SCIENCE IN WESTERN SZECHUAN

II. BIOLOGICAL AND SOCIAL SCIENCES

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IN the preceding article* something has been said of the state of physics and chemistry in the five universities at the great city of west Szechuan, Chengtu. On the whole, the biological work there is even more active. On the West China Union (Huahsi) University campus some excellent taxonomic and ecological work is being done. Thus Dr. Chang Ming-Chun of Huahsi specializes on gastropod systematics and embryology, while Dr. Liu Cheng-Chao of Yenching is a really outstanding authority on Asiatic Amphibia. His collections and data are astonishing, including torrent adaptations, strange breeding habits, etc., and many new species, such as *Vibrissaphora boringii*, a whiskered frog. There are great opportunities for experimental embryology here, which have so far not been taken advantage of. Dr. Liu himself goes on collecting expeditions in the Tibetan borderlands which involve real hardship and danger. For comparative physiology also there are great opportunities, for example, to work with the giant earthworms of the Mount Omei region, species of *Pheretima*, commonly up to 3 ft. long and at least 1 in. in diameter.

Parasitology has an eminent representative in Dr. Chang Kuei of Chilu, who has done remarkable work on a hookworm survey of the province, with the help of the Rockefeller Foundation. Infestation has a very close association with the maize and sweet potato pattern of cultivation rather than with the rice pattern. If pronounced, it leads to strange phenomena such as geophagia. Among the activities in the fine biological building on the Huahsi campus are also a service for the preparation of biological models in painted plaster for schools and universities, and of injected biological specimens. There is also an interesting project in domestic science under Dr. Peng Yuing-Hua, popularizing jam-making among the Chinese people in order to avoid the hitherto normal annual wastage of fruit. There is a strong school of plant pathology, economic insect pest survey, etc., under the direction of her husband, Dr. Ho Wen-Chun. They both studied in Iowa. Last, but not least, Dr. F. Dickinson's work on animal breeding, fruit-tree improvement, etc., has benefited the whole province and is known throughout China.

Plant pathology leads to reference to a sixth university not mentioned in the preceding article, namely, the provincial University of Szechuan, occupying its own new buildings on an unfinished campus some distance away from Huahsi University. Its strongest side is agricultural science, so that when the Szechuan Provincial Agricultural Experiment Station is also taken into account, the importance of Chengtu as an agricultural centre can be well seen. The plant pathologist at the Experiment Station is Dr. Ling Li, who has described mosaic disease in Cruciferae, and has published many papers in such journals as *Phytopathology*. He recently collaborated with the Imperial mycologist from New Delhi, Dr. Watts Padwick, who visited China as a technical expert at the invitation of the Chinese Government. The authority on insect pests at Szechuan University is Dr. Tseng Shen, who is very active against tobacco

diseases; he leads expeditions through the countryside, giving instruction to the peasants. The Agricultural Experiment Station actually operates an insecticide factory of considerable size, producing pyrethrum powder, copper carbonate and arsenate, etc., with very primitive but serviceable apparatus. In Dr. Liu Chwing-O, the University of Szechuan has an exceptionally eminent authority on wood-boring insects, especially the larvae of longicorn beetles; she is in touch with the British Museum (Natural History) through the British Scientific Mission. Her work on coleopteran parasites of coleopteran wood-borers is of much interest.

Other departments, too, are worth a visit. At Szechuan Agricultural Experiment Station there is good work going on in crop improvement under the active Dr. Li Hsien-Wen, an associate of the well-known geneticist Dr. Beadle. Dr. Li produces new disease-resistant wheats for the Chengtu plain, but is also interested in cytoplasmic inheritance of variegation in Triticum, and the production of new species of Setaria by crossing. Dr. Li points out that a certain kind of barley, selected at the University of Nanking in 1937, was taken to the United States by Dr. Love, and proved to be so good that 'Wang barley' has by now far more than paid for all the expenses incurred by the United States in sending technical experts to China. Then at the University of Szechuan the botanical department is outstanding. Under Prof. Fang Wen-Pei, very extensive collections of west Chinese and central Asiatic plants have been made; and duplicates are available for exchange with Western collections. Prof. Fang has recently produced a most beautifully illustrated work 'Icones Plantarum Omeiensis', which includes descriptions and pictures of new genera as well as many new species. Copies have been sent to Kew and other centres.

