A Contextual Understanding

of the Definition of Science in South Korea

by

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ABSTRACT

Despite the minor differences in the inclusiveness of the word, there is a general assumption among the scientific community that the 'pursuit of knowledge' is the most fundamental element in defining the word 'science'. However, a closer examination of how science is being conducted in modern-day South Korea reveals a value system starkly different from the value of knowledge. By analyzing the political discourse of the South Korean policymakers, mass media, and government documents, this study examines the definition of science in South Korea. The analysis revealed that the Korean science, informed by the cultural, historical, and societal contexts, is largely focused on the values of national economic prosperity, international competitiveness, and international reputation of the country, overshadowing other values like the pursuit of knowledge or even individual rights. The identification of the new value system in South Korean science deviating from the traditional definition of science implies that there must be other definitions of science that also deviates, and that even in the Western world, the definition of science may yield similar deviations upon closer examination. The compatibility of the South Korean brand of science to the international scientific

community also implies that a categorical quality is encompassing these different contextual definitions of science.

DEDICATION

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INTRODUCTION

Is Science Truly a Pursuit of Knowledge?

In 2009, the Science Council that serves as the organization for the scientific community in Britain released a statement that defined the meaning of the word 'science'. After a year of deliberation and numerous debates, they offered what they claimed as the 'first official definition of science ever published': “Science is the pursuit of knowledge and understanding of the natural and social world following a systematic methodology based on evidence.” (Sample, 2009)

As it is a bold claim on a subject that is inherently fundamental to one of the most important human activities in the world and history, their claim that this was the first published definition of science wasn't true. The topic has been debated for many years by various scholars within and outside the scientific community. Some recent examples include the Ohio Academy of Science, who offered their definition:

> ... science is a systematic method of continuing investigation, based on observation, scientific hypothesis testing... which leads to explanations of natural phenomena, processes, or objects, that are open to further testing, revision, and falsification... accepted or rejected

on the basis of scientific research. (Shrake, D.L., et. al, 2006, p. 1)

Meanwhile, the US Supreme Court in Daubert v. Merrell (1993) case asserted that "Science is not an encyclopedic body of knowledge about the universe... it represents a process for proposing... theoretical explanations about the world..." Dr. Steven W. Gilbert (1991), while discussing science education, posits that "...science [is] a process of constructing predictive conceptual models... the purpose of research is to produce models which represent consistent, predictive relationships." Even George Orwell (1945) attempted at offering a definition, when he stated "Clearly, scientific education ought to mean the implanting of a rational, skeptical, experimental habit of mind... science means a way of looking at the world, and not simply a body of knowledge..."

While these definitions of science come from various sources including a scientific society, the Supreme Court, an science educator, and even a novelist, the definitions share two common characteristics. One is that the definitions come from a Western, English-speaking environment. The other is that they all make the common assumption: science is foremost a pursuit of knowledge.

Indeed, the disagreements seem to be focused on whether science is simply a collection of knowledge or the process of discovering that knowledge, and the specifics in how that pursuit of knowledge is being conducted. In addition, by making a generic, all-encompassing statement about science, the assumption that the definition of science is categorical is also being made. The Science Council (2010), while concerned with "working collectively to advance UK science", was not talking about British science. The US Supreme Court, while concerned with how the US judicial system will deal with the expert witnesses practicing science in United States, was not talking about American science. The Ohio Academy of Science, surely, wasn't making a statement on the unique features of doing science in the State of Ohio.

George Orwell, at least, has a good excuse for making this assumption. When he was defining science in 1945, the scientifically active regions of the world were almost completely defined as the United States and Europe. The budding scientific communities in other regions were being educated and informed by the institutions of Europe and America, and the scientific development in general followed the same format.

Of course, the modern world has changed significantly from Orwell's time. The regions of the world that were not participating in the scientific development of the West in the past few centuries are now robust sources of scientific research, with their own institutions and traditions of education as well as developed scientific communities. In the modern world, the potential of science in different places having characteristics and motivations other than 'pursuit of knowledge' has become a real possibility.

Exploring the South Korean Science

In this paper, I pursue that possibility by examining how science is being done in South Korea. As the country's scientific community is only half a century old (a full two decades after Orwell's definition) but becoming a very active zone of scientific research, the country's method of doing science offers an interesting case of how the definition of science can depart from the assumptions made in the definitions offered above. Through this examination, I demonstrate that science in South Korea is informed by the cultural, historical, and societal contexts of its location, and that science is a function of the society that conducts science.

By examining the policies and rhetoric of policymakers concerning science, the societal and political reactions to the Hwang controversy, and the mechanisms of justification for showing Hwang leniency in the ova donor abuse case, I will demonstrate that South Korea defines science in terms of its efficiency and commercial potential that positively impact South Korea in terms of economic prosperity, international competitiveness, and international reputation. In the first chapter, I examine the political rhetoric of the South Korean policymakers concerning the government's investments in science and observe that science in South Korea is being evaluated under the standards of efficiency and commercial viability. Then, I identify the purposes of science in South Korea as economic prosperity, international competitiveness, and the international reputation. In the second chapter, I examine the case of Woo-Suk Hwang and how he was put under the pressure of nationalistic expectations, the cult of personality he generated for himself, and the historical and cultural contexts that informs his self-identity. I observe that Hwang appears to be fulfilling a certain role set up by society rather than independently striving for achievements and fame. In the third chapter, I examine how policymakers and the society at large reacted to the Hwang

incident. The goals of economic prosperity, international competitiveness, and the international reputation identified in the first chapter are once again evident in the reactions, and confirm that these three goals are defined as the purposes of science not only by the policymakers, but the society at large. In the final chapter, I examine the ova donor abuse controversy of the Hwang incident, where the three goals of Korean science come in conflict with the value of the traditional bioethics. By juxtaposing the abuses to the apathy of the Korean society, and examining how the donors were recruited and viewed, I conclude that the donor abuse case is an example of how the Korean science's commitment to the three goals have led to a complete disregard for the internationally recognized bioethical norms for coercion surrounding the ova donation and research.

By establishing that the three goals of economic prosperity, international competitiveness, and international reputation are motivating the Korean definition of science, I assert that the previously assumed trait of universality of the definition of science as motivated by 'pursuit of knowledge' should be questioned, and assert that science is shaped by numerous factors created from the distinct historical, cultural, and societal contexts.

Chapter 2

SCIENCE IN POLITICAL DISCOURSE OF SOUTH KOREA

Overview

In this chapter, I examine the discussions recorded in the minutes of the South Korean National Assembly, a national unicameral legislature. The minutes provide a closer look to how the South Korean policymakers shape science conducted in Korea to be efficient and commercially viable. These led to a strong focus on the betterment of Korea in terms of economic prosperity, international competitiveness, and the nation's image in the eyes of the international community. As investments in scientific research are made almost exclusively by the government, analyzing how science is talked about in the Assembly reveals not only how the policymakers think about science, but how science is being done by the Korean scientists.

History of the Korean Government and Science

This trend of government taking the lead in funding science can be traced back to the 1960s, when president Jung Hee Park decided that scientific advancement was crucial for the country's economy to develop and prosper. What began as the creation of Korea Institute of Science and Technology (KIST) along with the passage of Science and Technology Development

Act of 1967 quickly morphed into efforts towards military science to provide answers for the difficult question of defending against the possible invasions from the North Koreans, with over 70% of the research efforts being devoted to the projects led by Agency for Defense Development. The remaining efforts were directed toward semiconductors and steel industry in the forms of massive government support for the firms Samsung and POSCO (Pohang Steel Company), yielding economic development for the then-underdeveloped country. Once the economic impact of scientific investments had been demonstrated, South Korean government shifted their research efforts heavily towards the civilian industry, identifying the development of semiconductors, integrated services digital network, high-definition television, and information technology as priorities by the early 1990s. What remained constant throughout the modern history of South Korean investments in science, however, was that the course South Korea's science community took was completely controlled by the government, either through direct investments or indirect investments through corporations.

Evaluation of Science in South Korea

The view that a scientific effort must be evaluated in terms of efficiency and commerce is visible in various Assembly

minutes. In a confirmation hearing for the seat of Deputy Minister of Research and Development, Minister Candidate Yoon Jung (2006, p. 17) answers a question about his future plans for the ministry by stating that "We will begin to implement result-oriented evaluation methods that will encourage research environments focused on how beneficial the outcomes are. In addition, we will maximize the productivity of our research efforts." Here, the term 'result-oriented' is used by Jung in the context of the industry and commercial application rather than the results of the research itself, thereby demonstrating that one of the two Ministries in charge of assigning the investment funds are looking for commercial viability. The continued talk of 'beneficial outcome' is also used in this context, and the pledge to shape the nationwide research environment to be suitable for such goal offers a clear view of how the policies are being shaped and discussed. The rhetoric of 'maximizing the productivity' is reminiscent more of a factory than a laboratory.

This theme resonates with the language employed by the other Ministry in charge of assigning the government's investment in science. In a speech reporting the future plans of the Ministry of Education and Human Resources Development, Minister Nam Soo Suh (2005, p. 4) states, "In order to forge

research universities specializing in a specific field, we will start the second level of the BK21 project involving 300 to 400 billion Won. We are also planning to expand investments in fundamental science, humanities, and sociology as well." BK21, or BrainKorea 21 project is a massive governmental investment project meant to specifically encourage profitable research that is efficient and beneficial to the economy by both investing in educational facilities and research efforts that promotes such goals. While BK21's existence alone is yet another example of how science is being evaluated almost exclusively in terms of efficiency and commercial viability, Suh's statement also reveals how the profitable and efficient science are being treated relatively to the mostly unprofitable and commercially inefficient fundamental science. In the statement, BK21 is being funded an additional 300 million dollars after the yearly budget of 200 million dollars, while fundamental science is not only grouped with the non-science discipline, it is being mentioned as a secondary issue. The priority set by the Assembly and the Ministries are clear; long-term results of more fundamental science is vastly overlooked in favor of the scientific efforts with short-term payoff.

