SELECTED WORKS OF HUANG JIQING

(T. K. HUANG)

Volume 2

Regional Geology and Geotectonics

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EDITORIAL REMARKS

Prof. Huang Jiqing (formerly T. K. Huang), member (or academician) of Academia Sinica, and honorary president of the Chinese Academy of Geological Sciences under the Ministry of Geology and Mineral Resources, is one of the outstanding leaders of international renown in geoscience of China. His scientific activities and publications relate to different disciplines of geoscience, and his contribution to stratigraphy, paleontology, regional geology, geotectonics, petroleum geology and geological mapping are well-known both at home and abroad. Since the late 1930's he has been one of the leaders in geoscience research as well as mineral exploration, always pioneering in the frontiers of theoretical study and scientific practice. It is of particular interest to mention that in the domain of field work and geological mapping, in the establishment of theories of geotectonics and petroleum exploration in China, Huang's works played an important role and are still of value up to the present.

The scientific works of Huang form one part of the wealth of the treasure house of geoscience. They not only have high scientific value but also are of historical significance. His works, however, account almost to 300 titles, so the editors deem it necessary to publish only the leading articles as "SELECTED WORKS OF HUANG JIQING (T. K. HUANG)" which include 20 items encompassing three volumes.

The first volume, Paleontology and Stratigraphy, includes 4 articles, viz. On the Cambrian and the Ordovician Formations of Hsishan or Western Hills of Peking, his first published scientific paper, The Permian Formations of Southern China, Permian Corals of Southern China and Pleistocene Morainic and Non-Morainic Deposits in the Taqlaq Area, North of Aqsu, Sinkiang, all of which are here published in their original English form.

The second volume, Regional Geology and Geotectonics, includes 5 articles, viz. Mesozoic Orogenic Movements in the Pinghsiang Coalfield, Kiangsi, the first report on the Indosinian movement in China, On Major Tectonic Forms of China, a classic on the tectonics of China, and three major representative articles on the tectonics of China published in the 1960's, 1970's and 1980's, also appearing here in their original English form.

The third volume, in Chinese, includes 11 articles, e. g. On Major Tectonic Forms of China, An Attempt at the Seismogeological Subdivision of China from the Point of View of Geotectonics, On the Main Achievements in Geological Sciences in China over the Last 60 Years and Our Tasks Ahead, and the major representative articles on the tectonics of China published since the 1950's, among which the third listed above was contributed to the 60th aniversary of the Geological Society of China, and is here published in its full form for the first time.

Another volume composed of articles selected from his works on petroleum geology will be published by the Science Press. His recent book "The Evolution of the Tethys in China and Adjacent Regions" and "Polycyclic Tectonic Evolution and Metallogeny of the Tianshan Mountains", which were published in 1987 and 1990 respectively, are not included in the present selection.

All the papers in the present selection have been re-examined by Prof. Huang himself and are arranged in chronological order of their publication for the readers' convenience of studying his academic thinking from a historical point of view. In the preparation of this edition we have corrected the mistakes in the original editing and printing. Approved by the Ministry of Foreign Affairs of China; national boundaries, place names and administrative subdivision in the text maps are kept intact.

For a better understanding of Huang's scientific activities and works, you can read the article "Huang Jiqing, One of the Masters in the Geoscience of China" in the beginning pages of each vol-

ume, and miscellaneous photos in the front pages of the third volume. Associate Prof. Pan Yun-tang has prepared a quite full "Bibliography of scientific works by Professor Huang Jiqing" attached to the second and third volume.

Personnel of the Editorial Board and their work:

Ren Jishun: Editor-in-Chief

Xie Guanglian: editor, First and Second Volume

Wang Zongqi: editor, Third Volume

In the editing of the present selection, we received strong support and kindly help from Chen Yuchuan, President of the Chinese Academy of Geological Sciences, Lu Chunrong and Ai Huizhen, Director and Deputy Director of the Division of Science and Technology, Chinese Academy of Geological Sciences, and Sheng Shurong, Editor-in-Chief of the Geological Publishing House. Dr. Wang Zengji corrected the names of genera and species concerned in "Permian Corals of Southern China". All the sketches and maps were redrawn by Weng Huihua, Dong Xiaojin, Zhang Miao and Song Yingnian. Characters in the sketches and maps were typewritten by Kang Yumin. To all of them we tender our cordial gratitude.

Editorial Board

June 19, 1990

HUANG JIQING, ONE OF THE MASTERS IN THE GEOSCIENCE OF CHINA[1]

by Ren Jishun

Prof. Huang Jiqing, Honorary President of the Chinese Academy of Geological Sciences, and member of Academia Sinica, is an outstanding geoscientist and one of the pioneers in the modern geological sciences of China. His scientific activities and works relate to many branches of geosciences, being more prominent in paleontology, biostratigraphy, regional geology, geotectonics, and petroleum geology. Since the 1930's, he has been a leading figure in the geoscientific research, geological survey and mineral exploration in China. Well-known is his great contribution to the initiation of regional geological survey and geological mapping and the founding of the geotectonic theory of China. His concept that continental or non-marine source beds may give rise to oil-fields of economic importance and that the source beds as well as the reservoir rocks of a petroliferous basin are polygenetic, formed the theoretical basis for the successful exploration of oil and gas in China. The present article will give a chronological outline of Huang's scientific career and academic contribution.

