SCIENCE

VOL. 85 FRIDAY, JUNE 11, 1937 No. 2215

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City: Grand Central Terminal

Lancaster, Pa. Garrison, N. Y.

Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

THE DEVELOPMENT OF THE NATURAL SCIENCES IN CHINA[1]

By Dr. AMADEUS WILLIAM GRABAU

THE GEOLOGICAL SURVEY OF CHINA

I AM deeply conscious of the honor which you, the foremost body of scientific men of my country, have conferred upon me.

That I have been able to take an active part in the development of the natural sciences in China has been due, in the first place, to the fact that my coming to Peking has coincided with the awakening of interest in, and desire for scientific education along western lines, among the Chinese intellectuals.

The Geological Survey of China had been founded a few years before, and it had but recently completed its first task—the training of a number of men in the fundamentals of geological science.

It was still housed in an old adapted and inadequately equipped compound, with a library consisting of a few hundred books, and a few drawers of Chinese Paleozoic fossils. But, new buildings were under construction, and under the energetic guidance of Drs. Chang, Ting and Wong, phenomenal progress was made in the equipment and acquisition of material and the investigation of Chinese geology. Dr. J. G. Andersson, foreign adviser to the Survey, had organized the scientific exploitation of the important deposits of fossil vertebrate remains and the study of these was undertaken by foreign paleontologists.

To me was assigned the study of the Chinese invertebrate fossils, while my task at the university has been the training of young Chinese paleontologists and stratigraphers.

Through the efforts of Dr. Andersson a fund had been provided to begin the publication of the Paleon-

[1] Remarks on receiving the Mary Clark Thompson Medal of the National Academy of Sciences. Read by Mrs. Grabau in the absence of Dr. Grabau in China.

tologia Sinica in four series: A. Fossil Plants; B. Fossil Invertebrates; C. Fossil Vertebrates, and D. Ancient Man. The support of this was subsequently taken over by the Survey.

The first two fascicles which I prepared appeared one in April and the other in September, 1922. Since then 95 fascicles have been issued with a total of 8,760 quarto pages and 844 plates. If we add the fascicles in press, or prepared, the total number of fascicles is well over a hundred, with more than 9,000 pages. The smallest fascicle comprises 14 pages and 1 plate, and the largest 441 pages and 31 plates.

The first paleontological memoir, written by a Chinese paleontologist, Dr. Y. C. Sun, appeared in 1924, and of the 43 fascicles of Series B, so far issued, 32 have been written by Chinese. Nearly all these are graduates of the National University.

At first graduate students had to be sent abroad for the study of vertebrates, but in recent years the preliminary training of workers in that field is carried on in Peking. This was made possible by the founding of the Cenozoic Laboratory of the Survey, which now takes care of all the work on fossil vertebrates, including the researches on the Peking Man (*Sinanthropus pekinensis*) under the direction of Drs. Weidenreich and Young and Pere Teilhard de-Chardin. Additional impetus had previously been given by the explorations of the Third Asiatic Expedition under Dr. Andrews and the coming to Peking of such internationally famous men as Granger, Matthew Nelson, Chaney, Berkey and the Swedish scientists under Sven Hedin, and his royal highness the Crown Prince of Sweden, an active patron of science.

The Survey has since acquired the Chaukoutien site and provided the necessary equipment for the extensive exploitation of these now famous deposits of the remains of ancient man.

The Soil Survey and Seismological Observatory in the Western Hills are other lines along which the Survey has branched out, in addition to its active pursuit of the study of the structural geology and economic deposits of China and the making of geological maps.

In 1920 the geological department of the university was reorganized and under the guidance of such leaders as Drs. J. S. Lee, C. Y. Hsieh and the late V. K. Ting and others it developed rapidly. It is now housed in a building of its own, well equipped with lecture halls, laboratories, museum and library. The geological faculty consists of seven professors, two lecturers and four assistants.

Of the several hundred graduates of the department, the great majority is still in active geological work. Many of them are members of the national or of the various provincial surveys; others are teaching in various universities. The department now has resumed issuing its series of contributions, of which twelve have appeared, while others are in press.

In 1922, the Geological Society of China was organized with twenty-six charter members. At the first meeting (March 2) thirty-six new fellows and nine associates or student members were elected. Fifteen papers were presented, and the first volume of ninety-nine pages was published that year. Volume XV, totalling 574 pages, appeared in four parts during 1936.