But perhaps the most revealing observation can be made when Assemblymen Geun Chan Ryu questions Woo Shik Kim, a candidate for the seat of the Minister of Science and Technology that oversees the entire national policies set concerning science, during his confirmation hearing:

> But are you aware how many research projects were reported as a 'failure'?... Zero. Of these numerous government invested research project, are you telling me that 100% of them ended up producing results?... Isn't it strange that 100% of the research projects are reporting successes, when even mundane circumstances can interrupt a successful research team? (Ryu, 2006, p. 29)

The background research Ryu has done on the subject reveals a very interesting trend; not only does the South Korean government only invests in scientific research that would produce immediate positive results, the scientists themselves are shaping their research goals to fit the policymakers' view of the science. This is further explored as Ryu continued,

> Any scientists who have 'failed' is branded as incompetent. Then he or she is accused of laziness, dishonesty, and even embezzlement... This is the reality of the scientific community in South Korea. We must realize this at a

> fundamental level. Since the scientists must make a living, they are coerced into doing research that cannot fail. They won't do research that might fail...” (Ryu, 2006, p. 30)

The scientists in Korea are systematically pressured in terms of social reputation, performance evaluation, and even household economics to fit the standard of efficiency and commercial viability set by the policymakers, and such trend is becoming ubiquitous in the entire Korean scientific community. As Ryu (2006, p. 30) solemnly notes, “this is the reality of the scientific community of the Republic of Korea.”

Thus, science is viewed, defined, and even actively molded as an effort that is judged by how efficient and profitable the end result will be. While both characteristics would be considered in any form of investment from any private and public organizations around the world, a distinction in the South Korean viewpoint is made in that the two values are the ones being considered by the policymakers and actively and highly prioritized over all other values. With the words like 'profit', 'efficient', and even 'productivity' being employed, science in the South Korean rhetoric sounds more like an industrial effort than pursuing knowledge.

This concept of efficient and profitable science is then linked to the themes of economic prosperity, international competitiveness, and international reputation of South Korea as a whole in the same manner that the link between science and efficiency/profitability was established. As policymakers discuss the matters of investments, funding allocation, and other public policies concerning science, they even shape what the scientific efforts are supposed to strive for.

Economic Prosperity and Korean Science

The theme of economic prosperity is the most prevalent and obvious, as the prosperity of the Korean economics directly impacts to the international competitiveness and reputation of South Korea. In the confirmation hearing for the Minister of Science and Technology, Woo Shik Kim laid out his visions of how his ministry would impact the country. He stated,

> ...we will focus on fostering creativity in our scientific research as well as increasing efficiency in our research investments. This way, we will contribute to our advancement towards a first-class nation's economy. Above all, we will generate an industry in the future that will make this government's goal of increasing the average income from $20,000 to $30,000. (Kim, 2006, p. 12)

The keyword 'efficiency' can be seen again in the contexts of governmental research investments, but the most interesting part of this statement comes from what he identifies as the goal of his ministry's efforts. By identifying 'advancement towards a first-class nation's economy' and increasing the average income of the Korean citizen to a specific economic number, the statement establishes science's role as a means to an end. The specific goal of "$30,000" income is identified as an immediate and primary landmark for a ministry concerned with investing government's money into scientific projects. And through these government investments in an environment where private investments are scarce if any, the policymakers' sentiment of science as a means to achieving economic prosperity becomes the sentiment of the scientific community as well.

This is evident in the testimony by Dr. Dong Hwa Keum, a scientist employed by the government-run KIST. He notes, "The overall sentiment is that our scientific research must yield a result that can be converted into money and be evaluated in terms of economics, and it really is a pity." (Keum, 2005, p. 30) He confirms that the standard of science becoming a means to the ends of economic prosperity has become the norm even within the scientific community in Korea, and that such trend is

firmly established despite the individual scientists' objections. He also confirms the assertion made by Assemblyman Ryu by reiterating that the scientists, while displeased by the policies forcing science to become more profit-oriented, have no choice but to submit to the standard set by the politicians controlling the only source of research funds.

The sentiment of 'science for economy' is further echoed in a speech made by Assemblyman Dong Young Jung, who was also the Korean National Security Council Chairman who would eventually become the runner-up candidate in the presidential election in 2007. Discussing his recent visit to an industrial sector in China, Jung primarily discusses the inherent disadvantage Korea has in terms of manpower and resources. However, an interesting observation can be made when he begins to discuss industry and trade:

> I've learned two things; Science is the only way we can make our living, and that we must understand how China works. We can't help that a textile factory producing $1 profit per kilogram would prefer China over us. But we must prevent a notebook factory or a semiconductor factory producing $1000 profit per kilogram from preferring China over us... we must have the technology

that we can produce, sell, and use to make our living, and scientific research is the key to that. We must thus invest in science and scientific education... (Jung, 2004, p.2)

Here, Jung not only directly links science and economy together, he even provides the contexts that explains why such links must be made by the South Korean policymakers. From his speech, the thought that the inherent characteristics of South Korea lacking natural resources, land, and manpower are shaping the politicians to see science as the 'replacement' factor for traditional infrastructure is established. Science is thus the only way South Korea can make a living, and is frequently referred to as the means of the nation's survival in an internationally competitive world - another theme that will be discussed below.

Even the current president Myung Bak Lee, who defeated Jung in the 2007 election, expressed identical sentiments in his speeches. In a major speech that announced a renewed effort to invest heavily in stem-cell research, Lee (2011) stated "Stem Cell research is rewarding in that it gives hope to those who suffer from rare and/or incurable diseases, and it is a very profitable and high-yield paying industry for our economy." To a country that is still haunted by the Hwang Woo Suk controversy involving stem-cell research (a topic that will be discussed in the

next chapter), President Lee had to convince the people that re-investing in stem-cell research has large enough benefits to overcome the nation-wide psychological trauma. In such efforts, he markets the obvious and compelling humanitarian cause but follows it with the cause of economic prosperity. While not necessarily equating the two causes, citing both of them as the two major reasons certainly demonstrates just how important economic prosperity is to a discussion about science held in South Korea.

Competitiveness and Korean Science

The theme of economic prosperity naturally leads to another related but distinct theme of South Korea's international competitiveness. Already denoted in Assemblyman Jung's speech, international competitiveness is defined as a means in which South Korea can survive as a nation in an increasingly intense competition in the world. Jung's notion of science being the means to achieve this is frequently repeated by various politicians.

During his confirmation hearing for the Minister of Science and Technology, Woo Shik Kim offered his personal philosophy concerning science and the Korean government. He states, "As someone who is originally from a scientific community, my

unchanging belief is that our skills in science directly translate to our country's competitiveness." (Kim, 2006, p. 17) In a very direct and straightforward statement, Kim claimed that science is quite literally Korea's competitiveness. It's not just that science contributes to or helps Korea's competition with the rest of the world, but that science is the only tool available to Korea. This is further elaborated when he states, "For the sake of our country's advancement, we must continuously revolutionize our scientific field... it is our historical duty to continue advancing our science and technology...". (Kim, 2006, p. 12) The cause of advancing scientific knowledge is consumed by the cause of advancing the country's international competitiveness, and the both causes are identified as something as solemn and significant as a 'historical duty'. Such statement implies a nationalist undertone, a natural progression when the subject is how competent the country is when put into a competition with other countries.

This nationalist undertone within the cause of international competitiveness can also be observed in a proposal made by the Deputy Minister of Research and Development Yoon Jung (2006, p. 16-7), who stated, "We will do our utmost best to develop native science and technology that will become the foundation of creating a new industry in order to ensure our nation's

international competitiveness by 2010.” The phrase 'native science' further establishes the nationalism within the thought that views science as a means to the end of improving South Korea's chance in the international competition for survival. Without relying on 'foreign science', Deputy Minister Jung is proposing a science generated by Koreans that will lead to promoting Korea's competitiveness in respect to other countries.

This can also be observed in a speech by Assemblywoman Hye Suk Suh (2006, p. 44), who in a discussion about South Korea's civilian nuclear program, stated,”Isn't it the case that the countries around the world... are focusing on developing new nuclear reactors? Therefore, I believe that we must rigorously review whether our efforts in the nuclear technology are sufficient at the current level.” Civilian nuclear technology, which is being marketed around the world by the South Korean government and therefore a prime example of how South Korea would 'make a living' with scientific research, is encouraged and reviewed for additional funding by the Assembly because other countries are becoming more competitive in the field. This also becomes an incident where the goal of economic prosperity is overshadowed by the goal of international competitiveness, as the Assemblywoman does not mention the purported benefits of

an advanced nuclear reactor to either the Korean people's quality of life or the South Korean economy.

International Reputation and Korean Science

The existence of nationalist undertone and the policymakers becoming conscious of other countries' efforts in the same field has led to a rather bizarre political trend where South Korea is continuously 'ranked' in comparison to other countries in the fields of science. Science, rather than being an individual or organizational effort, has become a national effort where scientific achievements are attributed not to the individual scientists or universities but the country itself. This trend is the significant example of science being used to establish South Korea's identity in the world through promoting its international reputation.

