrated in treatises on philosophy but in technical writings on medicine, alchemy, geomancy, etc. No one has shown that any of these theories originated in or were the particular property of a Taoist movement. One can only agree with Strickmann's profound study of alchemy in the origins of the Supreme Purity movement: "As for all the technology, I see no reason to call it 'Taoist' except where it occurs in an indubitably Taoist social context." Strickmann suggests that alchemy and other arts be "visualized as separate entities, weaving in and out of Taoist (and other) contexts in the course of history, rather than as somehow being integral parts of a 'Taoism' that depends on them for its definition yet lacks any social dimension."<sup>89</sup>

2. The generalization that Confucians (undefined) limited their rationalism to human society "and did not even admit that the world of Nature was worth theorizing about at all" sets up a general Taoist/Confucian dichotomy. Confucius and his immediate successors were, to be sure, humanists, but the neo-Confucian orthodoxy of the second century B.C. was built around parallels between the state and the cosmos. It was grounded in theorizing about Nature. It so successfully absorbed the ideas of the *Chuang-tzu* and other unconventional books that, however many formal contradictions the undergraduate may easily identify, one can no longer speak of Taoist and Confucian philosophies engaged in conflict.

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88. II, 7, II, 71. The anecdote is from the comprehensive history *Tzu chih t'ung chien* 資治通鑑, 200: 6669-6670. Ssu-ma uses the language of *Lao-tzu* 48. For the context see Schipper 1982: 140 and Benn 1987. Ho Peng Yoke 1991 explains *shu*.

89. Strickmann 1979: 166.

3. The Baconian and Newtonian stress on avoiding preconceived theories has maintained a strong influence upon British philosophy, a field on which Needham made an enduring mark long before he began writing on Chinese science.<sup>90</sup> Historians of science in the last couple of decades, however, have tended to see this seventeenth-century notion not as an accurate reflection of the method that generated modern science, but as a specious claim meant to impress laymen with the superiority of the new science over scholasticism. Experimental science proceeded in early modern Europe, as it does now, by hunches, gambles, and premonitions, undesirable only if they are badly founded or uncritically maintained.

One should thus hardly be offended by preconceptions in the science of ancient China. Among the most common are the ideas that the cosmos is an organic whole, that a universal Tao comprises the tao of each individual phenomenon, and that the void state of meditation provides access to an underlying reality that abstract principles cannot encompass.<sup>91</sup> They were no more inimical to discovery than the Christian faith of the Oxford theologians who worked out the mathematical behavior of falling bodies.

The doubts conveyed above do not settle the question of Taoism and scientific attitudes. Empiricism is only one aspect of Needham's broad approach. When one evaluates his arguments that agnostic naturalism, mechanism, materialism, experimentalism, democracy, and collectivism were inherent in early Taoist philosophical writings, the problems I have raised are typical. In many instances, when the evidence is interpreted literally it does not support Needham's thesis. In others, the plausibility of the argument depends on how one defines vague terms. The reader will already have noticed that most of the isms just listed are notably vague.

If the case is unproven for a tight connection between Taoist philosophy and scientific attitudes, what can we now conclude about the role of Needham's threefold Taoism in the history of science?

1. Popular religion and orthodox Taoism overlapped considerably, but whether a given instance of liturgy, self-cultivation, magic, or divination was Taoist must be determined individually.

2. By almost any common stereotype of "Taoist" (naturalist thinker, dropout, priest, iconoclast, magician, official at home in the evening, etc.), a certain number of *fang-shih* (varying in each case) would undoubtedly qualify as Taoists. The only definition that makes all *fang-shih* Taoist is tautologous. It reveals merely that someone considered someone (about whom perhaps nothing more is known)

90. Nakayama 1973: 23-30.

91. On this last theme within science see Sivin 1989.

competent in marginal disciplines. Whether a given *fang-shih* was a Taoist by a given definition must be determined individually.

3. The authors of the *Lao-tzu* and similar books influenced other schools and inclinations. From the Han on, one can no more call this interaction "influence" than one would use that word for the role of vegetables in a stew. There is no doubt that the *Lao-tzu* etc. contributed to the Han neo-Confucian stew a spirit of openness toward Nature. At the same time Taoist philosophers were not responsible for the move of Confucianism away from humanism. One must also look within Han orthodoxy at the radiating influence of the Book of Changes as its commentaries reinterpreted it and made it part of the synthesis. The mountain of erudition in *Science and Civilisation in China*, in Needham's other writings, and in the publications of Sinologists who agree with it, has yet to prove, in concrete cases, that Taoist philosophers motivated concrete scientific explorations to an extent that other intellectual convictions did not. What seem to be instances of this motivation must be evaluated one by one.