At the annual meeting in February, 1937, sixty papers were presented and the membership was as follows:

Number of fellows	320
Number of student associates	66
Number of foreign corresponding members	36
Number of living honorary members	1
Number of institutions, listed as members	6
Total	429

When I came to China, a Chinese fellow passenger, Dr. C. C. Ping, was returning after several years of study at Cornell University. It was an opportunity for discussing plans to develop research in natural history in China, for Dr. Ping was to take charge of the biological laboratory of the Science Society of China. This society was organized a few years previously for the promotion and diffusion of science. It publishes a monthly journal *Science* in Chinese, which is now in its twenty-first year. Active work in the investigation of the fauna and flora of Central China was begun at once under Dr. Ping, the results appearing in English in numerous bulletins issued at irregular intervals. In Peking we organized the Peking Laboratory of Natural History, under the sponsorship of Mr. Sohtsu King, who has since become one of China's patrons of science. During two seasons he maintained a seaside laboratory at Peitaiho, where we collected the material for our illustrated guide to the shells of Peitaiho, in which 120 species were described and figured. Mr. King, who has since been elected to membership in several foreign malacological and conchological societies, has brought together the most complete library on conchology in China, and he and Dr. Ping are periodically issuing fascicles on the South Coast shells.

When the Fan Memorial Laboratory of Biology was organized, it took over most of the plans of the original Peking Laboratory, including the publication of the Zoologia Sinica, and extensively developed them, and since moving into its new and well-equipped quarters, it has become one of the leading biological research institutions of China.

Another direct outcome of the early activities of the Peking Laboratory of Natural History was the organi-

zation of the Peking Society of Natural History in 1925. The call was issued by Dr. N. Gist Gee, the ornithologist, as organizing secretary, and myself as convener, and the first meeting was held on September 21, with thirty-eight charter members.

Monthly meetings have been held ever since, with lectures and discussions on Chinese natural history. During the first year the membership rose to 101, including eighteen foreign correspondents and two honorary members. The society began at once to issue a bulletin, the first volume of 450 pages appearing in 1926. The present membership is 160 active members, 26 foreign correspondents and 4 honorary members, and the bulletin is now in its eleventh volume.

Besides this the society has undertaken the issue of the handbooks, of which four have appeared: (1) "Flowers of Peitaiho," by R. D. Wickes; (2) "Shells of Peitaiho," by Grabau and King, second edition; (3) "Hand-book of North China Amphibia and Reptiles," by Drs. Boring, Liu and Chou, and (4) "Familiar Trees of Hopei," by H. F. Chow.

In addition the society has issued five monographs on Chinese medicinal plants and animal drugs, by Dr. Bernard Read, and one on minerals and stones used in medicine, by Drs. Read and Pak. It has also brought out a profusely illustrated manual of the dragon-flies of China, by Dr. J. G. Needham.

The scientific study of natural history is now a recognized intellectual pursuit in China, and those of us who were privileged to be present and in a measure give aid, during the early years of development, feel confident that in the years to come geological, paleontological, biological and archeological contributions by Chinese naturalists will become of increasing importance, not only to their home country, but to the world of science at large.

Chinese naturalists feel as I do, that in honoring me to-night you are giving recognition to the progress of the scientific work in China, and they take it as an encouragement for the unabated continuance of their endeavors.

With this interpretation of your award to me of the Thompson Medal and with my sincere personal thanks, I accept the honor.

THE SOCIAL RESPONSIBILITY OF THE ENGINEER.[1]

II

By Dr. F. G. COTTRELL

RESEARCH ASSOCIATES, INC., WASHINGTON, D. C.

The particular project out of which have thus far evolved the Research Corporation and the Research Associates, Inc., originated over 30 years ago at the University of California primarily in the attempt to make certain technical developments arising in the laboratories more certainly and usefully available as practical results to the public on the one side and on the other securing therefrom some financial return toward further research in these laboratories.

The idea was not a new one even at that time, but concrete systematic attempts at its realization were few and scarcely any had as yet attracted much public attention.

The particular technical developments and patents giving us a basis to work on at the time happened to concern the application of electricity for the suppression of dust and smoke discharge from smelters and chemical works, some of which were then in serious litigation with surrounding agricultural regions. The scientific and technical side of this story though interesting in itself is not what I wish to cover to-night, as it is already fully available in the now voluminous published literature on the subject.[2]

Suffice it to say that these electrical methods, though originally proposed and even patented in their broadest general terms a quarter of a century earlier, had never up to then been successfully engineered and applied in industry. The work started purely as a private venture, a summer vacation's excursion into the technical commercial field when it was drastically necessary to supplement a university instructor's salary by outside work of some sort. It soon involved three associates besides myself, all alumni of the university, *viz.*, Dr. Harry East Miller, a consulting chemist (the only other member of our group still living), Professor Edmond O'Neill, of the Chemical Department, and Mr. E. S. Heller, a lawyer of San Francisco. They jointly financed the undertaking, including patents and early experimental work. As we proceeded, the scope and importance of the field we had stumbled upon gradually became evident.

None of us looked to this particular work as anything but a passing, though interesting and useful, incident of our chosen careers. Early in its development we therefore planned for its eventual liquidation as far as we as a group were concerned, but agreed that in so doing we would if possible segregate a part of the patent rights and turn them over to the univer-

[1] Address on the occasion of the presentation of the Washington award at a meeting of the Western Society of Engineers, Chicago, February 23, 1937.

[2] For brief summary and selected bibliography see "Fume Precipitation, Electrical," Encyclopaedia Britannica, 14th Edition, Vol. 9, p. 914, *et seq.*