

THE BEGINNINGS OF CHEMICAL RESEARCH IN CHINA

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The writer arrived in the Far East in 1915, enthusiastic; the outlook in China for research and the training of research workers was a bright one. Enroute to China, I had paid visits to a number of laboratories in Japan where chemists seemed alive to problems of research interest. By contrast, in China laboratory work in chemistry was only beginning. In one of the first universities visited in China we were shown considerable chemistry equipment, on display in show cases; there were also laboratory rooms, but these too were under lock and key. The teaching staff were not in evidence except at scheduled class periods. The laboratories moreover were generally unheated and, in winter, cold and uninviting; there was little interest in extra-curriculum laboratory study and our inquiries about research were met by a shrug of the shoulders.

In many of the colleges, chemistry was being taught by Chinese teachers who had received a smattering of chemistry in Japan. In one normal college which I visited, a Japanese professor lectured on general chemistry through a Chinese interpreter; there was no laboratory work accompanying the lectures; demonstrations were reduced to elaborate drawings on the blackboard. While some of the better trained teachers gave themselves conscientiously to the preparation of much-needed textbooks and laboratory manuals, the writing of textbooks represented often the path of least resistance; during the early years of the republic there was a deluge of ill-digested and second rate textbook material in the sciences generally.

A few months after my arrival, we were able at Cheeloo University to equip a small room for our first studies on Chinese food materials. Bean curd (tofu) was among the items analyzed. The Kjeldahl equipment was simple; some of it had a home-made appearance. Alcohol lamps, burning kaoliang spirit, supplemented by kerosene blast burners, took the place of Bunsen burners. A few selected students looked on: Was this research? No, it was only a beginning, but it was in this way, with simple problems and simple equipment, that beginnings were made.

There stands out in my memory one bright spot in this first year of laboratory visits. This was a glimpse into the work of Dr. E. V. Jones at Soochow University, who, himself an inspiring teacher of unusual ability, was steering his advanced students into short original laboratory projects, inculcating the spirit of original investigation.

It was he who posed the query: where should research papers be published?

time ripe for a chemical journal in China?

Shortly after came a visit to Southeastern University at Nanking, where Professors Wang Chin, Chang Tzu-kao and Sun Hung-fen had begun laboratory instruction in chemistry. Their thoroughness and perseverance is measured by the large number of Chinese chemists now in responsible posts who received their training in this laboratory.

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For the year 1917, *Chemical Abstracts* printed two abstracts of chemical work in China. For the year 1937, the date of the out-break of Sino-Japanese hostilities, the number of abstracts from China was approximately 200. The writer has been connected with the *Chemical Abstracts* services since 1917 and takes delight in recording the early history of chemical research in China as he has seen it pass in review during the score or more of years that have elapsed since that date. Tseng (1) has reviewed the progress of chemistry in China up to the year 1935, enumerating research organizations and chemistry publications. The years immediately following 1937 were accompanied by some confusion, with partial interruption of research activities.

The development of chemical research in China may be divided into three periods: first, an introductory period when chemistry was finding its place in the teaching curriculum; second, a period of intensive training in laboratory methods with the building up of important teaching centers; third, the present period, during which chemistry research has expanded and flourished.

The first period, 1911-1920, coincided roughly with the first decade of the republic. Chemistry was given a prominent place in the curriculum in both secondary schools and colleges, but only a few student laboratories had been established where the emphasis was upon individual experimentation. There were very few skilled chemistry teachers and work in chemistry had become largely a matter of textbook instruction. There was moreover among institutional and government administrators no adequate understanding of the research method as applied to science generally. Many Chinese students, returning from specialized training in chemistry abroad, became discouraged and drifted into other lines of employment. The writer has recorded elsewhere (2) observations on the early developments in chemical education in China.