In sericulture (Prof. Wang Tao-Yung) the University of Szechuan is strong too; work is under way on comparative silk-gland histology, bacterial diseases of silkworms, survey of mulberry varieties, and physiology of the wild race. Thirty-eight pure lines and many hybrids are maintained in this laboratory. Here again, after the War, there would be great opportunities for a physico-chemical attack on the nature of the spinning process, that is, how the liquid gland contents become the spun fibre. The stranger is surprised to be told that from each cocoon 500 m. of silk fibre can be drawn. Since the old form of the Chinese character for Szechuan contains the radical for insect, Szechuanese sericulturists believe that sericulture originated in their province.

In horticulture also the Szechuanese have an ancient tradition, for this province is thought to have been the original home of the orange. The department at the University of Szechuan points with pride to the treatise of the Yuen dynasty (about A.D. 1200) by Han Yuen-Chih called the 'Orange Record'. Chinese horticulturists are looking to Britain's Food Investigation Board to give them advice about the erection of refrigeration plants in the province after the War; let us hope that Britain will not be too behindhand in responding to the need for technical experts in China. One worker here comes, indeed, from East Malling, Dr. Chang Wen-Tsai. In the Forestry Department, there is little available knowledge about tung oil trees, for example, not possessed by Dr. Li Ying-Chen. Lastly, in agronomy, Dr. Yang Yin-Kuei is working on colchicine polyploidy, and trying to get the farmers to plant maize

* See NATURE, September 25, p. 343.

as an emergency crop, if the rice fails in July, so that they may have it in September.

In medicine and dentistry, Chengtu is as important as it is in agriculture. The medical school of the Huahsi University hospital under Dr. Leslie Kilborn was famous throughout China long before the War, and though it has lost in access to new equipment since, it has gained by the influx of personnel from the evacuated medical schools. Thus in the Department of Pathology there is the eminent Dr. Hou Bao-Chang of Chilun, now interested mainly in medical geography, and ably assisted by Dr. Chiang Ching-Fen, the daughter of Peter Chiang, the first Chinese to study biochemistry at Cambridge. The difficulties of work in China may be illustrated by the fact that all the records of this group were lost by bombing, started again and lost again by fire; work on leprosy had to be stopped for lack of funds, an experimental monkey colony was started, but had to be abandoned owing to financial straits, and all the time they had to make even their own typewriter ink, which faded on the records, and their own Canada balsam from local resins, which often spoiled the specimens. Perseverance is an inadequate word unless we add some adjective such as heroic.

So also in the Physiology and Pharmacology Departments; Dr. Feng Ta-Rjan of Huahsi investigates Chinese drugs such as the anti-dysmenorrhea *tang-kuei* and the uterine stimulant *i-mu-tsao*, while Dr. Chu Rjen-Bao, an incomer from Nanking (and former collaborator of Dr. A. S. Parkes), works on the sex hormones in relation to the pituitary and spermatogenesis. The Dental College, under Dr. Lindsay and Dr. Agnew, was always pre-eminent throughout China, and with such colleagues as the odontal morphologist Dr. Chou Shao-Wo, bears the greatest part of producing first-class modern Chinese dentists. This work is so necessary for the people of China that it ought to be expanded enormously, and deserves the fullest official financial support.

The Huahsi Medical School is not, however, the only one in Chengtu. There is also the Chungyang Medical School, belonging to the National Central University at Sandy Hook, already described in the third of this series of articles. Here also the standard is very high, particularly in the Departments of Physiology (under Dr. Tsai Chiao, now absent in the United States on a lecture tour), Biochemistry (under Dr. Cheng Li-Bin) and Anatomy (under Dr. Pan Ming-Tse). In Dr. Tsai's absence, Dr. Hsu Feng-Yen (a former collaborator of Prof. Lovatt Evans) presides over no fewer than fifteen research workers, including an able young woman from Amoy, Miss Chu Chiung-Yuing, who is studying acetylcholine physiology. Other work concerns a non-histamine smooth-muscle stimulant found in blood, the intestino-intestinal reflex, the anti-hæmolytic action of cholesterol, and a little-understood local disease known as Chiating paralysis and believed to be due to barium poisoning following the use of insufficiently purified salt. Dr. Hsu and Dr. Cheng pointed out to the visitor with justifiable pride perfusion pumps and kymographs all made in the workshops of the medical school itself. As for the Anatomical Department, Dr. Pan and his colleagues pursue a rather original line of study, namely, the physical anthropology of the soft parts, on which Dr. Pan has himself published many papers. Dr. Pan thus combines the interests of his master, the late Sir G. Elliot Smith.

