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THE ADVANCEMENT OF SCIENCE IN CHINA DURING THE PAST THIRTY YEARS

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I

EVER since the establishment of the Republic of China on October 10, 1911, the development of science in this country has entered a new era of activities in its own history. Unlike the early Ming and the late Ch'ing dynasties,[1] when science was superficially introduced into China, this time we have fostered modern-science from quite a different point of view and on a solid foundation. Characteristic features are easily to be noted. Firstly, scientific researches along various branches of science were duly initiated. Original work undertaken at institutes, laboratories and universities made valuable contributions to modern science either of universal nature or of local character. Secondly, since the beginning of this new period, the work of developing science has been entirely entrusted to the Chinese themselves, although a few foreign institutions inherited from the last century were still to be seen in the country, but were not very active. Thirdly, a large number of Chinese scientists, both trained abroad and at home, have served the country in various capacities—in government departments and private institutions. Fourthly, scientific education has received ever so much attention and considerable progress has been observed. Scientific courses were not only taught in schools, colleges and universities, but also gained an important position in their respective curricula. Fifthly, the application of science in various walks of life shows another phase of scientific activities from daily life to national de-

[1] Chungshee H. Liu, *The China Journal*, 34: 3, 120–125; 5, 210–219, 1941.

fense. With the rapid development of science in China, we have every reason to believe that the Chinese people have by now learned how to appreciate the nature of scientific truth and to acquire the technical method. Gradually they become scientifically minded. As a social institution and an academic learning, science has, indeed, steadily taken root in China with bright outlook and hopeful prospects.

Chronologically speaking, the foremost scientific research institution of its kind is undoubtedly the National Geological Survey of China, which was founded in 1916 by the Ministry of Agriculture and Mines at Peiping, then known as Peking. Under its two former distinguished directors, the late Dr. V. K. Ting and Dr. Wen-hao Wong, now China's war-time Minister of Economic Affairs, it has developed into an institution of national importance which attracted world-wide notice in 1929 with the discovery of the "Peking Man," or *Sinanthropus pekinensis*. From the very beginning, the Survey devoted itself to the economic field and undertook nation-wide plans for reconnoitering mineral deposits and carried out geological mapping, including paleontological researches. As a result of the work of a number of young Chinese geologists, many new discoveries were made and proved to be of value to science, not to mention their economic importance. This is best evidenced by the Survey's several serial publications, such as the *Palaeontologia Sinica, Geological Bulletin, Geological Memoirs, Soil Bulletin,* etc. The Survey has also taken up allied responsibility not usually entrusted to geologists. These include seismology, soil survey, fuel research and prehistoric studies; for the last subject the Laboratory for Cenozoic Research was established in 1927 for the purpose. Indeed, during the past twenty-five years this earliest scientific institution of China has made notable contributions to our knowledge of this part of the earth and has established a well-earned reputation in the scientific world.

II

After geology, biological sciences came into the limelight. About twenty years ago, Dr. C. Ping and Dr. H. H. Hu, professors of zoology and botany, respectively, in the Teachers College at Nanking, began to study the fauna and flora of China. Apart from fulfilling their academic duties, they led or planned expeditions from time to time to different regions of the country—from Mongolia and Manchuria in the north to Hainan Island in the south, from the China Seas in the east to the Tibetan Plateau in the west—to collect animal and plant specimens of which many new genera and species, even new families, have been discovered, hitherto unknown to science. By so doing they improved the teaching facilities and paved the way for research on the one hand and trained a large number of young biologists on the other.

In 1922 the Biological Laboratory of the Science Society of China was inaugurated, although the society itself was founded in 1914, the forerunner of its kind in this country. After a hard struggle for several years, the laboratory soon gained recognition of the learned circles of the country, and since 1925 the China Foundation for the Promotion of Education and Culture has made grants to the society for maintaining the activities of the laboratory. Now it has become one of the most important institutions for biological researches in China and is well known to the biological world through its hundreds of exchange publications—*Contributions, Icones* and *Monographs* —with foreign countries the world over. After twenty years of pioneer work, Dr. Ping, the founder of Chinese scientific zoology, still remains as its director and, at the same time, a godfather to many other affiliated institutions.

In 1928, thanks to the moving spirit of Dr. Ping, the China Foundation again helped to establish the Fan Memorial Institute of Biology in Peiping, and he became its first director. Under the experienced guidance for a number of years of Dr. H. H. Hu, the founder of Chinese scientific botany and now president of the National Chiang Kai-shek University, the institute has become one of the best, if not the best, of the scientific organizations of China. It possesses a well-equipped modern building with fine laboratories, a herbarium and a museum of its own. It issues bulletins in two series—zoological and botanical—which have a wide circulation all over the world. It was by this institute that the *Zoölogia Sinica* was published.