4. It is impossible to settle the question of links between Taoism and science by confronting doctrinal or canonical texts on a high level of abstraction. After examining Buddhist scriptures it is natural to conclude, at least as a broad and preliminary generalization, that "in the last resort, Buddhism was a profound rejection of the world . . . One of the pre-conditions absolutely necessary for the development of science is an acceptance of Nature, not a turning away from her." But then one is left unprepared to encounter individuals such as I-hsing (682/683–727), a major figure in both Tantrism and mathematical astronomy, or the T'ien-t'ai monk Tsan-ning 贊甯 (919–1001?), a devotee of natural history and physical studies who nevertheless earned the epithet "Tiger of Monastic Discipline."<sup>92</sup>

**Taoism as a spirit.** History is too subtle a matter to be neatly encompassed by definitions. As much may be lost by rigidly adhering to them as by not using them. It is necessary to consider a different aspect of Needham's Taoism.

Needham's Taoism is not only three sets of practices and convictions that affected Chinese civilization in particular ways. It is also a spirit, a cast of mind: curious, devoted to Nature, undistracted by convention, aware in a past-oriented society that the future can be shaped, convinced that when they strive for the social good all men and women stand on the same high level. This spirit shines through Needham's portrayals of individual scientists. It is the mind-set of modern science—not of what it is, but of what scientists who strive to be more than technicians tend to believe it should be. Most of these ideals were definitively

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92. II, 430–431. On I-hsing see Ang 1979 and the table on pp. 51–54 below; on Tsan-ning, Franke 1976: 1040–1046.



stated in the 1660's, and are often restated today. Needham held them high. They are, I think, largely responsible for his remarkable eloquence in portraying the science of all ages and places as part of an ecumenical and convergent enterprise.<sup>93</sup>

This most original and ample of all Needham's Taoisms subsumes the others, and ultimately determines the character of the linkage with science—or, to put it more exactly, the linkage from science. Needham's starting point was his view, formed by scientific and historical research, of what science has always been about.<sup>94</sup> His search in the scholarship on Taoism for this spirit led him toward the three aspects I have just discussed.

This is an ideal picture of science, not a description of Taoism. It does not correspond to what the documents of any Taoism reveal and to what its most penetrating students understand. But these objections are disabling only if Needham's work is misread as an attempt to write a definitive history of Chinese science. He made it clear at the outset that it is meant as "but a reconnaissance" addressed "not to sinologists, nor to the widest circles of the general public, but to all educated people, whether themselves scientists or not, who are interested in the history of science, scientific thought and technology, in relation to the general history of civilisation."<sup>95</sup> His picture of Taoism, as of much else that scientists, engineers, and physicians would find exotic, is heuristic. It has justified itself by holding the attention of readers who otherwise would never have given a moment's critical reflection to ancient Chinese thought and practice.

For two thousand years Taoism has been a religion, a matter of the spirit, as well as a social affiliation. No history that fails to consider both aspects can be fully adequate. But the flaw in Needham's account is confounding faith and collectivity, and reading modern ideals into both.

The old cliché has it that every gentleman was a Confucian at work and a Taoist at leisure. True; that is all that survived of the dissenting spirit of the *Chuang-tzu* once the book had been conventionalized and trivialized. The cliché tells us nothing about any class of Taoists except the one it defines: the class of all gentlemen at leisure. When these "Taoists" are mistaken for, say, the class of initiates who shaped the orthodox religion, or the class of artisans associated with the evolution of technology, the potential for misunderstanding is obvious. So long as we avoid this blurring of thought, even clichés can tell us something about the career of Taoism that we ignore at our peril.

93. For a cogent statement of this view see Needham 1973.

94. Nakayama 1973.

### *Great Scientists*

It should be possible to circumvent the shortcomings of philosophical and other doctrines as a guide to the attitudes of particular human beings by examining the affiliations of individual scientists. That is what I now propose to do. In this section I will examine the careers of a group of men and women consistently numbered among the greatest scientists, physicians, and practitioners of technology in traditional China. I will ask how many were Taoists, and in what sense.