The second period, covering the decade from 1921 to 1930, was marked by the growth and development of chemistry laboratories at university centers in Canton, Shanghai, Soochow, Nanking, Tainan, Tientsin and Peking, and by the beginnings of chemical research. In the centers named, a group of eight or ten teachers of outstanding personality, some Chinese, some western, laid sound foundations. The Peking Union Medical College, founded at the beginning of this period, helped set the pace and define the tone and quality of genuine research. During these years, the government universities gradually rose to positions of influence and leadership. The Rockefeller

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education and made grants to private and government universities for research equipment, and to aid in the erection of laboratory buildings. Most of the earliest laboratory buildings, of which that erected by the University of Nanking in 1916 is typical, were designed to house all the sciences. The first university laboratory building built for chemistry only was that erected at Tsinghua University in 1932. The laboratory building of the Chemistry Research Institute of the Academia Sinica in Shanghai was completed in 1936.

One of the difficulties which the first research workers in China encountered was the lack of gas for laboratory use. It is only within the last twenty-five years that satisfactory facilities for laboratory gas have been installed in the larger universities. These installations in a few cases supply coal gas; others are small units arranged for the cracking of Diesel oil, kerosene, or other liquid fuel. Many of the laboratories throughout the country, - and this includes most middle schools, - are still handicapped by the lack of gas supply.

Chemical research in China seems to have progressed through the same stages of development which characterized the growth of chemical research in America and in Japan. It began with a chemical study of natural products. The first papers, therefore, were essentially analytical; they were concerned with analyses of vegetable oils, minerals, coal, food materials, alloys. Mabee (3) gives a resumé of some of the laboratory studies being carried on in the year 1925. He is careful to use the term "chemical investigation" rather than "chemical research" to describe the activities of this earlier period. It was only after this field of China's natural resources had been explored that investigators attempted the more complicated problems of fundamental chemical research.

It is difficult to determine which was actually the first published research in chemistry from a laboratory in China. Among the early investigations however should be mentioned the papers by Hu Szu-hung on zinc in Chinese brass, Tsao Yuan-yu on tung oil, Han Tsu-kang on salt, and Wang Chin on ancient Chinese coinage. All of these appeared in *Science* (科學) in Chinese, before the year 1921. Tseng (1) gives a more complete list of the early contributions to chemistry which appeared in this earlier period. Among other contributions which appeared in China about this time, but written in English, may be mentioned two papers: one on Chinese cement by C. H. Hsu, another on Chinese bronzes by T. Y. Chen, published in the *Far Eastern Review* for 1921, also a paper on the analysis of soybean products by Adolph and Kiang, which appeared in the *Chinese Medical Journal* in 1920. Among papers from China laboratories which appeared in print outside of China, may be mentioned one on metabolism in China, by Read and Wong, published in the *Philippine Journal of Science* in 1923.

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One of the questions which confronted the early workers in chemistry was that of a medium for publication. There were no journals in China devoted strictly to chemistry or to chemistry research. Some of the early contributions from Chinese laboratories were therefore published in Europe or America, and a few in Japanese journals; others appeared in medical journals either in China or abroad. A list prepared by the writer (4) in 1924, names the periodicals in China in which articles of chemical interest had been published:

- China Medical Journal
- Journal of the North China Branch of the Royal Asiatic Society
- Far Eastern Review
- Science*
- Transactions of the Science Society of China
- China Journal of Science and Arts
- Lingnan Agricultural Review
- Journal of the Chinese Society of Chemical Industry*

All the above were printed in English, except those marked (*) which were in Chinese.

Among the early chemical papers which appeared in these journals many consisted mainly of tables of analyses; others were connected with trade reports, or were in the nature of reviews. There was not in fact enough genuine scientific research in China, previous to the year 1930, except perhaps in the field of medicine, to have justified even one thin number of an occasional research journal.