Since then, under the joint leadership of Dr. Ping and Dr. Hu, the biological sciences have been enhanced; considerable progress has been made and an enormous amount of work has been done on taxonomy, morphology, physiology, genetics and bio-chemistry, as well as in the economic field. In this connection mention must be made of the Botanical Institute of the National Sun Yat-sen University at Canton, which is devoted entirely to systematic botany with a well-arranged herbarium and good library under the direction of the eminent botanist, Professor Woon Yung Chun, whose knowledge of the botany of South China, especially Hainan Island, is second to none in China, if not in the world. *Sunyatsenia,* the official organ of the institute, enumerates all the achievements and results of the valuable research work sponsored by the institute. As time went on, there were a number of other biological institutions, such as the Entomological Bureau of Kiangsu, Chekiang, Kiangsi and Kwangtung, the Lushan Arboretum, the Tsingtao Aquarium, the Marine Biological Stations at Amoy and Tsingtao, Oceanographical Survey at Tinghai, Chekiang, etc.

III

But the most important landmark in Chinese scientific research was undoubtedly the establishment of the Academia Sinica, or National Academy of Sciences, soon after the formation of the National Government at Nanking in 1927. According to its charter the Academia Sinica is the highest institution for scientific research in China, designed as a sort of Académie des Sciences, U. S. National Research Council, Department of Scientific and Industrial Research of Great Britain and Kaiser-Wilhelm Gesellschaft combined. Unlike all the other institutions, it is independent of political control, for it does not rank under any ministry or board, but is directly responsible to the national government, which means the President of the Republic. It also functions as the highest national organization for conferring honors upon distinguished scientists and scientific institutions both at home and abroad. For the purpose of directing and coordinating scientific activities in China, there is a council consisting of thirty members, selected from among the scientific workers of the country and a number of *ex-officio* members who have the right to elect candidates for the presidency of the Academia Sinica.

As constituted at present, the Academia Sinica controls ten research institutes, including those of astronomy, meteorology, physics, chemistry, zoology and botany, geology, psychology, engineering, history and philology (including archeology and anthropology), and social sciences. Thus the scope of research is extremely wide; for, on the one hand, it includes such routine service as meteorology, which is usually undertaken by a government bureau; on the other, it embraces history and philology, which are usually considered as belonging to the "humanities," not to say social sciences.

It would be idle to go into details to enumerate the research works carried out by these ten national research institutes. However, a few words on each institute may not be superfluous. In addition to compiling the almanac, supplying time service and determining longitudes and latitudes, the Institute of Astronomy (Professor Y. C. Chang, director), carries out regular photometric and spectrophotometric studies of the sun, the planets and the stars. It also makes observations of variable stars and studies solar activities with the Hale spectrohelioscope. The Institute of Meteorology (Dr. Coching Chu, the pioneer of modern Chinese meteorological research work, director) possesses up-to-date equipment and maintains a seismological station. It has a radiotransmitting station of its own and broadcasts its forecasts daily. The institute keeps in close touch with provincial meteorological stations all over China and those in the Far East. It maintains several branch stations of its own, including one at Chinghai (Kokonor) and another at Lhasa, the capital of Tibet. For upper-air investigations, flights were usually made in cooperation with the National Bureau of Aviation.

The Institute of Physics (Professor H. L. Ting, director) concentrates on researches in wireless, x-rays and geophysical surveying. It maintains a well-equipped workshop for manufacturing scientific instruments, including microscopes, electrical and surveying apparatuses for the use of various schools and scientific institutions. The work carried out by the Institute of Chemistry (Dr. H. C. Woo, acting director) paid more attention to local problems than pure research. Thus, work has been done on Chinese drugs, paper and glass-making, metallurgy of certain rare minerals. The efforts being made by the Institute of Engineering (Jen Chow, director) are on ferrous metallurgy and ceramics with the purpose of better utilization of China's resources in industrialization. Cooperating with the Physics Institute, it maintains standards testing laboratories and thus it fulfils partly the function of a bureau of standards.