The table on pp. 51-54 includes all those represented in the two best general collections of scientific biographies, supplemented by a few outstanding names chosen from two more specialized collections of scientific biographies, one on medicine and one on Sung and Yuan mathematics and astronomy.<sup>96</sup> The table thus includes those considered by specialists to be of the first rank in the history of science, and an assortment of others nearly as famous. There is bound to be a great deal of arbitrariness in the composition of any reasonably short list. Nevertheless, after a number of mental experiments in substituting names, I believe that a wide range of changes would not greatly affect the outcome.

The tastes of modern Chinese scholars are, of course, different from those of most historians of European science. This list is more catholic in its range of pursuits and social backgrounds than what one would expect to see in a corresponding list devoted to Western science, medicine, and technology for the past 2500 years, or for that matter in any list based on the preferences of Chinese historians before modern times. That breadth recommends this selection for my purpose.

The table provides data on a far from simple issue. When we ask which of a group of scientific figures were Taoist, what definition of "Taoist" makes sense? If we admit every sense habitually used by Sinologists, the interest in technical matters that all these people shared would obviate biographical study. A Buddhist patriarch and a career bureaucrat who belonged to an orthodox school of Confucianism would be equally Taoist.

The obvious alternative is the narrow criterion of initiation. It lets us know, at least, what we are dealing with. Still, the simplicity of the criterion may distract attention from less clear-cut but no less interesting characteristics shared by many scientists. I have adopted neither extreme, but have attempted in investigating the

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95. I, 5, 8.

96. Li Kuang-pi 李光璧 & Ch'ien Chün-yeh 錢君曄 1955; Li Yen 李儼 1963; Jen An 鞠庵 1963; Ch'ien Pao-ts'ung 钱宝琮 et al. 1966.

careers of these thirty-nine people to look for any obvious pattern.

In the brief summaries of careers and contributions, I have characterized each scientist by occupation or intellectual concern, and specified one or two well-known achievements. The table pays special attention to formal religious affiliations and to civil service careers. It notes biographies in the Standard Histories as indications of conventional success. To indicate stereotypes, it records the labels (such as technician, *fang-chi*) under which certain biographies are grouped. It notes accounts in treatises on immortals in the Taoist Canon, not as proof of initiation, but to signify that the individual has played a role in the ideology of immortality. What that role was can be determined only by studying each account.

The most striking result to emerge from the table is that most of the people listed were regular civil servants. At least fifteen of the thirty-nine had full careers in the bureaucracy. Other careers were interrupted by dynastic transition or personal choice. On the other hand, only four subjects are accorded biographies in the various "lives of the immortals." Three of these four, Ko Hung, T'ao Hung-ching, and probably Sun Ssu-mo as well, were Taoist initiates. One, Hua T'o, was a legendary physician and surgeon whose marvelous exploits the hagiographies merely retell from the Standard Histories.<sup>97</sup>

Ko, T'ao, and Sun are conspicuously connected with laboratory alchemy as well as medicine. The connection between the two fields is not surprising, since the materials, implements, and methods of alchemy were largely derived from pharmacy. Claims that alchemy made important contributions to medicine are generally expressions of faith, not based on documented comparisons.

Hardly less striking is the unimportance of links with more ambiguous senses of "Taoist." For few who were not initiates does some indication of an interest in Taoist philosophy or religion emerge from the biographical information. When it does, its significance is regularly ambiguous.

There is a famous anecdote from I-hsing's childhood about an encounter with the Taoist master Yin Ch'ung 尹崇 at the Abbey of the Dark Capital (Hsuan-tu Kuan 玄都觀) in Ch'ang-an. Yin was amazed at how quickly the boy memorized the Canon of Supreme Mystery (written, as Chap. III indicates, squarely in the interest of Confucian orthodoxy). Tzu Ch'ung-chih compiled commentaries on the *Lao-tzu* and *Chuang-tzu*, hardly eccentric even for a conventional literatus in

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97. Of the three biographies of Hua in the *Tao tsang*, that in *Li shih chen hsien t'i tao t'ung chien* 歷世真仙體道通鑑, 20: 10a-10b, and the second in *San tung ch'ün hsien lu*, 8: 4b, copy the *Hou Han shu*, cited in the table. The first biography in *San tung ch'ün hsien lu*, 1: 20b-21a, copies the *San kuo chih* version. For the Indian origins of the Hua T'o legend see Ch'en Yin-k'o 1930. For Sun, see Chap. VI, n. 18.

