Is There an Idea of Laws of Nature in Chinese Classical Texts?

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摘要

Laws of nature are often considered to have played a crucial role in the development of modern science and continue to attract discussions in contemporary philosophy. Is there a similar idea developed in Chinese traditions? Despite its evident significance, there has not been much discussion on this question since Needham (1951) and Bodde (1979). Needham's answer is no, and Bodde largely agrees with him. In this paper, by examining Chinese classical texts, I argue that there is an idea of laws of nature, embodied by two notions, *dao* 道 and *li* 理.

1 Introduction

Laws of nature are often considered to have played a crucial role in the development of modern science. A prototypical example of laws of nature is Newton's second law of motion. Modern scientists continue to employ the notion of laws and propose new scientific laws. Contemporary philosophers debate about what it is to be a law. A comparative question naturally arises: Is there a similar idea of laws of nature developed in Chinese traditions?

Joseph Needham (1900–1995) once asked this question in a particular context. He is one of the most influential, if not the most influential, scholars on the history of Chinese science, and popularized what is now known as the *Needham Question*: Why did modern science not develop in Chinese civilization despite its earlier success in scientific development?[1] This question has two presumptions: On the one hand, Needham acknowledged that Chinese civilization was more scientifically advanced than the West before the sixteenth century. According to the mainstream history of science at the time, science was exclusively Western, and there had been a succession of scientific advances from ancient Greece to modern science with little influence from other traditions. Needham challenged such claims and took Chinese science to be an equal contributor among the tributaries that flowed into the sea of modern science.[2] On the other hand, Needham reaffirmed that modern science did not develop in China and wanted to explain why. While his explanations mostly focus on how the social, political, and economic conditions of China differed from those of the West, Needham believed intellectual or conceptual factors made a

1. Joseph Needham, *Science and Civilisation in China*, vol. Volume 3: Mathematics and the Sciences of the Heavens and the Earth (Cambridge University Press, 1959), 150–168; Joseph Needham, *The Grand Titration: Science and Society in East and West*, Reprint in 2005 (Routledge, 1969).

Needham was not the first one to ask this kind of why-not questions. For example, see Yu-Lan Fung, "Why China Has No Science–An Interpretation of the History and Consequences of Chinese Philosophy," *The International Journal of Ethics* 32, no. 3 (April 1922): 237–263. In 1953, Einstein gave an analysis of what the Greek philosophers contribute to Western science that the Chinese sages lack in a casual letter; for quotations of this letter by historians, see Arthur F. Wright, "review of Science and Civilisation in China. Volume II, History of Scientific Thought. By Joseph Needham, with the research assistance of Wang Ling.," *The American Historical Review* 62, no. 4 (July 1957): 918; Robert M. Hartwell, "Historical Analogism, Public Policy, and Social Science in Eleventh- and Twelfth-Century China," *The American Historical Review* 76, no. 3 (June 1971): 722–723.

2. Needham, *The Grand Titration: Science and Society in East and West*; Roger Hart, "Beyond Science and Civilization: A Post-Needham Critique," *East Asian Science, Technology, and Medicine* 16, no. 1 (August 1999): 94.

Needham's work stimulated extensive discussions on the multicultural origins of science.

difference as well. One of the factors he considered is the idea of laws of nature:

> There can be little doubt that this idea [of laws of nature] was intimately bound up with the development of modern science at the Renaissance in the West. If it was absent elsewhere, could that not have been one of the reasons why modern science arose only in Europe[?][3]

This motivated Needham to investigate whether or not a conception of laws of nature developed in Chinese thought.

Needham's conclusion is NO. His strategy involves selecting a list of notions in Chinese thought that resemble laws of nature, comparing each of these notions with the conception of laws as enacted by "a celestial lawgiver 'legislating' for non-human natural phenomena",[4] and explaining how each of them fails to be a notion of laws. For Needham, one of the main reasons China did not develop a conception of laws is because the Chinese tradition lacks the idea of a creator deity, a supreme law-giver.

After Needham, there has not been much systematic discussion on whether or not there is an idea of laws of nature in Chinese thought, with the exception of historian Derk Bodde (1909–2003) who largely agrees with Needham.[5] One reason could be that the quest for the Needham Question and its

3. Needham, *The Grand Titration: Science and Society in East and West*, 35–36.

4. Joseph Needham, "Human Laws and Laws of Nature in China and the West (II): Chinese Civilization and the laws of Nature," *Journal of the History of Ideas* 12, no. 2 (April 1951): 194–230; Joseph Needham, *Science and Civilisation in China*, vol. Volume 2: History of Scientific Thought (Cambridge University Press, 1956); Needham, *The Grand Titration: Science and Society in East and West*, 36.

5. Bodde argues that a few early Chinese thinkers in fact interpreted cosmic phenomena as being legislated by an all-powerful deity and developed ideas that were more congenial to the ideas underlying the notion of laws than one first thought. But he doesn't think this is sufficient to overthrow Needham's main conclusion. (Derk Bodde, "Evidence for "Laws of Nature" in Chinese Thought," *Harvard Journal of Asiatic Studies* 20, nos. 3/4 (1957): 709–727; Derk Bodde, "Chinese "Laws of Nature": A Reconsideration," *Harvard Journal of Asiatic Studies* 39, no. 1 (1979): 139–155.)

A few other scholars touch on this issue, but none address it systematically. For example, see Hu Shih, "The Natural Law in the Chinese Tradition," *Natural Law Institute Proceedings* 5 (1953): 119–153. Hu discusses the parallel question of whether or not China developed a moral or juridical concept of Natural Laws, and he considers *dao* and *li* as two candidates. If Hu and I are both right, the Chinese counterparts of Natural Laws and laws of nature in fact share a common root, as what Needham wants. Peerenboom also focuses on Natural Laws and argues that Huang-Lao's Boshu supports "natural law grounded in the constant and regular natural order". However, he doesn't think it is sufficient for scientific development because the Huang-Lao school lost to Confucianism (R. P. Peerenboom, "Natural Law in the "Huang-Lao Boshu"," *Philosophy East and West* 40, no. 3 (July 1990): 309–329). Chan is skeptical of Needham's claim that *li* does not amount to a notion of laws of nature and that a personal God is necessary for the development of modern science. But he didn't develop these ideas any further (Wing-Tsit Chan, "Neo-Confucianism and Chinese Scientific Thought," *Philosophy East and West* 6, no. 4 (1957): 309–332). Harbsmeier emphasizes the significance of this issue and offers a list of possible candidates, but does not provide an argument (Christoph Harbsmeier, "Towards A Conceptual History Of Some Concepts Of Nature In Classical Chinese: Zi Ran 自然

related issues has fallen out of fashion, or even been deemed inadmissible, for various reasons.[6] A.C. Graham, for example, notes that explanations of why China didn't develop modern science have usually been nothing more than showing that China was not on the same path as Europe.[7] According to Nathan Sivin, although the Needham Question is of heuristic interest, its accompanied discussions often falsely assume that a given feature of Western thought around the time of the Scientific Revolution is necessary to the rise of modern science.[8]

Although these criticisms certainly apply to Needham's discussion on laws of nature, there hasn't been any explication on *exactly* how it is problematic. Compared to other intellectual factors (such as experimentation, mathematization, or causation), laws of nature haven't received sufficient attention even just to set things straight. Until recently we still see claims like: "the idea of laws of nature is a distinctively Western idea. . . . it was one factor that led to the emergence of modern science".[9] It is thus worth disputing such claims.

Moreover, the fact that the Needham Question and its accompanied discussions were problematic does not mean that a comparative study on the idea of laws of nature would not be valuable. Independent of the context of the Needham Question, certain Chinese concepts (especially like *li* 理) are sometimes

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And Zi Ran Zhi Li 自然之理," chap. 6 in *Concepts of Nature: A Chinese-European Cross-Cultural Perspective*, ed. Hans Ulrich Vogel and Gunter Dux (Brill, 2010), 231–267).

6. For a review of the significance and problems of the Needham Question, see Hart, "Beyond Science and Civilization: A Post-Needham Critique"; Yung Sik Kim, *Questioning science in East Asian contexts: essays on science, Confucianism, and the comparative history of science* (Brill, 2014), Chapter 5, 9. For example, its presumption that civilizations are the appropriate starting point in studies of the history of science is questionable.

7. Angus C. Graham, "China, Europe and the Origins of Modern Science," chap. 3 in *Chinese Science: Explorations of an Ancient Tradition: Needham's The Grand Titration*, ed. Shigeru Nakayama and Nathan Sivin (Cambridge, Mass.: MIT Press, 1973), 45–69.

8. Nathan Sivin, "Why the Scientific Revolution did not take place in China—Or didn't it?," *Chinese Science* 5 (1982): 45–66.

9. Peter Harrison, "Laws of Nature, Moral Order, and the Intelligibility of the Cosmos," in *The Astronomy Revolution 400 Years of Exploring the Cosmos*, ed. Donald G. York (Taylor / Francis Group, 2011), 382.

translated as, assumed to be,[10] or even considered obvious to mean[11] laws of nature. This suggests, such concepts at least bear some similarities to the notion of laws. It is thus worth spelling out how and to what extent they do so in a systematic way. If such translations or understandings are mistaken, it worths spelling out why. A comparative study on the idea of laws of nature can be carried out independent of, and goes beyond, the Needham Question. The value of this comparative study lies not simply in giving a straightforward yes or no answer to the question of whether these concepts count as a notion of laws. It also enables us to explore whether such concepts, in their own terms, contributed to the development of natural knowledge and science in Chinese traditions.

Given these motivations, this paper aims to address whether or not there is an idea of laws of nature in Chinese classical texts. In Section 2, I first identify Needham's criteria for a notion of laws of nature, and explain why a divine legislator is not necessary for a notion of laws. I then specify central features of laws of nature for our comparative study and explain why I choose these features. In Section 3 and 4, I argue for two candidates for a notion of laws of nature in Chinese classical texts: *dao* 道 and *li* 理.

There's little doubt that *dao* and *li* are among the most important concepts in Chinese intellectual history. Most discussions on *dao* and *li* in Chinese philosophy focus on their moral and ontological aspects. Not much has been said about what role these two concepts played in the development of science. On the other hand, most efforts in the study of Chinese science have been directed towards excavating the content of scientific texts[12] and towards their technical details;[13] much less attention has been paid to how

10. Earlier scholars such as J. P. Bruce (1922, 1923), F. G. Henke (1916), G.G. Warren (1924), and Bodde (1942) adopt the translation "law" for *li*. Needham (1951, 208), of course, criticized this translation.