Huang Jiqing was born on March 30th, 1904, in Qinggangchang, Renshou County, Sichuan Province, in a scholarly family. Both his grandfather and father were teachers for a long time; and he graduated from the Tonghua Primary School established by his father. In 1917 he entered the First Provincial Middle School in Chengdu, and in 1921 he went to Tianjin and entered the Preparatory Class of the Beiyang University. In 1924, he became a student in the Geological Department, Peking University, starting his geological career. He changed his original name Te-Kan Huang to Huang Jiqing. However, all of his publications in foreign languages bear the name of Te-Kan Huang, abbreviated to T. K. Huang.

During his university years, Huang was diligent and assiduous in his studies. In 1927, he published his first scientific paper "On the Cambrian and the Ordovician formations of Hsishan or Western Hills of Peking", showing his talent for the first time. And in 1928 he graduated with the degree of bachelor of science and became a member of the Geological Survey of China thereafter.

In the 1920's China was in political turmoil and social disturbance. Believing that science and technology could save China, Huang persisted in the study of geological science, which, he knew, is strongly practical and strongly regional and therefore field work was requisite, particularly for a young man. So he went to East and West Liaoning in 1928 for the investigation of coalfields. And in March of 1929, he, together with Mr. Y. T. Chao, an outstanding young geologist of the Geological Survey, started from Xi'an, crossing the Qinling Mountains several times and the great Red Basin of Sichuan. In September they came to Suifu (now Yibin), when they joined the Expedition led by Dr. V. K. Ting whose chief aim was to find out and survey a railway line combining Chungking (now Chongqing) in Sichuan to the seaport of Guangzhouwan. Leaving Suifu they took different routes. Chao went directly southwards and was murdered by bandits near Zhaotong. Huang went southeastwards and after making several detours reached Tating (now Dafang) in Guizhou Province, where he met V. K. Ting's party. Thereafter, he worked together with the latter.

After 16 months of field investigation Huang returned to Beijing in June 1930. Armed with the great amount of first-hand material, Huang, during the years of 1930—1932, carried out assiduous

[1] Translated by Xie Guanglian from Chinese and revised by Prof. Huang Jiqing and Tang Shukai.

laboratory work and published six monographs including "The Geology of the Tsinlingshan and Szechuan", "Permian Corals of Southern China" and "The Permian Formations of Southern China", the last being an epoch-making summary of a stratigraphic system in China. It laid the foundation of the research of the Chinese Permian System, and was highly appraised by stratigraphers both at home and abroad.

In the summer of 1932, Huang, with the financial support of the China Foundation for the Promotion of Education and Culture, went to Switzerland. First he studied at the University of Berne. In the spring of 1933 he went to the Université de Neuchâtel and worked there as research student under the direction of Prof. E. Argand. Besides making numerous geological trips in different parts of the Swiss Alps, Huang concentrated his mapping work in the Pennic Nappes in the summer months of 1933—1934. In 1935 he completed his doctor's thesis "Etude de la région Weissmies-Portjengrat (Valais)", which was quickly published, and highly praised by Prof. Albert Heim and Prof. Rudolf Staub. In a letter of congradulation to Huang, Prof. Maurice Lugeon remarked: "Votre passage dans les Alpes restera inoubliable". In his three years' sojourn in Switzerland, Huang found time, in the winter and spring vacations, to visit Italy, Germany, France and Belgium with a view to studying the geological structure of these countries on the spot.

Having travelled extensively in England and Scotland, Huang went to the United States in the winter of 1935, where apart from paying visits to the leading universities and outstanding geologists thereof, his particular concern was to investigate the main oil and gas fields where he made friends with many petroleum geologists.

In the spring of 1936 Huang returned home and immediately joined the Geological Survey of China and was promoted as Chief Geologist. With his associates he studied and mapped the coalfields of Leping, Poyang and Anyuan of Jiangxi Province and preliminarily evaluated their potentials. In September, in cooperation with the Geological Survey of Hunan, he organized and launched the Nanling Expedition, which covered areas of the provinces of Jiangxi, Hunan, Guangdong, Guangxi and Guizhou. The field work of the Expedition lasted six months or more, resulting in the 1 : 200000 map sheets of the said areas as well as numerous reports of different mineral deposits, of which the discovery of the Zixing Coalfield in eastern Hunan was of particular interest. In the spring of 1937, Huang, as acting director of the Geological Survey, cooperated, by order of the Ministry of Industry, with the "China Petroleum Company" led by Gu Shaochuan (the well-known Wellington Koo) and organized a field party to explore the northwestern provinces especially Gansu and Qinghai. Gu engaged two American geologists, Dr. Marvin Weller and Mr. F. A. Sutton, while Huang appointed Mr. C. C. Sun (Sun Jian Cu) to form the staff of the party, with a Mr. Shi as its leader. Their chief contribution was the discovery of the Laochunmiao oil-bearing anticline. In July Huang attended the 17th International Geological Congress (Moscow) and participated in the excursions. Since war broke out between China and Japan Huang returned home in October. Soon after, Shanghai was occupied by the invaders and Nanjing was in danger. Huang successfully organized the members of the Survey to transport the library, instruments and equipments of the laboratories to Changsha. In December he was formally appointed director of the Survey. During his stay in Hunan Province, Huang investigated the Shuikoushan lead-zinc deposit, pointing out its potential of becoming an outstanding mine district. Besides, he took personal command of the geological mapping work of the Changsha-Xiangtan area on the scale of 1 : 50000. In the summer of 1938, when the Japanese troops encircled Wuhan area, the Survey withdrew from Changsha to Chongqing, Sichuan Province, and finally was installed at the town of Beipei.