The 'ranking' trend manifests in two forms; the phrase 'first-class nation level', 'world-class level', or '~-strong nation' and the literal ranking where South Korea is given a number. The term 'first-class nation level' must be discussed beforehand, as the Korean term 'sun-jin gook soojoon' is academically used as the equivalent of the phrase 'developed nation'. This paper rejects the definition of 'developed nation' in the contexts used by the politicians, however, because it is nonsensical for South

Korea to use 'developed nation' as a goal for itself when it is already considered a developed nation by any empirical and internationally accepted measurement. The term and the overall approach to science policy originated when South Korea was an underdeveloped/ developing country, and it implies a sense of admiration, envy, and the desire to become like a 'first-class' nation. As the politicians are using the term colloquially, it is only fitting to consider the term as such.

The non-numerical rhetoric can be seen in the confirmation hearing of the Minister of Science and Technology, as the Minister-to-be Woo Shik Kim (2006, p. 12) identifies "...developing our native science to the level of a first-class nation by expanding our investments and reorganizing our support structures..." as one of his five goals for his ministry, which also includes "...going forward with Space Korea project in order for us to become a Space Travel-Strong nation...". The statement is a good example of the case where the terms 'first-class' and '~-strong nation' is used. The term '~-strong nation' demonstrates that a scientific achievement is first attributed to the country, and that the scientific achievement also works to define the country in the eyes of the world. The hope is that when the world thinks of the country South Korea, it will think a

'~ - strong nation'. In addition, the phrase 'first-class' in the statement indicates that the governmental effort to invest and develop the country's scientific community is meant to raise South Korea's status in the world in some arbitrary form. An amusing example of this can also be found when the Minister of Meteorological Administration Man Ki Lee (2006, p.20) stated, "We will enhance our ability to predict the path of a hurricane to a 'first-class' nation... by using a 'world-class' IT technology.". Even in the matter of predicting weather patterns, South Korean policymakers see an opportunity to raise South Korea's reputation in the world.

The numerical criteria, far too frequent to list them all here, are much more prevalent. Deputy Minister of Research and Development Yoon Jung identifies the goal for the Korean scientific community in the same manner that a student would discuss his or her school rankings in various subjects. He states,

> We will intensify our... support for the scientific community in order to become one of the top 3 nations in nanotechnology and top 7 nations in biotechnology before 2010... further invest in research and infrastructure in order to become one of the top 10 nations in space technology before 2015..." (Jung, 2006, p. 17)

While further reinforcing the theme of international competitiveness by discussing scientific advancements in terms of numerical rankings, Jung's pledge also demonstrates that Korean science is viewed as a tool to raise the rankings and thereby reputation of South Korea as a country. It's not that a university, a research group, or even a scientist is being evaluated in an arbitrary ranking, but an entire nation. The scientific efforts are seen as South Korea's effort, and consequently the accolades also belong to South Korea as a whole as well.

President Lee's (2011) speech on restarting massive governmental investments in stem cell research perhaps expresses this theme most blatantly; "...to contribute to humanity's health and happiness, and raise the Republic of Korea's international reputation..." The justifications for the massive investment are identified as the humanitarian reasons and raising the nation's international reputation, making the existence of the notion of science being a means to the end of raising South Korea's reputation concrete.

An intriguing observation can be made in that prosperity, international competitiveness, and international reputation, while all distinct goals for the science as a means, are also logically

linked by one another. Science in Korea is a means to promote the economic prosperity of the country, which is vital to raising the international competitiveness of the country, which in turn is the key component in raising South Korea's reputation in the international community. And with the raised national reputation, South Korea can market its science further and achieve even greater economic prosperity. This sentiment is perhaps best expressed by the central character of the next chapter, Dr. Woo Suk Hwang;

> We must discuss all possibilities in order to maximize our efficiency and achieving our research objectives. Science must become a fodder to our country becoming a first-class nation, fodder for our industry and commerce, and the source of dream and hope for our citizens in the increasingly fierce competition between nations." (Hwang, 2003, p. 74)

Chapter 3

THE HWANG CONTROVERSY

Overview

In this chapter, I will examine the controversy that surrounded Dr. Hwang Woo Suk since 2005 in terms of the pressure coming from the nationalistic expectations, the cult of personality, and the expectations he created for himself induced by the historical and cultural contexts of South Korea. I observe that, given the way Hwang was shaped and motivated by these pressures, Hwang's identity appears to be shaped by the society itself to fulfill a certain role rather than an independently shaped self-identity.

The Controversy

In order to examine the Hwang case, a brief review of what had actually occurred is necessary. On March, 12, 2004, Hwang published an article claiming a successful production of human embryonic stem cell line by inserting a somatic cell nucleus into an oocyte with its own nucleus removed. He published yet another article on June 17, 2005, claiming that he had dramatically increased the success rate of somatic cell nuclear transfer (SCNT) as well as producing a patient-specific embryonic stem cells from a non specific source. In the minds of

the public, Hwang had figured out a way to make stem cell treatments affordable, and he became a national hero and a superstar. As one Assemblyman wryly noted later, “Everyone here in the Assembly rushed to get a photograph with Dr. Hwang whenever he visited us.” (Lee, 2006, p. 53).

This took a quick turn when, after several months of accusations from a news program and local scientists, Hwang's research had been publicly confirmed as fraudulent by the Seoul National University Investigative Committee (SNU investigation). Often referred to as the 'national tragedy', 'national shame', and 'nationwide trauma', the Hwang incident devastated the South Koreans, not in the least the patients who looked to Hwang as a source of inspiration and hope.

On the surface, Hwang's fraudulent research appears to be yet another case of scientific dishonesty motivated by the desire for fame and wealth. Indeed, the international scientific community has treated the incident as so, primarily discussing the incident's potential negative effects on future stem-cell research (Cajigal, 2006) and the damage it has done to the implicit trust between the scientists (Kennedy, 2006). But when observed in greater detail, Hwang Controversy is much more complex than a simple case of scientific misconduct – for one,

Hwang still enjoys a significant public and political support. He is favored by both the governor of the prosperous Kyunggi Province and the technologically-savvy Guro District of Seoul (Kim, 2009), and the recent media activities indicate that at least the conservative Grand National Party is ready to support him again (Jung, 2011; Kim, 2011; Nam, 2011). The inconsistency of being publicly condemned as a fraud and receiving public adulation is a sign of how this story is not about a man blinded by greed, but about something much greater than an individual.

Hwang and the Korean Nationalism

This is easily seen when examining the public rhetoric prior to the incident that seemed to make Hwang a nationalist symbol where the South Koreans can rally around. One of the most publicized aspects of Hwang's research before the incident was the so-called 'chopstick method', where the ovum is 'squeezed' with needles under a microscope in order to enucleate it. This technique becomes especially challenging as the relative fragility and sticky surfaces of the human ova become factors. An extreme precision on the part of the technician both in terms of orientation and grip control are required, and both the media as well as Hwang himself has attributed the high success rate of the

'chopstick method' in Hwang's lab to what has been called the 'Chopstick Theory'. The 'theory', a rhetoric rather than an actual scientific theory, posits that because Koreans have been using round, iron chopsticks that require precision of hand strength and orientation for thousands of years, their hands are coordinated and precise in ways that no other race can approach (Mandavilli, 2005; Hwang Y.S., 2006; Lee, 2008). Indeed, Hwang himself has said that "Koreans use iron chopsticks from their childhood, and this gives us exceptional dexterity with our hands" (Hwang, Y.S., 2006). A nationalistic undertone is firmly established, especially when the 'theory' is also used to explain South Korean's supposedly inherent superiority in producing semiconductors, archery, and even the general intelligence (Lee, 2008).

By interpreting the technical details of a laboratory technique in Hwang's lab as a characteristic of the Korean race as a whole, two implications are made. First, by making a laboratory technique critical to Hwang's achievements a consequence of a racial superiority of the Koreans, this rhetoric transforms Hwang's achievements into Korean achievements. Rather than acknowledging the exceptional skills of the individual technicians, researchers, or even Hwang himself, the

rhetoric asserts that they were able to achieve such successes because they were Koreans. Second, the rhetoric transforms 'Hwang the Scientist' into 'Hwang the Korean Scientist' by asserting that Hwang was able to succeed because he is a Korean, instead of considering his individual characteristics.

These two implications construct an important notion; Hwang's actions are not actions of an individual, but actions of the Korean people as a whole. Under this rhetoric, Hwang is defined as 'a Korean'. Thus, a Korean squeezed the nucleus out of a human ovum, a Korean published numerous important research articles, and a Korean received awards and honors for his achievements. Above all other traits, Hwang is 'a Korean'.

This idea of the societal identity consuming an individual identity can also be seen with the rhetoric surrounding the 'World Stem Cell Hub' initiated by Hwang. Shortly before the incident, Hwang and the South Korean government opened the 'World Stem Cell Hub', an international stem cell research center where the researchers from around the world can cooperate with one another to further the knowledge of stem cell applications. While the concept itself seems contrary to nationalism, the rhetoric surrounding the center was not.

In a press conference on May 25, 2005, Hwang is quoted as stating

> "If a stem cell bank is created in Korea, it will provide the fruits of the cooperated research to the patients around the world as well as collecting data. Then, South Korea will become the supplier of stem cells to the rest of the world."... [His statement] implies that he will make South Korea the international leader of stem cell research, a field with fierce international competition. (Hyun, 2005).