In this connexion, it should be noted that social anthropology is also not lacking at Chengtu. The

distinguished anthropologist Dr. Li An-Che (a pupil of Prof. Sapir) heads the Huahsi Institute of Sino-Tibetan anthropology, which deserves much more support than it has so far, in war-time, been able to receive. Mrs. Li An-Che (Yu Sse-Yü), sister of Yu Dao-Chuan, the Tibetan scholar now in England, also works in the field and speaks Tibetan.

Coming now to Chiating, the biological laboratories of Wuhan University are housed, not in the city, but some distance outside it; they include an old stone thick-walled watch-tower which makes an excellent laboratory. It was Dr. T'ang Pei-Sung (now of Kunming) who deserves a great deal of credit for building up biology at Wuhan. To-day Dr. Gao Shang-Yin, who was trained at Yale, with his collaborators, have there the only laboratory in Free China devoted to non-medical bacteriology; while below the ingenious Dr. Shih Shen-Han teaches plant physiology and pathology, and in the watch-tower above Ling Chun-Yo devises new electrodes for blood pH and investigates the permeability of erythrocytes. The watch-tower contains one of the few Warburg manometer sets in China. With its lovely view over the river, the watch-tower symbolically reminds one of John Donne's

"But up into the watch-tower get . . ."

though the moral is very different. A pool in the river below the laboratories is no ordinary river pool, for there each year a population of freshwater medusæ develops (2,000 miles from the sea). This medusa has been named *Craspedacusta kiatingi* by Dr. Gao and Kung Li-Hua, who have also made studies of its physiology. The whole group of biological departments is headed by Dr. Chang Ting, a botanist of considerable seniority.

Not far from the city is to be found, on a high eminence beneath a tall pagoda, the National Forest Products Research Station. Under the energetic direction of Dr. T'ang Yao, who until the War was in close contact with forestry in most other countries, this is an active centre. While the United States, for example, has only about a thousand species of forest-trees, China has two thousand; in each case about 10 per cent are really valuable. The Station possesses a fine collection of timber specimens from all over the world as well as China, and an admirable reprint and microfilm collection.

Proceeding down the Yangtze, our next biological port of call would be Tongchi University at Appletree Rapids. Here the biological departments are also extremely good. In physiology there is Dr. H. Stübel, who has worked in China for more than twenty years, and with Dr. Liang Tze-Yen was responsible for some historical work on the fine structure of muscle fibres. In botany there is Dr. Wu Yin-Chan, and in zoology Dr. Tung Ti-Chao, who is undoubtedly the most active experimental embryologist in China to-day. He collaborates with his wife, Dr. Yeh Yu-Fung, and they contrive to produce really excellent work in cramped and very uncomfortable surroundings. This has been done, not only by improvising at all stages, but also because Dr. Tung (a pupil of Prof. A. M. Daleq at Brussels) chose an important problem which could be worked on with the minimum use of stains, wax, microtomes, etc. This problem is that of the determination of ciliary polarity in the embryo, which the Tungs link up with the determination of antero-posterior polarity as a whole in the inducing tissue. They have made a great step forward by demonstrating that the

inductor for ciliary polarity is a diffusing chemical substance, and they have already established some of its properties; it differs from all previously known inductors in being stable to 50° but not to 100° C. It will diffuse into and out of agar. The fact that such a 'field' property as direction of beat can be determined by a diffusible chemical substance throws light on regional differentiation in general, and agrees with the latest views of such an authority as Dr. Holtfreter at the other side of the world. The British Scientific Mission has been honoured to communicate the memoirs of the Tungs to Western scientific journals for publication.