In Beipei Huang organized and took part in a series of geological investigations and mineral deposits prospecting, particularly general exploration of petroleum and natural gas in cooperation with the Sichuan Petroleum Prospecting Department under the Natural Resources Commission. In 1938

he, together with Mr. Chen Binfan, investigated the geological structure of the Shengdengshan area in Longchang County, where gas seepages occur. They wrote a report, considering the structure most favorable and urging immediate drilling work to be done. Actual drilling was carried out by the aforesaid Department, with great success, and good productive gas wells came into existence. Meanwhile, Huang led a topographic and geolgical party, doing detailed mapping of the Weiyuan County, Central Sichuan, which was considered promising for natural gas. During 1939—1941 he had also taken command of reconnaissance work in the districts of Jiangyou, Ziliujing, Wutongqiao and Jiading in Sichuan, with the purpose of finding favorable oil and gas fields. At Tongjiezi near Jiading, gas seepages were discovered on the crest of an anticline formed by the Permian Maokou Limestone along the banks of the Daduhe River. This decidedly negated the erroneous conclusion of the German scientist Prof. Salfeld, who held that the natural gas in Sichuan was produced from the Upper Permian coal series and thus was of little economic importance. As the director of the Geological Survey, Huang sent Li Shanbang, Qin Xingling and others to do geophysical prospecting on the Panzhihua iron deposit and sent Cheng Yuqi, Cui Kexin and others to investigate gold mines in Sikang Province (now western Sichuan). Beginning from 1938, the Survey established its Kunming Office in Kunming, Yunnan Province, with Dr. C. C. Young as its director. Geological and soil mapping of the Kunming and adjacent areas was the main purpose of the Office while investigation of continental red beds was also carried out. It was at this time that Mr. M. N. Bien discovered the important Lufeng dinosaur fauna, which was studied by Young and became world famous through the publication of the latter's monographs.

In the summer of 1940 the Kong Xiangxi (then Prime Minister) capitalist clique ordered Huang, via the Ministry of Economic Affairs, to make detailed investigation of the Fuling-Pengshui iron deposits in eastern Sichuan, for Kong's private industrial company. Refusing to serve the ruling bourgeoisie, Huang resigned immediately. Subsequently he devoted his every effort to geological investigation and scientific research. From the autumn of 1941 to the spring of 1942, he led a field party to Gansu and Qinghai for geological mapping, focusing on oil and gas. In the summer of 1942 he went to the Huayinshan, central Sichuan, to study the Permian stratigraphy. From the autumn of 1942 to the summer of 1943, by order of the Ministry of Economic Affairs, he organized the Sinkiang Petroleum Geology Expedition, which included C. C. Young, Cheng Yuqi, Weng Wenpo and others. They made reconnaissance surveys in the northern and southern foothills of the Tianshan Mts. and mapped in detail the Tushantzu oilfield in Wusu County, the Kan area in Kucha County and the Taqlaq area in Wensu County. They also investigated the Quaternary and glacial geology in the area north of Aqsu. Their "Report on Geological Investigation of Some Oil-fields in Sinkiang" was accepted by the Natural Resources Commission in September, 1943. It is in this report that Huang sets forth the conception that continental or non-marine source beds may give rise to oilfields of economic importance[1]. He also maintains that the source beds as well as the reservoir rocks of a petroliferous basin do not belong to a single geological formation but frequently to different formations, that is to say, they are "polygenetic".

From late 1943 to early 1945 Huang completed his monograph "On Major Tectonic Forms of China", which is a classic of the geotectonics of China written on the basis of his long and extensive field work and a summarization of all available data published both at home and abroad up to 1943. With a series of tectono-paleogeographic maps and a detailed geotectonic map, he systematically, though succinctly, described, for the first time, the tectonic framework of China, outlined the char-

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[1] In 1941, C. H. Pan put forward the same theory in an article published in the American Association of Petroleum Geologists Bulletin. It was impossible to get an American magazine because of the war, so Huang did not read the article until the war came to an end.