## FAMOUS CHINESE SCIENTISTS, PHYSICIANS, AND TECHNOLOGISTS

NAME	DATES	BIOGRAPHIES IN HISTORIES	TYPE	BIOS. IN '77	TAO IST?	REFERENCES	CAREER
Ch'in Yueh-jen 秦越人 (Pien Ch'ueh 扁鵲)	fl. ca. 501 B.C.?	<i>Shih chi</i> , 105	shared	none	no	Li 7-9	Physician, deified; case records attributed to him survive
Kung-shu Pan 公輸般 or Lu Pan 魯班	born after 470?	none	none	none	no	Li 1-6	Semi-legendary artisan and inventor, deified
Li Ping 李冰	fl. ca. 250	none	none	none	no	IV, 3, 288-296; Li 11-14	Career official; he and son built Kuan-hsien (Szechwan) water transport and irrigation system; deified
T's'ai Lun 蔡倫	ca. A.D. 57-ca. 121	<i>Hou Han shu</i> , 68	eunuchs	none	no	Li 15-17	Eunuch, career official, classicist, ennobled; invention of paper attributed to him
Chang Heng 張衡	78-139	<i>Hou Han shu</i> , 49	own	none	no	Sun 1935; Lai 1956	Career official, inventor, instrument-maker, astronomer, cosmologist, poet
Hua T'o 華佗	ca. 145-ca. 208	<i>Hou Han shu</i> , 72B; <i>San kuo chih</i> , Wei, 29	technicians ( <i>fang-shu</i> 方術, <i>fang-chi</i> 方伎)	2	no	Li 37-41	Legendary physician; prodigious feats of surgery, diagnosis, use of anesthesia
Chang Chi 張機 (Chung-ching 仲景)	ca. 150-ca. 219	none	none	none	no	Li 31-36	Physician; systematic approach to therapy
Ma Chun 馬均	fl. 220/250	none	none	none	no	IV, 2, 39-42, 158; Li 42-47	Inventor; south-pointing chariot, ballistae, looms, water-raising machinery, mechanical puppets, etc.
P'ei Hui 裴秀	224-271	<i>Chin shu</i> , 35	shared	none	no	Li 48-53	Career official, cartographer, ennobled
Liu Hui 劉徽	active before 263	none	none	none	no	Ho in DSB; Wagner 1975: 4	Mathematician, career unknown

Ko Hung 葛洪 (Pao-p'u-tzu 抱朴子)	283-343	<i>Chin shu</i> , 72	shared	7	yes	Li 55-59	Official, wrote books he called Taoist and Confucian, ennobled; medical author; amateur of alchemy, immortality
Tsu Ch'ung-chih 祖沖之	429-500	<i>Nan Chi shu</i> , 52; <i>Nan shih</i> , 72	litterateurs	none	no	Li 61-72	Official, mathematician, astronomer, mechanic, classicist
T'ao Hung ching 陶弘景	456-536	<i>Liang shu</i> , 51; <i>Nan shih</i> , 76	recluses ( <i>ch'u-shih</i> 處士; <i>yin-i</i> 隱逸)	many	yes	Mugitani 1976; Strickmann 1978a	Official, polymath, medical scholar, creator of Mao Shan movement with imperial patronage
Li Tao-yuan 顧道元	465 or 472-527	<i>Wei shu</i> , 89; <i>Pei shih</i> , 27	harsh officials; shared	none	no	Li 73-78	Career official, geographer, classicist
Chia Su-hsieh 賈思勰	fl. 532/555	none	none	none	no	Amano 1978	Official, agriculturalist
Li Ch'un 李春	fl. ca. 605	none	none	none	no	IV. 3, 175-178; Li 97-99	Career unknown; planned and built famous Hopei bridge
Sun Su-mo 孫思邈	alive 673	<i>Chiu Tang shu</i> , 191; <i>Hsin Tang shu</i> , 196	technicians; recluses ( <i>yin-i</i> )	6	probably	Sivin 1968: 81-144	Physician and alchemist, courtier, legendary figure in both Taoist and Buddhist writing
I-hsing 一行 (secular name Chang Sui 張遂)	682/683-727	<i>Chiu Tang shu</i> , 191	technicians	none	no	Li 1965; Ang 1979	Ch'an monk, then Tantric patriarch, astronomical official; astronomy, mathematics, clock design, meridian survey
Wang Ping 王冰	ca. 710-805	none	none	none	no	Okamishi 1958: 5	Medical scholar, military and civil administrator
Pi Sheng 畢昇	fl. 1041/1048	none	none	none	no	Li 119-122	Commoner; movable-type printing
Su Sung 蘇頌	1020-1101	<i>Sung shih</i> , 340	shared	none	no	Needham, Wang & Price 1960: 5-9; Li 135-144	Career official, prime minister, polymath; planned astronomical clock, compiled materia medica
Shen Kua 沈括	1031-1095	<i>Sung shih</i> , 331	shared, appended	none	no	Holzman 1959; Sivin 1975	Career official, polymath; contributions to every field
Li Chieh 李誠	d. 1110	none	none	none	no	Yetts 1927; Yü 1959	Career official, polymath, artist; architectural standards