Fung uses "law of the evolution of things" and "universal law" in analyzing Shao Yong's diagram and cosmology (Yu-lan Feng, *A Short History of Chinese Philosophy*, ed. Derk Bodde (Free Press, 1948), 276–277). Liu argues for distinguishing *li* for Zhang Zai and Wang Fuzhi (1619-1692) as laws *of* nature from *li* for Zhou Dunyi and Zhu Xi as what Nicholas Rescher calls laws *for* nature. Liu thus assumes that *li* can be understood as laws of nature (Jeeloo Liu, "The Status of Cosmic Principle (Li) in Neo-Confucian Metaphysics," *Journal of Chinese Philosophy* 32, no. 3 (2005): 391–407). Angle and Tiwald analyze the Neo-Confucian concept of *li* by appealing to natural laws (Stephen C. Angle and Justin Tiwald, *Neo-Confucianism: A Philosophical Introduction* (Cambridge, UK: Polity, 2017), Chapter 2.3) It is common to use '*laws of nature*' 自然法则 to understand *Dao of Heaven* 天道 and *Li of Heaven* 天理, especially in contemporary literature in Chinese; see, e.g., 陈来 Lai Chen, *Song Ming Lixue* 宋明理学 *(Song-Ming Confucianism)*, originally published in 1936 (Beijing Book CO. INC., 2021). Also see Footnote 5.

11. I thank Harvey Lederman for pointing this out.

12. Robin D. S. Yates, "Science and Technology," in *Encyclopedia of Chinese Philosophy*, ed. Antonio S. Cua (New York and London: Routledge, 2003), 658.

13. Kim, *Questioning science in East Asian contexts: essays on science, Confucianism, and the comparative history of science*,

philosophical concepts and background assumptions underlie or have shaped the particular course of science.[14] This paper aims to fill this gap at the intersection of Chinese philosophy and history of science. It provides a preliminary survey of the scientific aspects of the notions of *dao* and *li* used in classical texts, particularly by explicating in what sense they amount to a notion of laws of nature.

2 Notions of Laws of Nature

In order to address whether there is a notion of laws of nature in Chinese classical texts, we first need to specify what notion of laws we are looking for. For Needham, the notion of laws of nature in the sense of the natural sciences shares the common root with the notion of *natural law* in the juristic sense. He takes the essential features of laws of nature as enacted by "a celestial lawgiver 'legislating' for non-human natural phenomena".[15] Such notion, according to Needham, can be traced back to as early as the Babylonian period,[16] and "after so many centuries of existence as a theological commonplace in European civilization, the idea of laws of Nature attained a position of such importance in the sixteenth and seventeenth centuries".[17] Needham tacitly assumes that there is a unique notion of laws of nature, which is essential to the development of modern science.

Needham's understanding of laws of nature is built on the scholarly work around his time, particularly, the historical analyses of seventeenth-century scientists' (or natural philosophers') uses of laws (especially work by Edgar Zilsel). Such understanding, however, is limited and too simplistic.[18] The lit-

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116–123.

14. There are a few exceptions including Needham. Kim, however, thinks Needham overemphasized the role of Daoism and urges more studies on the connection between Neo-Confucian natural philosophy and Chinese science (Kim, *Questioning science in East Asian contexts: essays on science, Confucianism, and the comparative history of science*, Chapter 5). For exceptions, also see, e.g., Chan, "Neo-Confucianism and Chinese Scientific Thought"; Lisa Raphals, "Chinese Philosophy and Chinese Medicine," in *The Stanford Encyclopedia of Philosophy*, Winter 2020, ed. Edward N. Zalta (Metaphysics Research Lab, Stanford University, 2020).

15. Joseph Needham, "Human Laws and Laws of Nature in China and the West (I)," *Journal of the History of Ideas* 12, no. 1 (January 1951): 4, 8; Needham, *The Grand Titration: Science and Society in East and West*, 36.

16. Needham, "Human Laws and Laws of Nature in China and the West (I)," 18.

17. Needham, 29.

18. Needham is aware that the notion of laws of nature as used in modern science no longer has the element of divine command, and he wonders whether or not there could be a different path to the modern notion of laws without divine command. But that's all he has said about this possibility. (Needham, *The Grand Titration: Science and Society in East and West*, 37.)

erature on laws of nature—both how the notion has developed historically[19] and how it is employed in science—has advanced and become much more nuanced and sophisticated since then.

For one, it is disputable whether, and to what extent, the idea of divine legislation plays a role in the development of the idea of laws of nature in Western traditions. In a classic paper, the historian Jane Ruby argues that "it is for the most part mistaken" to think that the concept of scientific laws as used today arose from the idea of divine legislation; the modern use emerged, rather, "through different processes at different times in three distinct fields".[20] Moreover, consider Descartes (who is usually considered to be responsible for the modern concept of laws of nature[21]) and Newton (whose laws are prototypical examples of scientific laws): Although God plays a role in both of their notions of laws, it does not mean that a divine legislator is necessary to their notions. Peter Harrison, for instance, argues that both Descartes' and Newton's notions of laws were susceptible to a purely naturalistic reading and the operations of God could be reconceptualized simply as 'nature'.[22] John Henry argues that Descartes only introduced the divine legislator "in order to make sense of, and to persuade contemporaries of the validity of, the concept of laws of nature".[23]

Generally speaking, contrary to Needham's assumption, there isn't a unique concept of laws of nature that came in common use in the seventeenth century, which can be regarded as *the* modern concept of laws. Although there are surely important aspects common to the uses of laws by (say) Kepler, Descartes, Boyle, and Newton, the differences among them are in fact larger than one may previously

19. See, e.g., Lorraine Daston and Michael Stolleis, eds., *Natural law and laws of nature in early modern Europe: Jurisprudence, theology, moral and natural philosophy* (Ashgate Publishing, 2008).

20. Jane E. Ruby, "The Origins of Scientific 'Law'," *Journal of the History of Ideas* 47, no. 3 (1986): 342.

21. See, e.g., Edgar Zilsel, "The Genesis of the Concept of Physical Law," *The Philosophical Review* 51, no. 3 (1942): 269; John Henry, "Metaphysics and the Origins of Modern Science: Descartes and the Importance of Laws of Nature," *Early Science and Medicine* 9, no. 2 (2004): 73–114; Helen Hattab, "Early Modern Roots of the Philosophical Concept of a Law of Nature," in *Laws of Nature*, ed. Walter Ott and Lydia Patton (Oxford University Press, 2018), 18–41; Peter Harrison, "Laws of God or Laws of Nature?," in *Science Without God?: Rethinking the History of Scientific Naturalism*, ed. P. Harrison and J. Roberts (Oxford University Press, 2019), 58–76.

In contrast, Needham thinks the turning point when the notion of laws began to be taken seriously happened between Copernicus and Kepler (even though Copernicus never used the expression 'law' and Kepler did not use the expression for his 'laws' of planetary motion (Needham, *The Grand Titration: Science and Society in East and West*, 36).

22. Harrison, "Laws of God or Laws of Nature?"

23. Henry, "Metaphysics and the Origins of Modern Science," 97.

recognize.[24] One's account of when and how the modern notion of laws was formed depends on their preconception of what laws are, which does not necessarily track how laws are used by modern scientists.[25] As for instances where laws of nature were invoked before the seventeenth century, their significance is also judged in accordance with one's preconceived concept of laws.[26]

Worse, there aren't even simple and uniform criteria on laws as used by modern scientists, and it is an ongoing debate in contemporary philosophy regarding what laws of nature are.[27] For instance, philosophers vehemently disagree about whether or not laws are something over and above mere regularities. Some think that laws necessitate or govern how things behave and are irreducible to mere regularities; in other words, laws are *prescriptive*.[28] The opposed view denies that laws of nature involve a sense of necessity or governing and takes laws to be merely descriptive—laws are just a special kinds of regularities.[29]

In sum, our intuition and understanding of what laws of nature are come from three fields: (A) history (the historical development of the notion), (B) modern science (how the notion is used by modern scientists), and (C) contemporary philosophy (mostly metaphysics and philosophy of science). The

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24. Friedrich Steinle, "The Amalgamation of a Concept–Laws of nature in the New Sciences," in *Laws of nature: Essays on the philosophical, scientific and historical dimensions*, ed. F. Weinert (Berlin: de Gruyter, 1995), 318.

25. Bixin Guo, *On the Origins of Laws of Nature*, Manuscript, 2021.

26. Henry, "Metaphysics and the Origins of Modern Science," 76.

27. Although there are *prima facie* scientific laws that we can point to as paradigmatic examples of laws of nature (such as Kepler's laws, Newton's laws of motion and law of gravity, the second law of thermodynamics, and the Mendelian laws of inheritance), it is controversial whether or not any of these laws indeed qualifies as a law of nature. For instance, it has been argued that only fundamental laws of physics are genuine laws of nature, and non-fundamental 'laws' (or the so-called 'laws' of special sciences) are not really laws; see, e.g., Tim Maudlin, *The Metaphysics Within Physics* (Oxford University Press, 2007). In particular, it has been argued that biology has no laws; for more details, see, e.g., J. Beatty, "The Evolutionary Contingency Thesis," in *Concepts, Theories, and Rationality in the Biological Sciences*, ed. G. Wolters and J.G. Lennox (Pittsburgh: University of Pittsburgh Press, 1995); Sandra D. Mitchell, "Dimensions of Scientific Law," *Philosophy of Science* 67, no. 2 (2000): 242–265). In that case, the Mendelian laws of inheritance would not count as laws. One of the reasons why only fundamental laws are genuine laws is that laws of nature are supposed to be universal and only fundamental laws are universal. Even laws as broad as Newton's laws of motion are not universal, since they fail in the quantum regime. The second law of thermodynamics, consider another example, is not universal either, but for a different reason: It is not strict, but only expresses a statistical regularity.

28. 'Governing' here does not imply an external deity. Although talks of governing echo a theological origin of the notions of laws in the seventeenth century, neither scientists nor philosophers who hold this view "make an overt appeal to theology to explicate it. Rather, they understand laws to be features of reality over and above occurrent events that in some way necessitate or govern them". (Barry Loewer, "The Package Deal Account of Laws and Properties," *Synthese*, 2020, 1–25; also see Harrison, "Laws of God or Laws of Nature?")

29. This is the so-called Humean accounts of laws. For more details on this debate, see, e.g., David K. Lewis, *Philosophical Papers*, vol. 2 (Oxford University Press, 1986); Maudlin, *The Metaphysics Within Physics*.

concepts of laws from each of these three fields do not necessarily converge. A variety of scientific and philosophical discourses have come and gone under the name of 'laws of nature'. What we have is not *the* notion of laws of nature, but instead *a cluster of similar but distinct ideas* that can be reasonably categorized under the name 'law'.[30] It is thus nontrivial to select *a* notion of laws for the comparative study. If we include features of laws that are inessential or contentious, we risk being overly stringent and unfair in judging whether there is an idea of laws of nature in Chinese traditions, as happens with Needham.

Needham picks his notion of laws from (A), or more precisely, a particular analysis of (A). When he evaluates whether a Chinese concept counts as a notion of laws of nature, what is really being evaluated is whether the concept matches up to *his preconceptions* of laws, which *he deems as necessary* to the development of modern science. Even granted that a divine legislator was essential to the historical development of the idea of laws of nature in Western traditions (which is, as discussed earlier, questionable), it certainly no longer plays any role in the notion of laws as used by scientists today. Accordingly, what Needham has shown at best is only that China did not take the same route through which a specific notion of laws of nature (that is, in terms of a celestial lawgiver) developed in European traditions. This paper challenges Needham's presumptions, and suggests an alternative picture of how the idea of laws of nature could develop without a divine legislator.