acteristics of its main tectonic elements, orogenic cycles, elucidated the tectonic evolution of China and its adjacent regions, and put forward the well-known theory of polycyclic tectonic movement. He further suggested the three main tectonic types of Asia, namely, the Pal-Asiatic, the Pacific, and the Tethys-Himalayan, and made a brilliant geodynamic explanation about their formation: "In Mesozoic times when Pal-Asia drove towards the Pacific Ocean, this latter 'struck back' with a powerful push, thus giving rise to the Pacific type of folds. The same southward drive of Pal-Asia met with great resistence from the northward drifting Gondwanaland (if Wegener is right); the powerful tangential compression resulted therefrom wrinkled the thick Tethys sediments into the Tethys-Himalayan type of folds forming the greatest and highest fold mountains of the world." and "Thus the Assam Syntaxis, like the Pamir-Himalayan Syntaxis, might be explained by the action of a powerful underthrust coming from the Shillong promontory of Gondwanaland beneath the Yunnan-Burmese Crystalline Complex". It is the tectonic theory advanced in this book, which has played a guiding role in the geoscientific research and mineral exploration in China, that distinguished Huang as the indisputable pioneer and founder of historical geotectonics of China. In his preface to the Russian edition of the monograph published in 1952, Academician N. S. Shatsky, of the Soviet Union, wrote: "The author, an experienced field geologist and famous scholar, has given us a very perfect picture of the geotectonic development in China". 40 years after its publication, the well-known Japanese American geologist, A. Miyashiro, praised the book as "epoch-making classic in the history of the geotectonic study of Asia".

During 1944—1947 Huang compiled the "Paleogeographic Atlas of China", which was eventually completed by his assistant Mr. Liu Hongyun. It is the first of its kind in China and was published in 1953.

The Japanese surrendered in the autumn of 1945. In the summer of the next year Huang flew to Beijing and worked there as visiting professor of the Peking University and the editor-in-chief of the Bulletin of the Geological Society of China. At the same time he edited, with the assistance of Zeng Dingqian and Zhou Mulin, the posthumous works of Dr. V. K. Ting, one of the founders of geological institutions in China.

In 1946 Huang, at the age of 42, was elected academician of Academia Sinica for his remarkable achievements in geoscience.

In April of 1947 Huang went back to the Geological Survey of China in Nanjing where he took charge of editing of 14 sheets of geological maps of eastern China on the scale of 1 : 1000000 according to international grid, together with a geological map of China on the scale of 1 : 3000000. These maps, systematically compiled for the first time, summarized all data and results of geological investigation up to the late 1940's. They were of high scientific value and acted as a direct guide to the national mineral resource exploration and regional geological mapping in the early years of New China.

Invited by the British Council, Huang visited Great Britain and attended the 18th International Geological Congress held in the summer of 1948. Subsequently he visited Sweden, Denmark and Switzerland, and arrived in the United States in January, 1949. For nearly six months, he was busy in meeting leading American geologists and visiting geological departments and institutions including Massachusetts Institute of Technology, Yale University, Columbia University, University of Chicago, University of California, Stanford University, United States Geological Survey, Geological Surveys of several States, as well as the Smithsonian Museum of Washington. His particular conncern, however, was to inspect and investigate well-known oilfields in Texas, Arizona, Colorado and California, when, with the help of the engineers on the spot, he improved his knowledge of petroleum geology both in theory and practice.

In June, 1949, Nanjing and Shanghai were taken by the victorious Liberation Army and com-

munications with the latter cities were completely cut off. Refusing to accept the invitation of Mr. Fu Ssunian, President of the Taiwan University, Huang flew from Hong Kong to Chongqing to meet his family there. Huang met leaders of the Second Field Army who established the Southwest Politico-Military Commission, of which Huang was a member and was authorized to gather together geologists scattered in the southwestern provinces. And soon the Southwest Geological Survey was inaugurated and Huang was appointed director. At the meantime he was a member of the National Committee for the Planning and Directing of Geological Works, advisor of the General Bureau of Petroleum, Ministry of Fuel Industry, and president of the Chongqing Geological Prospecting School. In 1952 when the Ministry of Geology was established he was appointed director of the Southwest Bureau of Geology. During his stay in the southwest he organized geological and mineral prospecting parties in the region, including the drilling of the Zhongliangshan coalfield near Chongqing, of the Qijiang iron ore deposits, and of the Pengxian copper ore deposits in Sichuan, of the Zunyi manganese deposits, and of the Guanyinshan iron ore deposits in Shuicheng, Guizhou, of the Dongchuan copper ore deposits in Yunnan, etc. The Zhongliangshan coalfield, whose drilling and evaluation Huang himself was in charge of, became one of the major bases of energy source of Chongqing City. In cooperation with the Sichuan Petroleum Prospecting Department, he carried out deep drilling at Haitangpu, Jiangyou County, and near Shijinsi, Jianyang County. Meanwhile, in disagreement with the pessimism of some geologists at the prospect of oil and gas in Sichuan, he made it clear that the Sichuan Basin was quite promising at least in natural gas, so prospecting should not be stopped.