Li Chieh 李誠	d. 1110	none	none	none	no	Yetts 1927; Yü 1959	Career official, polymath, artist; architectural standards
Liu Wan-su 劉完素	b. ca. 1110	<i>Chin shih</i> , 131	technicians	none	no	Jen 75-80; Rall 1970: 38-52	Physician, deified
Chang Ts'ung-cheng 張從正	ca. 1156-ca. 1228	<i>Chin shih</i> , 131	technicians	none	no	Jen 81-85; Rall 1970: 52-58	Physician, briefly Imperial Physician
Li Kao 李杲 (Tung-yuan 東垣)	ca. 1180-1251	<i>Yuan shih</i> , 203	technicians	none	no	Jen 86-90; Rall 1970: 58-69	Physician, wealthy
Li Yeh 李冶 (or Li Chih 李治)	1192?-1279?	<i>Yuan shih</i> , 160; <i>Hsin Y. s.</i> , 171	shared	none	no	Ch'ien 1966: 104-148; Ho in DSB	Mathematician, man of letters, high exam rank, briefly official
Ch'in Chiu-shao 秦九韶	1202-1261?	none	none	none	no	Ch'ien 1966: 60-103; Libbrecht 1973: 22-30	Mathematician, military and then civil official, corrupt
Yang Hui 楊輝	fl. ca. 1261/1275	none	none	none	no	Ch'ien 1966: 149-165; Lam 1977	Mathematician, official
Kuo Shou-ching 郭守敬	1231-1316	<i>Yuan shih</i> 164; <i>Hsin Y. s.</i> 171	shared	none	no	Li 1966	Career official, astronomer, hydraulic engineer
Chu Shih-chieh 朱世傑	fl. ca. 1280-1303	<i>Hsin Yuan shih</i> , 171	shared, appended	none	no	Ch'ien 1966: 166-209; Ho in DSB	Mathematician, teacher of mathematics
Huang Tao-p'o 黃道婆	fl. ca. 1296	none	none	none	no	Li 165-170	Entrepreneur, deified; cotton manufacture
Wang Chen 王禎	fl. 1295/1300	<i>Ming shih</i> , 289	loyal officials	none	no	Li 151-155; Amano 1967	Model official, inventor, scholar of agriculture
Chu Chen-heng 朱震亨 (Tan-hsi 丹溪)	ca. 1281-1358	<i>Yuan shih</i> , 189	Confucians	none	no	Jen 91-96; Rall 1970: 69-95	Physician; initiate of Chu Hsi school
Li Shih-chen 李時珍	1518-1593	<i>Ming shih</i> , 299	technicians	none	no	Chang 1954; Sivin 1973	Physician, man of letters, briefly medical official
Hsu Kuang-ch'i 徐光啓	1562-1633	<i>Ming shih</i> , 251	shared	none	no	ECCP 316-319	High official, pious Christian, astronomer, translator, agriculturalist
Hsu Hung-tsu 徐宏祖 (Hsia-k'o 霞客)	1586-1641	none	none	none	no	Li Chi 1974: 13-22	Explorer, geographer

