今试与人盱衡而论吾国贫弱之病，则必以无科学为其重要原因之一矣。然则吾国无科学之原因又安在乎？是问也吾怀之数年而未能答，且以为苟得其答，是犹治病而抉其根，于以引针施砭，荣养滋补，奏霍然之功而收起死之效不难也。今欲论吾国科学之有无，当先知科学之何物。

When we try to talk about the fundamental causes of our nation’s weakness and poverty, one of the major reasons is the lack of science. But why does our nation lack science? I have thought about this question for many years and cannot give an answer. To find the answer is like a doctor finding the root of the disease by injection and medicine as well as providing nourishment. It is not difficult to quickly achieve the effect of the medicine to treat the disease and then go back to being alive. To discuss whether science exists in our country or not, firstly, we must know what science is.

科学者，智识而有统系者之大名。就广义言之，凡智识之分别部居，以类相从，井然独绎一事物者，皆得谓之科学。自狭义言之，则智识之关于某一现象，其推理重实验，其察物有条贯，而又能分别关联抽举其大例者谓之科学。是故历史美术文学哲学神学之属非科学也，而天文物理生理心理之属为科学。今世普通之所谓科学，狭义之科学也。持此以与吾国古来之学术相较，而科学之有无可得而言。

Science is a general term for systematic knowledge. In a broad sense, it refers to any knowledge that can be divided into categories and that can give a unique and well-structured explanation of a particular term. In a narrow sense, science means knowledge about certain phenomena with reasoning based on experiments. Moreover, it also includes observational research that is well structured, summarising scientific principles from the various connections. Therefore, history, fine arts, literature, philosophy, theology, and other similar fields are not science. While astronomy,

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1 H. C. Zen (1886-1961) was an outstanding leader in the organization of scientific undertakings and the pioneer of modern Chinese science. He was a founding member of the Science Society of China, a major science organization in the modern history of China initiated by Chinese students at Cornell University in 1914, and served as its president from 1914 to 1923. See Peter Buck, American Science and Modern China, 1876-1936. (Cambridge University Press, 1980): 94.
physics, physiology, and psychology are science. Science is narrowly defined in contemporary society. Comparing the academic works in our history by science in a narrow sense, we can tell whether there is science in our country.

The history of academic thinking in our nation shows a progress of continuous degradation. After the Qin and Han dynasties, people were confined to the knowledge which were popular at that time. They only observed and studied the world but did not investigate and conclude. Thus, it could be confirmed there was no science. Those who promoted the national essence cited the earliest sages’ experiment as examples to prove the superiority of our own inherent knowledge in order to suppress the exaggeration of others. Such as Divine Farmer (Shennong 神农), who studied plants and trees, and Huangdi 黄帝, who created arithmetic. Or Mo Tzu 墨翟 and Gong Lu 公输般 in the pre-imperial period, who understood physical machinations. This included Dengxi 邓析 and Gongsun
Long 公孙龙7, who could tell the differences and similarities; Zisi 子思8, who doubted the view of “Round Sky and Square Earth”; Chuang Tzu 庄子9, who stated cold water could store and transform fire. While these creations of the former sages mentioned above were sufficient to prove the spiritual wisdom of our nation, they can not prove the existence of science in our nation. Why? Because this sort of knowledge is neither systematic nor well-structured.

Even so, science appeared in Europe only in the last three or four hundred years. Therefore, there was no doubt that science did not exist in ancient China. I used to have doubts when I read history. When the barbarians occupied Rome, the darkness of the European academia was so strong that the academy field of our country since the Qin and Han dynasties were not comparable at all. By the 16th century European Renaissance, science also began to sprout and thrive. Francis Bacon boosted its beginning, and then Galileo and Newton mastred its method. After that, various scholars appeared, taking over its continuation and flourishing science. Therefore, science was improving day by day and flourishing at that time. In China, there was still a slight hope during the Zhou Dynasty and the Zhai Dynasty. After the Qin Dynasty, society entered into a long night, a thousand years of drowsiness, and we might have no hope of seeing the light again. Why was it so easy to get rid of the darkness in Europe but so difficult to see the light in our country? Was the wisdom of the East and the West different? But the descendants of Huang (Huangdi zisun 黄帝子孙) had long been known as gods. Was the social environment favourable to Europe but not to our country? However, the rejection of heresy in our country was far less powerful than the religious confinement in Europe. Therefore, the reason there is no science in our country was not the difference in natural talent nor the harsh restriction of the social environment. In short, it is because of the lack of a scientific

