

Kim Geun Bae 김근배, *Han'guk gwahakgisul hyeokmyeongui gujo*
한국 과학기술혁명의 구조 (The Structure of Scientific and Tech-
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Kim Geun Bae's *Han'guk gwahakgisul hyeokmyeongui gujo* (The Structure of Scientific and Technological Revolution in Korea) begins with a comparison between Western and Korean science and technology. In the history of Western science and technology, science has always been superior to technology. Science has been regarded as the origin of new technologies and industries; scientific creativity has been emphasized as the most important virtue of scientists; and the nature of scientific rationality has been the subject of intense philosophical controversy and exploration. The university has prioritized science education over engineering. Finally, research in science and engineering, which has largely been conducted in universities, has been funded by independent research foundations.

On the other hand, technology has always been more emphasized than science in Korea.¹ In Korea, it was thought that the development of industrial technology could lead to the development of science; effective leadership rather than individual scientific creativity has been emphasized as an important virtue of scientists and engineers; and scientism prevails without serious debates over the epistemological primacy of scientific knowledge. The university has emphasized engineering rather than science. Finally, research in science and engineering has always been under the direct influence of government control.

Thomas Kuhn's *The Structure of Scientific Revolutions* and his idea of "paradigm" provide a useful tool for understanding the evolution of Western science. Kim argues that Kuhn's *Structure* does not help much in understanding Korean science and technology. This is because Korean science and technology have very different characteristics from Western science and technology. However, Korea's science and technology has also undergone a rapid development which can be called a "revolution." Kim thus provides several conceptual frameworks to understand Korean science and technology, and then presents the "structure" of the Korean scientific and technological revolution.

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¹ Kim coins the term "scientechnology" as a translation of "gwahak-gisul" (과학기술). Scientechnology spotlights technology rather than science, and in this sense, it is different from "technoscience" (pp. 49-50).

In order to understand the revolutionary development of Korean science and technology, Kim first pays attention to the “institutions” of science and technology. Scientific and technological institutions include administration, education, research, culture, policy, organization, business, laws and regulations related to science and technology. The institutional school dominated the sociology of science before the 1970s in the United States and Europe, with the pioneering works of figures like Robert Merton and Joseph Ben-David, investigating institutions that facilitate or hinder scientific development. However, the institutional sociology of science began to decline as social constructivism, which explores the social construction of scientific knowledge, and actor-network theory, which asserts human-nonhuman symmetry, emerged as the mainstream sociology of science. Yet Kim asserts that the institution can be seen as the most important factor in understanding the rapid development of Korean science and technology. In developing countries such as Korea in the 1960s, where the basics of science and technology were weak and far from self-sufficient, institutions were “the ecological base” on which science and technology kept its “self-sufficiency and vitality” (p. 130).

Furthermore, Kim maintains, certain institutions play a similar role to Kuhn’s paradigm because they define the scope, content and direction of science and engineering research. There is another similarity. Just as an old paradigm shifts to a new paradigm during a scientific revolution, an old institution is also transformed into a new one. It is important, however, to recognize the difference between these two changes. First, there exists an incommensurability between two different paradigms, but there is a sort of continuity, that is, commensurability, between institutional changes. This is because institutional changes are cumulative, adding a new dominant institution to older ones. Second, whereas the change of paradigms is triggered by an internal crisis, the change of institutions in Korean science and technology has been driven by changes in political power. Finally, although Kuhn has clearly stated that a paradigm shift should not be understood as progress to a better paradigm, Kim highlights that changes in institutions over the past several decades led to the rapid development of Korean science and technology, which has been progressive and revolutionary.

More specifically, Kim explains, South Korea’s principal scientific and technological institution has changed four times: the main institutions were universities in the 1950s; then government-sponsored research institutes in the 1960s and 1970s; then national research and development projects in the 1980s and 1990s; and finally, private corporations after the 2000s. In each period, model institutions played a central and conspicuous role: Seoul National University in the 1950s; KIST in the 1970s; the National R&D Program in the 1980s, etc. The periods in which a new institution was launched and established correspond to the Rhee Syngman, Park Chunghee, and Chun Doo-hwan regimes, respectively.

The second characteristic of Korean science and technology that Kim focuses on is “practice.” Scientific and engineering practice is a topic that has been widely studied in the history and sociology of science and technology. However, Kim draws

attention to the unique practices in Korean science and technology different from those in Western science and technology. These are communal (familial) practices, task-oriented practices, large-scale practices, and finally, high-intensity practices. Putting such practices into effect, the Korean scientific and engineering community succeeded in accelerating the development of science and technology without any revolutionary discovery or invention. Kim characterizes this as a “great quantity of incremental innovation.”

Kim points out that these practices largely correspond to a given scientific and technological institution. In the 1950s, when universities were the main institution, communal practices were dominant. In the 1960s and 1970s, when government-sponsored research institutes dominated, the dominant practice was task-oriented. And the National R&D Program in the 1980s needed large-scale practice. High-intensity practice existed through all of these periods, but it was accelerating. The outcome of such practices was different as well. The rudimentary research of the 1950s was published in the form of review papers and trend reports, the task-oriented research of the 1960s and 1970s was published in the form of domestic academic papers and domestic patents, and the research conducted under the National R&D Program began to be published in international journals and as foreign patents.