The Institute of Geology (Dr. J. S. Lee, an internationally known geologist, director) has four sections: stratigraphy and paleontology, petrography and mineralogy, economic geology, dynamic geology and geophysics. Thus, its work is more on the theoretical side than practical. In cooperation with the National Geological Survey it has also done considerable mapping, especially in the Lower Yangtse Valley. Its publications have also gained international recognition. The Institute of Zoology and Botany (Dr. C. C. Wang, a distinguished young zoologist, director) was originally the Metropolitan Museum of Natural History. It devoted itself exclusively to faunal and floral studies, especially of South and Southwest China. At present, the institute concentrates on taxonomy, economic entomology and plant pathology besides paying special attention to fishery. It took an extensive oceanographic survey in the East China Sea and the Gulf of Chihli. The Institute of Psychology (Mr. G. H. Wong, director) is the smallest and at present its work is largely confined to neural physiology and anatomy.

For "humanities" and social sciences, the Institute of History and Philology (Ssu-nien Fu, director) is quite misnamed, for it is better known by its archeological and anthropological works. For a number of years, it carried out excavation work in Northern China, especially in the Shang capital at Anyang, where discoveries of inscribed bones and shells, bronze, pottery, stone implements and stone carvings belonging to different periods of culture were made. By means of these discoveries, ancient Chinese history, hitherto disputed, is being checked and verified.

Again, the Anthropological Section, under the capable direction of the famous anthropologist and statistician, Dr. T. L. Woo, maintains an excellent anthropometric laboratory and considerable work on measurements, both on the living and on skeletons, has been done. The recently founded *Anthropologia Sinica* is its official organ of publication. Moreover, the Philological and Historical Sections of the same institute have also issued some publications. Like the "humanities" institute, the Institute of Social Sciences (Dr. L. K. Tao, director) had four sections: those of law, economics, sociology and ethnology. However, in 1934, it was amalgamated with the Institute of Social Survey of the China Foundation. Thus reorganized, the new institute devotes itself entirely to economic studies with regard to which some publications have already appeared.

IV

So much for the Academia Sinica. In 1929, another group of research institutes under the Academia Peipinica was organized by the Ministry of Education. This was intended to serve the same purpose as the Academia Sinica, but with a much smaller budget and in different geographical centers. So far, it has maintained six institutes, namely, those of physics, chemistry, zoology, botany, physiology and pharmacology, all of which were located in Peiping except that the Physics Institute (Dr. Ny Tsi-zé, director) has a branch known as the Radium Institute in Shanghai. Like other institutes, they also issue their scientific bulletins.

Other research institutions which deserve mention are the National Agricultural Research Bureau and the National Industrial Research Bureau, both of which are patronized by the Ministry of Economic Affairs. Medical researches are undertaken by the Central Field Health Station, which has done good work on cholera vibrio, the larvacide value of various chemicals, enrichment of soybean milk, the toxicity of habit-forming drugs and the like. It will become the focus of all medical research in connection with public health in China.

Furthermore, some of the scientific institutions under foreign control are worthwhile mentioning in this connection. For instance, the Peiping Medical Union College, supported by the Rockefeller Foundation, has had a considerable influence on Chinese medical research and education, while the Obsérvatoire de Zikawei, Musée Heude, Institute Pasteur de Changhai, the Henry Lester Institute for Medical Research and the Shanghai Science Institute, all located in Shanghai, have done their part in contributing to science.

It is needless to say that research work is also being done in various universities where graduate schools have been steadily organized. In quantity it is naturally less than that of the special research institutions, but its importance is increasing. This shows that a modern Chinese university is organized on just the same plan as those to be found in Western countries and its standing has been raised to a high level. In other words, Chinese scientific education to-day has made considerable progress in comparison with thirty years ago.

Another phase of activities showing the progress of science in China was the flourishing of scientific societies. As mentioned before, the first scientific body ever organized in this country was the Science Society of China, founded in 1914, which is devoted to "the diffusion of scientific spirit and knowledge among the Chinese people, the active participation in scientific research, and the encouragement in their practical application so as to lay a firm foundation for scientific growth and industrial prosperity of the nation as well as contributing to the welfare and progress of the world." For a little more than a quarter of a century, the society has, through its official organ, the *K'o Hsüeh* (*Science*), a semi-technical monthly, made considerable contributions to the promotion of scientific knowledge and cultivation of scientific environment among the people. Before long, the society gained a nation-wide reputation and its members, numbering thousands, are distributed not only throughout the country, but also all over the world.

Other scientific bodies of a general character, such as the Chinese Society of Science and Arts, the Natural Science Society of China and the China Scientification Movement Association, have likewise done some service to the country. Respectively, they have issued *Wissen und Wissenschaft, Scientific World* and *Scientific China* as their official organs.

