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On the innovation virtue of scientists

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Abstract

Innovation has become more and more important to the social development of the 21st century. It is not only the driving force behind social development, but also a manifestation of the comprehensive strength of various countries on the international stage. It plays a vital role in the development of any country. This paper makes a targeted elaboration on the group of scientists who are the main force that influences the development of innovation. In addition, this study also reveals the internal development mechanism that affects the development of scientific ethics, and puts forward 4 targeted suggestions based on examples.

Keywords: Innovation; Virtue; Scientists; Developing

1. Introduction

American futurist Asimov pointed out: "The 21st century may be a great era of creation. At that time, machines will finally replace people to complete all monotonous work. Electronic computers will ensure the operation of the world, and humans will finally be able to do it freely-to create[1]." Innovation is the first driving force leading development, the inevitable path of technological development, and the essential requirement of technological progress. The life of science and technology lies in innovation. The virtue of innovation is not only the starting point and key of scientists' innovative activities, but also the essential quality and soul of an outstanding scientist.

2. Having the courage to innovate

Scientific activity plows in uncharted territory. It is a process of exploration and innovation that constantly seeks new discoveries and inventions, and constantly pushes the level of understanding to a new level. The most prominent feature of basic research is originality. According to John Ziman, a contemporary sociologist of science, originality drives the selection process of variation ("guessing") through critical skepticism ("refutation"). And that process is preserved by the community. That is to say, he regards "true science" as an evolutionary process, which embodies practices such as "guessing", "refuting", "selecting" and "retaining", and this evolutionary process always runs through originality. Based on this, he included originality into the five ethos of the scientist group (publicism, universalism, impartiality, originality and skepticism). Nobel laureate Weinberg (Steven Weinberg) believes that the most important quality of innovative talents is 'offensiveness', which does not refer to the kind of aggressiveness in interpersonal relationships, but refers to the natural one. "You should not be content with the answers given to you in the book, but try to find out what is different from the book. This quality may be more important than intelligence." [2]

British chemist Newlands (John Alexander Reina Newlands) proposed the "octave law", which was close to discovering the periodic rate of elements, but because he could not stand the sarcasm of authoritative figures, he finally gave up due to lack of confidence and courage. However, the young Mendeleev withstood the ridicule of the authorities with unstoppable courage, persisted in the research, and finally discovered the periodic rate of elements. [3]After Edward

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Jenner's vaccination law was announced, the church attacked it as "a lie of the devil" and "blasphemed the image of God by touching livestock". But Jenner did not flinch. He said: "My boat, which has set sail and is determined to reach the other shore, should withstand some storms." Due to the spread of vaccination, smallpox was finally eliminated all over the world. There is a statue of Jenner in Paris, with the inscription below, "To the mother, the child, the benefactor of the people." There is a crocodile statue in the Mond Laboratory of Cambridge University to commemorate Dr. Rutherford's scientific spirit of forging ahead and making progress, because crocodiles have a habit of only knowing how to move forward and never retreat. Of course, there are also negative examples. The British youth Watson wrote a paper on the theory of gas molecules in 1845, which proposed many contents that were later proposed by Joule and others. The Royal Society called his paper "full of nonsense" and dismissed it. Watson has since been disheartened and unknown. By the time the value of the paper was discovered forty-five years later, Watson was nowhere to be found.[4].

Before the 1940s, the surgical community had always regarded the liver as a "forbidden zone" for surgical operations. The great love spirit of benevolent doctors gave birth to Wu Mengchao's strong emotion of saving lives and healing the wounded and the driving force for innovation. In 1958, Wu Mengchao took the initiative to form a "three-person team" for liver and gallbladder research, and produced a "Coral Flower" liver duct cast specimen. In addition, he also put forward the innovative theory of "five lobes and four segments", which laid the theoretical foundation for liver tumor resection. And the "intermittent hepatic portal blockage and liver resection at room temperature" he created, which shocked the medical world, is an innovative achievement that surpasses the "forbidden zone in the forbidden zone" of the "central liver lobectomy" operation. Finally, the motto of the Oriental Hepatobiliary Surgery Hospital was formed, which is "be brave in innovation and always strive for the first". [5]The quantum anomalous Hall effect was a world-class problem raised by the physics community in the 1980s. Xue Qikun's team, who pursued the ultimate, chose to complete this scientific imagination. In 2013, the team used new ideas to create suitable materials, and observed the last and most mysterious member of the quantum Hall effect family—the quantum anomalous Hall effect—from experiments for the first time. This is an important physical phenomenon independently observed by Chinese scientists from experiments, and it is also an important scientific discovery in the field of physics. Academician Yang Zhenning said that this is a Nobel-level physics achievement made in a Chinese laboratory.[6]