Sung Ying-hsing 宋應星	1587-ca. 1665	none	none	none	no	ECCP 690-691; P'an 1990	Career official until Ch'ing, technological encyclopedist, cosmologist
Minggantu 明安圖	ca. 1692-1763	none	none	none	no	Li 1978	Mongol, career astronomical official, mathematician, cartographic surveyor

### Notes

1. Sources cited without dates: DSB=Gillispie 1970-1990, s.v.; ECCP=Hummel 1943-1944, s.v.; Li=Li Yen 1959; Jen=Jen An 1963.
2. To indicate type of biography in the Standard Histories, "shared" means that the biography takes up part of a *chüan* labelled by the names of the subjects rather than by type, an indication of prestige. "Appended" indicates that the subject's biography is appended to that of a more famous relative or teacher. The titles of biographies grouped by type are noted.
3. Only the number of biographical accounts in the *Tao tsang* is noted; for full references see Weng 1935.
4. Only one or two citations are given here, with preference for a scholarly monograph if available and Li 1959. A reference to the latter alone usually means that my characterization is based mainly on primary sources.
5. In dates, the form "1210/1215" means "some time between 1210 and 1215."
6. Persons listed here were chosen because they are generally known, and appear regularly in biographical collections. Sources for more detailed studies include Chuang Wei-feng 1989 (2300 astronomers), Li Ching-wei 1988 (6000 physicians), and Li Yun 1989 (10,500 physicians) or, for local studies, to mention only two on Kiangsu, Hsu Po-ch'un 1983 and Ch'en & Hsieh 1985.

the late fifth century. Su Sung produced a critical edition of the *Huai-nan-tzu*.

But these involvements must be weighed against other themes in each career. F-hsing was committed to the life of a Buddhist monk by the time he reached maturity. Tsu Ch'ung-chih also annotated the Confucian Analects and the Canon of Filial Piety. Su Sung's literary remains testify to his overwhelming activity on behalf of "state Confucianism" (i.e., the imperial cult), including its religious aspect. His prefaces to several Buddhist writings survive. Men of letters were seldom forced to choose between religious or philosophic enthusiasms. These data remind us that the two Taoist classics were an integral part of high culture, and that curious people tend to be curious about a great many matters.<sup>98</sup>

In this group every instance of a Taoist involvement short of initiation is counterbalanced by involvements that can be stereotyped as Confucian or Buddhist. It is surprising that no peripheral but clearly partisan Taoist affiliations have surfaced among these thirty-nine figures. No doubt less superficial research than mine and that of my secondary sources will reveal a few. At the moment practically nothing is known about the lives of several people on the list. But it will take more than a few such affiliations to justify concluding from "Taoist" quotations, encounters, or book titles that the people involved were empiricists, agnostic naturalists, democrats, etc.

The pattern of biographies in the Standard Histories supports the hypothesis about *fang-shih* advanced above (p. 30). Twenty-three of the thirty-nine scientists have biographies in the Standard Histories. Only one of these, Chang Heng, has a chapter of his own. Ten share an unlabeled chapter with others, which indicates uncomplicated elite status. Of the various labels under which the biographies of thirteen people fall, only "technicians" (*fang-chi*, *fang-shu*) and "recluses" recur. The rubrics that occur only once include eunuchs, litterateurs, harsh officials, loyal officials, and Confucian scholars.<sup>99</sup>

A bias in the biographic approach works to the detriment of those who did

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98. For the texts that Tsu annotated see his two official biographies. The preface to Su Sung's ed. of the *Huai-nan-tzu*, compiled from recensions in the imperial library and the collection of his own family, still exists. It is entirely concerned with bibliographic detail, and expresses not a hint of interest in the content of the book (*Su Wei-kung wen chi* 蘇魏公文集, 66: 7a-8b). For his prefaces to Buddhist writings see 67: 7b-12b. His interest in the subject matter emerges clearly in these. On Su see also Weng Fu-ch'ing 1986.