By analyzing what is common to (A), (B) and (C), I propose a preliminary but crucial step in developing an idea of laws of nature: recognizing that there are patterns, regularities, or lawful generalizations in nature. Such a step may seem mundane to us now, but was not always so. The idea that nature is orderly and stable needed to prevail over the idea that things or events just happen arbitrarily or randomly, or are influenced or determined by capricious gods, ancestors or demons. That is, for a notion of laws of nature to develop, it is crucial to recognize that the universe, despite its seemingly orderless appearances or its vicissitudes on the surface, is fundamentally orderly, systematic, and predictable.

Furthermore, it needs to be recognized that there are underlying principles, or perhaps rules, that determine and account for the order and regularity across a wide range of diverse phenomena in nature. Put it another way, underneath the incessant changes and variations of myriad things, there is something

30. One might argue that there is *the* right notion of laws of nature, but we don't know yet what it is.

constant and homogeneous, which denotes the underlying mechanism that guides how things change and is the reason why various things behave the way they do. Perhaps even stronger: such principles or laws compel things to act in accordance with them, and it is not possible for things to behave in any other way. While those myriad things are subject to change, such principles (or rules) do not—they hold irrespective of time, location, or subject. We thus can use these laws to make inferences and predictions.

These preliminary ideas suggest a minimal concept of laws of nature: the constant patterns, regularities, or orders underlying the motion and change of things that explain why things behave the way they do. It has the features of being (i) constant or invariant (laws do not change as things change), (ii) explanatory (laws are the reasons why things behave or change the way they do), and (iii) can be used to make predictions or inferences. If we were to find a notion in Chinese classical texts that share these features, it would be sufficiently valuable for our comparative project.

There are other features of laws that are salient in the cluster of ideas under the name of 'laws of nature'. For instance, laws are (iv) universal (being applicable to all natural phenomena) or (v) prescriptive (that is, involving a sense of necessity). Such features may not be necessary to a notion of laws (for reasons discussed earlier). But if our candidates for a notion of laws of nature in Chinese traditions do share these features, it worths noting that our candidates bear further important similarities to the notions of laws developed in Western traditions.

3 *Dao*

Dao is often translated as the way, path, or course. There is no simple answer to what exactly *dao* is, as different scholars or schools of thoughts at different times use or interpret it differently. In fact, it is polysemous, with different meanings ascribed in different contexts, even by the same author or within the same text. Nonetheless, it is seldom disputed that the notion of *dao* embodies the idea of pattern, natural order, or rule of specific things or the universe as a whole. Even Needham himself admits this and couldn't resist the word 'law' in describing *dao*:

> it is nonsense to say that the assumption of a permanent, uniform, abstract order and *laws* by means of which the regular changes in the world could be explained, was a purely Greek

> invention. The order of Nature was for the ancient Chinese the *Tao* [*dao*], and as a *chhang Tao* it was an 'unvarying Way'.[31]

However, *dao* didn't even make the list of notions that Needham considers as candidates for the notion of laws of nature. For him, "the Taoist thinkers . . . failed . . . to develop anything resembling the idea of laws of Nature. . . . It was not that the Tao, the cosmic order in all things, did not work according to system and rule; but the tendency of the Taoists was to regard it as inscrutable for the intellect."[32] What Needham conveniently neglected is that the notion of *dao* is not exclusive to Daoism. It is pervasive across various schools of thought (including Confucianism and Legalism)[33] and throughout Chinese intellectual history. Although the scholarly interests or the contexts in which *dao* is invoked vary greatly, what is common, and also most relevant to our discussion, is the idea that *dao* is the way the universe works and why the universe is the way it is.[34]

This notion of *dao*, as argued by Zhang Dainian, originated from *dao of Heaven* 天道,[35] a notion already in common use during the Spring and Autumn period (770–476 BCE).[36] Originally, *dao of Heaven* meant the orbits or regularities of heavenly bodies. According to Chen Lai, advances in astronomy at the time provided the means and context for such a notion to develop, indicating a departure from attributing the motion of celestial bodies to being determined by sorcery. 'Heaven', generally speaking, encompasses a spectrum of meanings: At one end of the spectrum, it embodies the religious idea of God or a higher

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31. Needham, *The Grand Titration: Science and Society in East and West*, 46; emphasis mine.

32. Needham, *Science and Civilisation in China*, 543.

33. In fact, the major schools during the Spring and Autumn period and the Warring States period (475–221 BCE) were only classified and labeled by later historians Sima Tan 司马谈 (d. 110 BCE) and Liu Xin 刘歆 (d. 23). (For more detail, see Gu 班固 [32–92 CE] Ban, *Han shu* 汉书 *(Standard History of the Han Dynasty)* (Beijing: Zhonghua shuju 中华书局, 1962); Kidder Smith, "Sima Tan and the Invention of Daoism, "Legalism," et cetera," *The Journal of Asian Studies* 62, no. 1 (2003): 129–156.)

34. For a review on the notion of *dao* in Chinese philosophy, see, e.g., Wing-Tsit Chan, *A Source Book in Chinese Philosophy* (Princeton: Princeton University Press, 1963); 张岱年 Dainian Zhang, *Zhongguo gudian zhexue gainian fanchou yaolun* 中国古典哲学概念范畴要论 *(Key Concepts in Chinese Philosophy)*, Reprint in 2017; English translation by Edmund Ryden Published by New Haven and London: Yale University Press and Beijing: Foreign Languages Press in 2002 (Beijing: Zhonghua shuju 中华书局, 1989); 陈来 Lai Chen, "The Concepts of Dao and Li in Song-Ming Neo-Confucian Philosophy," *Contemporary Chinese Thought* 30, no. 4 (1999): 9–24.

35. Zhang, *Zhongguo gudian zhexue gainian fanchou yaolun* 中国古典哲学概念范畴要论 *(Key Concepts in Chinese Philosophy)*.

36. Also see 陈来 Lai Chen, "Chunqiu shidaide tiandao guannian 春秋时代的天道观念 (The Notion of Dao of Heaven in the Spring and Autumn Period)," in *Quanshi yu jiangou* 诠释与建构——汤一介先生 *75* 周年华诞暨从教 *50* 周年纪念文集 *(Explanation and Construction: On the Memoriam of Zhang Yijie)* (2001).

power that has a will and rules the universe.[37] This sense of Heaven faced criticism by later scholars,[38] and gradually became less popular. At the other end, 'Heaven' refers to the sky or the above, in contrast to Earth or Humans. Somewhere in between, 'Heaven' denotes the natural world as a whole. Accordingly, the meaning of *dao of Heaven* expands to the general rules or laws of everything.[39]

Let's first consider the idea of *dao* as the fundamental principle or law, or the constant pattern of the universe, as presented in the *Zhouyi* 周易 (also known as *Yijing* or *Book of Change*). It is one of the oldest of the Chinese classics, and, while later incorporated into the Confucian canon, its influence extends far beyond any single school of thought.[40] The *Book of Change*, as the name suggests, is about change—the world is fully of ceaseless change and transformation; the only thing that doesn't change is the fact that everything changes. But the change is not arbitrary or haphazard, but adhere to basic principles, which can be characterized generally in terms of the dynamic interplay between *yin* 阴 and *yang* 阳.[41] According to the *Zhouyi*, *Taiji* 太极 (the *Supreme Ultimate*) is the origin of the universe and the ontological basis of everything. It generates the two Modes, *yin* and *yang*. The successive alteration and interaction of *yin* and *yang* ultimately generates and underlies the constant change of everything.

> The [successive] alteration and interaction of *yin* and *yang* is called *dao*.[42]

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37. This is how Bodde's view differs from Needham's.

38. Such as Wang Chong 王充 (27–c. 97). For more details, see Alexus McLeod, *The Philosophical Thought of Wang Chong* (Palgrave Macmillan, 2018).

39. Chen, "Chunqiu shidaide tiandao guannian 春秋时代的天道观念 (The Notion of Dao of Heaven in the Spring and Autumn Period)." Chen's analysis is largely based on two ancient history texts on the Spring and Autumn period, *Guoyu* 国语 and *Zuo Zhuan* 左传. The exact composition dates and authors of these texts are controversial. They are usually taken to be written during the Warring States period.

40. Initially the *Zhouyi* was an ancient divination manual, allegedly created by the mythical emperor, Fu Xi 伏羲, with statements supposedly written by King Wen and the Duke of Zhou during the eleventh century BCE. Commentaries were later added by unknown authors around 500–200 BCE, and the *Zhouyi* then came to have great significance in Chinese philosophy and cosmogony.

41. Alan Chan, "Neo-Daoism," in *The Stanford Encyclopedia of Philosophy*, Summer 2019, ed. Edward N. Zalta (Metaphysics Research Lab, Stanford University, 2019).

42. 《周易·系辞上》: 一阴一阳之谓道。My translation, checked against James Legge and Chung-yin Cheng, "Philosophy of Change," in *Encyclopedia of Chinese Philosophy*, ed. Antonio S. Cua (New York and London: Routledge, 2003), 517–523.

The exact dates and authors of the texts quoted in this section (such as this one and some from the *Zhuangzi*) are contentious. As a result, it is debatable when *dao* as laws of nature came into use. Edward Slingerland points out that it was not until Xunzi 荀子 (a Confucian during the late Warring States period) that the idea of nature having some universal pattern or principle developed, and not until the Han dynasty (206 BCE–220) that *dao* was systematically interpreted as the universal principle. Whether or not this is the case, nonetheless, does not affect the thesis of this paper, which concerns whether *dao* embodies the idea of laws of nature, rather than when it came to be.

Dao is not the *yin* and *yang*; that by which (*suo yi* 所以) the *yin* and *yang* alternates[43] and interacts is *dao*. It is thus understood as the fundamental principle or mechanism, or the universal law, that underlies and explains the motion and change of everything.

The classic that takes *dao* as a core concept is the *Dao De Jing* 道德经, a canonical text of Daoism.[44] What is special about the *Dao De Jing* is that it attributes an additional role to *dao*, besides being the general laws, universal patterns, or natural order for all things—*dao* is the origin and the ontological basis for everything:

> There was something formed from chaos, coming into existence before Heaven and Earth. How quiet it was and formless, standing alone and never changing, cyclically moving everywhere and never slacking. It can be the mother of Heaven and Earth. I don't know its name, and call it *dao*. If I have to name it, it would be the Great. The Great is so broad [that it is everywhere; as it's everywhere,] it is passing. As it passes, it becomes far away. As it is far away, it returns.[45]

The *Dao De Jing* starts with: "The *dao* that can be expressed in words [*dao*] is not the true and constant *dao*."[46] This is probably why Needham thinks that Daoists regarded *dao* as "inscrutable for the theoretical intellect". However, interpreting the text in this way is overly simplistic and contestable, if one takes into consideration its broader context and especially what follows: "The name [*ming*] that can be articulated [*ming*] is not the true and eternal name [*ming*]. The Unnamable is the beginning of Heaven and Earth; The namable is the mother of all things." "*Dao*, being constant, is unnamable."[47] According to Feng's analysis, *ming* is the same term that is central to the School of Names. All concrete, material things, which "lie within shapes and features", have names or at least are namable. Not everything that is namable "lie within shapes and features", but the unnamable must "lie beyond shapes and features". This is what "*dao*

43. Chen, "The Concepts of Dao and Li in Song-Ming Neo-Confucian Philosophy," 17.

44. Its reputed author is Laozi 老子, the semi-mythical founder of Daoism. His identity is debated and so is the date of composition of the text. Estimates typically place the *Dao De Jing* in the Spring and Autumn period or the Warring States period. For the purpose of this project, I refer to its most influential version.