The rapid development of Korean science and technology was a result of two rotating axes—one of institutions and the other of practices. Institutions were constantly changed by the state, which needed to renew its political agenda, and the scientific and engineering community responded to the demands of the new institution by implementing new practices that fit with it. As Kim puts it: “If the institution is a structure and a guideline, practice is a behavioral mode and a production method. As a result, the outcome of science and technology created through the implementation of the practice corresponding to the institution has been different from one generation to another. The achievement of science and technology was a product forged by the combination of institution and practice” (p. 218).

Kim Geun Bae names this dynamic combination of institution and practice the “Institution-Practice Escalation Theory.” This theory explains, he says, the revolutionary development of Korean science and technology during the past sixty years. It is the core theory that he constructed in scrutinizing and reflecting on his (and others’) research on the history of science and technology in Korea during the last three decades. He concludes that “the extraordinary speed of Korean science and technology was the result of a dynamic combination of institutional systems and practicing complexes,” and that “Korea’s science and technology leapfrogging was a synergistic combination of multi-phase leaps in the institution and continued progress in practices” (p. 219).²

² In this sense, Kim’s model is similar to the traditional Korean millstone. Andrew Pickering’s term “mangle” can also be employed here, although Pickering used the term to illuminate the plastic nature of scientific practice. It would be interesting to note that the rotation of the traditional millstone is not automatic; someone must

Kim Geun Bae's thesis is highly interesting and contains significant insights into the past development of Korean science and technology. I am confident that the book, along with Kim's thesis, will provoke subsequent research and interesting exchanges, not only among historians but also among the sociologists and economists of Korean science and technology.

However, I should say that there are a couple of points on which I diverge from Kim. The first concerns the meaning of "revolution" used in the text many times, as well as in the title. Kim explicitly states several times why he used the term "revolution" rather than "rapid development," for instance, but I was not quite persuaded that the rapid or accelerating development of Korean science and technology should be called a "revolution." Above all, it is unclear whether Kim's revolution represents a remarkable change in Korean science and technology that took place over the sixty years of 1950-2010, or a series of escalating changes in the "institution-practice" combination. For example, in the figure on page 204, Korean science and technology shows three "punctuated" escalations or small-scale revolutions in the 1950s, 1960s, and 1980s, each of which is followed by ascending progress (see Figure 1). Kim seems to think that the "Scientific and Technological Revolution in Korea" consists of, and is a combined effect of, several punctuations or small-scale revolutions.

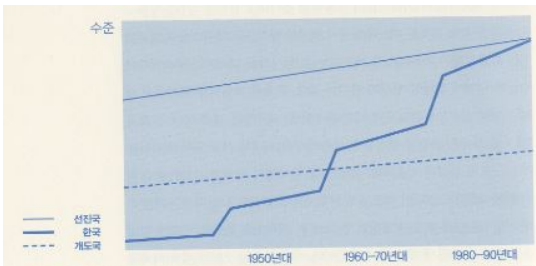


Figure 1. Kim Geun Bae's punctuated-ascending development of Korean science and technology (Source: Kim, p. 204.)

This pictorial conceptualization, however, raises more questions than answers. When we examine the increase in national R&D expenditure, the human power in science and technology, the number of domestic and foreign patents, and the number of SCI papers, it is deficient to detect such punctuations or small-scale revolutions, for there are only continuously ascending graphs (see Figure 2-5). Such punctua-

tions or small-scale revolutions may be qualitative rather than quantitative, and that is why they are not captured by R&D statistics. I am also inclined to think so, but to show qualitative transformations or ruptures, one needs much more empirical, historical, and concrete pieces of evidence, which are strikingly lacking in Kim's book.

rotate its handle. Likewise, the evolution of Kim's "institution-practice" combination is not automatic either; someone outside it must change the institution in the first place.



Figure 2.

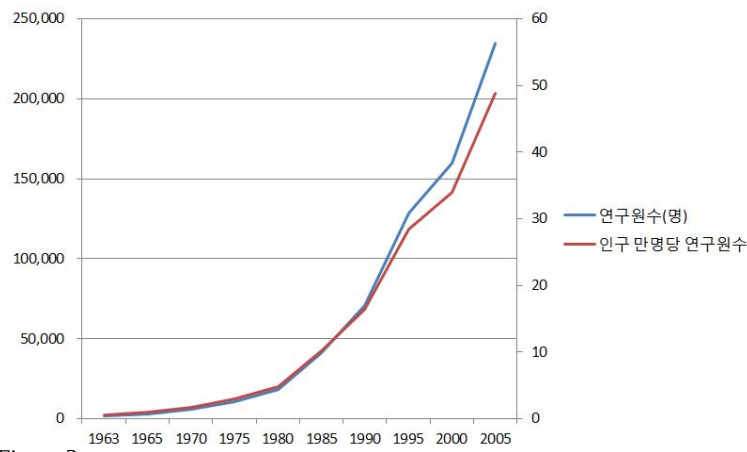


Figure 3.