Here, the themes of international reputation and international competitiveness identified in the previous chapter can be observed, but it should also be noted that the emphasis of opening this center is not on the fact that researchers from around the world would be able to coordinate multiple cooperative research efforts and further the human knowledge involving the human embryos. Instead, the focal point is that South Korea will be the one leading the effort that the rest of the world wants and needs. The point of constructing the Hub has more to do with making South Korea an important country to the rest of the world, and Hwang's effort to create the research center is thus viewed as just another means to improve South

Korea's reputation to the rest of the world, rather than an individual-level achievement.

Interestingly, Hwang's own statements indicate that he completely agrees with the notion that his works and efforts are that of the South Koreans rather than of himself. When the Seoul National University Investigative Committee released its report confirming that Hwang had fabricated his data, Hwang apologized to the public by stating that "Patient-Specific Embryonic Stem Cell is the technology that belongs to the Great Republic of Korea, and the South Korean people will be able to confirm that fact again." (Jin, 2005). By his own words, the technology of creating a patient-specific embryonic stem cell is described as the intellectual property of the South Koreans rather than himself. Even if we are to consider that Hwang may be simply flattering the public with his words, the very fact that such rhetoric would be appealing to the public opinion demonstrates that Hwang's accomplishments are viewed as a national achievement rather than an individual one.

These examples of how Hwang's work has interacted with the South Korean nationalism demonstrate the level of pressure he was under from the entire country. His laboratory techniques are attributed to his Koreanness by the usage of the term

'chopstick method', and his successes and failures transform into an international evaluation of the Korean people as a race in the minds of Hwang and the Korean society at large. This is compounded by the title 'World Stem Cell Hub', where Hwang's efforts to create a cooperative research center becomes a testament to South Korea's worth in the eyes of the international community. And as Hwang himself accepts this burden by identifying his research effort to be a 'Korean technology', Hwang appears to agree with the nationalist sentiment towards his work. Thus, he is accepting that he is in a position where he has the duty to meet the expectations generated by the nationalist sentiments of the South Koreans.

Hwang and His Cult of Personality

But where does this feeling of responsibility comes from? I assert that the sense of duty that Hwang feels that led to accepting the nationalist expectations partially comes from an almost mythical narrative that emerged around Hwang during his meteoric rise to prominence. These myth-like stories surrounding Hwang are best observed in a biography of Hwang written for children titled *Hwang Woo Suk: Bull-Like Persistence That Cannot be Broken*. Focusing mostly on Hwang's life before his successes, the narrative of the biography establishes the

themes of rags-to-riches, the almost superhuman work ethic, and the savior complex that reinforces Hwang's image as a national hero.

The book immediately establishes the fact that Hwang's adolescent years were mired by extreme poverty. It states,

> ...Woo-Suk's house was going through a difficult time. His mother worked from dawn to late into the night, and after a hard day of work in the fields her legs would be covered with leeches. Woo-Suk tried to help out by feeding the cows, but the financial difficulties wouldn't just go away. (Hong, 2005, p. 21).

In fact, the portions of the book covering his childhood include constant reminder that his family was in abject poverty. Against these detailed description of how poor Hwang's family was, his own successes become more impressive and gives his narrative a feel similar to a legend. This rags-to-riches dynamics also leads to the theme of working hard to overcome such adversities, as if the message has become 'even if you are facing great difficulties, you shouldn't give up; after all, a great man like Hwang overcame his own challenges to achieve great things'. Indeed, this theme of 'perseverance in the face of great challenges' is reinforced later when Hwang's adult years are

discussed. Hwang is quoted as stating "The only thing I have is my ability to not despair and go forward with my diligence," (Hong, 2005, p. 56). Rather than giving up after being faced with challenges in life, Hwang confirms his hero-like qualities and vows to try even harder.

This theme of perseverance is directly linked to the biography's main theme of good work ethic, as numerous references of Hwang facing difficulties but persevering and trying harder are made. The most prominent example of this theme comes in a particular anecdote that Hwang has told the press in other occasions. In the biography, Hwang states, "Yes, 'Forbidden-to-lie-down Club. Until we go to college, we won't let ourselves lie down and sleep. Let's work really hard. How about it?" (Hong, 2005, p. 34) This club is claimed by Hwang to have been made after his disastrous first examination in high school, and that Hwang did not relent until he was sure of his acceptance at the prestigious Seoul National University three years later. Essentially, Hwang imposed a set of rules on himself where he is only allowed to take short naps while sitting up, but never to lie down and have a restful sleep. This incredible account of work ethic, while also suggesting that he is a natural leader by mentioning that the other kids were convinced and

followed this way of life, sets Hwang up as someone to look up to and emulate for the children who would be reading this biography. This account of an unrealistic commitment to hard work serves to intensify the rags-to-riches narrative while also establishing Hwang as an inspirational figure, and Hwang repeats these themes with his interactions with the media as examined later in this chapter.

However, it is with the image of a 'great healer' that Hwang finally achieves the status of a mythical, legendary figure in the biography's narrative. The biography quotes Dr. Jose B. Cibelli, a co-author of Hwang's 2004 article, as stating "This is simply amazing. Dr. Hwang is a general saving the world, and [the researchers and technicians] are his army. Because you exist, the suffering humanity now has a hope." (Hong, 2005, p. 76) This expression of adulation is somewhat different from a real-life quote from Cibelli in an article published in Nature: ""The atmosphere in Hwang's lab is "very intense, very, very intense," says Jose Cibelli... They're not just after the headlines, they just love what they do." (Mandavilli, 2005) While Cibelli is very generous in describing Hwang and his staff (an account that was challenged by Korean bioethicists in the very same article),

the intensity of admiration is significantly different from the accounts of the biography.

The stark difference between the children-oriented biography's Cibelli and the real-life Cibelli suggests that the biography was meant to achieve several specific effects. First, by having an American scientist almost worship Hwang and his Korean staff, the biography incites a sense of nationalistic pride in the children who reads the section. This also confirms Hwang's qualification as a role model for the children by having a foreign scientist intensely praise him. Second, by using the words of an objective observer from an advanced country like Cibelli, the book tries to establish the legitimacy and objectivity of the evaluation of Hwang as a source of hope for the suffering humanity. This also connects with the themes of international reputation and competitiveness, as examined in the previous chapter. Finally, Hwang is painted as a healer who will save humanity from deadly diseases – in fact, he is the only one who can 'save the world'. This image of a benevolent, mighty healer is perhaps best captured by the book's illustration of a young girl in wheelchairs giving a bouquet of flowers to Hwang. Thus, the biography completes the legend of Hwang.

Unsurprisingly, the themes of this biography can be observed in Hwang's own interaction with the South Korean media. The improbable work ethic is constantly repeated in the interviews, where Hwang (2004) once stated "For ten years, I have lived a life where I can barely afford to sleep 3~4 hours a day... for the past three years, I had to surrender any holidays or vacation.". In this particular interview, Hwang is reinforcing the idea of self-sacrifice for the sake of the greater good (an idea that will be examined in the final chapter). He is abnormally disrupting his sleep cycle as well as his life for the sake of his work, and also implies that his achievements would have been impossible without such fanatic commitment. The choice to mention 3~4 hours of sleep is also curious, given that the high school seniors facing the extremely competitive college admissions tests are often told that 'Sleep three hours and get accepted, or sleep four hours and get rejected.' The empathy that this particular number generates becomes very effective in an education-conscious country like South Korea, and Hwang receives both the respect and sympathy from the South Korean society at large. The emphasis on his sacrifices and linking them with the significant scientific breakthrough, Hwang successfully generates a sentiment that his successes happened because of

his self-sacrifice and diligent work ethic, and thus he became a subject of much admiration from the public.

The empirical proof of this intense admiration from the public exists in his supporters. One of Hwang's most emotionally resonating interactions with the mass media before the Controversy involved a singer/dancer named Wonrae Kang. A member of a popular techno music duo ironically named 'The Clone', Kang became paraplegic in 2000 after a motorcycle accident and since became a major social activist fighting for the rights of the disabled community in South Korea. After an emotional return to the stage in an episode of the popular music show 'Open Concert', Kang appeared on stage with Hwang to discuss what Hwang's research can do for Kang (Shin, 2005). In this interview, Hwang stated, “Mr. Kang has shown us an amazing performance with the wheelchair dance today. I hope that I'll be able to make him stand up so that the next time he appears on 'Open Concert', he'll be able to dance like he used to back in the day.” (Shin, 2005). Hwang attributes the potential for Kang's cure to himself, and invokes sentimental agreement from his audience by mentioning Kang's life before the accident. Adding to this a picture of Hwang smiling with Kang in the wheelchair, a thematically congruent image with the image in

the children's biography, Hwang firmly establishes the image of a great healer surrounded by legendary and mythical characteristics in the eyes of the public. As if to confirm Hwang's status as a mythical healer, Kang himself has made public statements supporting Hwang as late as 2008, where he stated that even if Hwang gave him “0.0001% of hope” (Kim, 2008), he will support him. The fanatical devotion of Hwang's 'fan clubs' that ranges from political lobbying to attacking the investigative committee member (Jung, 2006), suicide attempts (Suh, 2006), and even a public self-immolation (Chae, 2006) is also a testament to just how effective Hwang's message had been. As one local columnist noted, “When I look at these fanatics, I can't help but think that Dr. Hwang might have had a more successful career as a cult leader than a scientist.” (Lee, 2006).