In 1954, when the Ministry of Geology organized the Exploration Committee, with Prof. Li Siguang (J. S. Lee), Minister of Geology, at its head, Huang was appointed, together with Xie Jiarong (C. Y. Hsieh), standing member of the Committee in charge of scientific leadership. In December, the Ministry of Geology took on petroleum exploration as its priority task by order of the State Council, and the Exploration Committee was reorganized to take the charge. In early 1955, when Mr. Liu Jie, Party Secretary of the Ministry, consulted Huang on petroleum exploration, Huang said: "In the United States, an advanced nation in oil and natural gas production, more than half of its geologists are employed in petroleum sector, mostly in petroleum companies. Similar is the case in the USSR, where petroleum exploration and development are state-run. China is a country with a vast territory and diverse geological structures, so for the discovery of oilfields a substantial imput of resources is required, including at least one third of the technical force of the Ministry, and correspondingly necessary equipment and financial expenditure". Liu agreed with and supported Huang.

In January 1955, to make appropriate preparations for the First Conference on Petroleum Exploration, Huang and Xie spared no efforts to mobilize the technical staff of the Exploration Committee and the Fuel Resources Section of the Department of Geology and Mineral Resources, carry out an extensive data collection and analysis, and formulate a programme of future work. Huang and Xie, after repeated consultations, shared the view that petroleum exploration should be launched across the whole country, with the priority to be given to a number of large- and medium-sized basins such as Sichuan, Ordos, North China, Songliao, Junggar, Turpan, Tarim and Qaidam, to which exploration parties must be sent. Huang proposed, on the basis of his geotectonic research and theory of continental source beds, that large Mesozoic and Cenozoic basins be the main targets.

The First Conference on Petroleum Exploration, held in Beijing from January 20 to February 11, 1955, under the auspices of the Ministry of Geology, was attended by 316 delegates from various and provincial bureaux of the Ministry of Geology, and the Ministry of Petroleum Industry, including about 130 administrative leaders and technical professionals assigned to do the field work. It was decided at the meeting that the main task of the Ministry of Geology was to reinforce its geological surveying, evaluate the prospects of petroleum and determine the most promising areas for subse-

quent prospecting. In response to the "Report on the policy and task in the petroleum and natural gas exploration in 1955" delivered by Xu Jie, Vice Minister of Geology, the discussions at the meeting laid particular emphases on large- and medium-sized sedimentary basins, such as Junggar, Turpan, Tarim, Qaidam, Sichuan, Ordos and North China, and a decision was made to organize altogether five separate petroleum exploration parties in Xinjiang, Qaidam, Sichuan, Ordos and North China in accordance with the technical force available at that time. In the last phase of the conference Huang, on behalf of the Exploration Committee, presented a report to the ministrial meeting presided by Li Siguang, the Minister, and the report was formally approved.

With a view to arrange the exploration in the Songliao Basin, Huang interviewed, shortly after the meeting, Mr. Hu Ke, department chief from the Northeast Bureau of Geology. In that interview, Huang stressed the importance of the exploration in the basin and inquired who in the Bureau would be appointed to be technical leader of the field party there. Later on, Huang let Mr. Su Yunshan to consult technical data and draft an exploration programme, which, after Huang's revision, was assigned to the Northeast Bureau for implementation by the Exploration Committee.

Huang paid special attention to the Sichuan, Ordos, Songliao and North China basins. He pointed out that in the North China Basin the Mesozoic and Cenozoic source beds were the main targets to be searched for, in the Songliao Basin traverse reconnaissance should be carried out along the Songhua River, in the Ordos Basin emphasis of work should be laid on the western margin, and in the Sichuan Basin field investigation should be directed toward central and southern Sichuan.

In the period of May 22 to October, 1955, Huang spent four and a half months in Xinjiang, Qaidam and western Ordos on inspecting and directing the field work there, and in November 1 to December 2, he accomplished another mission in Sichuan.

In early 1956, Mr. Chen Yun, Vice Premier, consulted Huang on petroleum-related problems of China. In their interview, Huang made a brief review of the petroleum exploration activities in the previous year. He stressed that on the vast territory of China there were many large- and medium-sized possible petroliferous basins but they remained untapped much due to the still insufficient imput of technical force, financial and material resources and therefore more such resources should be mobilized from all sources and devoted to the significant undertaking of oil exploration. He further pointed out that only with concerted efforts could major breakthrough be achieved within a short period of time, and more exertion was indispensible.

At the Second Conference on Petroleum Exploration in February, 1956, Huang delivered the report "A Review of the Petroleum Exploration Activities in the Past Year and Some Suggestions on the Work Ahead". After the meeting, petroleum and natural gas exploration activities were undertaken on a larger scale and in more regions. Nine exploration field parties, including the one for the Songliao plain, were newly organized and went into operation. Henceforth, a vigorous strategic reconnaissance of oil-gas resources was unfolded all over China, from the Gobi of Xinjiang in the west to the coasts of the East China Sea and the Yellow Sea in the east, and from the Songliao plain in the north to the Yunnan-Guizhou-Guangxi Plateau in the south, making the strategic development of the first nation-wide oil-gas exploration campaign (otherwise referred to as the first round of petroleum exploration).