45. 有物混成，先天地生。寂兮寥兮，独立而不改，周行而不殆，可以为天地母。吾不知其名，字之曰道，强为之名曰大。大曰逝，逝曰远，远曰反。 My translation modified from Legge.

46. 道可道，非常道。My translation, modified from Feng, *A Short History of Chinese Philosophy*, 95.

47. 名可名，非常名。无名，天地之始；有名，万物之母。
道常无名。My translation, modified from Feng, 95.

is unnamable" means. *Dao*, the unnamable, is "that by which all namables come to be". The sentence in question is thus not saying that *dao* is inscrutable, but suggests that *dao* is fundamentally different from all material things. In fact, as Mou points out, one can find that the true and constant *dao* is reached in language in various ways in the *Dao De Jing*. A more complete translation would be: "The *Dao* can be reached in language, but the *Dao* that has been characterized in language is not identical with, or does not exhaust, the eternal *Dao*."[48]

Even if we accept that *dao* is inscrutable for Daoists, it does not mean that *dao* is inscrutable *simpliciter*. As mentioned earlier, *dao* is not exclusively a Daoist notion. Other schools do not take *dao* to be inscrutable. "Throughout classical texts, we find that daos are spoken, heard, forgotten, transmitted, learned, studied, understood and misunderstood, distorted, mastered, and performed with pleasure."[49] Confucius (551–479 BCE), for example, discusses *dao*:

> The duke said: "I venture to ask what it is that the gentlemen value in *dao of Heaven*?" Confucius replied: "[They] value its ceaselessness. Such as the sun and moon following each other around from east to west without ceasing—that is *dao of Heaven*. There is no stopping and no interruption—that is *dao of Heaven*. With no interference [wuwei] and things come to their completion—that is *dao of Heaven*."[50]

It is true that Confucius and Mencius (d. 289 BCE) discuss *dao of Heaven* much less. Generally speaking, Confucianism primarily focuses on the order and harmony of human society. But it does not mean that Confucians do not employ the notion of *dao* or do not think there is *dao*. Rather, their discourse tends to focus more on *dao of Humans* 人道, reflecting their interest in the moral and social aspects of *dao*. (I'll say more about the relation between *dao of Heaven* and *dao of Humans* later.)

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48. Bo Mou, "Ultimate Concern and Language Engagement: A Reexamination of the Opening Message of the Dao-de-Jing," *Journal of Chinese Philosophy* 27, no. 4 (2000): 429–439. Mou gives a different analysis of the sentence; it does not suggest *dao* is inscrutable either.

49. Chad Hansen, "Daoism," in *The Stanford Encyclopedia of Philosophy*, Spring 2020, ed. Edward N. Zalta (Metaphysics Research Lab, Stanford University, 2020).

50. 《礼记·哀公问》公曰：敢问君子何贵乎天道也？孔子对曰：贵其不已。如日月东西相从而不已也，是天道也；不闭其久，是天道也；无为而物成，是天道也；已成而明，是天道也。My translation modified from Legge and Needham, "Human Laws and Laws of Nature in China and the West (II): Chinese Civilization and the laws of Nature," 214.

Consider another example from the Legalist text *Han Feizi*:

> *Dao* is why everything is the way it is, and is the totality of all principles [*li*]. *Li* is the form of what things come to be. *Dao* is why all things come to be. Thus it is said: "*Dao* is what *li* is." Everything has its *li*, and can't conflict with one another. This is why *li* is what constrains things. Everything has its own *li* different from that of others. Once everything has its own *li*, *dao* has done its job.[51]

The *Han Feizi* goes on to suggest that *dao* is the reason why the sun and the moon are bright, why celestial bodies move the way they do, why four seasons change, and why sages can write a masterpiece.[52] This passage highlights the explanatory role of *dao*, not only in natural phenomena but also in social phenomena.

Furthermore, it is in fact the goal of Xuanxue 玄学 (often translated as Neo-Daoism and developed around the Wei [220-266] and Jin [266-420] dynasties) to explicate *dao* with "analytic rigor and clarity".[53] Consider, for example, the Neo-Daoist Wang Bi 王弼 (226–249) who claims:

> *Dao* has its great constancy, and the principle [*li*] has its great fastidiousness, [so] "hold on to the *dao* of old" [then one] can "preside over [what exists] now". Although we live in the present, it is possible for one to know [how things were at] the beginning of the universe. Thus one can know [*dao*] "without going out the door" or "peering out the window".[54]

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51. 《韩非子·解老》: 道者，万物之所以然也，万理之所稽。理者，成物之文也。道者，万物之所以成也。故曰: "道，理之者也"。物有理，不可以相薄，物有理不可以相薄故理之为物之制。万物各异理，万物各异理而道尽。Fei 韩非 [d. 233 BCE] Han, *Han Feizi xin jiaozhu* 韩非子新校注 *(Han Feizi, with New Collations and Commentary)*, ed. Chen Qiyou 陈奇猷 (Shanghai: Guji 古籍, 2000), 6.20.411–14. My translation modified from Chen, "The Concepts of Dao and Li in Song-Ming Neo-Confucian Philosophy."

It is disputable whether this passage or the whole section is actually written by Han Fei, or added by latter editors. See, e.g., Sarah A Queen, "Han Feizi and the Old Master: A Comparative Analysis and Translation of Han Feizi Chapter 20,"Jie Lao," and Chapter 21,"Yu Lao"," in *Dao Companion to the Philosophy of Han Fei*, ed. Paul R. Goldin (Springer, 2013), 197–256. For our purposes, it suffices to show that the notion of *dao* is commonly used and not exclusive to Daoism.

52. Hsiao-Po Wang and Leo S. Chang argue that the *Han Feizi* appeals to the notion of *dao* to build a foundation for its legal and political theories. (Hsiao-Po Wang and Leo S. Chang, *The Philosophical Foundations of Han Fei's Political Theory* (Honolulu: University of Hawaii Press, 1986)).

53. Chan, "Neo-Daoism," Section 1.

54. 《道德经》注: 道有大常，理有大致，执古之道，可以御今，虽处于今，可以知古始，故不出户窥牖而可知也。My translation modified from Bi Wang translated by Richard John Lynn, *The Classic of the Way and Virtue: A New Translation of the Tao-te Ching of Laozi as Interpreted by Wang Bi* (New York: Columbia University Press, 1999), 141.

This is a comment on the *Daodejing*, "without going out the door, [one] can know the whole world; without peering out the window, [one] can grasp *dao of Heaven*."[55] It synthesizes an earlier part of the *Daodejing*, "hold on to the *dao* of old to preside over what exists now. The ability to know [how things were at] the beginning of the universe is called the principle of *dao*."[56] Wang first emphasizes that *dao* is constant. "What this means is that the Daoist origin and structure of the world is seen to entail an inherent order. The plenitude of nature and the regularity of seasons, for example, both attest to the presence of Dao in the world, not as primary substance, but as pristine order or coherence marked by intelligible patterns of change and principles of operation. This is the underlying assumption for the claim that Dao not only originates things but also nurtures and completes them."[57] It is not uncommon to characterize *dao* as constant or invariable (*chang* 常). For instance, according to the *Xunzi* (attributed to Xun Kuang 荀况, a prominent Confucian who lived in the late Warring States period), "Heaven has constant *dao*."[58]

Because *dao* is constant, it can be used to make inferences: from the present to the past and from the past to the present; what we know about *dao* can be generalized to the entire world. Wang adopts the idea from the *Daodejing* while making explicit the inferential role of *dao*. *Dao* in this sense aligns with the notions of laws of nature: laws hold irrespective of time or location, and can thus be used to make inferences and retrodiction.

In sum, *dao* embodies the ultimate nature of reality. It is the fundamental principle or law that underlies and explains the motion and change of everything. It is constant, universal, explanatory, and can be used to make inferences. All these features match with the notion of laws of nature identified in Section 2. I've responded to Needham's objection that *dao* does not resemble laws because it is inscrutable. Next, I will address two more issues raised by Needham.

As mentioned in Section 2, Needham thinks that, in Western traditions, the notion of laws of nature

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55. 不出户，知天下；不窥牖，见天道。

56. 执古之道，以御今之有。能知古始，是谓道纪。My translation modified from P. J. Ivanhoe and Bryan W. van Norden, eds., *Readings in Classical Chinese Philosophy*, Second Edition (Indianapolis/Cambridge: Hackett Publishing Company, Inc., 2005).

57. Chan, "Neo-Daoism," Section 2.

58. 《荀子·天论》：天有常道矣。My translation.

for the natural world and the notion of natural law for humans share the common root:

> For without doubt one of the oldest notions of Western civilization was that just as earthly imperial lawgivers enacted codes of positive law, to be obeyed by men; so also the celestial and supreme rational creator deity had laid down a series of which must be obeyed by minerals, crystals, plants, animals and stars in their courses.

He asks: "What development . . . paralleled this in the thought of the Chinese? Was it more difficult for them to reach the conception of Laws of Nature obeyed by every created thing?"[59] To address this question, let's consider how *dao of Heaven* and *dao of Humans* are related. We can get a clue from a famous passage from the *Daodejing*:

> Humans *fa* [takes their laws from] Earth, Earth *fa* [takes their laws from] Heaven, and Heaven *fa* [takes their laws from] *dao*; the *fa* [law] of *dao* is being what it is [*ziran*].[60]

This specifies the relationship between *dao* and everything else (Heaven, Earth, and Humans), which is described by *fa* (used as a verb): They all, ultimately, *takes their laws from dao*. The key to understanding this relationship lies in how we interpret *fa*.

Fa 法 is the same character as used systematically by Legalism. When used as a noun, it is usually translated as laws in the juristic sense. But *fa* also has the broader meaning of rule, order, or standard, which unambiguously applies to non-human things.[61] For example, the *Zhuangzi* 庄子, another canonical text of Daoism,[62] takes natural things or natural phenomena to have *fa*:

> Four seasons have clear *fa* [order] but never argue. Everything has fixed *li* [principle] but never talk.[63]

59. Needham, "Human Laws and Laws of Nature in China and the West (I)," 3.

60. 《道德经》：人法地，地法天，天法道，道法自然。 My translation modified from Legge.