7 Gongsun Long 公孙龙 (320BC-250BC) was a Chinese philosopher and writer who belonged to the School of Names (also known as the Logicians), which was part of the ancient Chinese philosophy. He not only taught at a school but also received support from rulers. He promoted the use of peaceful methods for resolving conflicts instead of the prevalent warfare during the Warring States era.

8 Zisi 子思 (481BC-402BC) was a Chinese philosopher and the grandson of Confucius. Zisi was the son of Kong Li 孔鲤 and Boyu 伯鱼, and the only grandson of Confucius.

9 Chuang Tzu 庄子 (369BC-286BC) was a famous thinker, philosopher, and literary figure in the mid-Warring States period of China. He was a representative figure of the Daoist school, and inherited and developed the philosophy of Lao Tzu. Later generations referred to him and Lao Tzu together as “Lao-Zhuang.” See Yi Xiaobin 易小斌, “Zhuangzi Shengzuniandai jiqi Guliguguo kaobian” 庄子生卒年代及其故里故国考辨 [Research on Chuang Tzu's Birth and Death Dates and His Hometown and Country], Journal of the Xiangnanxueyuan 湘南学院院报 (2021).
C. W. Eliot, the former president of Harvard University, once visited the Far East. After returning, he wrote a book, announcing to the Americans: “In education, we Western countries have a treasure, the inductive method, which can serve as a remedy and can save people’s lives in the East. Eastern scholars lose themselves in speculation, being trapped in deep contemplation, and got their epiphanies through meditation. What they studied is theory and philosophy. All that they held as a doctrine was the knowledge handed by their ancestors, and they never tried to find out the truth through experimentation through the inductive method. The progress of the West in the last hundred years relied on the inductive method...We must save the Eastern people from indolence so that they may have an independent and impartial spirit. Also, they should not be influenced by external factors as well as keep on doing research and pursuing truth. Only by teaching them the natural sciences, using the inductive method and scientific experimentation and then simplifying their functions, may these scholars have the ability to acquire correct knowledge from daily observation.” These words are honest and straightforward enough to give the reason for the absence of science in our country.

It is said that logic has two main methods, one is the deductive method and the other is the inductive method. To what extent do these two methods mean for science, as two wheels mean to a car or a pair of wings mean to a bird, and science cannot be effective without anyone of them. Is there any comment on the statement that the main reason for the absence of science in China is the lack of the inductive method? The answer is that I said that induction is a necessary method for scientific research, but I did not say that deduction is an unnecessary method for scientific research. Even so, there is some truth to the statement that there is no science without induction, as explained below.