Thus, Hwang had become something more than an individual scientist. He has become a focal point of the nationalist expectations and an intense cult of personality, a vessel in which South Korea as a society and a nation operates. It is not surprising that Hwang himself accepted this identity as a Korean Scientist, given the immense pressure coming from nationalism and fanaticism. But to understand why Hwang

decided to accept the pressures themselves, his own life story in conjunction with the historical narrative of Korea must be examined.

Hwang, His Life, and the Korean Hero

Raised by a single mother in an impoverished rural area, Hwang had helped his mother with her job as the caretaker of the townspeople's cows since childhood. He was the only student in his town to advance to middle school, and this fact denotes two things. First, the economic level and the consequent opportunity for education in his environment were extremely low. Second, Hwang was already a 'special' child this early in his life by being the only child in his town to move past 6th grade. The merit-based scholarship he received for his middle school education must have reinforced this sentiment in Hwang.

While the fantastic story of 'Forbidden-to-lie-down Club' is not confirmed by any reliable sources, the fact that Hwang had gone from 400th out of 480 students to 21st in three years of his high school life indicates that Hwang had indeed studied intensely. Such experience would have generated two factors relevant to his self-image; the pride he has in himself for being

able to excel in a difficult environment, and the belief that excellence can be achieved through hard work.

The circumstances of his college life are not well-documented, but it is known that Hwang was able to attend the prestigious Seoul National University and receive his doctorate due to the help received from an unnamed mentor within the faculty. Unfortunately for Hwang, his mentor was apparently involved in a very hostile rivalry within the university, and when he passed away, the position of a full-time lecturer were taken away from Hwang. He was soon kicked out of the university, and made living as a part-time lecturer for several other universities. Three years later, he began to work for Hokkaido University, and when the political atmosphere within the Seoul National University had changed, he was able to return with a full professorship in hand and to start his own research that culminated in the birth of South Korea's first cow created through in-vitro fertilization.

His life story is then characterized by tough challenges overcome by diligence and hard work. Poverty, difficult academic standards, hostile faculty, and language barrier had all been broken down by Hwang's ability to persevere and work

hard, and at least in his mind, the value of never giving up and always willing to try his best must have been paramount.

This is complimented by Hwang's own sense of social responsibility as observed in his writings. In a column written for a local magazine, he states, “I didn't want to face the interviews from the media all over the world, but … As a scientist responsible for such a great breakthrough, I have the duty to inform the public of what I have achieved.” (Shin, 2005) Hwang seemed to feel a social responsibility to do something great for the people, and that the responsibility comes from his own abilities. Because he has the ability to continuously work hard, he feels that he is obligated to achieve great results. This is further reinforced by another column Hwang wrote in 2003, where he states,

> It's all my responsibility... Later in my life, I hope a time will come when you'll visit me... and tell me “your research and your career as a whole have become a very precious gift for the humanity.”... may I still believe that my research must achieve results that will feed our people? (Hwang, 2003)

The theme of economic prosperity discussed in the previous chapter can be observed with the rhetoric of 'feed our people',

but it also demonstrate that Hwang had felt a sense of social responsibility. In fact, the sentiment is that not only must Hwang achieve something great, but that his achievements must positively impact South Korea in a profound manner. Hwang is thus a person who essentially defines himself through the pressures from the egalitarian sentiments generated by his ability to achieve great things through his tenacity, commitment, and diligence.

But the most significant aspect of this is that none of these characteristics of Hwang are unique or original. Even a superficial survey of the major figures in Korean history reveals the identical themes of tenacity, commitment, diligence, and social responsibility. The congruency between Hwang and the 'Korean heroes' suggest that Hwang had been molded by the expectations of the Korean society to fulfill the duties as propagated by exalting the historical figures and recounting their deeds with the emphasis to the values of hard work, tenacity, and social responsibility.

First, Hwang's impoverished background fits with the profiles of numerous Korean heroes, allowing for his story to fit the heroic narrative of Korea. The stories of Suk-Bong Han, a famous calligrapher who practiced his skills by tracing water on a

boulder to save money, or the tales of Man-Duk Kim, a celebrated rags-to-riches merchant who saved an entire province from famine by sacrificing her entire wealth, corresponds with Hwang's tales of having to help his mother take care of the cows while doing his best to advance through the grades.

The value of tenacity that Hwang displayed in his own story mirrors the story of Admiral Soon-Shin Yi, a celebrated military figure who failed the officer's exam four times in a row but kept on trying nonetheless. The narrative focuses more on the Admiral's unwillingness to quit rather than describing and even mystifying his military prowess or ingenuity, and corresponds with Hwang's own experience of working hard to go from 400th to 21st in school rankings. Rather than being an inherent genius, both of them are portrayed as a tenacious student who did not give up.

The congruency becomes even clearer as Hwang's adult life is examined. Admiral Yi's exile after being framed by a jealous colleague, as well as the exile of Joon Huh, a legendary physician, corresponds both to Hwang's 'exile' to Hokkaido University as well as his current predicament of being cast out of the Korean scientific community. Both Yi and Huh persevered and had magnificent comebacks, with Yi winning even more

significant battles and Huh writing his magnum opus in exile. Hwang's triumphant return to Seoul National University after spending some time in Hokkaido University makes Hwang's narrative correspond with Yi and Huh's narrative, and provides even more substance for becoming a Korean heroic narrative.

In addition, all the stories of the Korean heroes involve heroic men and women driven by the obligation to help the Korean people with their unique talents, whether by developing calligraphy as a popular culture, feeding famine victims, protecting the country from a foreign invasion, or compiling a medical encyclopedia. Considering the correlation of Hwang's story to these heroes so far, it is not surprising that Hwang also feels the same type of social responsibility.

Thus, Hwang is far from a simple scientist who committed a fraud for his own personal benefit. In fact, it would be difficult to even call Hwang an individual scientist. Instead, Hwang is a man following the heroic narrative set up by his people's culture and history, and accepting the immense pressures from the nationalistic and fanatical expectations. Rather than an individual motivations and objectives, he was a vessel in which South Korea as a nation can work through to achieve the national ambitions and agendas. Hwang's story is therefore a

story of the Korean brand of science, and as examined in the next chapter, the theme of economic prosperity, international competitiveness, and international reputation as attributed to the Korean science by the previous chapter emerges in the aftermath of the Hwang Controversy.

Chapter 4

HWANG AND THE KOREAN SCIENCE

Overview

In this chapter, I examine the reactions of the South Korean policymakers, public, and even Hwang himself in regards to the fabrication controversy and demonstrate that the same themes of economic prosperity, international competitiveness, and raising the nation's reputation existed and still exist in regards to Hwang's fraudulent research. As Hwang is arguably the most prominent example of a scientist operating under the model of 'Korean Science' proposed in the first chapter, examining his fabricated research and the South Korean reactions would yield valuable understandings in how science shaped by economic prosperity, international competitiveness, and international reputation works in real life. In addition, a component of Hwang's story regarding ova donation also introduces us to a case where traditionally held ethical values come in conflict with the values upheld by the Korean brand of science - a subject that will be discussed in the last chapter.

I have already argued that Hwang had been molded by the nationalism, hero-worship, and historical contexts inherent to the South Korean society, and that his story is more a Korean

story than an individual's. Here, I will further expand on that concept by exploring how the motives of economic prosperity, international competitiveness, and international reputation inform Hwang's story and its aftermath.

Hwang and the Evaluation of Korean Science

First, it must be established that Hwang's research was meant to fulfill the obligation of efficiency and commercial viability as dictated by the Korean brand of science. Evidence that Hwang was indeed driven by these two values can be found when one of his laboratory technicians stated,

> He thought that he needed to demonstrate the commercialization of the stem cells immediately... I think the pressure to demonstrate that has led him to lie that we have achieved something that probably won't be possible for another decade or so." (Han, 2005)

Here, a witness close to Hwang and his behavior notes that Hwang felt pressured not only to demonstrate that his research had commercial potential, but that it needed to be presented as quickly as possible. The efficient, potentially profitable research was indeed part of what drove Hwang to conduct his research and, failing to meet those expectations, resorted to data fabrication.

This sentiment is echoed by the Deputy Minister of Research and Development Yoon Jung – an ironic twist considering that, as seen in the previous chapter, he has spoken countless times to promote the very same standard. He states, "We as a society has ignored the characteristics of the fundamental science and has focused instead on short-term practical gains and pressures from demanding such results... we have become too result-oriented." (Jung, 2006, p. 12). A hypocritical contradiction to his previous statements aside, Jung nevertheless suggests that Hwang had been pressured by the standard of efficiency and commercial viability and even driven to commit a fraud because of it.

Thus, Hwang, in addition to the multiple and complex pressures from nationalism, cult of personality, and historical/cultural contexts, had been operating under the pressures caused by the standards of science being set as efficiency and profitability. Logically, this would mean that Hwang had also been working for the same goals set by the Korean brand of science established in the first chapter, and that South Korea's expectations for Hwang had also been formed under the same standard.

Hwang Controversy and Economic Prosperity

The theme of economic prosperity can be observed in a statement made by the Minister of Science and Technology, Woo Shik Kim, who stated,

> The principle that I will follow when dealing with Dr. Hwang's situation is... if there is a definitive proof of fabricating his research or corruption, I feel that he should be sternly punished. But what he has already achieved in terms of research and research atmosphere must be kept intact and be allowed to continue. (Kim, 2006, p. 15)

In a hearing meant to discuss the ethical and moral implication of the Hwang controversy, the focus of the discussion is visibly concentrated towards whether Hwang's research is still salvageable despite the data fabrication. Bioethics, the subject that intuitively ought to be the main (arguably the only) focus, is pushed aside for the sake of economic benefits from Hwang's research.