61. Although it is true that *fa* is usually translated as *laws* for Legalists and as *standard* or *to model* for early Confucians, Daoists, and Mohists, it is disputable whether there is a clear boundary between these two uses of *fa*. See Chad Hansen, "Fa (Standards: Laws) and Meaning Changes in Chinese Philosophy," *Philosophy East and West* 44, no. 3 (1994): 435–488; Jeffrey Richey, "Lost and Found Theories of Law in Early China," *Journal of the Economic and Social History of the Orient* 49, no. 3 (2006): 329–343.

62. It is named after Zhuangzi, who lived around 300 BCE. The text is widely agreed to be a compiled work by multiple authors, including possibly Zhuangzi himself, his students, and later editors.

63. 《庄子·知北游》：四时有名法而不议，万物有成理而不说。My translation, checked against Legge and Needham, *Science and Civilisation in China*, 546.

Moreover, the use of *fa* as taking laws from *dao* or Heaven is not unique to the *Dao De Jing*, but can also be found in other schools of thought. For instance, in the *Mozi*:

> Hence, the ancient sage-kings take investigating prudently, endorsing the virtuous, and employing the capable as governing policy, and thus by taking *fa* [laws] from Heaven.[64]

We can also see this idea in the *Guanzi* 管子:

> The *fa* [laws] as engraved *fa* [takes laws from] the position of Heaven and Earth, and imitates the operation of four seasons, in order to rule the world. The operation of four seasons has winter and summer. The sage *fa* [takes laws from] it, thus has intellectual and fighting skills.[65]

One might question whether these statements should be interpreted as expressing the idea of *taking laws from*, rather than simply *modeling*. Indeed, Needham interprets them as saying "the laws of human society were, or should be, *modeled* on non-human Nature". More specifically, he takes these statements to be "a poetical and metaphorical derivation of human laws, the qualities of which were thought of as mirroring *certain desirable qualities* seen in non-human Nature". Nonetheless, Needham finds this whole idea "[o]ne of the strangest" and calls it a paradox in the sense that "the Chinese law [in the juristic sense] could not be said to be in non-human Nature" and consequently the laws of human society could not be "derived from where no Law existed".[66]

First, it is not always the case that human laws in these texts were taken to be just modeling some sporadic virtues seen in the natural world, instead of how the world works more generally and systematically. For example, in the *Guanzi*, they are modeled on the *dao* of the natural world: "Sagacious kings

64. 《墨子·尚贤中》: 故古圣王以审、以尚贤、使能为政，而取法于天。 My translation, checked against Legge. The *Mozi* is usually attributed to Mo Di 墨翟 (~400 BCE), the founder of Mohism. It is, however, likely a compilation from different authors (possibly the followers of Mo Di) and different dates.

65. 《管子·版法解》: 版法者，法天地之位，象四时之行，以治天下。四时之行，有寒有暑，圣人法之，故有文有武。 My translation.
The *Guanzi* is usually attributed to Guan Zhong 管仲, a famous minister of state in the Spring and Autumn period. It however contains a wide range of materials by different authors from the Warring States period to the Han dynasty (202–220 BCE). Guan Zhong is often considered as a pioneer of Legalism, while the *Guanzi* is categorized as a Daoist text by Liu Xin.)

66. Needham, "Human Laws and Laws of Nature in China and the West (II): Chinese Civilization and the laws of Nature," 200–201, my emphasis.

model and *fa* [take laws from] *dao of Heaven*".[67]

If there are no laws for the natural world, then it makes sense to say that human laws "could not be said to be in non-human Nature" and humans cannot take their laws from "where no Law existed"—the best humans can do is to model sporadic virtues seen in nature. However, the assumption that there are no laws of nature is exactly what gives rise to the paradox that Needham identifies—the paradox in fact would never arise without such an assumption.

Moreover, if the laws of human society merely model or imitate sporadic virtues or orders seen in nature and thus are separate and independent from them, it then becomes puzzling why humans should model their laws on nature in the first place. It is only puzzling because Needham began with a false assumption. In fact, what he quickly dismissed is one of the most significant themes in Chinese thought: the unity of the natural and the ethical (or social) order.[68] As mentioned earlier, it is recognized that, despite the appearance of ceaseless change, there are stable and persistent regularities in the natural realm, such as the motions of celestial bodies and the succession of the four seasons—these are results or manifestation of *dao*. Similar regularities or orderliness are also found in the human realm. These are not mere similarities. Since the human realm is a part of the cosmos, just like the natural realm, there is no reason to think that *dao* or *dao of Heaven* applies only to nature but not to human society. Moral and political laws are also seen as results or manifestations of *dao*, just like the regularities in celestial bodies and seasonal changes are results or manifestations of *dao*. Thus, humans are not modeling or imitating virtues seen in the natural world, but following *dao*. *Fa* specifies in what sense of following.

This interpretation is supported by the Neo-Daoist Wang Bi 王弼 (226–249) influential reading of

67. 《管子·形势解》：明主法象天道。 My translation.

68. This is often associated with the phrase *tian ren he yi* 天人合一. For more details, see, e.g., 张岱年 Dainian Zhang, "Zhongguo zhexuezhong "tian ren he yi" sixiangde pouxi 中国哲学中 "天人合一" 思想的剖析," *Journal of Peking University (Philosophy and Social Sciences)* 1 (1985).

This later developed into the idea of interactions between Heaven and humans, or correlative cosmology 天人感应, in the Han dynasty. Needham considered this idea of unity more in his later work, but asserted that "the phenomenalist conviction of cosmic-ethical unity gave no stimulation whatever to the idea of laws of Nature" without giving an argument (Needham, *Science and Civilisation in China*, 528). It seems that Needham focused only on correlative cosmology where the human realm can influence the natural realm. Later on, Neo-Confucianism criticizes correlative cosmology, but further advances the idea that the fundamental principle, pattern, or law of the universe applies to the human realm as equally as to the natural realm (I will say more about this in the next section).

the *Dao De Jing*:[69]

> *fa* is what is called laws or rules. Humans do not defy Earth so obtain complete peace; this is taking laws from [fa] Earth. Earth does not defy Heaven so achieves its capacity to uphold [everything]; this is taking laws from [fa] Heaven. Heaven does not defy *dao* so achieves capacity to cover [everything]; this is taking laws from [fa] *dao*.[70]

Fa complements the notion of *dao* and explicates its relation with everything else: They obey and do not defy, *dao*. It is in this sense that we may say *dao* governs the motion and change of everything. Thus, in this particular aspect, *dao* resembles the notion of laws of nature developed in Western traditions, but without appealing to a divine lawgiver.

One might object: there is no sense of govern or command in Daoism, given its central idea of *wu wei* 无为, often translated as non-action or unforced action. In fact, this is one of the reasons Needham does not consider *dao* as a candidate for the notion of laws of nature.[71] According to him, *wu wei* stands in direct opposition to the legislation of a celestial lawgiver, which "would be 'wei,' a forcing of things to be obedien[t], involving imposition of sanctions". Needham, while admitting nature according to Daoism "shows a ceaselessness and regularity", thinks this is insufficient to produce a notion of laws, because "it is not a *commanded* ceaselessness and regularity".[72]

However, this argument not only employs a simplistic and limited interpretation of *wu wei*, but also imposes an unnecessary requirement on the sense in which laws of nature govern or command. The *Dao De Jing* indeed says: "*dao* invariably does nothing (*wu wei*) and yet there is nothing which it does not do."[73] Although no action or the absence of doing is the literal translation of *wu wei*, a more accurate understanding would be non-interference or effortless action, letting things follow their natural course,

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69. Also see 王中江 Zhongjiang Wang, "Dao and the Spontaneousness of Things: A Study on the Meaning of Laozi's "Dao Emulates What Is Spontaneously So" 道与事物的自然：老子 "道法自然" 实义考论," *Philosophical Researches* 哲学研究, no. 8 (2010): 39.

70. 《道德经注》：法，谓法则也。人不违地，乃得全安，法地也。地不违天，乃得全载，法天也。天不违道，乃得全覆，法道也。My translation.

71. Needham, "Human Laws and Laws of Nature in China and the West (II): Chinese Civilization and the laws of Nature," 213.

72. Needham, 214; emphasis in original.

73. 《道德经》：道常无为而无不为。My translation modified from Feng, *A Short History of Chinese Philosophy*, 10.

or acting in a way that is natural, spontaneous, uncoerced, and yet accords with the order of the universe.[74] Despite being *wu wei*, *dao* is still responsible for everything: *dao* produces, "clothes[,] and nourishes all the things, but does not lord over them".[75] We can also see what 'work' *dao* does in the *Zhuangzi*:

> As the air of spring comes forth, all plants grow; as it's the right time of autumn, all the treasures [of nature] are fully grown. Are spring and autumn what they are without receiving anything? *Dao* of Heaven has been in process.[76]

Thus, *dao* being *wu wei* does not mean that things can act arbitrarily, haphazardly, or in any possible manner; rather, their natural course is in alignment with *dao*.

The fact that *dao* is *wu wei* conforms to the notion of laws of nature, instead of contradicting it. In contemporary metaphysics and science, when laws of nature are said to govern, no external lawgiver is needed, and laws do not govern by interfering with the nature or disposition of objects. Nor is it as if objects can somehow disobey the laws and then the divine legislator would punish them for disobeying.[77] Instead, objects simply follow the laws, and there is no other way for them to act differently. What "governing" means is that laws compel objects to act in certain ways, or objects are disposed to act in accordance with the laws. This is exactly what *wu wei* says about *dao*.

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74. This is more or less the standard interpretation. For example, see Edward Slingerland, *Effortless action: Wu-wei as conceptual metaphor and spiritual ideal in early China* (Oxford University Press, 2007), 5; Ivanhoe and Norden, *Readings in Classical Chinese Philosophy*. For interpretations that are slightly different from but compatible with this one, see, for example, Chad Hansen, "Wuwei (Wu-wei): Taking No Action," in *Encyclopedia of Chinese Philosophy*, ed. Antonio S. Cua (New York and London: Routledge, 2003), 784–786; David Loy, "Wei-Wu-Wei: Nondual Action," *Philosophy East and West* 35, no. 1 (1985): 73–86.

When *wu wei* is used in a moral or political context, it indicates that rulers should not impose their will or intention on others or the world and should let things follow their nature.

75. 《道德经》：衣养万物而不为主。My translation.

76. 《庄子·庚桑楚》：夫春气发而百草生，正得秋而万宝成。夫春与秋，岂无得而然哉？天道已行矣。My translation checked against Legge. Although the *Zhuangzi* does not explicitly use the word *wu wei*, the idea is there. Guo Xiang 郭象 (d. 312), who edited the version of the *Zhuangzi* as we see now, identifies the idea of *wu wei* in his comment on this sentence: "Both [spring and autumn] is bestowed with *dao* of being what it is [*ziran*]; thus *wu wei* (皆得自然之道，故无为也)."