第一归纳法者实验的也。论理学上之定义曰，由特例而之通义者曰归纳，由通义而得特例曰演绎。其应用于科学也，则演绎者先为定例以验事实之合否，归纳者积多数试验以抽统赅之定律，其不同之点则归纳法尚官感，而演绎法尚心思。归纳法置实事于推理之前，演绎法置事实于推理之后是也。夫演绎法执一本以赅万殊。在辩论上常有御人口给之便，然非所以经
First, the inductive method is experimental. According to the definition provided by the study of Logic, the inductive method moves from particular to general, while the deductive method has the opposite meaning. When the deductive method is applied to science, it is necessary to have a general theorem first and to verify whether the facts conform to it. While the inductive method, it abstracts the theorems of the phenomena of unification by accumulating numerous experimental results. The difference between the two is that induction focuses on external sensory experience, whereas deduction focuses on internal mental reflection. The inductive method places facts before reasoning (i.e., reasoning through facts), while the deductive method places facts after reasoning (i.e., knowing facts through reasoning). Deduction adapts and solves different problems based on its constant principles. Although it is often convenient in debates, it is not a scientific approach. Because the human mind is always trying to simplify complicated natural phenomena, it is very difficult to obtain the correct and immutable premises (i.e., general laws). Someone gives up due to difficulties and becomes disappointed, frustrated, and indifferent. In times of adversity, some people may experience a decline in motivation and lose sight of their goals, resulting in a lack of effort. Conversely, others strive to rekindle their drive by pursuing seemingly feasible strategies that can be practically applied. Nevertheless, they may neither validate the correctness of their approaches nor seek relevant precedents and examples. To get the correct premise, one must start by doing experiments. As soon as a certain number of experiments have been conducted, the relationship between them will naturally appear, and the corresponding hypothesis will be generated. The so-called hypothesis is based on a large number of experiments and requires further experimentation to verify. If the hypothesis cannot be verified through experimentation, it must be abandoned. If the hypothesis is confirmed through experimentation, the theorem is established. Therefore, though a hypothesis is used after experimentation, its conclusion is still derived through factual induction, rather than through hypothetical deduction. We must attach great importance to experimentation when using induction. Only with experimentation can we have facts, and scientific theorems can be discovered through this. Aristotle ¹⁰ said: “Without external sensory experience, there is no induction. Without induction, there is no way to produce knowledge. And without knowledge, there

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¹⁰ Aristotle (Greek: Ἀριστοτέλης, Aristotélēs, 384 BC – 322 BC) was an ancient Greek philosopher, scientist, and educator, considered one of the greatest in the history of ancient world philosophy. He is often regarded as the culmination of Greek philosophy.
is not enough to explore the laws of nature.” The root of the problem with scholars in China is that they do not pay enough attention to the external sensory experience and rely exclusively on their internal thinking abilities. There are also those who only know about the nature of reasoning through books. For example, Wang Yangming11 considered bamboo in the yard for seven days in order to practice the principle of the Investigation of things (Gewu 格物), and Yan Xizhai13 had lectures specialising in three things.14 They certainly have their own achievements in learning, but the methods they use are completely different from today's scientific research. This is the most important reason for the absence of science in our country.

第二归纳法者进步的也。科学为有统系之智识，唯其有统系之智识，亦能为有统系之发达。即合众事实而得一公例，而此公例又生新事实，合诸新事实又发见新公例。循环递引，以迄无穷。此略翻一专门之书，而可得其兆迹者也。举其最近之例，如物理学者研究稀薄气体中电流导之理，而得所谓阴极光线(Kathode Ray)。因研究此阴极光线之性质，而得电子(Electron)之说。因此阴极光线之射触于试验管壁，而得所谓 X 光线。因研究 X 光线，而得所谓 αβγ 光线。因此三种光线而发见镭之放射作用(Radioactivity)，而元素不变之说且因以震动焉。不特此也，一科学之进步常足以影响于他科，而挟以俱进，此任观一性质相近之两科学而可得其例也。如数学上微积分法发明而后，物理学之进步乃益可考，物理学者高压与低温之术发明而后，化学上之气体定律乃益确定，元素分析之法乃益精密，化学上光色分析(Spectrum Analysis)与物理学上光波长短之研究精，而后日球之质体与空间恒星之进退可推算而知也。夫事理联属，相引愈进，然非归纳法以为研究，则前者与后者为无意味，用归纳法有时难误，而亦有得。读者亦知化学之起原乎？当物质不变定律之未发明也，欧洲人士精

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11 Wang Yangming 王阳明 (1472-1592), also known as Wang Shouren 王守仁, was a renowned thinker, philosopher, calligrapher, and writer in the mid-Ming dynasty of China. He was born in Yuyao, Shaoxing, Zhejiang (now Yuyao, Ningbo, Zhejiang). His philosophical ideas, literary works, and calligraphy have had a profound and lasting impact on Chinese and East Asian philosophy and culture.

