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Influence of External Environments on Outstanding Scientists and Technicians

A Case Study for the Chinese Meritorious Scientists Group for "Two Bombs and One Satellite"*

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***Abstract*—By using the research method of collective biography for sociology of science, this paper reviews literatures and researches from the 23 meritorious scientist group for "two bombs and one satellite", trying to discuss the growth environment and the success regulation for these Scientists. The research find out that external environment can influence them. 'Four excellent environments' are important: the impact of the advantageous geographical culture, the influence from an enlightened family, the cultivation of outstanding university and counselors and the existence of appropriate research environment.**

Keywords—outstanding scientists and technicians; Two bombs and one satellite; meritorious scientist; 'four excellent environments'

I. INTRODUCTION

In the age of science and technology, human resources, especially the outstanding science and technology talents, are becoming an important subject of original innovation, which is playing an increasingly important role. It is important to study the law of outstanding scientific and technological talents growth and success .There are lots of individual studies monographs, biographies have widely been available about "Bombs and one satellite", but lack of a comprehensive study of the overall results. With the methods of collective biography——a comprehensive analysis of social (area) and their growth environment, family environment, education and scientific research environment, the purpose of this paper is using the rule of this group grow up to cultivate the outstanding scientists and technicians.

II. SUPERIOR GEOGRAPHICAL AND CULTURAL INFILTRATION

Most of the 23 scientists were born in Jiangsu and Zhejiang areas where the economy and culture are developed. There are six people in Jiangsu and Zhejiang areas, two persons in Hunan and Henan province, others in Hebei, Liaoning, Shandong and Yunnan province .Birthplace of academicians are also concentrated in Jiangsu and Zhejiang cultural district. According to relevant reports, Yangtze River Delta region called the "Academy Cradle"—there are 323 national academicians who were born in Jiangsu, ranking first of the provinces and autonomous regions in China; Shanghai-born academician 234 people, ranking second; Zhejiang has 223 people, ranks third [1], which in total is 41 percent of the total number of academicians—between the Chinese Academy of Sciences and Academy of Engineering elected academicians in 1955 to 2009.

Talent geography think that the geographical environment effects on talent growth is mainly characterized by regional geographical culture, namely the specific regional natural geographical features and the political, economic, cultural and other humanities style. It will form a strong regional culture advantage. A certain regional culture with appropriate way of thinking and values provide humanistic and social environment support for talent growth, which influence the way of thinking, the breadth and depth of recognizing things. Elite concentrated in Jiangnan region which has the prosperous science and technology, it has intrinsic connection with Jiangsu and Zhejiang culture prosperous [2]. The core characteristics of Jiangsu and Zhejiang culture is "coexist and accommodate; intelligent with smart, clever with wisdom; Statecraft, pragmatic truth; Dare to be first, beyond the self". In modern times, Jiangsu and Zhejiang provinces have become the leading benchmark in economy, science and technology culture, education, ideology, literature and art and other fields in our country, continues to this day.

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TABLE I. "TWO BOMBS-ONE SATELLITE" MERITORIOUS SCIENTIST FAMILY (SOURCE: ACCORDING TO THE BAIDU ENCYCLOPEDIA AND BIOGRAPHICAL SORTED)