3. Daring to question authority

The spirit of questioning is the life of science, the guarantee and driving force of scientific progress. Balzac famously said: "The key to all science is undoubtedly the question mark." Merton proposed that scientists should have a "systematic skepticism". Popper regards "doubt" as the core of the scientist's spirit, and believes that science is speculation and refutation. Questions, doubts, criticisms are the gist. Innovation often starts from doubts, and innovation requires a skeptical and critical mind to think and analyze the gains and losses of previous theories. Engels vividly called the "skeptical-critical" mind a "main instrument" of a scientist. But doubt must be grounded, because it is not a blind doubt. Scientists need to have this attitude of daring to be different and not blindly skeptical. A questioning mind guides people to think rationally and calmly face the truth of things, which is the driving force behind innovation.

Many great theories have subverted the established hypotheses and created new scientific theories because of "doubt". Copernicus went from doubting the "geocentric theory" to his "heliocentric universe system", Darwin's theory of evolution started from doubting creationism, and Einstein's theory of relativity originated from doubting Newton's absolute space-time theory. Science always advances by relying on its reasonable skeptical spirit. The charm of science comes from the unknown rather than the known. The true meaning of science lies in negation rather than affirmation. [7]Joliot Curie accidentally discovered a very strong radiation in an experiment, which was equivalent to the discovery of neutrons. But he regarded the radiation as gamma rays, and found a plausible explanation for this anomaly. Chadwick, who was a contemporary of Curie, immediately had a big doubt after seeing the experimental report of Joliot Curie. And foresee the important scientific value of this strong radiation. He immediately set about experimenting, and after a month of exploration, he announced the discovery of the neutron, which won him the Nobel Prize in 1935. [8]Many facts in the history of science show that if the correct result of practice does not match the existing theory, it is often the breakthrough point of innovation. As Joliot Curie said: "The farther the experimental results are from the theory, the closer to the Nobel Prize." [9]

In the 1960s, Yuan Longping found that conventional rice breeding methods had limited advantages in increasing yield, and wanted to use heterosis to increase rice yield. However, "Cytogenetics" published by the famous American geneticists Sinlot and Dunn believes that self-pollinated crops such as rice have no hybrid vigor. A "outstanding" rice made him determined to move forward independently. The paper "Male Sterility of Rice" published in 1966 impacted the authoritative assertion that "self-pollination is no heterosis". This provided a strong support for his bold innovation in the future. It is the questioning of the "non-dominance theory" that led to the design idea of "using rice heterosis and the first promotion of rice male sterility" and the entire technical route of the later "three-line matching". [10]Entering

Chinese characters into computers was once a world-class problem, because there are only 26 letters in English, while the "Kangxi Dictionary" contains more than 47,000 Chinese characters, more than 10 fonts, and nearly 20 font sizes. Some experts predicted, "The computer age is the end of Chinese characters. If we want to keep up with the pace of the information age, we must take the road of Pinyin." Wang Xuan gave full play to his expertise in "Computational Mathematics", led the team to overcome many difficulties, developed a Chinese character laser phototypesetting system, and constantly realized the replacement of technology. [11]In 1953, Professor William T. Miller, a well-known chemist at that time and one of the scientists who played a key role in the "Manhattan Project", proposed in a report that electro-deficiency perfluorinated or polyfluoroolefins (such as four vinyl fluoride) can only react with nucleophiles. Facing the academic authority at the time, Jiang Xikui, who was only 27 years old, expressed doubts about Miller's assertion. Jiang Xikui believes that this conclusion is correct in most cases. However, if a more electrophilic reagent is used to attack perfluoro or polyfluoroalkenes, electrophilic addition reactions may occur on perfluoro or polyfluoroalkenes. According to this train of thought, the invention of chlorotrifluoroethylene lactone is widely used in the chlor-alkali industry and the synthesis of high-performance surfactants. [12]

4. Being good at taking the lead

The experience of previous scientific and technological revolutions tells us that scientific and technological innovation is the forerunner of the scientific and technological revolution. Whoever seizes the opportunity may become the leader of the scientific and technological revolution, gain more power to speak and make decisions in the country, and bring greater benefits to the country and nation. Relevant research by the Modernization Research Center of the Chinese Academy of Sciences believes that the sixth scientific and technological revolution will occur between 2020 and 2050. This scientific and technological revolution is characterized by unprecedentedly intensive technological innovation, and the starting point of innovation is getting higher and higher, and innovation is becoming more and more difficult. [13] The accumulation of more than 70 years since the founding of New China shows that our country has the foundation and conditions to win the initiative of scientific and technological innovation.