99. For Chu Chen-heng's prominent position in the orthodox line descended from Chu Hsi 朱熹 (1130-1200), see *Sung Yuan hsueh an* 宋元學案, 82: 39a. The biographical notice there asserts that Chu studied medicine as the best means to practice the ethical principles he learnt from his teacher Hsu Ch'ien 許謙 (1199-1266).



not follow conventional careers, including Taoist and Buddhist clerics. We are most reliably and usually most fully informed about the lives of the regular bureaucrats, the "Confucians" of current clichés. For instance, among the most important alchemical authors were the unknown author of the *Chou i ts'an t'ung ch'i* 周易參同契 (second century A.D. or later) and Ch'en Shao-wei 陳少微 (fl. ca. 712?). We know nothing about the life of either, so they do not appear in the biographical collections. Medicine is not badly covered, since it was practiced at every level of society, but mathematics and astronomy are no doubt underrepresented. Siting ("geomancy")<sup>100</sup> does not appear at all, due in part to the same paucity of biographical information, and in part to its modern official classification as superstition. The names of most inventive craftsmen and engineers are not recorded.

Even when due regard is paid to this bias, the conclusion is inescapable. The only regularity conspicuous among scientists is official position. With a very few exceptions, neither the texts of the Taoist philosophers nor the allegiances demanded by the Taoist religion played a dominant role in the lives of the best-known scientists, physicians, and technologists. The sources disclose the usual concomitants of office, aristocratic status or family traditions of prestige, the privileged upbringing that marked the highly educated. The Tantric patriarch and all three Taoists belonged to great families with long office-holding traditions. I-hsing, T'ao, and Sun were intimates of emperors, and Ko an ennobled military and civil officer. These were hardly resolute enemies of "feudal bureaucratism."

### Conclusions

This biographical investigation supports the conclusion based earlier on a critical examination of Needham's hypotheses. There is no evidence for any regular and necessary link between Taoism and science that will let us predict, given an individual's affiliation to one Taoism or another, that we will find attitudes friendly to scientific investigation; nor, given an individual's involvement in science, technology, or medicine, that we will find Taoist motivations.

This is true whether we consider the philosophy or the religion. The other dozen or so "Taoisms" frequent in Sinological publications merely confuse the issue. Previous hypotheses have relied heavily on the "Taoism" of the *fang-shih*. As we have seen, that label and its synonyms tell us only that someone has mastered an art and that the writer does not consider him a peer. They tell us nothing about his alignment with any other Taoism.

100. Bennett 1978.

This clearing of the air would have been a great deal more difficult had it not been for the scholarly care with which Needham built and documented, on his usual bold scale, the most substantial set of hypotheses about the relations of Taoism and science. This view, formed in the 1950's, reflected the conventions of the time. By his participation in the meetings that formed modern studies of Taoism, Needham also encouraged the emergence of a more adequate view.

What part of his argument is likely to survive for more than heuristic purposes? The part that is at the same time most subtle and most central, and perhaps most likely to be overlooked as studies of Taoism become more specialized.

I remarked earlier that Needham means most fundamentally by "Taoism" a spirit that infuses science, that defines a timeless fellowship, curious, skeptical, honoring experience above authority, valuing Nature in its own right, willing to unite the manual and the intellectual, and so on. Believing that this spirit is necessary for science to flourish, he discovered that the *Chuang-tzu* and the *Lao-tzu* expressed some of these themes for the first time. Not every aspect, to be sure, but more than are found in other classics before the Han synthesis. This perception is true. That is obvious when we find the great physicist Hideki Yukawa reminiscing that the *Chuang-tzu* taught him serendipity. But it is true only so long as, like Yukawa, we read the *Chuang-tzu* as a timeless classic.<sup>101</sup>

Why, then, are we unable to trace the spirit in the flesh? Why do particular arguments about "the Taoists" in the history of science after 250 B.C. turn out to be so equivocal? Why do we not find these Taoist notions playing an overwhelming role in the particular motivations and imaginations of most great scientists?

These philosophies represent a short and in some senses a transitory interval in the long history of China's encounter with the Way. The *Chuang-tzu* and *Lao-tzu*, two very different statements that began the tradition, unite popular beliefs and mystical striving with profound esthetic impulses. To Chinese readers of later centuries they were, rather than the inception, two culminations of an archaic view of man and Nature. All but a few critical scholars believed that Lieh-tzu, Kuan-yin-tzu, and their ilk were also archaic Taoist philosophers. Only in recent times are they generally understood to be late imitations and extensions of the two pre-Han books.