This is even more clearly observed when Assemblyman Young Jin states,

> Many of my fellow Assemblymen have already spoken enough about the research paper or the morality of the Hwang incident. But I am confident that everyone here

> believes that if there is something that Dr. Hwang had already achieved, we must revive those achievements and continue on. (Jin, 2006, p. 37)

This statement was made after a brief, four sentence long discussion on the ethical implications of Hwang's fraudulent research, further establishing that the focal point of Hwang's failure is not in his morality or ethics, but his productivity. Hwang was meant to deliver a complete product ready for sale, and his sin was bringing a defective product instead.

Even Hwang himself refers to the subject in the same manner. In a curiously timed interview scheduled immediately after President Lee announced the massive investment plans towards stem cell research, Hwang describes his research as something that "will catalyze our economy as much as – no, even more than the IT revolution. I'm sure of it." (Huh, 2011) In an appeal to the nation meant to ask the public for forgiveness and a chance at redemption, Hwang markets his research in terms of the country's economic prosperity. Even from Hwang's perspective, the means for his redemption from his ethical, moral failure is to bring economic prosperity through scientific research – this also implies that in his mind, his failure was not an ethical matter but a commercial, nationalistic matter.

He further expands on this idea later in the same interview when he rhetorically asks "For what am I doing my research? In other words, for whom am I contributing for? How can science exist without contributing?" (Huh, 2011) The guilt he must carry in his opinion is the guilt of failing to contribute to the country, as opposed to the multiple ethical violations in the process of his research. At the same time, he is reinforcing the idea that the Korean brand of science is being done and evaluated at a national level; he has failed his country, rather than himself, his peers, other scientists, or even the world.

Thus, the reaction to the Hwang controversy from South Korea demonstrates for us a real-world example of how economic prosperity as a goal is using science as a means. Rather than the ethical implications, the policymakers and even Hwang are much more concerned with the economic impacts and aftershocks from the data fabrication.

Hwang Controversy and the Competitiveness

A similar theme is also found when considering the goal of international competitiveness. In the hearing that was actually titled "Investigation Concerning Stem Cell Research Paper Fabrication Suspicion and Future Preventative Plans", the discussions were dominated by whether Hwang's research was

still salvageable. Assemblywoman Hye Suk Suh stated, "The people are very interested in this case, and yet I think you are being too reserved in your actions. Most importantly, you must ensure that we don't lose out on anything in regards to the international community." (Suh, 2006, p. 66) The statement puts the primary focus of the Assembly inquiry towards whether Hwang's research can still be used to improve South Korea's international competitiveness, and also reinforces the idea that the science is conducted in South Korea at a national level by using the people taking interest in the case as the justification. Additionally, with that justification, she is implicitly making a link between the public opinion and the idea that science is meant to raise South Korea's international competitiveness.

Assemblyman Sun Taek Kwon's (2006, p. 16) statement is even more blatant, as he stated, "If we are to nurture the seeds already sown by Dr. Hwang, does that mean that we can continue the stem cell research and produce something that can be acknowledged both nationally and internationally?" Similar to Assemblywoman Suh, Assemblyman Kwon promotes the idea that Hwang's research was supposed to have created a product that would have increased South Korea's ability to compete with the rest of the world. By mentioning both national and

international acknowledgment, he also suggests that the public opinion also dictates that science is a means to the end of increasing South Korea's ability to compete with the rest of the world.

But no one else provides a better example of this than Hwang himself. After boldly claiming that he has the stem-cell research finished and ready to be recognized and patented, he was asked by the reporter why he wouldn't just go to another country to continue his research. He responded,

> There is no way I can give my research to another country when it is beneficial to our national interest... without our government, I felt like an orphan yearning for his parents. No matter how brilliant and great a scientist is, he will only be used and exploited when he is scouted by a foreign country. They will praise you and uplift you, but in the end they want to use you as a slave in return for insignificant rewards. (Huh, 2011)

The notion that science is a tool used by South Korea to compete with other nations is immediately established by labeling the idea of working in another country as unthinkable while the national interest was at stake. This is expanded upon in a very interesting way next, when Hwang describes what it would be

like to work for a foreign country. Yet he is describing the same thing that has, is, and will happen in the Korean brand of science; scientists would be working for a purely practical and pragmatic goal of the host country, and they are basically the servants of the people who expect wealth, global competitiveness, and worldwide recognition of the country's heightened status in the world. Yet, through describing the exact same experience in a dramatically negative way by alluding to even slavery, Hwang establishes that there is a genuine conflict between advancing science and advancing Korean science – same exact acts, when done in a non-Korean environment, is considered slavery while the works done in a Korean environment is considered a duty and even an honor.

This is further established in his description of how the rest of the world is coming along with stem cell research. He states,

> To sum it up, it's 'full throttle'... a colleague from Harvard told me that 'The professors at the Harvard Medical School find it hard to hide that they are overjoyed by the fact that the flame known as Hwang Woo Suk has been extinguished in South Korea.' In 2006, South Korea was the only country who had cloned embryos; now there are

> at least 5 countries. Thankfully, none of them have developed a stem cell line from it yet. (Huh, 2011)

The researchers at a foreign university are portrayed almost like cartoon villains, laughing and taking pleasure in the fall of a 'formidable opponent', inciting a nationalist ire from the Korean readers and thereby confirming the nationalist undertone in the goal of international competitiveness. This provocative description is immediately followed by an attempt at creating a sense of desperation; the evil foreign professors are laughing at Korea's misfortune, and now they have caught up to us. The appeal to nationalism is then followed by a sense of reassurance - that it's not too late for South Korea to keep moving ahead of the rest of the world. While it is an inconspicuous attempt at marketing himself to the public, Hwang also displays the underlying belief concerning science. He must be reinstated, the appeal asserts, because South Korea is in danger of losing its competitive edge; he 'proves' that South Korea is about to fall behind by describing foreign researchers as taking great joy in South Korea's stunted stem cell research and juxtaposing that notion with the fact that other nations have 'caught up' with South Korea.

This is reiterated when he answers which countries are the biggest threats to South Korea, a question already accepting and even abetting Hwang's premise. Hwang identifies the threat as,

> United States and China. This year, China selected stem cell research as one of the 3 industries that they will strive to make it the world's best within 8 years. They already have succeeded in creating a cloned embryo. Right now, the world is at a "stem cell research" war. An international war to see who lives and dies in the future. (Huh, 2011)

Here, Hwang is curiously applying geopolitics to his appeal by using China and the United States, two extremely powerful and influential superpowers. Therefore, citing both US and China are already effective in inciting the nationalist sentiment that aids the sense of desperation within the contexts of the international competition Korea is engaged in. By specifically mentioning their policies on scientific investments, Hwang is amplifying the sense of desperation and thereby further demonstrating that the science is being used as means to improving South Korea's international competitiveness. Finally, Hwang refers to the competition as a 'stem cell research war', and that it is an international fight for survival that Korea must win. With this direct description, Hwang's statement confirms that he has been,

and still is, operating under the assumption that the Korean brand of science is driven by the end goal of increasing Korea's chances in a global struggle for survival, and that such idea is the norm in the scientific community as well as the Korean society itself.

Hwang Controversy and Korea's Reputation

In congruence with the theme of international competitiveness, the end goal of raising South Korea's international reputation and defining Korea's place in the world can be found in the reactions to the Hwang controversy. Even before the controversy, an example can be found where Hwang's case was considered in terms of raising South Korea's international reputation. Assemblyman Suk Joon Kim states,

> Perhaps we should pursue the route of adult stem cells... as it is internationally less controversial and present a better prospect for a Nobel Prize... and you are all aware that the Korean scientists, the native scientists are very advanced in those fields? (Kim, 2005, p. 58).

Assemblyman Kim proposes converting the contemporary effort towards embryonic stem cell research to adult stem cell research, not because of a moral or an ethical reason, but because the rest of the world seem less disturbed by the

alternative. The statement clearly demonstrates that the underlying motivation is geared towards international reputation of South Korea both in the forms of international community's aggregated opinions and the Nobel Prize, as well as confirming the importance of being competitive.

Assemblyman Kim again confirms the theme of international reputation during the inquiry to discuss the Hwang incident. He asks rhetorically, “Why has this Hwang Woo Suk incident become a national and international problem? Is it not because of the issues of morality, ethics, and trust?” (Kim, 2006, p. 4) In one of the four brief instances where morality and ethics are even mentioned, Kim reveals that morality and ethics are considered only when there may be a risk to the country's international reputation. Even the motivations for keeping up with morality and ethics are assigned under the end goal of raising the country's reputation, as opposed to the inherent appeal of such values.

This sentiment is echoed by the Deputy Minister of Research and Development Yoon Jung in the same hearing, where he describes his plans to 'respond' to the Hwang incident. He states,

> In response to the recent incident, we will develop our review process to the level of the international community in order to prevent any harm to our nation's international reputation, and aggressively advertise our efforts to reform the review process to other countries... Also, we will use the news media in foreign countries to advertise our plans in response to the incident.” (Jung, 2006, p.15)

Here, the review process that is crucial to keeping ethics intact in research is being described as a means to reach the ends of preventing harms to the country's international reputation. It should also be noted that even the review process that is the means is also being gauged by the 'level of the international community', confirming the notion of 'ranking' as a result of considering the international reputation as the end goal of science. But perhaps most significantly, the major response that the ministry will take in response to a grave ethical violation by a prominent scientist is being framed under the context of what other countries will think of South Korea. Rather than reforming the review process so that the unethical behaviors can't happen again, the reform is done for the sake of the international image of South Korea.