Full name	Date of birth	Birth Region	Family Background
Qian Sanqiang	1913-1992	Huzhou in Zhejiang Province	Father Qian Xuantong, language philology
Qian Ji	1917-1983	Jintan, Jiangsu Province	Peasant family, cultural foundation
Yao Tongbin	1922-1968	Wuxi, Jiangsu Province	A poor family, the importance of education
Zhao Jiuzhang	1907-1968	Wuxing, Zhejiang Province	Father Zhaoguo Yan, attorney
Deng Jiaxian	1924-1986	Huaining, Anhui Province	father Deng sting,professor of Beijing Medical University Department of Philosophy
Wang Ganchang	1907-1998	Changshu, Jiangsu Province	Father Wang Yiren, studied medicine, won the medical knowledge
Peng Huanwu	1915-2007	Changchun, Jilin Province	Father Pengshu Tang , the late Qing Dynasty Juren, a former Republican county magistrate Changchun
Cheng Kaijia	1918-	Wujiang, Jiangsu province	Father Chengshi Tong to teaching as a career
Huang Weilu	1916-2011	Wuhu, Anhui province	Father Huang Qing Dynasty scholar algae, a former primary school teacher
Tu Shou'e	1917-2012	Huzhou, Jiangsu province	Father Tu Weiping, general staff
Qian Xuesen	1911-2009	Hangzhou, Zhejiang province	Father Qian Junfu, studied in Japan, he served as director of Zhejiang Provincial Education Department
Zhou Guangzhao	1929-	Changsha, Hunan province	Father Zhou Junfeng, road engineering experts
Yang Jiaxi	1919-2006	Wujiang in Jiangsu Province	The famous family of local silk industry
Chen Nengkuan	1923-	Cili, Hunan province	Peasant family, cultural foundation
Chen Fangyun	1916-2000	Huangyan, Zhejiang province	Father Chen Lixin, graduated in Baoding Military Academy
Wu Ziliang	1917-2008	Pujiang, Zhejiang province	his father died in his Childhood ,he was bring up by his mother and brother, sister
Ren Xinmin	1915-	Ningguo, Anhui province	Father Ren Haiqing, teacher and principal in Ningguo, Anhui province, director of the county Department of Education, county bank and other staff
Sun Jiadong	1929-	Fu county, Liaoning province	Father Sun Shuren，principal in Gai Ping Normal School
Zhu Guangya	1924-2011	Wuhan, Hubei province	General Staff Family
Wang Xiji	1921-	Kunming, Yunnan province	Merchant family
Wang Daheng	1915-2011	Wuxian, Jiangsu province	Father Wang Yingwei, studied abroad in Japan, astronomy and meteorologists
Yu Min	1926-	Ninghe , Tianjin province	General Staff Family
Guo Yonghuai	1909-1968	Rongcheng, Shandong Province	Father Guo Wenji，peasant family

III. ADVANTAGE INFLUENCE OF FAMILY EDUCATION

These 23 scientists' growth were most effected by the poems by Li family heirloom, Gengdu family heirloom, worshing to learn ——twelve people (accounts for about 52%) were born in intellectual family (including 8 was born in a senior intellectual family); Six people were born in business, Chinese medicine and general clerk family, accounts for about 26%; five people were born in farmer family, including four people have family culture foundation (accounts for about 22%) in "Table I") . Although some families are in needy circumstances, generally their parents are considered to have guileless, enlightened qualities, patriotic and progressive spirit. Learning atmosphere has also profoundly affects their ideology and value orientation [3]. It can be concluded with two points: firstly, affluent family conditions provide material foundation for their growth. More superior family status provided the material conditions so that they can get more development of early intelligence. Second is the genetic gene of learning. Some families have outstanding technology talent — some of their family members, such as father, husband or wife, and brothers had an experience to study abroad. For example, Qian Xuesen, the father and the son Qian Xuantong; Qian Sanjiang father and son; Deng Yizhe, Deng Jiaxian, father and son; Wang Yingwei, Wang Dahang father and son; Zhou Fengjiu, Zhou Guangzhao father and son. It has shown that in the growth they were gifted with talent, strong receptive ability, excellent grades, which has related to the good hereditary genetic qualities.

IV. EDUCATION OF OUTSTANDING TEACHERS AND SCHOOLS

These 23 scientists not only had good family atmosphere, personal interest and efforts, but also they get the guidance from great teachers in their growth stage. Most of them experienced an outstanding growth in their student life——studied at the new-style school, learnt in the best domestic universities, have experience of studying abroad [4]. Specifically, they have five advantages.