In March and April of 1956 Huang devoted most of his energies to the National Conference on the 12-Year Plan of Science and Technology Development. During June to mid-September, Huang visited the Soviet Union as a member of the Delegation of the Ministry of Geology. In Moscow and Leningrad he met many eminent geologists and discussed problems in geology with them, particularly D. V. Nalivkin, N. S. Shatsky, A. V. Peive, V. V. Beloussov, A. L. Yanshin, and a number of leading petroleum geologists. He spent two weeks in inspecting the productive oilfields of the "Second Baku". In September, the Exploration Committee was reorganized into the Bureau of Petroleum Ge-

ology, of which Huang was the engineer-in-chief. He was also then the deputy director of the newly established Institute of Geology under the Ministry of Geology. In the same year he was elected member of Academia Sinica (similar to academician) and later was appointed deputy director of the Division of Earth Sciences.

On March 8, 1957, Huang showed the "Map of prospective areas of petroleum in China" at the Third Conference on Petroleum Exploration and delivered a speech entitled "Preliminary Opinions on the Subdivision of Prospective Areas of Petroleum in China". On the map the most promising basins, Songliao, North China, Sichuan, and Ordos, are shown by deep orange red color. He concluded that "it is correct to regard the Ordos, Sichuan, North China and Songliao basins as the first priority of exploration within the next 4-5 years" and added, "The work in the Tarim basin should be concentrated on geophysical prospecting and should be done in the next year if not in this year. It is necessary to carry out exploration in that greatest basin for the preparation of the second five-year plan".

Thus, within a short span of three years from 1955 to 1957, Huang and Xie made an indelible contribution to the discovery of a series of large oilfields in the Songliao, North China and other basins, which was the main breakthrough in the exploration in China; because, with their theoretical basis, rich practical experience and meticulous scholarship, they fostered and brought up rapidly a contingent of qualified oil-gas explorationists not only by giving perfect macroscopic guidence in theory, but also by on-the-spot teaching with personal demonstration, verbal instruction in the field or lecturing at meetings of various types.

During the Spring Festival of 1959 He Changgong, Vice Minister of Geology, presided over an important meeting which was attended by Yu Qiuli and Kang Shi'en, Minister and Vice-Minister of Petroleum Industry. The meeting decided that the two Ministries would launch a joint mass campaign of petroleum exploration and prospecting in the Songliao plain because it promised to be a large oil-and-bearing basin.

After the festival, Huang went to Changchun to meet with Li Ben, Han Jingxing, Lü Hua and others in order to have a comprehensive review of the geological, geophysical and drilling data of the Songliao Basin, and subsequently he considered that there might be several formations of petroliferous rocks rather than a single one, and urged to drill a datum well for petroleum geological studies at the depth.

On September 26, a large amount of crude oil gushed out from Well Songji No. 3. This proved the Songliao Basin, or more exactly the Datongzhen Wale, to be a large-scale oilfield, later named the Daqing Oilfield.

Since 1958 Huang has devoted his major effort to the work in the Institute of Geology and the Chinese Academy of Geological Sciences under the Ministry of Geology. In the late 1950's, he took charge of compiling the "Geotectonic Map of China" (scale 1 : 3000000) with its explanatory text "Fundamental Characteristics of Geotectonics of China". He also wrote papers such as "The Main Characteristics of the Geological Structure of China: Preliminary Conclusions" and "Preliminary Investigation on the Evolution of the Earth's Crust from the Point of View of Polycyclic Movements" in which, on the basis of new data, he comprehensively and systematically elucidated the system of theory on the geotectonics of China and the theory of polycyclic tectonic movement that he put forward in 1945. These works, which were translated into English, German and Russian and published in Western Europe and the Soviet Union, were highly praised both at home and broad.

As Vice-President of the Academy, Huang, together with Wang Xiaoqing and Guo Wenkui, took the leadership of a great project, carried out by geologists of all the provinces of China. This was the compilation of a set of maps on the scale of 1 : 1000000 according to the international grid, including geological maps, geotectonic maps and metallogenic maps. The compilation of the map series,

showing all the fruits of the labor and wisdom of Chinese geologists in the half century since 1914, was then a pioneering work in the history of world geological map-editing.

Furnished with some significant clues obtained during the geological investigation in the Qinling Mts., western Sichuan and western Yunnan in 1962-1965, Huang instructed Jiang Chunfa and Ren Jishun to carry out monographic studies on the geotectonics of the Qinling Mts. and western Sichuan respectively. This was to be done on the basis of the achievements made by the Sichuan Bureau of Geology and the western Sichuan Expedition of Academia Sinica that tried to find a route to channel water from the south to the north. As a result of these studies they discovered the greatest Indosinides in the world, the Qinling—Songpan-Garze—Sanjiang (Nujiang, Lancangjiang and Jinshajiang) Indosinides. This made an important contribution to the study of the tectonic evolution of the eastern Tethys and attracted much attention in the field of world geoscience.

In 1965 Huang published the paper "On Eugeosynclines and Miogeosynclines of China and Their Polycyclic Development".