77. It was thought that both living and non-living things could transgress the laws of God. But as we discussed in the previous section, it is hard to see why this religious element is necessary to a notion of laws of nature.

4 *Li*

Li has been translated as principle, reason, structure, law, order, pattern, and coherence. Similar to the case of *dao*, there is no straightforward answer to what *li* is; it has many facets, and its meanings are rich and can be flexible. Tang Junyi (1909–1978), for instance, identified six distinct meanings of *li* that emerged throughout the history of Chinese philosophy. The most extensive and systematic explication and analysis of *li* is provided by Lixue 理学 (the School or the Study of *Li*), also known as Neo-Confucianism.[78] It is the major school of thought in the Song (960–1279) and Ming (1368–1644) dynasties. As the name suggests, this school takes *li* as its most central concept.

Needham recognizes that *li* is "not far removed from" the Daoist conception of *dao* as "the order and pattern in Nature".[79] Unlike *dao*, Needham does consider *li* as a possible candidate for a notion of laws of nature. He even says: "There is 'law' implicit in it". Nevertheless, he does not think *li* qualifies as a notion of laws, because it is understood in Neo-Confucianism in an organismic sense, in contrast to the mechanical Newtonian sense. According to Needham, the law implicit in *li* is "the law to which parts of wholes have to conform by virtue of their very existence as parts of wholes", and *li* is intrinsic to all things or patterns of things, "not extrinsic to them, and dominating them, as the laws of human society constrain individual men". Hence, such a 'law' does not have the status as legislated by a celestial lawgiver, but "arose directly out of the nature of the universe".[80]

First, the organismic reading of Neo-Confucianism was proposed by Needham. It is an open question whether or not such a reading is adequate, or if it is the best interpretation that accurately encompasses the complexities of Neo-Confucianism.[81] Second, even if we grant that *li* as used by Neo-

78. The name 'Neo-Confucianism' was only coined specifically for its introduction to the West.

79. Needham, *Science and Civilisation in China*, 558.

80. Needham, "Human Laws and Laws of Nature in China and the West (II): Chinese Civilization and the laws of Nature," 218; Needham, *Science and Civilisation in China*, 567.

81. See, e.g., Brook Ziporyn, "Form, Principle, Pattern, or Coherence? Li in Chinese Philosophy," *Philosophy Compass* 3, no. 3 (2008): 405, 411.

Even Needham himself admits that "one could not say that 'law' in the Newtonian sense was completely absent from the minds of [Zhu Xi] and the Neo-Confucians in their definition of Li" (Needham, "Human Laws and Laws of Nature in China and the West (II): Chinese Civilization and the laws of Nature," 219).

Confucians is indeed organismic, what Needham has shown at best is that there is no mechanical conception of laws in China, rather than that there is no conception of laws of nature *simpliciter*. There are conceptions of laws other than the mechanical one, as Needham himself acknowledges.[82] Moreover, the primary reason Needham believes that organismic *li* does not qualify as a notion of laws is that it is intrinsic and not imposed by an external lawgiver. But, as discussed earlier, such a feature is not necessary for a notion of laws. Last, the notion of *li* is not exclusive to Neo-Confucianism. For Needham's argument to work, one needs to show that other uses of *li* as the order or pattern of nature should be interpreted as organismic as well. But it's unclear whether this can be done.

The notion of *li* in fact precedes Neo-Confucianism. '*Li*' originally referred to the veins or patterns inherent in jade. Its meaning later expanded to the nature, structure, or pattern of things in general. We have seen this use from the *Zhuangzi* and *Han Feizi* in Section 3. This use of *li* is not limited to philosophical texts. The history book *Stratagems of the Warring States* states: "Things [that will happen] must happen. The *li* is fixed as this."[83] This sentence was later quoted by Su Xun 苏洵 (1009–1066) and his son Su Shi 苏轼 (1037–1101).[84] Su Shi also talks about the *li* of everything 万物之理 and *li* of being what it is [*ziran*] 自然之理.[85]

Neo-Confucian understanding of *li* is greatly in debt to Wang Bi.[86] Wang is the one who made the notion of *li* parallel to that of *dao*, as "the fundamental principle of the cosmos itself".[87] For Wang, *li* is not just pattern of things: *li* is what gives order and pattern.[88] He recognizes:

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82. Needham, *Science and Civilisation in China*, 582.

83. The book records anecdotes of politics and warfare during the Warring States period. It is compiled by Liu Xiang in the Han dynasty, whereas its original author is unknown. 《战国策·齐策四》: 事有必至，理有固然。My translation.

84. They are considered to be two of the most influential writers in the Tang (618–907) and Song dynasties.

85. 《上曾丞相书》: 凡学之难者，难于无私，无私之难者，难于通万物之理。……是故幽居处而观万物之变，尽其自然之理而断之于中。

It is an open question whether there is a notion of nature in Chinese thought, and particularly whether *ziran* can mean nature. See, e.g., Harbsmeier, "Towards A Conceptual History Of Some Concepts Of Nature In Classical Chinese: Zi Ran 自然 And Zi Ran Zhi Li 自然之理." What matters for our purposes is that *li* (or *dao*) clearly applies to the natural realm.

86. 钱穆 Mu Qian, *Zhuanglao tongbian 庄老通辨 (General Discussion on Laozi and Zhuangzi)*, Reprint in 2002 (Sanlian 三联, 1973), 331.

87. Alan K. L. Chan, *Two Visions of the Way: A Study of the Wang Pi and the Ho-shang Kung Commentaries on the Lao-Tzu*, SUNY Series in Chinese Philosophy and culture (New York: State University of New York Press, 1991), 52–53.

88. Chen, "The Concepts of Dao and Li in Song-Ming Neo-Confucian Philosophy," 13.

> Things don't happen at random. They must follow their laws (*li*). There is a unifying origin and foundation when organized and ordered; that is why things are many and intricate but not disordered.[89]

Importantly, Wang points out how we can know about *li*: "By observing the movement of things, then the *li* of why things are the way they are can all be known."[90]

The idea of *li* as "the fundamental principle of the cosmos" became more explicit in early Neo-Confucians' models of cosmology, especially of cosmogony. Zhou Dunyi 周敦颐 (1017–1073), Shao Yong 邵雍 (1011-1077), and Zhang Zai 张载 (1020-1077) each developed their own model based on the *Zhouyi* (see Section 3), and incorporated the notion of *li* into their models in different ways. Zhou adopted the concept *Taiji* (the *Supreme Ultimate*), and takes it to be the source that transforms into all things in the universe.[91] Shao employs *Taiji* as well, but unlike Zhou, Shao focuses on numbers to emblemize the generation of the universe and the regularities of formation and evolution of all things. He believes that all numbers are from *li*, and numbers without *li* are just used for superstitious predictions.[92]

Let's consider Zhang's model of cosmology as a more detailed example to demonstrate in what sense his notion of li is similar to laws of nature. Zhang takes *Taixu* 太虚 (the *Supreme Emptiness*) to be the undifferentiated state of the universe. It is the original state of *qi* 气.[93] *Qi* is often translated as gas, ether,

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89. 王弼《周易略例·明彖》：物无妄然，必由其理。统之有宗，会之有元，故繁而不乱，众而不惑。My translation.

90. 《周易注·乾》：夫识物之动，则其所以然之理，皆可知也。My translation.

91. "*Taiji* produces *yang* through movement. As the movement reaches the ultimate, it becomes quiescent. As it becomes quiescent, it produces *yin*." Eventually, *Taiji* transforms into the myriad things, which in turn produce and reproduce. Such transformations and changes are limitless. (《太极图说》：太极动而生阳，动极而静，静而生阴。My translation checked against Feng, *A Short History of Chinese Philosophy*, 269; Justin Tiwald and Bryan W. van Norden, *Readings in Later Chinese Philosophy: Han to the 20th Century* (Indianapolis/Cambridge: Hackett Publishing Company, Inc., 2014), 138.)

Zhou connects *Taiji* with *Wuji* 无极 (the *Empty Ultimate*) from the *Dao De Jing*. It is open to discussion how to understand the relation between them.

92. 《皇极经世书·观物外篇》：天下之数出于理，违乎理则入于术。My translation.

What is interesting to note is that Leibniz uesed Shao's diagram of trigrams to show its connection with his binary system. It is, however, not clear whether Leibniz was aware that it was Shao's diagram that he was using, instead of the original diagram in the *Zhouyi*, which was in fact already lost). I discuss this in more detail in my paper *Leibniz, Binary System and I Ching*.

93. 张载《正蒙·太和》：太虚无形，气之本体。My translation.

Zhang thinks *Taixu* cannot but consist of *qi*. It thus "is not empty, but only the dissipating state of *qi*" (《正蒙·太和》：方其散也，安得遽谓之无。My translation). We can see that Zhang developed his theory explicitly to reject the Buddhist idea of emptiness.

material force, or vital energy. It is the fundamental source of the universe; everything is generated from the motion and change of *qi*: "*Qi* cannot but coalesce to form all things. All things cannot but become dispersed into *Taixu*. Following this coalescing and dispersing is what is inevitable."[94] *Yang* and *yin* are two attributes of *qi*, which are in constant interaction. When *qi* coalesces, things exist; when *qi* disperses, things cease to exist.[95] The way *qi* changes and transform is not arbitrary or random. The rule or order that *qi* follows is *li*:

> The *qi* of Heaven and Earth, though it coalesces and disperses, repels and assimilates, and has all kinds of ways to change and vary, it has *li* to follow, acting in accordance with [*li*] and not in a random manner.[96]

That is to say, *li* is the underlying principle or order for the existence and change of everything. Zhang describes and explains natural phenomena, especially astronomical ones, in terms of his theory of *qi* and *li*:

> The earth, being purely yin, coalesces at the center, while the sky, being buoyant yang, revolves and rotates outside. These are the constant bodies of Heaven and Earth. The regular stars are not fixed . . . they revolve with the buoyant yang endlessly. The sun, the moon, and the five stars move in the direction opposite to the sky's rotation, and also surround the earth. The earth is in the midst of *qi*, though follows the sky rotating leftward.[97] Its associated constellations follow; if there's a slight delay, they shift and move to the right . . . Venus and Mars, accompanying the sun, move forward and backward; its *li* is profound and intricate, but can be known through the perceptions of things. . . .
>
> The sun and moon obtain [their position in] the sky, by obtaining the *li* of being what it is [*ziran*], not just their physical attributes.[98]

94. 《正蒙·太和》：气不能不聚而为万物，万物不能不散而为太虚。循是出入，是皆不得已而然也。My translation modified from Feng, *A Short History of Chinese Philosophy*, 280.

95. Robin R. Wang and DING Weixiang, "Zhang Zai's Theory of Vital Energy," in *Dao companion to Neo-Confucian philosophy* (Springer, 2010), 49.

96. 《正蒙·太和》：天地之气，虽聚散、攻取百涂，然其为理也，顺而不妄。My translation.

97. For interpretational dispute, see Yung Sik Kim, "Independent Development, Transmission from the West, and Chinese Forerunners: Ideas about the Earth's Rotation in Seventeenth-and Eighteenth-Century East Asia," *Asia Major*, 2009, 101–120.