Little has so far been said in this article about the social sciences, but some distance from Appletree Rapids are a number of spacious manor-houses in the hills in which the Historical and Sociological Institutes of Academia Sinica are established. Headed by two famous scholars, Dr. Fu Se-Nien and Dr. Tao Meng-Ho respectively, they have a staff of some seventy scholars all told, thus constituting the largest institutes of the Academy. They guard indeed many precious treasures, such as some of the world-renowned Anyang oracle-bones, bamboo tablets on which the classics were written, and much of the Imperial Archives. There is even a section on physical anthropology, under Dr. Wu Ting-Lang (a former pupil of Karl Pearson and Elliot Smith), engaged in measuring the skulls excavated in association with the oracle-bones. Space is lacking to describe the concentrated atmosphere of learning which prevails in these Institutes, but those who are interested in the history of science, for example, find much willing and kindly help there. Lastly must be mentioned the existence of the National Archaeological Museum in this neighbourhood, directed by Dr. Li Chi, and the Institute for the Study of the History of Chinese Architecture, directed by Dr. Liang Se-Cheng (son of the famous scholar, well known in England, Liang Chi-Chao). The section on linguistics in the Historical Institute (Dr. Li Fang-Kuei) is also interesting, with its great collections of gramophone records of dialects of all provinces of China, and song and speech of many peoples.

It will thus be seen that western Szechuan is extremely rich in matters of biological and sociological interest, even in these difficult times.

It is hoped to describe, in a later article in this series, the scientific situation in the north-west.

HISTORICAL DEVELOPMENT OF MICROBIOLOGICAL METHODS IN VITAMIN RESEARCH

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THE subject of microbiological nutrition, in its qualitative and quantitative aspects alike, is ever gaining increased prominence. Whereas, until some ten years ago the whole abstruse subject served merely as a minor source of contention among bacteriologists, it has now risen to an eminence sufficient to command the attention of research and other workers in several diverse fields of thought. Thus it would seem not inappropriate to outline the historical events through which these changes have been wrought.

The earliest conceptions of the nutritional fundamentals for bacteria arose as a result of the efforts of bacteriologists to cultivate organisms in chemically defined media. Until this was accomplished the study of the biochemical nature of bacteria, and particularly of diffusible substances elaborated during their metabolism, was very seriously hindered owing to the extremely complex and largely unknown constituents present in the medium. In the case of certain organisms, the provision of recognized substances (whether of organic or inorganic nature) furnishing building and energy materials, sufficed for growth; in the case of other organisms, especially pathogenic species, cultivation was singularly unsuccessful unless small addenda of natural products were also provided. Thus there originated the belief that the addenda supplied "accessory growth factors" or "bacterial vitamins", which, it was shown, were active at extremely high dilutions and were destroyed by unfavourable conditions of heat, oxidation, etc., in the manner of the animal vitamins.

The existence of the animal vitamins was not postulated definitely before the end of the nineteenth century, although empirical methods of vitamin therapy had been known from much earlier periods. Not until about 1920, however, were vitamins isolated in pure form, their constitution determined and their synthesis accomplished. During the next phase of vitamin research the studies of pioneers like von Bunge, Lunin, Eijkman, Hopkins, Funk and others led to considerable advances, use being made exclusively of higher animals in which distinctive deficiency diseases were usually recognizable. During this same period other investigators concerned themselves with the problem of the existence and nature of "accessory growth factors" functioning in the nutrition of bacteria and yeasts. The third phase of vitamin research was initiated by a change in ideas tantamount to a revolution. It became recognized that substances hitherto found essential for the growth of lower organisms are at the same time no less important in the metabolism of higher animals. Furthermore, considerable emphasis was placed on microbiological studies owing to the great advantages to be gained.

The fusion of the two methods of approach to the study of vitamins had a very pronounced stimulatory effect on work concerning the B complex. It is notable that at least nine B vitamins are capable of detection by microbiological means. It is a reasonable surmise that if chemists had turned their attention to yeasts and bacteria instead of confining it to higher organisms, they would have had the means at their disposal to isolate all the members of the B complex in a much shorter time than was actually required¹. Nevertheless, even though the course of vitamin research was such as to lack emphasis on microbiological nutrition, microbes have played a leading part in the isolation of six out of nine B vitamins (pantothenic acid, nicotinic acid, biotin, inositol, *p*-aminobenzoic acid and folic acid).

The history of microbial growth factors may be said to have originated in 1860-70 in the controversy between Pasteur, Liebig and Berzelius concerning the possibility of cultivating yeast in chemically defined media. It was noted that growth did not ensue from small inocula². No advance was made, however, until 1901, when Wildiers, working in Ide's laboratory at Louvain, found that large seedings of yeast into certain media were able to proliferate, whereas small ones failed to do so³. Wildiers believed the ability