Just as the philosophers of the Tao drew on early popular traditions, well before the Later Han they had ceased to speak—if indeed they ever did—to a restricted audience of "Taoists." They were integrated—along with the Book of Changes and other "Confucian" writings—into a spectrum of comprehensive

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101. Yukawa 1973: 64–69.

world-views to which every educated person had access. They were ceasing to be uniquely Taoist at just the moment when Ssu-ma T'an's effusion about a "Taoist school" was first suggesting to many generations of careless readers that there had been a single Taoist philosophy.

To the educated reader from the Han on, the *Lao-tzu* was not the spearhead of a movement that might well strike terror in the mind of a feudal bureaucrat. It was a text that spoke to everyone, not only to aspiring mystics but to careerists and indeed to emperors. To the Taoist initiate it was not a supreme canon, and did not proclaim opposition to the established order. It became one among many epochal divine revelations. It became a mighty spell when recited. Imperial cults used the book from the second century B.C. on to proclaim that the established order of society was in fact the promised millennium.

Needham has left us with some intriguing possibilities for the sciences that opened up during the philosophic moment of Taoism. But these possibilities have nothing to do with Taoism's eighteen centuries as a cluster of religious traditions the goal of which was communal or personal salvation. Nor do they concern Taoist initiates as persons joined in making history. How in studying the influence of Taoism on science can we ignore either the goal or the agents?

Needham's survey also does not prove that science influenced Taoism, in any historically significant sense of either word. He has clearly documented his claim, allowing the conclusion that if we mean by science more than general cosmological perspectives, such an influence rests unproven and will be difficult to prove.<sup>102</sup>

### *Prospects*

The new history of Taoism as a specialized outgrowth of popular religion has begun to reveal concrete linkages to science in specific circumstances. Ultimately these will disclose general patterns. An accurate and thorough inventory of ignorance is an obvious first step. It is thus fitting to admit how poorly we understand both the early Taoist masterpieces and the many religious movements as forces in history. Once we are no longer distracted by questions about what this or that ism contributed to the evolution of this or that field in traditional China, we can proceed with less abstract and more open-ended research questions that will eventually lead to a third history.

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102. If on the other hand we take "science" to mean nothing more precise than general cosmological perspectives, their role in shaping liturgy has already been proven. See, e.g., Strickmann 1979 and Schipper & Wang 1986.

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## RETROSPECT

It may seem odd to be looking back at a newly published essay, but this one, as I noted in the Introduction, was drafted in 1979. In other words, the research and writing that led to it followed closely upon that for Chap. VI. Preparing this one for publication, however, has meant a thorough rethinking. It now incorporates, and the argument is built on, a new understanding of Taoism that was not nearly so clear to any of us sixteen years ago. The analysis is now, I believe, sounder, and perhaps more interesting. Some readers will find it instructive to compare this current viewpoint with that of 1978 reflected in the last chapter.

I was also eager to finish this paper so that it could provide a summary of changes in our understanding of Taoism over the last generation, and references to the scholarship that created this largely new field. The needs of specialists have been met to a large extent by the comprehensive bibliographical survey of Seidel in 1989-1990, supplemented by Verellen 1995 (which appeared when this paper was in the final stages of revision). My dilettante's view of the new history of Taoism, and this essay's very selective citations, will complement those in the two earlier publications.

Chaps. VI and VII differ in the issues that they address. The former points out the unreflective and confusing use of terminology in conventional writing about Chinese religion. It applies to Confucianism and Buddhism as well as to Taoism. Since it was published, the prevalent reliance on vague isms has abated not at all. Such matters are generational. Perhaps Chap. VI will play a part in persuading a new generation of Sinologists and students of religion to make distinctions that any historian of ideas or sociologist would consider elementary. My modest proposal that authors simply state what they mean when they use "Taoism" and other isms will, I believe, prove its worth once it is tried.

This chapter is about not usage but history, specifically the history of science, technology, and medicine. It asks how Taoism was actually related to these enterprises, scrutinizing numerous claims made over the past century based on a large number of undefined Taoisms. Some overlap cannot be avoided. To answer such a question requires attention to terminology, just as certain historical issues had to be taken up in Chap. VI. I have minimized repetition when preparing this chapter for publication. There is in fact more overlap with Chap. VIII. The emphasis of the latter is different, however, because of its narrower topic. I trust that in all three chapters I have shown that there is a broader horizon to be seen once we step outside the comfortable perimeter of our unexamined assumptions.