Though suffering deep misery from the "Cultural Revolution" from the middle 1960's to the middle 1970's, Huang and his assistants did not stop their scientific research. From 1974 onwards he published in succession many papers, including "Some New Observations on the Geotectonic Characteristics of China", "An Outline of the Tectonic Characteristics of China", "A Preliminary Discussion on the Polycyclic Development of Geosynclinal Foldbelts", "An Attempt at the Seismogeological Subdivision of China from the Point of View of Geotectonics" and "On the Formation of Pliocene-Quaternary Molasse in Tethys-Himalayan Tectonic Domain and Its Relation with the Indian Plate Motion". Under his direction the assistants compiled the Geotectonic Map of China on the scale of 1 : 30000000 and 1 : 4000000, and wrote the book "Geotectonic Evolution of China" and many related papers. In these works a model of the geotectonic evolution of China was established on a new level reached through application of both the theory of polycyclic tectonic movement and the theory of plate tectonics together with a combination of geological research with geophysical data analysis, and introduction of the latest scientific achievements in the world. As far as petroleum exploration of China in the 1980's is concerned the authors, in the book "Geotectonic Evolution of China", incisively pointed out: "The petroleum resources of China in the east, especially in the continental shelf, are of great importance, but it does not necessarily mean that western China should be ignored. The oil-bearing potential of the Tarim Basin is probably unique in the mainland of China" (p. 182). Accordingly Huang and his assistants, from time to time, made proposals on petroleum exploration and prospecting in China to the Ministry of Geology and Mineral Resources and petroleum institutions❶.

Huang is highly appreciated and respected by his colleagues at home and abroad for his brilliant contribution to earth science and the exploration of natural resources, especially oil and natural gas. In early 1979 he was elected President of the Geological Society of China at a national congress of the Society. In that October, on behalf of the Ministry of Geology and Mineral Resources, he attended the 100th anniversary of the United States Geological Survey. In 1980 the degree of **Docteur es Sciences Naturelles honoris causa** was conferred upon him by L'Ecole Polytechnique Federale de Zurich. Also in 1980 he led the Chinese delegation to attend the 26th International Geological

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❶ Huang Jiqing, 1984. Some suggestions on how to increase China's oil and gas reserve. In: Selected papers of experts' suggestions on how to enlarge oil and gas reserve, No. 1. ed. Secretariat of the Petroleum Society of China.

Ren Jishun, 1984. Opinions on the oil and gas exploration in China, *Ibid.*

Ren Jishun, 1982. Some opinions on the strategic plan for the search of petroleum resources in China, Speech at the seminar on the energy geology in the Chinese Academy of Geological Sciences and the suggestions sent to the Petroleum Bureau of the Ministry of Geology and Mineral Resources and the Ministry's Communist Party Leading Group after the seminar.

Congress in Paris. In 1982 he was awarded two first prizes of the National Scientific Reward for "geoscientific work in the discovery of the Daqing Oilfield" and "Geological Map Series of China and Geological Map of Asia", and a second prize for "Fundamental Characteristics of the Geotectonics of China". In the same year he presided over the 60th anniversary of the Geological Society of China and subsequent academic activities, and delivered his presidential address "On the Main Achievements in the Geological Sciences in China over the Last 60 Years and Our Tasks Ahead". This is the most comprehensive summary of the development of geological sciences in China so far. In 1983 he was invited to pay an academic visit to Japan where he conferred with some famous Japanese geologists such as Teiichi Kobayashi and Masso Minato. In 1985 he was elected honorary member of the Geological Society of America and in 1988 foreign academician of the USSR Academy of Sciences.

Not content with what has been achieved Huang is still striving for further progress in science. In June of 1984 at the age of 80 he attended the International Symposium on the Himalaya held in Chengdu and delivered a scientific address. That same year he presented the paper "New Researches on the Tectonic Characteristics of China" to the 27th International Geological Congress held in Moscow. In the September he went to Urumqi to attend the "3rd Symposium on Oil and Gas Resources in the Tarim Basin," and delivered a long speech on the structure of the Tarim Basin, major petroliferous and reservoir sequences, types of oil and gas field and preference exploration, suggesting that the oil source rock series in the Tarim Basin comprised at least 5 to 6 layers respectively of the Carboniferous, Permian, Triassic, Jurassic and Tertiary in age; oilfield types might be diversified; and petroleum exploration should be carried out along the Central Uplift Belt, the northern Tarim Uplift Belt and the Qiemo (Qarqan) Uplift and on their both sides. In the summer of 1986 he visited the Daqing oilfield again and after a penetrating grasp of the current prospecting and development of the oilfield, put forward detailed written suggestions over the future undertakings in the oilfield. In 1987 he published the book "The Evolution of the Tethys in China and Adjacent Regions" in which he made a comprehensive survey of the tectonic evolution of the eastern Tethys with abundant data collected in the geological exploration over the Qinghai-Xizang (Tibet) region in the past several years and offered his critical remarks on the opinions of some foreign geologists. In 1990 under his direction, Ren Jishun, Chen Tingyu, et al. published "Tectonic Evolution of the Continental Lithosphere and Metallogeny in Eastern China and Its Adjacent Areas", developing further the theory of polycyclic movement, and Wang Zuoxun, Wu Jiye et al. published the book "Polycyclic Tectonic Evolution and Metallogeny of the Tianshan Mountains" in which a model of accordion movement of plate was established. In addition to all this he is the editor-in-chief of "Selected Works of Weng Wenhao" and "Selected Works of Ding Wenjiang" that record the representative scientific achievements of Weng Wenhao (W. H. Wong) and Ding Wenjiang (V. K. Ting), two pioneers of geology in China.