Thus, the Hwang case and the aftermath provide us with real life examples of how a Korean brand of science actually functions while being motivated by the goals of prosperity, competitiveness, and reputation for the country. A significant consistency arises in all three goals within the Hwang controversy, however. In all three incidences, bioethics is overlooked in favor of the goals; bioethics is either a tool to achieve the three goals, or it is an inconsequential end that ought to be ignored in favor of the three goals. This idea of bioethics coming into conflict with the pragmatic goals of prosperity, competitiveness, and reputation and losing can be best observed in the last chapter's subject; Hwang's ova donation controversy.

Chapter 5

HWANG'S ANGELS AND THE STRANGE IRRELEVANCY

Overview

In the last chapter, I discuss the apathetic responses by the South Korean society to the 'ova donation scandal', and how even in a conflict between bioethics/individual rights and the three national goals of prosperity, competitiveness, and reputation, the three goals triumph as the primary themes of the Korean brand of science. By examining the ova donors abuse case, arguably the aspect of the Hwang controversy with the most direct ethical impact, and through its irrelevancy in the minds of the South Korean policymakers and public despite the level of abuse carried out by Hwang and his researchers, I will demonstrate that the three pragmatic goals are prioritized over the bioethical standards established by the international scientific community.

The Donor Abuse

The Seoul National University investigative committee, formed in order to fully examine Hwang's research efforts and make judgments in terms of both the scientific honesty and bioethics, released its report where it described the details of Hwang's treatment of the ova donors. Collaborating with four

different hospitals specializing in infertility in women, Hwang and his team had collected 2,076 human ova from 130 donors, an incredibly high number of both donors and ova. Through examining the investigative committee's research and the investigations conducted by the National Bioethics Committee that released a report on the subject ten months afterward, the specifics of the donor abuse by Hwang and his team can be organized into donor exploitation, donor coercion, questionable use of informed consent, and the failure in safety procedures.

Out of the 130 donors, Hwang and his team offered up to $2000 in monetary compensation to 63 women, far exceeding the recommended range of $300 and a significant sum of money in a country where the average gross income barely exceeds $20,000. An additional 22 donors were given discounts to the medical procedures that they already needed before being recruited for donation. Of these women, 13 volunteered to donate multiple times, with one even going as far as donating four times.

The prospect of overcompensating the donors becomes ethically problematic when the donors' motives come into question. If the motive is purely for the monetary compensation, then the donor pool invariably shifts to the poor

and the disadvantaged, causing a scenario where they are being exploited by the researchers. In Hwang's case, it becomes clear that such scenarios had become a reality. Hwang and his team offered significantly large sum of money to their donors, as well as offer discounts to medical treatments valued up to $2300 that some of the donors needed. It is not surprising that 13 donors went back to donate again, when such enticing incentives were offered.

The case of medical service discount contains an additional point of questionable practices. Because all four hospitals were specialized in infertility, vast majority of the medical treatments that the donors needed were in-vitro fertilization procedures. Hwang's team would essentially offer discounts to women in return for harvesting the ova that would not be used for IVF. This enticing offer had an incredible catch, however, as Hwang's team examined all ova extracted for IVF and chose which ova to use for their experiments without the donor's knowledge or consent. The 'high quality' oocytes with higher probability of success were taken away while the women were given 'low quality' oocytes with markedly lower probability of success for the IVF process.

Here, we see exploitation of the donors through monetary compensation as well as an outright abuse of their rights by manipulating the IVF process without their consent. The ethical violations in this aspect of the case are crystal clear, as noted by both the Seoul National University Investigative Committee and the National Bioethics Committee.

While offering monetary compensation to a donor in monetary need is a form of coercion, Hwang and his team had committed a more direct form of coercion with the two female researchers working under Hwang. While there were claims from Hwang's side that stated that the researchers volunteered because they accidentally broke a container with an ova in it, the National Bioethics Committee was able to obtain an email sent by one of the researchers shortly before the donation occurred. In the email, the donor states,

> ... Though it was I who started it, I'm scared. General anesthesia, self-cloning (it's inconceivable?cloning using my own eggs?how tough I am). Trust me and stand by me the same way as you have done till now, so I can understand myself and become strong. I shouldn't have done it this way, not giving up until the end, not standing up to the professor. I will work harder to forgive myself.

> Only good things are waiting in the future?publishing paper with our names, and getting admission in a foreign university. I'm going there. (National Bioethics Committee, 2008)

There are numerous elements in the email that indicates fear of the procedures; the donor continually tries to reassure herself in her writing, despite feeling several emotional and ethical conflicts over going through the procedure. These indications for fear and concern are juxtaposed with several hints that allude to her being under duress by Hwang and his team. She specifically mentions that she should have stood up to 'the professor', as well as reminds herself of the incentive of being published and being admitted to a foreign university. The elements of this email paint a picture of a researcher being pressured by Hwang and his team through both direct coercion and indirect coercion in the forms of professional benefits.

This is further supported by the donor's colleague's interview with the committee, where he stated

> As though researcher P showed strong willingness to donate oocytes, I and former researcher L persuaded her not to donate. She said she told Prof. Hwang Woo-suk and Director Roh Sung-il she would not go through with the

> procedure one day or two days before, and Professor Hwang got upset and said, 'What could I do if you refuse it now?'. (National Bioethics Committee, 2008)

This confirms that the donor, while initially enthusiastic, changed her opinion of the procedure and informed the people in charge that she didn't want to go through with the procedure. It also supports the notion that the donor may have been incentivized by the various professional perks. But the most revealing aspects of the interview is what Hwang had supposedly said; the phrase 'What could I do if-' denotes a sense of great disappointment, disgust, and resentment while implying that the person in question is being extremely irresponsible.

Considering the power Hwang had held over the donor, and the additional societal pressure that he wields against her given the societal contexts of the hierarchical relationships between the teacher and his students, it seems prudent not to even consider the researchers to be valid candidates for ova donations. It seems almost impossible for the donors in the researcher's situation not to be under duress, and the evidences point toward an outright coercion.

In the modern-day bioethics, informed consent is constantly being questioned for its validity even when it is being

implemented in the best circumstances. As ova donation is a significantly traumatic procedure both physically and mentally plagued with numerous health problems, a patient's consent given after she fully understood all the risks, consequences, and other pertinent information becomes especially critical to keeping the standard of bioethics. Thus, the inadequacy of obtaining informed consent by Hwang's team thereby seems even more ethically troubling.

The National Bioethics Committee's report offers the MizMedi Women's Hospital as an example. While being the largest source of ova for Hwang's research, the hospital used a handwritten consent form that the director of the hospital hastily and arbitrarily wrote. The handwritten consent form omitted any information on the serious side effects of the ova donation that includes infertility and even death, and barely mentioned the possibility of suffering from ovarian hyper-stimulation syndrome, or OHSS. It is not surprising that the form completely lacked any mention of donors' rights.

In addition, the report states that Hwang had instructed his recruiting team to significantly downplay the potential side effects and complications; many donors who were interviewed by the National Bioethics Committee stated that they were not

told of the risks and complications. Some of these donors, so called 'Hwang's Angels', are now suffering from various side effects and complications caused by ova donations, and only realized that their conditions were caused by donating ova after being informed by the committee.

Considering the grave risks of ova donation, a patient's autonomous decision is absolutely required. By relaxing the standards of the informed consent and even manipulating it to gain the donors more easily, Hwang and his team have stripped the donors of free will and severely endangered the health of the donors.

The most disturbing part of the ova donor abuse by Hwang, however, is the incredible display of medical negligence displayed by Hwang's staff before, during, and after the donation. Because ova donation is quite risky, many cautions must be taken to minimize the harms done to the donors. Hyper-ovulation and extraction process are especially dangerous, and anything less than extreme caution is an act that unethically endangers the donor's health and even life. Thus, the negligence displayed by Hwang's team seems especially shocking.

Even at the basic first step of donor screening, Hwang's team displayed incredible negligence. None of the donors were screened for any substantial risk factors or incompatibility with the hormonal treatments necessary for the procedures, and none of their medical records were kept. For one unfortunate donor, this meant that she was allowed to donate even though she suffered from OHSS during her first donation. The second donation also caused her to suffer from OHSS, and she had to be hospitalized.

Multiple donors were also given dangerously large dosage of hyper-ovulation inducers, despite the fact that they were already suffering from OHSS. In fact, the National Bioethics Committee isn't quite sure just how many donors are suffering from health complications because none of the hospitals or Hwang's staff kept track of the donors. However, the only statistics available paints a very dark picture; 19% of the donors who went through the procedure at MizMedi Women's Hospital suffered from OHSS due to excessive hyper-ovulation inducer injections.

Here, Hwang and his team displayed an arguably criminal level of negligence towards the donors. Their decision to skip the procedures vital to protecting the donors has caused actual

bodily harm. The Committee (2008) sums it up best when it states, "there were no considerations to protect the right, health and well-being of oocyte donors all the way from designing the protocol, and collecting and donating oocytes."

The Strange Irrelevancy

Closer examination of the ova donor abuse by Hwang and his team offers a dismal picture of a massive, organization-wide failure in terms of bioethics. The exploitation and coercion of the donors are coupled with interfering with their informed consent rights and even basic medical safety, and violates countless ethical standards set for a dangerous procedure like ova donation. Hwang had demonstrably violated the rights of the donors and stripped them of their autonomy and physical well being.