98. 《正蒙·参两》："地纯阴凝聚于中，天浮阳运旋于外，此天地之常体也。恒星不定，纯系乎天，与浮阳运

Here, Zhang refers to what underlies the motion of stars and planets as *li*. It signifies a deeper reality that goes beyond the physical appearance of thing.

In Zhang's theory, *li* is not yet *the* core concept. It is Cheng Hao 程顥 (1032–1085) and his brother Cheng Yi 程頤 (1033–1107) who formally establish the Neo-Confucian framework that takes *li* to be its core.[99] For them, *li* is not just the principle or order that things obey, but also the ultimate reality, the ontological basis of the universe—in this sense, it becomes closer to the Daoist notion of *dao*. Zhu Xi 朱熹 (1130–1200) further developed the Cheng brothers' theories into a more systematic and complete framework. After him, Neo-Confucian texts became the official canon of the government. From their work, we can demonstrate and summarize that *li* resembles a notion of laws of nature in the following aspects.

First, *li* is invariant and explanatory. In addition to indicating the order and pattern of things, there is a second layer of the meaning of *li* associated with the idea of a deeper reality. Following the fundamental idea from the *Zhouyi*: although the world may appear to be messy, arbitrary, or even chaotic, constantly going through changes, there's something *unchanging* underlying all the changes, which guide how things change and give them order. That is *li*. It does not change regardless of how things change. *Li* is explanatory in the sense that it is the underlying reason why things are the way they are and why things change the way they do. It gives explanations for the appearances of things in terms of their deeper reality, what they really are, their ultimate nature. We have seen this suggested by Wang Bi and Zhang Zai.

The Cheng brothers make it explicit that *li* is explanatory of natural phenomena. For example:

> [Someone] asked: "What is the target of investigating things (*gewu* 格物), external things or things within our nature and function?" [Cheng] answered: "There is no restriction. All that is in front of us is nothing but things, and all things have *li*. Such as from why fire is

旋而不穷者也。日月五星逆天而行，并包乎地者也。地在气中，虽顺天左旋，其所系辰象随之，稍迟则反移徙而右而，间有缓速不齐者..... 金水附日前后进退而行者，其理精深，存乎物感可知矣。..... 日月得天，得自然之理也，非苍苍之形也。" For more details, see 簡誌寬 Zhikuan Jian, "Lun zhangzai zhengmeng canliangpian zhong de tianwen zhishi 論張載《正蒙. 參兩篇》中的天文知識 (Discussions on the Astronomical Knowledge of Zhangzai's Zhengmeng and Canliang)," *Youfeng chuming niankan* 有鳳初鳴年刊, no. 15 (2019): 305–327.

99. There are differences between Cheng Yi's and Cheng Hao's views, which I won't engage in this paper.

> hot, why water is cold, to the relations between ruler and minister, and father and son, these are all *li*."[100]

Zhu integrated Zhang's theory of *qi* and the Cheng brothers' theories of *li* and further developed them to explain the world, especially various natural phenomena.[101] For instance, he explains thunder and lightning as rubbing of *qi* and refers to its underlying mechanism as *li*.[102] He explains the regularities of the speed and size of tides in terms of the motion of the moon, and refers as *li*.[103]

Second, *li* is prescriptive. For Zhu, this is tied to the explanatory role of *li*:

> As for [all] things in the world, each of them *must* have its own reason for why it is as it is, and its principle for how it *should be*. This is what is called by *li*.[104] (Emphasis mine.)

Li does not simply describe what things are, but also prescribes how they *should* be. This understanding of *li* is not necessarily shared by other Neo-Confucians. Along this line of disagreement, Neo-Confucians also debate the metaphysical status of *li*: whether it is prior to *qi* and material things. These disputes echo the debate between the Humean and non-Humean accounts of laws of nature in contemporary philosophy (see Section 2). Thus, not only does the notion of *li* share similar features with the notion of laws of nature, but also the philosophical debate about *li* is similar to the debate about laws of nature developed in Western traditions.

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100. 《二程遗书·卷十九》: 问: 格物是外物，是性分中物？曰: 不拘。凡眼前无非是物，物物皆有理。如火之所以热，水之所以寒，至于君臣、父子间皆是理。 My translation checked against Chan, *A Source Book in Chinese Philosophy*, 568–569.

101. The following dialogue illustrates what Zhu takes the relation between *qi* and *li* to be:
> Someone asked again: "How does *li* manifests itself in *qi*?" Zhu replied: "What makes *yin* and *yang* and the *Five Phases* (*wuxing* 五行) not lose their order in the complex interrelationships is *li*. If *qi* does not condensed, *li* would have nothing to adhere to either." (《朱子语类·理气上》: 又问: "理在气中发见处如何？" 曰: "如阴阳五行错综不失条绪，便是理。若气不结聚时，理亦无所附著。My translation modified from Tiwald and Norden, *Readings in Later Chinese Philosophy: Han to the 20th Century*, 171.)

102. "As for thunder and lightning, Cheng said it's just rubbing of qi. True or false?" "It is correct. . . . When qi condenses, there is [thunder and lightning]; once it releases its potential, it disperses. . . . This is li." 《朱子语类·理气下》: 问: "雷电，程子曰: '只是气相摩轧'。是否？"曰: "然。""'或以为有神物。"曰: "气聚则须有，然才过便散。如雷斧之类，亦是气聚而成者。但已有渣滓，便散不得，此亦属'成之者性'。张子云: '其来也，几微易简；其究也，广大坚固。'即此理也。 My translation.

103. 《朱子语类》卷二

104. 《四书集注》: 至于天下之物，则必各有所以然之故，与其所当然之则，所谓理也。My translation modified from Chen, "The Concepts of Dao and Li in Song-Ming Neo-Confucian Philosophy."

Third, *li* can be used to make inferences or predictions. The Cheng brothers are explicit about this (continuing the previous quote from them):

> [Someone] asked again: "If [I] only understand one thing, only see this thing, can I still see all these *li*?" [Cheng] answered: "You need to look everywhere. Even Yanzi can know only ten things from hearing one. But if [one] later fully understands *li*, then they can infer ten thousands of billions of things."[105]

Zhu discusses using *li* to make inferences regarding, for instance, the motion and change of the moon:

> If we infer by *li*, then the moon does not wax and wane in and off itself; [it only appears to us as if it does].[106]

Moreover, based on his understanding of *li* and *qi*, Zhu infers from the presence of conches and oysters fossils on high mountains that the conches and oysters once lived in water, the rocks were once soils, and the mountains were previously at a low altitude under water and only became elevated later.[107]

Fourth, *li* is ubiquitous and, in some sense, universal. Zhang is already explicit that *li* is ubiquitous:

> Everything has *li*. If one is not aware of understanding *li*, it is as if they are in a dream their whole life.[108]

Zhang believes that understanding *li* is not only possible but also crucial for us. He criticizes Buddhism for not aiming to understanding *li*, and Zhuangzi for not understanding the *li* correctly as stated in the *Zhouyi*.[109]

The Cheng brothers agree that *li* is ubiquitous:

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105. 《二程遗书·卷十九》：又问：只穷一物，见此一物，还便见得诸理否？曰：须得遍求。虽颜子亦只能闻一知十，若到后来达理了，虽万亿亦可通。 My translation checked against Chan, *A Source Book in Chinese Philosophy*, 568–569.

106. 《朱子语类·理气下》：若以理推之，则无有盈阙也。 My translation.

107. For disputes about whether Zhu really understands the mechanism of fossil formation, see Kim, *Questioning science in East Asian contexts: essays on science, Confucianism, and the comparative history of science*, 17–19.

108. 《张子语录》：万物皆有理，若不知穷理，如梦过一生。My translation.

109. 《张子语录》：释氏便不穷理，皆以为见病所致。庄生尽能明理，反至穷极亦以为梦，故称孔子与颜渊语曰"吾与尔皆梦也"，盖不知易之穷理也。My translation.

> All the things in the world can be enlightened by *li*. If there is a thing, there must be a rule (*ze*) for it. Each thing has a *li*.[110]

Moreover, for Cheng, "there is only one *Li* in the world; hence it can be applied universally [reaching to the four seas]."[111] It is in this sense that *Li* is taken to be universal. For later Neo-Confucians, it is a deep philosophical issue of how the single, unified *Li* is related to various particular things (often discussed under the topic *One Li, Manifested Differently* 理一分殊). Different Neo-Confucians address the issue in different ways.

Although it is difficult to pin down the specific content of *li*, Neo-Confucians give suggestions on how we can understand or know about *li*. Recall the second quote from the Cheng brothers: we can only understand *li* by extensive observations. Zhang also gives a methodology on how to understand *li*:

> Understanding *li* should be gradual. The more things we see, the more *li* that we understand. In this way, we can exhaustively understand the nature of things.[112]
>
> Perceiving all the things and inspecting human affairs are both ways to understand the *li*.[113]

Li is not merely a philosophical term, but used by mathematicians and scientists as well, especially during the Song dynasty.[114] Consider the scientist Shen Kuo 沈括 (1031–1095) as an example.[115] Shen uses *li* to refer to the patterns or regularities in various scientific contexts, including astronomy, medicine, and, to a lesser extent, magnets, weather, and plants. For instance, when he discusses the phenomena of resonance, he describes it as constant *li*.[116] In a discussion on geology, he claims: "This *li* is necessary."[117] Shen thinks that events or phenomena are highly sensitive to the situations or contexts in which they

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110. 《二程遗书》：天下物皆以理照，有物必有则，一物须有一理。 My translation.

111. 《河南程氏遗书 · 卷二下》：理则天下只有一个理，故推至四海而准。

112. 《张子语录》：穷理亦当有渐，见物多，穷理多，如此可尽物之性。My translation.

113. 《张子语录》：明庶物，察人伦，皆穷理也。My translation.

114. Song is usually considered to be the peak of scientific and technological development in China. It'd be interesting to see whether there is a mutually beneficial relation between the development of Neo-Confucianism and the development of science and technology.

115. Needham praises him as "one of the greatest scientific minds in Chinese history" (Needham, *The Grand Titration: Science and Society in East and West*, 27).