One of the easiest questions for a scientist to ask is: What's the next question? This may be the awareness and ability of scientists to gain insights into new problems and seize opportunities for technological innovation. In the 1940s, the thesis that enzymes are proteins was widely accepted by scientists. Proteins are smart and multifunctional molecules. When Francis Cricket (1916-2004) heard of such molecules, he immediately thought of a key question: What does it look like to elucidate how proteins are synthesized? After Crick assembled all the new knowledge about cells, genes and how cells metabolize, grow and interact, he immediately had an insight into the key question: What are genes made of? How exactly are they reproduced? How do they control protein synthesis? It can be said that it was his keen insight into the frontiers of science that made him the "stepping stone" for winning the Nobel Prize. [14]

In the history of science, there are many examples of missed opportunities for technological innovation. In early 1939, German chemists and physicists O. Hahn (Hahn, Otto) and F. Strassman (F. Strassman) published a paper on the phenomenon of uranium nuclear fission, which was recognized by many scientists. At that time Germany was in the forefront of atomic energy research. But unfortunately, Hitler did not pay much attention to these scientists, nor did he invest a lot of money in the development of the atomic bomb. In July of the same year, American physicist Leo Szilard invited two other physicists, E.P. Wigner and Edward Teller to present to Einstein the impact of developing nuclear weapons on war. In August of the same year, Einstein wrote to Roosevelt, detailing the importance of developing the atomic bomb. In 1942, Roosevelt decided to establish an atomic bomb research institute, under the leader of Oppenheimer (Julius Robert Oppenheimer), Fermi (Enrico Fermi), Bohr (Niels Henrik David Bohr, Hans Bethe, Norman ˙Ramsey (Norman F. Ramsey), von ˙ Neumann (John von Neumann), Compton (Arthur Holly Compton), Wu Jianxiong and other outstanding scientists， the United States developed three atomic bombs in 1945, and finally walked ahead of Germany. [15]In fact, Germany, the Soviet Union, Japan and other countries also carried out atomic bomb research and development at the same time during this period. The first breakthrough of the "Manhattan Project" in the United States fully demonstrated the importance of taking the lead in technological innovation.

Various pathogenic microorganisms may become weapons in the hands of the enemy in wartime, and may become the culprit of large-scale epidemics in peacetime. In 2006, when most Chinese people did not know what the Ebola virus was, Chen Wei was keenly aware: "Ebola is only one flight away from us." broke out. Due to the high fatality rate of the virus (50%-90%), the United States classified it as the "highest level of bioterrorism attack weapon", which caused global panic. At this time, Chen Wei's team has laid a solid foundation for the successful development of the vaccine. In 2015, Chen Wei's team developed the world's first 2014 genotype vaccine, which opened the door to hope for life for people in the epidemic area, and it also provided people with sufficient coping capabilities in the face of unfamiliar viruses in the future. [16] In 2020, Chen Wei's team developed the world's first COVID-19 vaccine, providing "triple protection" for healthy people.

In 1974, China launched the "Chinese Character Information Processing System Project" in order to change the backward situation of lead printing in our country. In fact, advanced countries in the world have gradually adopted phototypesetting technology since the 1940s, and basically experienced four stages of technological transformation: In the 1940s, the United States launched the first generation of phototypesetting machines, namely manual phototypesetting machines; In the 1950s, the United States launched the second-generation phototypesetter, the photomechanical phototypesetter; in the mid-1960s, Germany introduced the third-generation phototypesetter, the cathode ray tube phototypesetter; in the mid-1970s, Britain launched the fourth-generation phototypesetter machine, that is, laser phototypesetting machine. Wang Xuan made a bold decision when developing the "Precise Chinese Character Phototypesetting System": He skipped the stage of the second-generation and third-generation machines that were popular in the world at that time, and directly developed the fourth-generation laser phototypesetting system, which had no products yet. designed a dedicated chip and successfully used the "parameter description method" to describe the characteristics of strokes for the first time in the world, entering the "no man's land" of technological innovation. He took the lead in designing corresponding special-purpose chips, and used the "parameter description method" to describe the characteristics of strokes for the first time in the world, and thus successfully entered the "no man's land" of technological innovation. Founded in 2017, Alibaba's Dharma Academy has 14 laboratories covering 8 cities around the world, and is committed to becoming the group's sharp-edged soldier to explore the no-man's land of technology; Huawei, which has been striving for 30 years, has gradually entered the infinite People area.