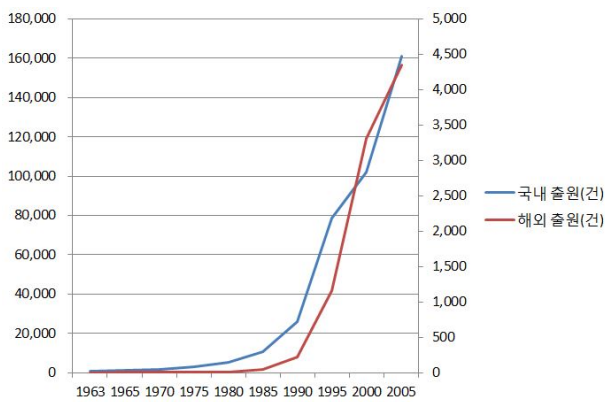


Figure 4.

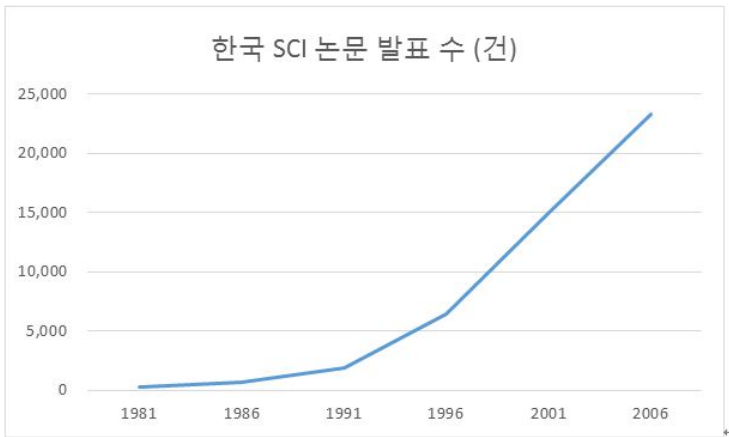


Figure 5.

Figures 2, 3, 4, 5. The increase in R&D expenditure (Fig. 2), manpower (Fig. 3), patent (Fig. 4), and SCI paper (Fig. 5) in Korean science and technology [Source: *40 Years of Science and Technology* (Seoul: Ministry of Science and Technology, 2008)]

The second issue is related to the use of the term “structure.” Even without resorting to structuralism, in speaking of “revolution,” we believe that the cause of a revolution resides in structures. In Marxist historical materialism, capitalism is to be replaced by socialism due to the internal contradiction between productive forces and relations of production. In political revolutions, the inner contradictions of the *ancient régime* explode, leading to the upheaval of old political regimes. Even in Kuhnian scientific revolutions, the old paradigm’s inability to explain a few anomalies provokes a crisis, triggering the emergence of a new paradigm. The common elements in such revolutions is a “crisis” which is internal to the structure. A crisis is caused by an internal contradiction, imbalance, or anomaly. Such a crisis is perceived and utilized by revolutionary factions, and frequently provides the legitimacy of the revolution.

Thinking of this, I wonder why Kim sticks to the concept of “structure.” The three or four small-scale revolutions that he has found in the history of Korean science and technology seem to have been caused not by internal crises but by external political forces. Korean scientists and engineers, as well as politicians and bureaucrats, did not seem to perceive such a crisis in the structure of science and technology in Korea. Or did they? Kim’s book is not certain about this issue. I am not saying that Kim is wrong to use the term structure; rather, I am seeking more justifications for its use and for the ways in which he uses it. Neither structure nor revolution seems to have been a term used by the actors themselves.

Kim’s ambitious book explores the structural factors that caused the revolution in science and technology in Korea. The book reveals that understanding the revolution

is a highly challenging and complicated task. Kim tries to show us a way to tackle this task. No one can deny that Korean science and technology underwent rapid development during the past 50 or 60 years. This rapid development can be fairly described as “revolutionary.” I am not, however, convinced why this rapid development should be called a “revolution”; why causes of this revolution should be found in the “structure”; and whether the “Institution-Practice Escalation Theory” truly explains this revolution in a persuasive manner. Do we really need such an overarching theory to understand Korean science and technology over the past sixty years? Do all the achievements of Korean science and technology fit within Kim’s scheme? I am left unconvinced.

Maybe I am too skeptical. Here is a reason. The institutional sociology of science in the United States and Europe was criticized and rejected, not because it could not explain the development of science, but because institutional factors such as Robert Merton’s ethos of science and Ben-David’s “decentralization and competition” reflected a dominant ideology of society at that time. A more reflexive historical sociology of science emerged in its place. We need to be wary of falling into the same trap when talking about institutions and thinking of the “big picture” of Korean science and technology.