116. 《梦溪笔谈》卷十七：殊不知此乃常理。二十八调但有声同者即应。

117. 《梦溪笔谈》卷二十四：此理必然。My translation.

occur—one can make inferences and predictions only if both the constancy of *li* and changing variables are taken into account. He emphasizes the importance of intricacy and even the slightest discrepancies in inferring the ultimate *li*.[118] In particular, it has been argued that Shen and his scientific studies were influenced by Neo-Confucianism.[119]

Neo-Confucianism and especially its analysis of *li* have a profound influence on the scientific discourse in Chinese traditions at later times. Consider *gewu*, a term that appears in the first quote from the Cheng brothers. It is a part of the term *gewu zhizhi* 格物致知 from the canonical Confucian text, *Great Learning* (allegedly written in the Warring States period). *Zhizhi* means extending knowledge. The Cheng brothers and Zhu interpret *gewu* as "intellectually understanding *li* that underlies things". Zhu believes that *zhizhi* lies in *gewu*;[120] that is, gaining knowledge lies in "intellectually understanding *li*" and exhausting the *li* of things. Following this Neo-Confucian tradition, since the Yuan dynasty (1271–1368), "natural studies" in China had often been classified under the term *gezhi* 格致, which is the abbreviation of *gewu zhizhi* and roughly means inquiring into and extending knowledge of things. For example, early translations of Aristotle's theory of the four elements (1633) and Agricola's *De Re Metallica* (1640) into classical Chinese used *gezhi* for the Latin *scientia* in their titles.[121] In the late Qing dynasty (1636–1912), *gezhi* was used to refer to courses in physics, chemistry, biology, etc. taught at the time.[122] This usage was retained until it was replaced by the modern word *kexue* 科学 (which was adopted from Japanese) in the early twentieth century.[123] Since understanding *li* is essential to *gezhi*, this close relation mirrors

118. 《梦溪笔谈》卷七：……以是知其必雨。此亦当处所占也。若他处候别，所占异迹。其造微之妙，间不容发。推此而求，自臻至理。

119. 乐爱国 Ai-guo LE, "Shen Kuo's Scientific Research in the Background of Northen-Song Confucianism 北宋儒学背景下沈括的科学研究," *Journal of Zhejiang Normal University (Social Sciences)* 浙江师范大学学报(社会科学版) 32, no. 6 (2007).

On how Shen's uses of *li* differ from Neo-Confucians' understanding *li*, see Ya Zuo, *Shen Gua's Empiricism*, Harvard-Yenching Institute Monograph Series 113 (the Harvard University Asia Center, 2018).

120. 朱熹《大学章句》：致知在格物者，言欲尽吾之知，在即物而穷其理也。 My translation.

121. Benjamin A. Elman, *A Cultural History of Civil Examinations in Late Imperial China* (University of California Press, 2000), 461–465.

122. This is noted by the Chinese writer Lu Xun 鲁迅 (1881-1936) in *Na Han* 《呐喊·自序》.

123. In particular, physics was initially translated as *gewu*. See American missionaries, Young John Allen and William Alexander Parsons Martin. Zhang Taiyan criticizes such translations.

One might argue that the epistemology of science differs from Neo-Confucian epistemology (which often involves self-cultivation or secluded meditation), and thus *gezhi* cannot be interpreted as denoting science (I thank to Stephen Angle for pointing this out). However, the fact that later scholars naturally aligned these two concepts together suggests that the episte-

the relation between laws of nature and science in Western traditions. The use of *gezhi* as science and the essential role of *li* in *gezhi* further demonstrate that *li* has the potential to develop into a notion of laws of nature that plays a role in the development of science.

There are aspects of *li* that differ from the notion of laws of nature developed in Western traditions (similar things can also be said about *dao*). As mentioned earlier, *li* sometimes is taken to be the ontological basis of everything in a way that laws of nature are not. Neither have I found an instance where *li* is formulated in terms of a mathematical equation. Another salient difference is that *li* explicitly and extensively covers the human realm and Neo-Confucians focus on the normative aspect of *li* more than its natural aspect. Nevertheless, I don't think these differences indicate that *li* fails to embody the idea of laws of nature, or cannot give rise to a more precise, scientific notion of laws.

To see why, consider the last difference. It is not the case that Neo-Confucians regard the *li* for humans as something irrelevant or independent from the *li* of natural phenomena. Rather, *li* applies to both the natural and human realm in the sense that the human realm is just a part of the natural realm. This is emphasized by, for instance, Zhang: "*li* is not in humans, but entirely in things. Humans are just one of the things."[124] One might wonder how it can be the case that *li* encompasses both natural and moral norms, just as someone asked Zhu: "You say that *li* is something that people and things equally receive from Heaven. But do insentient things also have *li*?" Zhu replied: "They definitely have *li*, like boats can only travel on water and carriages can only travel on land."[125] This dual feature of *li* is compatible with the idea of laws of nature developed in Western traditions: It is not the case that human beings somehow are not subject to laws of nature. In fact, we can distinguish laws of psychology or sociology from laws of physics or chemistry, just like we can distinguish the *li* of humans from the *li* of nature.

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mological differences do not preclude a connection between them.

124. 《张子语录》：理不在人，皆在物。人但物中之一物耳。My translation.

125. 《朱子语类·性理一》：问："理是人物同得于天者。如物之无情者，亦有理否"。曰："固是有理，如舟只可行之于水，车只可行之于陆。" My translation. This is the same example used by Deng Xizi (see the quote in the last section). We can see a clear connection here.

5 *Dao*, *Li*, and Package Deal

As readers may have noticed, Neo-Confucians continue to use *dao*. Given their apparent similarities, how exactly is *li* related to *dao*? Here's Zhang's answer:

> The *yin* and *yang* are *qi* of Heaven, which can also be called *dao*. . . . Generating and covering is *dao* of Heaven, which can also be called *li*.[126]

Zhu more systematically explains how *li* and *dao* are related:[127]

> Whoever speaks of *dao*, they all mean the *li* of what things should be.[128]
>
> [Someone] asked: "What is the difference between *dao* and *li*?" Zhu replied: "*Dao* is the road; *li* is its pattern of differentiations." The questioner continued: "Is it like the pattern of wood?" Zhu answered: "It is." One asked: "In that case they seem to be the same?" Zhu responded: "The word '*dao*' is the overarching term, while '*li*' is the many differentiations within *dao*.[129]

Why did Neo-Confucians move from *dao* to *li*? It is partially due to the influence from Buddhism, which popularized the notion of *li* to "account for the ultimate nature and unity of things".[130] On the one hand, since ancient Confucianism focused on the *dao* of Humans and had little discussion on the *dao* of nature (as mentioned in Section 3), Neo-Confucians felt the need to expand their theory and introduce new concepts. Since Buddhism was popular at the time, framing Confucian theories in Buddhist terms could be helpful to gain "widespread respectability and currency".[131] On the other hand, because Neo-Confucians viewed themselves as continuous with the great ancient Confucians like Confucius, it is also

126. 《张子语录》：阴阳者，天之气也，亦可谓道。……生成覆帱，天之道也，亦可谓理。My translation.

127. For more details, see Chen, "The Concepts of Dao and Li in Song-Ming Neo-Confucian Philosophy."

128. 朱熹《论语集注》：凡言道者，皆谓事物当然之理。 My translation.

129. 《朱子语类·性理三》：问："道与理如何分？"曰："道便是路，理是那文理。"问："如木理相似？"曰："是。问：如此却似一般？曰：道字包得大，理是道字里面许多理脉。 My translation modified from Tiwald and Norden, *Readings in Later Chinese Philosophy: Han to the 20th Century*.

130. Justin Tiwald, "Song-Ming Confucianism," in *The Stanford Encyclopedia of Philosophy*, Summer 2020, ed. Edward N. Zalta (Metaphysics Research Lab, Stanford University, 2020). Limitation of space does not allow me to introduce Buddhist views on *li* and whether or not it has a notion of laws of nature.

131. Tiwald.

important for Neo-Confucians to show their views were either indicated by, or at least consistent with, the Confucian canon.[132] That's why the new concept, *li*, could not be radically different from *dao*.

Given this continuous development from *dao* to *li* and their close relation,[133] it would be better to consider them together as a package expressing the idea of laws of nature. That is to say, to show that there is an idea of laws in Chinese classical texts, *dao* and *li* should not be treated in isolation. In fact, they are further complemented by a cluster of notions, such as *chang* 常, *fa* 法, *ze* 则, and *lü* 律, which add or highlight the meaning of constancy, governing, rule, and law. This also suggests that the presence of the idea of laws in those texts is not just a few isolated, sporadic instances, but rather widespread (*pace* Bodde).

My arguments are not intended to be exhaustive; I have specifically chosen texts that are influential. Nor do I intend to argue that either *dao* or *li* exactly matches the notion of laws of nature developed in Western traditions, or that every instance of the uses of *dao* and *li* conveys the idea of laws. Rather, this paper is meant to be a starting point to consider that there is an idea of laws of nature in Chinese classical texts, as embodied by *dao* and *li* together (complemented by other notions such as *chang*). This idea of laws is not unique to a particular text or author, but fairly robust through Chinese intellectual history. Even if some of the particular interpretations that I adopted in this paper turned out to be inadequate, it would not affect the overall thesis that there is such an idea of laws of nature. To put it another way, this paper provides a context and a way to compare two clusters of ideas: one goes under the name 'laws of nature' in Western traditions and the other including *dao*, *li*, *fa*, *chang*, etc. These two clusters of ideas share important similarities.

Summary. In this paper, I first introduced the general context and significance of a comparative project on the idea of laws of nature. By considering concepts of laws as developed in Western traditions, used by modern scientists, and discussed by contemporary philosophers, I laid out the essential features of laws that are under consideration for our comparative study: being the constant patterns or orders that

132. Tiwald and Norden, *Readings in Later Chinese Philosophy: Han to the 20th Century*.

133. Recall that this relation can be traced to the *Han Feizi* (see Section 3).

underly the motion and change of everything and explain why things behave the way they do. I demonstrated that *dao* and *li* share these features and thus count as, or at least can be seen as counterparts of, a notion of laws of nature. This analysis of *dao* and *li* undercuts Needham's claim that there is no notion of laws of nature in Chinese thought. In particular, I refuted Needham's arguments that (1) a celestial lawgiver is essential to the notion of laws, whereas Daoism and Neo-Confucianism lack an external lawgiver to command non-human things; (2) *dao* fails to be a notion of laws because it is *wu wei* and inscrutable; (3) *li* fails because it is organismic instead of mechanical. Even if one perceives the Needham Question as ill-posed or questions the essential role of laws of nature in the development of modern science, this comparative study remains meaningful. It explores how philosophical concepts like *dao* and *li* played a role in the development of natural knowledge and science in Chinese traditions.

Where will this starting point lead us? On the one hand, we can reframe Needham's project in a more charitable way: if modern concepts of laws of nature emerged, at least in part, from the idea of divine legislation, could such a concept have evolved by a different route? The tentative answer of this paper is yes, *dao* and *li* show promise in giving rise to a notion of laws just like the idea of divine legislation gave rise to a modern notion of laws in Western traditions. We can further investigate how philosophical concepts such as *li* are employed in more technical scientific texts and how they may have shaped the development of natural knowledge and science. On the other hand, understanding *dao* and *li* in terms of laws of nature provides additional conceptual tools to analyze philosophical texts. The idea of laws is often associated with modality and counterfactuals. Are there similar notions in Chinese thought? Moreover, the differences between, for example, Zhang Zai's and Zhu Xi's *li* echo the debate between the Humean and non-Humean accounts of laws in contemporary philosophy. Drawing this analogy can add another perspective to understand Zhang and Zhu. In general, this project can greatly benefit from further detailed case studies on individual authors or texts.

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