In addition to the general science organizations, special scientific societies have been formed one after another. As they are too many to enumerate here, we may only mention those whose activities are better known. For pure science, there are the societies of geology, physiology, astronomy, meteorology, physics, chemistry, botany, zoology, geography, mathematics, ethnology, marine biology, etc. All of them have issued their own journals, proceedings or transactions of a high order in Chinese or in European languages. As far as applied science is concerned, there have been no less than 28 societies or associations established belonging to engineering, agricultural and medical sciences. Most of them have their own publications. It is significant that all the above-mentioned societies are purely Chinese in character, although there may be a few foreign members among their members. In order to coordinate scientific activities among various branches of sciences, annual conferences or joint

meetings have taken place year by year and from city to city throughout the country.

V

With regard to the application of science either to the development of industry and agriculture or the welfare of the people, it is obvious that during the past thirty-odd years China has made marvelous advancement in various aspects by the benefit of science. As individual cases are too many to enumerate, we may say in general terms that many modern industrial enterprises have been undertaken on a scientific basis or under scientific management. While heavy industries are still awaiting development in this country, light industries, such as cotton mills, pharmaceutical works, etc., have already made considerable advancement in large cities and seaports like Shanghai, Hankow, Chungking, Canton, Tsingtao and Tientsin. Meanwhile, most of the mining industry has been operated according to scientific methods and management. Scientific agriculture has also been introduced in many fields, such as the improvement of breeding of various crops like cotton, rice and wheat. Reforestation, horticulture and sericulture have also recorded an appreciable improvement.

In the field of engineering sciences, most of the Chinese railways were constructed within the past thirty years, while highways have been rapidly extended during recent years. Scientific hydraulic engineering has replaced the old methods in water conservation works and canaling. Electricity has been employed in various places for different purposes, not only in the telephone and telegram services, but also in a number of ways in the daily life of the people, such as for electric lights, the cinema and the radio. Moreover, machines have been used in numerous ways. In a word, the whole Chinese nation has gradually been transformed from the handicraft stage to a modern machinery age, in so far as the daily life is concerned.

It should be noted, however, that what we have stated in the above paragraphs was merely the advancement of science in China from the beginning of the Republic up to the time when the so-called "China Incident" occurred. During the past four eventful years scientific activities have been speeded up along various fields in the interior provinces. Great efforts are being exerted in biological expeditions, geological surveys, mineral reconnoitering, engineering reconstructions, agricultural improvements, ammunition manufacturing and what not, not to mention laboratory research, with one noble purpose, namely, to meet the wartime need of the nation. The details of these works need not concern us here.

In conclusion, it is no exaggeration to say that during the past thirty years of the Republic, science alone has seen tremendous progress in many sides. Comparing the shortness of time with what has been accomplished, we have at least this feeling of satisfaction that science has become deeply rooted in Chinese soil and our scientists have proved competent for their task in making valuable contributions to modern science and have done good service to the country which was and is urgently needed. The people as a whole have heartily recognized the advantage of the application of science. Therefore, from a historical and scientific point of view, the past thirty years have been a most important and memorable period in Chinese history. With the help of science, we are confident that we shall be able to rejuvenate our nation and reconstruct our country.

OBITUARY

DR. LEONHARD STEJNEGER

October 30, 1851–February 28, 1943

THE stimulating endeavors of Spencer F. Baird, the second secretary of the Smithsonian Institution, attracted not only the naturalists and embryo-naturalists of our own country to this institution of learning, but similarly gifted individuals from abroad came to seek their fortunes at this seat of scientific endeavors. It was Baird's splendid leadership and discernment of men of ability and lack of self-seeking that eventually surrounded him with a staff of scientific men probably unequalled anywhere at any time before. However, this is not intended to be a eulogy of Baird, but a simple appraisal of a great naturalist attracted to our shores by the rapidly spreading fame of the Smithsonian Institution.

Dr. Stejneger was born in Bergen, Norway, on October 30, 1851, the son of Peter Stamer and Ingeborg Catharina (Hess) Stejneger.

From early youth, Stejneger was bitten by the naturalist bug. I have seen a set of his childhood drawings in color of birds of his region which would do credit to an artist of maturer years.

His mother's delicate health requiring a milder winter climate than that afforded by their northland home caused the family to winter in Meran (South Tirol), where we find Stejneger extending his ornithological observations as evidenced by his first published contribution, "Ornithologische Notizen ans Meran, Süd Tirol, wahrend der Winter 1869, 1870, und 70–71."[1] This contribution was followed by a number

[1] *Jour. Ornith.*, pp. 122–124, 1871.