A. *Excellent Basic Education*

The 23 famous scientists finished their primary and secondary school education in their local famous schools in "Table II", especially in math, science and English. 70% of them have great scores. It has laid a foundation for their further study. Moreover, quite a few principals of their middle school are educator. They bring advanced teaching ideas, excellent teachers, and emphasis on liberal arts and

quality education. They pay more attention to the cultivation of thinking and innovation ability, giving students a sufficient freedom to explore unknown and new things. For example, Qian Xuesen thinks that it has far-reaching effect of studying for him in The High School Affiliated to Beijing Normal University; Qian Sanjiang went into Comtes school of which CAI Yuanpei take charge in his childhood; Yang Jiachi and cousin Tu Shou'e studied in the middle school of Shanghai; Cheng Kaijia was in Xiuzhou middle school in Jiaxing, Zhejiang province, and instructed by his mentor Gu Hui principal; Yu Min was in Yao Hua middle school in Tianjin, and so on.

B. The Experience of Study Abroad

From the point of educational background, most of 23 scientists had finish their postgraduate study at overseas and had good learning experience in "Table II", 87% had postgraduate education, 65% had a doctorate, 91% studied abroad, which have a good learning environment, strong faculty research institutes of learning for further study. As for education institutions, they all graduated from famous universities or colleges. Furthermore, seven of them graduated from Tsinghua University, two from Peking University, four from Southwest Jiaotong University, two from Central University and Zhejiang University, and atleast one from these universities-Chongqing, Tianjin, Beiyang and the former Soviet Union, Moscow RuKeFu, air force engineering college. Except Yu and Qian Ji, they had not overseas experience, other went abroad to study in the well-known universities or research institutes from United States, Britain, Germany, France and the former Soviet Union, which the United States is the most, up to eleven, followed by the five in Britain , and two in Germany, two in Soviet union, one in France. On average they worked abroad for seven years.

TABLE II. "HYDROGEN BOMBS" EDUCATION SITUATION OF MERITORIOUS SCIENTIST (SOURCE: ACCORDING TO THE BAIDU ENCYCLOPEDIA AND BIOGRAPHICAL SORTED)

Full name	Graduate College& Department (Time of Graduation)	study abroad	Graduation colleges of Study abroad &Department(Time of Graduation)	Highest degree	tutor
Qian Sanqiang	Tsinghua university&physics(1936)	France	Nuclear physics at the university of Paris(1940)	Doctor	Ye Qisun、 Irina Curie
Qian Ji	The central university's teachers college(1943)			Bachelor	Zhao Jiuzhang
Yao Tongbin	Tangshan Jiaotong University&mining and metallurgy(1945)	Britain	Metallurgy at Birmingham University (1951)	Doctor	Mao Yisheng、 Christopher Kant west
Zhao Jiuzhang	Tsinghua university&physics(1933)	Germany	Meteorology at Berlin university (1938)	Doctor	Ye Qisun, Wu Youxun, Zhu Kezhen, Ficker
Deng Jiaxian	Southwest Associated University& physics(1945)	America	Physics at Purdue university (1950)	Doctor	Ye Qisun, Rao Yutai, Del Hal
Wang Ganchang	Tsinghua university&physics(1929)	Germany	Experimental physics at Berlin university (1934)	Doctor	Ye Qisun, Wu Youxu、Maithri
Peng Huanwu	Tsinghua university&physics(1935)	Britain	Physics at Edinburgh university (1945)	Doctor	Ye Qisun, Zhou Peiyuan, Max Born
Cheng Kaijia	Zhejiang University&physics(1941)	Britain	Physics at Edinburgh university (1948)	Doctor	Wang Ganchang, Shu Xingbei, Max ·Born
Huang Weilu	National Central University&Electrical engineering(1940)	Britain	Imperial College London ,radiophysics (1947)	Master	Chen Zhang, 佛泰斯库
Tu Shou'e	Tsinghua university&aerospace(1940)	America	Massachusetts Institute of Technology,aeronautics(1943)	Master	Wu Youxun, Zhuang Qianding, Wang Shizhuo
Qian Xuesen	Shanghai jiaotong university&mechanical engineering(1934)	America	Master of Massachusetts Institute of Technology(1935),California Institute of Technology,aeronautics,Mathematics, Dr. (1938)	Doctor	Zhong Zhaolin,Wang Shizhuo, Ye Qisun, Von ·karman
Zhou Guangzhao	Tsinghua university&physics(1951),Theoretical physics postgraduate of Beijing university(1954)	Soviet Union	Dubna in Moscow, the Soviet union joint nuclear research(1957)	Master	Ye Qisun, Wang Zhuxi, Peng Huanwu
Yang Jiaxi	Shanghai jiaotong university&Electrical engineering department(1941)	America	Harvard University,Physics (1949)	Doctor	Ma Jiuyun, Zhong Zhaolin 耐科贝勒