Yet, despite the level of ethical violations committed by Hwang and his team, the issue of ova donor abuse is virtually never mentioned in the South Korean society. The general tone of apathy permeated the discourse at all levels, with a hint of concern only when the reputation of the country may be at stake as observed in the previous chapter. This is in spite of the fact that the Hwang controversy actually began with the local news program accusing Hwang of ova donor abuse. The Seoul

National University Investigative Committee devoted nearly 20% of its report on the issue, and even the facts at the surface level are enough to cause an outrage.

The apathy can be observed in the entirety of the Assembly's investigative hearing concerning the Hwang incident. Out of the 80 pages of discussions on the matter, the word 'ova' appears 17 times; only 2 of them are discussing the ova donor abuse, and they are both discussed only briefly. The slightly lengthier discussion of the two is stated by the Deputy Minister of Research and Development Yoon Jung (2006, p. 13), who states, "We will develop a procedure in order for the ova donation to be ethical and safe." Both the fact that Jung was not pushed to give further details by the Assembly and that this sentence was spoken between extended discussions about retaining Hwang's patents on embryonic stem cell research and using the foreign media to improve the image of the country tarnished by the Hwang incident reveal that the ova donor abuse is considered an extremely minor issue, especially when in conflict with the three goals of prosperity, competitiveness, and reputation.

The juxtaposition of the extent of the ova donor abuse conducted by Hwang and the apathetic response from South

Korea reveals the fact that even individual rights and causes of bioethics cannot win against the goals of economic prosperity, international competitiveness, and international reputation. The significant rights abuse is cast aside or flat-out ignored repeatedly in favor of discussing maximizing the three national goals, and the only circumstances where rights and bioethics are becoming pertinent is when it becomes a component of achieving the three goals.

There are even hints that the Korean brand of science would willingly accept sacrificing individual rights and bioethics for the sake of the three goals. When Hwang appealed to the High Court after the initial trial at a lower court, the judges sentenced him to a conditional prison term that would keep him from being imprisoned. The court justified its decision by stating that, "...as Dr. Hwang had achieved significant breakthrough in the fields of animal cloning, sentencing him to an actual sentence and thereby preventing him from participating in the scientific progress would not be a righteous decision for our society." (Lee & Im, 2010) Citing specifically the national benefits that Korea can reap from Hwang's research, the court has showed leniency in spite of the massive donor rights violation. For the sake of what Hwang's science can do for the

general betterment of South Korea, it seems that no other values can become obstacles. Recent media activities suggest that Hwang may be on the track to come back to the public's arm; aside from a very friendly interview by a prominent conservative journalist, a recent editorial in a major newspaper also attributed Korea's "potential to become a bio-strong nation" (Lee, 2011) to Hwang, along with a comparison to Jean Valjean and the saying "Hate the Sin, Love the Sinner." (Lee, 2011)

Hwang's Angels

This trend can also be observed in the ways the donors were recruited. The cult of personality of Hwang discussed in chapter 2 comes to play here, as the social status of the donors was significantly elevated as a function of Hwang himself. The donors, dubbed 'Hwang's Angels' by the media, have been continuously celebrated as patriots. As one journalist noted in a column written while Hwang's fabrication was being brought to the public's attention, the public campaign to support Hwang's research by donating ova were hailed by the media as "Great Women Who Will Save This Country" (Go, 2005) and the "Second Siege of Haengju" (Park, 2005). Here, the allusion to the Siege of Haengju is particularly significant, as the famous defense of the Haengju fortress against the Japanese troops in

1593 is often (mistakenly) attributed to the anecdotal accounts of the local women braving Japanese musket fire to carry heavy stones on their skirts to be thrown at the enemy. Both the elements of international competitiveness and nationalism are invoked by this reference, as well as reinforcing the idea that these women are bravely making a sacrifice for the sake of their country.

Other rhetoric promotes 'Hwang's Angels' in a similar way, but perhaps the most notable concept is “Ova Donation Campaign is the 21st Century's Collect Gold for the Love of Korea Campaign!” (I Love Hwang Woo Suk, 2005), used by both the Hwang fan site's attempt to support Hwang by gathering more donors as well as the media making identical allusions. The 'Collect Gold for the Love of Korea Campaign' refers to the nationwide efforts to collect household gold to be donated to the national treasury during the late 90s in South Korea. Suffering heavily from the Asian Financial Crisis of 1997, South Korea took out a substantial loan from the International Monetary Fund to minimize the damages. Viewing the nation's attempt to pay back the IMF as a nationwide effort, the citizens donated gold-based jewelry and household products to the government to be melted into ingots and be sold to procure funds to pay back the

IMF. While it is questionable whether the campaign actually impacted the country's ability to pay back the debt, as a society the campaign is seen as a point of pride and a demonstration that the Koreans are willing to sacrifice the individual need for the good of their country. Thus, equating the ova donation to the gold campaign induces a similar feeling; for the good of the country, individuals – women - must volunteer to donate their ova. Not only is Hwang's research viewed as a national effort that will benefit the country as a whole (done by the people and for the country), the virtue of self-sacrifice for the sake of the common good is promoted. It is no wonder, then, that the ova donation never became a focal point of the Hwang controversy; even if there had been risks and injuries, they are just part of the self-sacrifice necessary for the good of the country.

Chapter 6

CONCLUSION

What Science Means to South Korea

This study of modern-day South Korean science suggests that the cultural, historical, and societal contexts mold what science means for a particular country or a society. The political discourse surrounding South Korean science demonstrates that science is evaluated under the standards of efficiency and economic viability, and that science is supposed to achieve the three goals of economic prosperity, international competitiveness, and raised international reputation for the country as a whole. The implication is not only that science is a tool meant for practical gain, but that science (at least in the case of South Korea) is being conducted at the national level. I have argued that the Hwang Controversy demonstrates that scientists like Hwang are not seen as individuals, but representatives of the entire nation and embodiments of nationalistic goals. With intense nationalistic and near-fanatical support, Hwang was elevated to the position of a 'Korean hero', and thus was saddled with an immense duty to sacrifice oneself for the sake of the society as a whole. Hwang's research was Korea's research, his success was Korea's success, and his

failures were Korea's failures. This is evident even in Hwang's fall from grace, where the discourse concerning the Hwang Controversy reveals the same themes of economic prosperity, international competitiveness, and international reputation informed how the society dealt with the aftermath of the incident. Hwang failed his country not because he was being dishonest nor because of his questionable bioethics procedures, but because he failed to deliver the three goals of the Korean brand of science to his country. This notion of Korean science is evident also in the ova donor abuse controversy. It offers a case where the values of the Korean science come directly in conflict with the bioethical standards that exist in parallel with the idea that science is universally a pursuit of knowledge. Despite the disregard for widely accepted bioethical values and standards, the Korean responses were apathetic. In fact, given the way the donors were recruited and revered by the society before the Controversy, it suggests that because the goals of Korean science are for the sake of the greater good, abuses and harms at the individual level were seen as acceptable or weren't recognized as abuses at all.

Thus, we are presented with an approach to science (and ethics) that differs markedly from the Science Council definition

cited above. While it appears that at least some of the scientists like Dr. Dong Hwa Keum (see Chapter 2) still adhere to the traditional definition of science, the South Korean society at large has an entirely different mindset. Rather than knowledge, science in South Korea is focused on how the results of research will enrich the nation's economy and standard of life, or how competitive the research will make its industries, or how the research will give South Korea as a nation increased international standing and reputation. It is not surprising, then, that Hwang is currently on the path to recovering his old status. While it would be unimaginable to let a scientist with a mark of dishonesty on his record return to the scientific community in a system of science where knowledge is paramount, Hwang's return would be (and likely will be) acceptable in South Korean science. He is still billed as having the capability to bring prosperity, competitiveness, and raised reputation to his country, and that means that he is still a valuable asset to the nation's aspirations.

Future Considerations

Normative statements about whether South Korea's views towards science are right or wrong should be withheld for now, but instead the nature of the definition of science must be

explored. This thesis offers a detailed study of a case in which science isn't defined as the detached pursuit of knowledge. This study has situated South Korean science within values, goals and approaches that were generated by South Korean history, culture, and societal context. The adequacy of the Science Council's definition is thus challenged by demonstrating that South Korean science is deeply embedded in – and inseparable from – South Korea. In the South Korean example, not only does science function and react in manners drastically different from the science defined as the pursuit of knowledge, science is shaped and molded by the contexts of the locality it is being practiced in. The fact that the dynamic factors like history, culture, and societal structure dictate the characteristics of science give credence to the idea that the definition of science is correspondingly dynamic – rather than being a chronologically and globally categorical concept, science is a malleable, socially-embedded and ever-changing human activity.

Thus, this study suggests that in seeking to define science under a set, categorical term, the Science Council is asking the wrong question. Instead, the question ought to be how the historical, cultural, and societal contexts of the different countries and cultures of North America and Europe has shaped

their own views (and practices) of science. The vastly different cultures and environments of different countries such as Britain, Germany, and United States must have generated unique characteristics of science that differ from one another, just as the factors discussed above have shaped a uniquely 'Korean' science.

In fact, the attempt to give science a universalistic definition appears to be one of the most interesting qualities of the ‘British Science’ and the ‘American Science’. Such attempt assumes that the possibility of divergence in how human societies interact with science does not exist, and that science is completely detached from the culture developing and advancing it. Ironically enough, the lack of awareness in how cultural context influences science would be caused by the culture of that society itself, and by investigating how culture understands and interacts with science, new insights into how science is undertaken in British and American society can be gained.

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