5. Willing to consolidate the foundation

Basic research is not only the cornerstone of scientific and technological innovation, but also an important carrier for the growth of scientists and the formation of national strategic scientific and technological strength. Gauss (Carl Friedrich Gauss) believes that mathematics is the "Queen of Science", which was initiated by him, and by Johann Dirichlet, Georg Friedrich Bernhard Rieman, Christian Feliu Klein, Carl Runge, David Hilber, Hermann Minkowski, Emmy Noether, John von Neumann, A large number of descendants such as Richard Courant forged the German mathematics empire. This prepared Germany to become a world science center. [17]After World War II, German basic research institutions quickly recovered. The Max Planck Society (MPG), established in 1948, is currently the most important basic scientific research institution in Germany. It has always been valued by the German government and society. In addition, a group of the world's top scientists joined it, therefore, it is very popular. The society has always adhered to the "Harnack principle" of academic freedom, that is, academic research is not controlled by the federal government and the corporate world. As of June 2020, a total of 18 scientists from the Society have won the Nobel Prize, accounting for half of the total number of German awards during the same period, and thus won the nickname of "Nobel Prize Forging Furnace" in Germany. [18]Henry Augustus Rowland, the first president of the American Physical Society, wrote in 1883: "If science ceases to advance and men focus only on the development of technology, we shall soon be corrupted, It will be reduced to the same nation as the Chinese. They have not made progress for several generations because they are only satisfied with the application of technology and never explore the underlying reasons. The Chinese have long known the use of gunpowder. If they can use the right method to explore the reasons for its function, they can develop chemistry and even physics... (But none of them) so that we now regard this ancient nation with a large population as a barbarian nation. If we don't explore deeply, it's like picking up the bread crumbs dropped by the lady. If we get more bread crumbs, we will think we are richer than the rich, and forgetting that the rich have bread. "Although such harsh criticism did not wake up the Chinese people at that time, it has aroused the vigilance and deep thinking of modern and contemporary scientists.

At the National Science Planning Conference held in 1956, Premier Zhou Enlai added another one (major basic theoretical research in natural science) to the original 55 major scientific research projects, and said to scientists: "If we don't strengthen the attention to long-term needs and theoretical work, then we will make big mistakes." The meeting also raised the urgent need to solve the theoretical problems of polymer material synthesis and improvement. Against this background, Tang Aoqing (1915-2008) resolutely devoted himself to the field of polymers, and worked on the statistical theory of the chemical potential of polymer addition polymerization, the solidification theory of polymers, the theory of polymer instability, and the statistical theory of copolymerization reactions. This work laid a theoretical foundation for promoting the development of China's radiation chemistry and polymer industry at that time. [19]Feng Kang (1920-1993) was independent of the finite element method theory created by Western countries, and proposed a Hamiltonian system algorithm based on symplectic geometry, which not only enabled him to enter the palace of world-class mathematicians, but also placed China in the field of applied mathematics and Computational mathematics on the world map. As the pioneer and master of computational mathematics in China, the finite element method has greatly promoted the communication and penetration among mathematics, engineering science, mechanics and computer science, and solved the calculation problems encountered in Liujiaxia Hydropower Station. His symplectic geometry algorithm solves the problem of long-term prediction and calculation of dynamics that has plagued scientists for a long

time, and is widely used in orbit calculations in astromechanics, particle accelerators, and molecular dynamics calculations. [20]

However, unfortunately, under the influence of the current utilitarian thinking, people often do not understand the importance of basic research enough, and instead are keen on applied research with "immediate results". And this understanding will seriously affect the choice and attitude of scientists, especially young scientists, in their scientific research direction. In view of this "short-sightedness" of scientific research, academician Tong Tanjun pointed out that basic research is the root of all technological development. In an interview with "China Science Daily" in 2012, he said: "If the foundation is not solid, how can we talk about innovation? If the foundation is solid, the innovation will naturally be strong, and vice versa. This is like building a skyscraper. Before building a building, the foundation must be laid, if the foundation is not firm, no matter how high the building is built, it will collapse one day." "Many basic research results, at the very beginning, people did not fully understand its role and significance, such as the discovery of telomeres and telomerase, which did not attract the attention of scientists at the beginning. Until recent years, People have discovered that the occurrence of many diseases has a certain relationship with the length of telomeres." [21]The 2009 Nobel Prize in Physiology or Medicine was awarded to three scholars who discovered how telomeres and telomerase protect chromosomes.

6. Conclusion

All in all, if we want to speed up the pace of technological development, we must be bold and innovative and actively encourage it. It is not only necessary to explore the imprint of science from the long-term development of national policies and society, but also to inspire more young people to start innovative explorations and not be controlled by inherent thinking.

Compliance with ethical standards

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