Full name	Graduate College& Department (Time of Graduation)	study abroad	Graduation colleges of Study abroad &Department(Time of Graduation)	Highest degree	tutor
Chen Nengkuan	Tangshan Jiaotong University&Department of mining and metallurgy(1946)	America	Yale university,physico-metallurgy(1950)	Doctor	Mao Yisheng、Wang Junhao、麦休逊
Chen Fangyun	Tsinghua university&physics(1938)	America	Researchers The British Cossor wireless power plant research institute (1949)	Bachelor	Ren Zhigong 、 Ye Qisun、Wu Youxun
Wu Ziliang	Peiyang University & aerospace engineering(1937)	America	The Carnegie institute of Pittsburgh Carnegie institute of metallurgy of neo-confucianism(1948)	Doctor	Physical metallurgyC.SBarrett 、Physics R.Si MoLuoKe paderewski
Ren Xinmin	Studied in The central university&Chemical Engineering(1937),Bachelor Degreeof Chongqing weapon and industrial school	America	The university of Michigan mechanical engineering master's degree 、 Dr. Of Engineering mechanics, (1949)	Doctor	
Sun Jiadong	1958,Was admitted to Harbin industrial university prep	Soviet Union	1951,to study at zhukov, the air force academy		卡拉普托夫 卡耳贝尔
Zhu Guangya	Southwest Associated University& physics (1945)	America	The university of Michigan(1950)	Doctor	Wei Rongjue 、 Zhao Guangzeng 、 Zhou Peiyuan 、 Zhao Zhongyao 、 Ye Qisun、Wu Dayou
Wang Xiji	Southwest Associated University& mechanical engineering(1942)	America	Viginia Technology Institute,power and fuel(1950)	Master	Liu Xianzhou、Zhang Dayi
Wang Daheng	Tsinghua university&physics(1936)	Britain	Imperial College London ,physics(1942)Dr. at the university of Sheffield	Doctor	Ye Qisun 、 Wu Youxun 、 Zhao Zhongyao、Turner
Yu Min	Peking university&physics(1949)postgraduate(1951)			Master	Hu Ning
Guo Yonghuai	Peking university&physics(1935)	America	The university of Toronto, Canada , Application of mathematics(1941),The California institute of technology , aeronautics(1945)	Doctor	Gu Jingwei 、 Rao Yutai、Von ·Carman

C. High Academic Level of Tutor

It has shown that they are instructed by famous scholars in domestic and abroad (see chart 2), in china such as Ye Qisun, Wu Youxun, Zhao Zhongyao, RaoYuTai, Chou Peiyuan, Ren Zhigong, Wu Dayou , Wang Zhuxi, Zhu Kezhen etc. When they study in Europe and the United States their mentors were the authority of the academic field at that time, such as Qian Sanjiang' mentor Irina· Curie who is Marie Curie's daughter, the winner of the Nobel Prize in chemistry; Peng Huanwu and Cheng Kaijia's teacher Max· Bonn is one of the founder of quantum mechanics, the winner of the Nobel Prize in physics; Qian Xuesen, Guo Gonghuai's mentor is the world's aerodynamics authority Von· Carmen and so on. Great mentors made great scientists, teacher guidance is one of the important factor of success.