12 The investigation of things, which Chinese meaning is Gewu 格物, and the full name is Gewuzhizhi 格物致知. It is an important concept in ancient Chinese Confucianism. Xiandai hanyu cidian 现代汉语词典 [Modern Chinese Dictionary] explains it as: studying the principles and laws of things and summarizing them as rational knowledge. Wang Yangming spent seven days and nights thinking about bamboos in the yard in order to practice the principle of the investigation of things. See Benjamin A. Elman, “The investigation of things (Gewu 格物), natural studies (Gexizhe 格致学), and evidential studies (Kaozhengxue 考证学) in late imperial China, 1600-1800”, Brill, 2010.

13 Yan Xizhai 颜习斋 (1635-1704), also known as Yan Yuan 颜元, was a philosopher and educator in the late Ming and early Qing dynasties in China. He was the founder of the Yan-Li school of Confucianism. Throughout his life, Yan Yuan practiced and taught medicine, inheriting and developing the educational philosophy of Confucius.

心炼金之术，以谓黄金可以由他质变成。于是熔铸化炼，不遗余力。而其结果，则黄金未得，而化学以之始诞。此无他，以其发见种种新事实为研究之资故也。不由归纳法，则虽圣智独绝，极思想之能，成开物之务，亦不过取给于一时，未能继美于来祀。某说部言有西人适中国者，以吾指南针发明在数千年前，谓必精美逾彼所有，入市急购一具，则彼所见为数千年前之物无异，凡若此类，其例宏多，岂特一指南针哉。故无进步之术者，必无进步之学，此可质之万世者也。

Secondly, the inductive method is progressive. Because science is a systematic knowledge, it also develops systematically. Theorems are induced from numerous facts, and these theorems in turn generate new facts, which lead to the discovery of further theorems. This cycle can go on infinitely. This principle can be found in specialised books with little difficulty. For example, physicists discovered cathode rays when studying the principles of electrical conduction in rarefied gases. Furthermore, the study of cathode rays led to the theory of electrons. When cathode rays were observed to irradiate the walls of the experimental tube, X-rays were discovered, and the study of X-rays led to the discovery of alpha, beta, and gamma radiation. Research on these three types of rays led to the discovery of radioactivity in radium, which shook the theory of the constancy of elements. Not only that, but the progress of one discipline often affects other disciplines and progresses together with them. Any two disciplines with similar properties can obtain such examples by observing each other. For example, after the invention of calculus in mathematics, physics made significant progress. When high-pressure and low-temperature techniques were invented in physics, the gas laws in chemistry became more precise, and the methods of elemental analysis became more accurate. As a spectral analysis in chemistry and the study of light wavelengths in physics became more precise, the composition of the sun and the variations of celestial bodies could be deduced. It can be seen that facts and theories are interrelated and mutually beneficial. Without the inductive method, facts are meaningless to theory. And although there may be errors in using the inductive method, it can ultimately lead to discoveries. Do you know the origin of chemistry? Before the law of conservation of matter was discovered, Europeans were obsessed with alchemy. They believed that gold could be extracted from other substances, so they spared no effort in experimenting, melting, casting, and analysing. Although they did not find gold, chemistry was born as a result. Undoubtedly, all the new facts discovered during the process of alchemy are materials for scientific research. Even with unique wisdom, extremely powerful thinking ability, and the ability to understand the development of all things in the world, without the inductive method, it can only achieve short-term results and cannot continue to develop and be beneficial to the future. It is said that a Westerner came to China and thought that since the compass had been invented in China thousands of years ago, the compass made by the Chinese must be more sophisticated than those made by Westerners. He quickly went to the market to buy one, only to find that it was no different from the compass made thousands of years ago. There are countless examples like this. Therefore, without a method of progress, there is no progress in learning, and this principle can be verified no matter when or where.
In short, the essence of science is not in the process of the physical but in its methodology. There is no difference in the definition of “physical” between today and thousands of years ago. Thousands of years ago, there was no science, and with the use of methodology, science exists today. With the right methodology, all observed facts can be scientific. Otherwise, even with all the advanced theories and technologies of others, they may imitate others without experiencing and finding the truth. Moreover, they might learn to grasp the scientific method and be unable to produce independent progress, becoming subservient and following behind professional scholars. How could such followers make progress then? Those who are dedicated to learning can therefore realise what they should do.
Bibliography