There were moreover in the earlier days no annual meetings at which chemists could gather to present and discuss research papers. Several papers of interest to the biochemists were presented at a meeting of the Chinese Medical Association held in Peking in 1920. Again, in 1925, at a general conference in Nanking of teachers from the western-founded colleges and universities, a group of a dozen chemistry teachers met for the presentation of original laboratory contributions. As teachers they were primarily interested in incorporating the research point-of-view in every well-rounded teaching program. At the annual meetings of the Science Society, occasional papers of chemical interest had also been included in the program. The Chinese Physiological Society, founded in 1927, also attracted a group of chemists to their annual meetings. The meetings of the Chinese Chemical Society did not become a recognized annual function for the presentation of chemistry research papers till about 1931; since that date their meetings have been characterized by vigorous programs.

The third period in the history of chemical research began about 1931, shortly after the Kuomintang government came into power. This period was marked by the founding of the *Journal of the Chinese Chemical Society* in 1933 and the *Journal of Chemical Engineering, China*, in 1934, and also by the establishment in the universities

and elsewhere of institutes specifically for chemical research. Among the first of these institutes should be mentioned: the Chemistry Research Institute of the Academia Sinica at Shanghai established in 1928, the Shanghai Science Institute (1929), the Chemistry Research Institute of the Peiping Academy founded in 1930, the Huang Hai Chemical Research Laboratory at Tangku founded in 1922, and the two government laboratories, the Central Research Laboratory and the Fuel Research Laboratory (1930). Enthusiasm for the founding of research institutes of all kinds spread among the universities in the years immediately following 1928; only the most vigorous of these have survived. Most of these research institutes planned to publish their own research papers each in a separate series of Science Reports. The *Science Reports of the National Tsinghua University, Series A and B* is an example of this type of publication. Many papers which might otherwise have been published in the Journal of the Chinese Chemical Society appeared instead in one of these report series. The Chemistry Research Institute of the Academia Sinica discontinued its separate publication after the completion of volume 1.

The Ministry of Education had already prescribed that all candidates for the B.S. (學士) degree, the degree awarded at the close of the 4-year undergraduate course, should submit a thesis as part of the degree requirement. This was interpreted by the progressive universities to mean a laboratory thesis, involving as far as possible a piece of original work. This became a distinct stimulus to research work. University departments of chemistry were re-organized with this requirement in mind, and the younger members of the teaching staffs returning from abroad with higher degrees and special training were able to make a vital contribution to this type of laboratory teaching. Equipment was already available in many universities and the new personnel knew how to use it.

In China, as in western countries, chemical research in the universities is closely related to work for the higher or postgraduate degrees. As far as can be determined, the first M.S. degrees in chemistry in China were awarded at Soochow University in 1917. The two theses submitted for this degree in that year were the result of laboratory studies carried out under the direction of Professor E. V. Jones. The first fully organized graduate school (研究院) in China was established by Yenching University in 1926, with a research thesis required for the M.S. degree; some of the first degrees awarded under this plan were in chemistry. Other universities followed with similar arrangements for graduate work within the research institute plan. According to the government regulations, the M.S. degree (碩士) was to be awarded after a minimum of two years of work including the completion of a research thesis. It was now possible for the student of chemistry at institutions meeting the Ministry of Education's requirements to obtain a chemical training equal to that represented by the M.S. degree in chemistry in the better universities abroad.

The distribution of research interest in China between different fields of

150

WILLIAM H. ADOLPH

of the published papers were in the field of biochemistry, including foods and nutrition, 20 percent in industrial chemistry, 18 percent in organic chemistry and 27 percent in inorganic and physical chemistry. In general, interest was centered in the development of China's natural resources, and in problems related to medicine and nutritional welfare.

During the years following 1937 the attention of many Chinese research workers was turned to the war industries. Important investigations were carried out in the field of liquid fuels, explosives, ceramics and adsorbents for gas masks. Probably China's most outstanding war studies were those on motor fuels. Difficulties in securing petroleum products led to the successful employment in certain areas of a gasoline substitute obtained by the cracking of vegetable oils.

The stage is set for very substantial advances in chemical research. The public, the universities and the new government, alive to the importance of chemistry in industry, are ready to stress the research method of approach to technical problems. It is inevitable that an era of peace will furnish the appropriate opportunity.

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