D. High Related to Consanguinity of Scholarships

From consanguinity of scholarships, feat scientists shaped a community of teachers and students to research and a chain of talent development. Some of them were taught from the same teacher, and some teachers and students had developed "rocket"together. (see "Table II"). The 23 scientist in the early growth are closely related with them who is Ye Qisun——"The founder of modern physics in China" and Wu Dayou , Wu Youxun, Cao Youxun were called "The founder of two bombs-one satellite". Ye Qisun, a physicist, educators, and director of department of physics in Tsinghua University, is authority not only in knowledge, but in tutor and organization [5]. He won a number of students to follow because of the excellent personality, being a sense of school leaders. Ye Qisun and "two bombs-one satellite" has inherited the relationship between the weights of 13, nine of them are his students, two of his students. Wang Kanchang, for example, the class of 1929, 1933 annual research digest, Peng Huanwu of the class of 1935, the 1936th Qian Sanjiang, Wang Dahang, Chen Fangyun of the class of 1938, the 1940th Tu Shou'e, Deng Jiaxian, Zhu Guangya, class of 1945. Feats also has inherited the relationship between scientists, zhou Guangzhao, Cheng Kaijia from Wang Ganchang , research digest Qian Ji guidance, Yu Min from Hu Ning (class of 1938 students of Ye Qisun). Visibly, with a core of great scientists academic community experience form the scientist's talent chain, continuously developed new great scientists.

E. Highly Blend of Arts and Sciences

Humanistic spirit is often decided to science and technology workers can arrive at the height of the way to explore. Architect Liang Sicheng pointed that education

should be combines "institute" and "humanity", and cultivate persons with full personality; But only heavy "tech" or just "humanity", just "half a man" education. 23 scientists most hobby is widespread, liberal arts, there are both scientific and rational and humanistic feelings, there are both scientific creation and the humanities. Qian Xuesen has perfect knowledge structure, payed attention to the combination of science and art, the music, painting, photography, literature, have higher attainments; Yu Min has research results of Chinese history, classical Chinese literature and the opera ; Tai Chi is TuShoue's hobby, listening the classical music; Chen Nengkuan like poetry and is famous for good at crosswords poetry in academic circles; Hwan-wu peng have been widely read book of traditional culture; Zhu Guangya attended school choir and served as the conductor in his teenager time ; Wang Xiji attended drama club and played in the street in middle school , and so on.

V. BUILD AN EXCELLENT RESEARCH ENVIRONMENT

The research group is, faith community, the academic community and with the national people's fate community, the community of interests, in the process of the development of "rocket" formed the Chinese characteristic "the system", build the appropriate collaborative science to create the healthy atmosphere, to practice and for great ideas.

First, implement participating high synergy innovation, conform to the requirements of the era of big science research need cooperation. By politicians, scientists, and collaborative participation of the people throughout the country, to realize the coordination of political leadership and scientific experts, research group internal research collaborative leadership and general researchers, coordination of different areas, different industries. Scientists, and other personnel should play an important role of science and technology, respecting the opinions of front-line science and technology personnel, especially in major s&t decision-making. After determine the research and development tasks, departments and leadership for the execution but more intervention, implements the relative autonomy of science and technology, formed a "there is a problem to discuss together, have difficulty overcome together, share 'allowance' use, there are risks to share" the experience of [6], for the growth of the talent of science and technology to create a good environment and conditions.

Second, experience a large number of tough practice, conform to the theory of genuine knowledge comes from practice. It has shown that the prominent scientists make a significant contribution to the best age area between 25 to 45 years old, this stage is the best of the creativity of science and technology workers "golden age", often have rich practical experience, and has a wide range of scientific knowledge; both of have a large number of materials, and the spirit of innovation. The best way to cultivate talents of science and technology is to provide the opportunity of scientific research practice, the major task and important positions continuously hone [7]. Most of them as young adults is the head of the important areas and post work was only 37 years old, for example, Wang Dahang when ordered to set up scientific instruments museum and curator of China; Zhu Guangya is thirty-five years old, he was appointed as nuclear science and technology leader; Ren Xinmin is thirty-nine years old, he was appointed military engineering institute of artillery engineering professor and deputy director of the rocket weapon director; Deng Jiaxian presided over the age of thirty-five to the atomic bomb development tasks, etc.

Third, the pursuit of patriotic and a high level of devotion, conform to consciousness have active reaction principle. The 23 scientists dedication, for fame and wealth to the country willing to lonely, to dare to researches on patriotism and scientific spirit, is the inner power of their scientific success. As Einstein said, "most people think is wit accomplished scientists, they are wrong, is the character". First of all, they have strong patriotic feelings. The needs of the motherland is their struggle and to create the source of power. To many scientists is anonymity, silent dedication and sacrificed his own life. They also came up with many creative, forward-looking suggestion has significant value, leading the development of science and technology in our country, especially in the rapid development of the national defense science and technology. Second, they have disinterestedness scientific spirit. They simply behave, work hard, and study the physical happily. They don't care undeserved reputation in this lifetime, with the time and energy focused on the development of the "rocket". Third, they have confidence for creating the miracle of scientific research. By using limited even original scientific research and experimental means, they break through all the technical challenges, to create a "two bombs and one satellite" miracle of science and technology, to enhance the confidence of the Chinese people, encouraging the national spirit.

VI. CONCLUSION

To sum up, the growth of scientific and technological personnel success lies in not only its own efforts and struggle, but also necessary and appropriate "four kinds of excellent environment". Countries, such as family, personal three levels all needs to create and use "four kinds of excellent environment", adopt corresponding countermeasures to make outstanding scientific and technological personnel.

From the national level, the need to create a good academic ecological environment, optimize the talents of science and technology policy. First, cultivate social (regional) innovation culture. Scientific and technological personnel growth cannot leave the innovation friendly culture atmosphere, to promote the academic democracy, and break the seniority, inhibit innovation, creating a relaxed academic ecological environment; to improve students studying abroad returned, and introduced a number of world-class scientists. Second is to use the phenomenon of the best age for scientific creation. Scientific research management shall add tasks to youth science and technology talents with scientific research potential create conditions for young researchers, provide the opportunity to make them grow up as soon as possible. Third, politicians and scientists should have full communication and benign interaction. It is necessary to pay attention to science and technology management, listening attentively to the views of the

scientists in the major s&t decision-making and the suggestion, playing the role of the strategy of scientists. According to the national strategic demand and development trend of science and technology, forward-looking and strategic development planning is put forward. Fourth is to strengthen the education of patriotism and scientific spirit. Only the pursuit of them together with the fate of the motherland, fully realize personal value; persistence and practice the scientific spirit can go further on scientific research. From the point of scientific and technological personnel themselves, they have to overcome the spontaneous state of blindly seek on their growth path, follow the rules of talent growth developing career planning.

First is to consciously accept the teacher advising. Science and technology personnel should also try to study in famous universities, conscientiously follow the excellent teachers, in addition to its own unremitting efforts. It is an important way to accelerate their growth. Second is the determination to join the research team. Members of the team are complementing each other's advantages. Around the direction and goal of scientific research team, the implementation of members knowledge structure, way of thinking and personality characteristics of complementary advantages, form mutually promote cooperation and competition environment, help produce talent cluster effect. Third, perfect the knowledge structure of consciously. Scientists need to scientific rationality, also human life and the upper thinking of scientific research, profound humanistic feelings and reasonable knowledge structure. Practice proves that research personnel who integrated the ancient and modern elements, Chinese and western, liberal arts scientific tend to grow into outstanding scientists. Fourth is to engage in scientific research practice consciously. The outstanding scientific and technological personnel, not only need a solid theoretical foundation, but also need to attend a rich of scientific research practice. In solving the key technology research it can cultivate talents. Fifth, sets up the scientific confidence consciously. Researchers need to advance and enrich the "rocket" spirit, overcome the follow-up study, the imitation innovation thinking habit and ability, to counsel the fear, have the courage to open up a new research field and original achievements.

From the point of family environment we should attach importance to family education and the knowledge transfer. Scientific development needs accumulation and inheritance, often requires decades of the joint efforts of individuals and the society as a whole. It has a close relationship between knowledge accumulation and generations intelligence relay—good family conditions and parents in the children's academic attention have provided the basic safeguard to talent growth, parents' occupation and level of education constitute the basic factors of family mental environment, helps to form the cultural genes. Fine tradition of family learning, parents unconsciously behavior, all precept children growth deeply and advocates learning family atmosphere can stimulate talent potential.

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