Huang, an internationally well-known earth scientist, is frank and good-natured, rigorous and meticulous. As a geotectonician of great achievements, he respects his counterparts, though he does not necessarily agree with them. As early as the 1960's he sent members of his research group to the Institute of Geomechanics led by Li Siguang (J. S. Lee) to learn from its relevant theories. In the 1980's he invited his classmate and old friend, Prof. Li Chunyu (C. Y. Lee) to his research group although Li held a different academic view from his. The two tectonicians got along with each other very well in scientific research despite their differing opinions. Huang is tolerant of unfair criticism over his point of view and responds usually with a description of his own in a positive way. He encourages the middle-aged and young geologists as well as his students to have "no blind faith in experts, authorities, and of course also Huang Jiqing". He frequently tells his young assistants: "Be encouraged to offer your own opinion and argue with me". Because of this there is academic democra-

cy and an easy atmosphere in the research group led by him. And he often tells his young assistants: "To put a problem to 'death' is a contribution, and what is of crucial importance is the 'deathy', that is, the final solution of the problem, no one else can find an alternative solution to it". It is this philosophy that led Huang to his glory in scientific research.

At the age of 86, Huang is still managing to improve his scientific thinking. Now, as a scientific adviser, he is instructing his assistants, together with other geologists, in the compilation of a new geotectonic map of China and a geotectonic map of Asia. This is to be compiled with international cooperation, so as to develop the modern theory of geotectonics.

Acknowledgement

The first manuscript of the present article written in June of 1990, was sent to the Geological Publishing House after Prof. Huang Jiqing's critical review. Editor Zhang Yixun of the House handed over the manuscript to Mr. Guan Shicong, former Chief Geologist of the Bureau of Petroleum Geology and Marine Geology of the Ministry of Geology and Mineral Resources (MGMR), and Senior Editor Li Erong of the Geological Publishing House for comments and they provided valuable advice for revision. Then in May of 1991, again Zhang handed the revised version over to Mr. Su Yunshan, Senior Geologist and former Deputy Director of the Bureau of Petroleum Geology and Marine Geology of the MGMR, for critical review. Mr. Su made serious supplements and amendments, on the basis of undoubted historical facts, in the paragraphs that deal with the first round of petroleum exploration in the 1950's. After the second revision, the author consulted Mr. Lü Hua, former director of the Guangzhou Marine Geological Survey of the MGMR, and originally Head of the Geological Department of the Exploration Committee, Senior Geologist Han Jingxing, Chief Geologist of the Petroleum Exploration Party for the Songliao Basin, and Senior Geologist Zhu Jingshan, once technician of the Exploration Committee, for confirmation of some significant historical facts concerning Huang's work in the Exploration Committee. Besides, for the same purpose, the author also wrote to Mr. Li Ben, Deputy Director of the Bureau of Petroleum Geology, MGMR, and Deputy Head of the Secretariat of the Exploration Committee. This article was finally completed on July 7, 1991. To all of those mentioned above the author tenders his sincerest thanks.

CONTENTS

MESOZOIC OROGENIC MOVEMENTS IN THE PINGHSIANG COALFIELD, KIANGSI[1][2]

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Introduction

The Pinghsiang coalfield of Kiangsi province has been repeatedly visited by Chinese as well as by foreign geologists most of whom however spent much of their time in determining the economic value of the coalfield and consequently very little attention was paid to the stratigraphic and tectonic complications the elucidation of which is also of paramount importance to the miner. Fully realizing this, we have, during our three weeks' stay in the Pinghsiang district in April 1936, spent a good part of our time in the study of the coal-bearing formations and their mutual relation. We unexpectedly found important unconformities in the Mesozoic sequence hitherto not or little known from this part of Chinese territory.

In Kiangsi the earliest Mesozoic orogenic movement occurred, according to observations made by Messrs. P. Kao and K. C. Hsü[3], probably at the beginning of Triassic. In many regions Triassic beds transgressed over Permian limestones, thus indicating an unconformity between them. In the Pinghsiang area, however, the Permian-Triassic contact is obscured by superficial covering. The first important Mesozoic movement there is marked by an unconformity between the Tzuchiachung series of Rhaetic-Liassic age and the underlying Triassic sandstones. Since this unconformity is well-exposed at many places in the Anyuan part of the Pinghsiang coalfield we propose to name it the *Anyuanian movement*. The second Mesozoic movement occurred within the Jurassic. Though less intense than the Anyuanian it is still of a mountain-making nature. We term it the Sanwanian movement since it can be clearly observed near Sanwan and Huangkeng some 5 kilometers SSE of the Pinghsiang city. The third movement falls between the Jurassic and the red beds of probably Eocene age. It marks the major orogenic disturbance of the region and is characterized by thrusts or Schuppenstruktur. Since the red beds are well-developed in the environs of the Pinghsiang city we shall

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[1] A detailed report on the geology and coal resources of the Pinghsiang area will be published in Bull. Geol. Surv. China.

[2] (second author K. C. Hsü) Originally published in the Bulletin of the Geological Society of China, Vol. 16, pp. 177—196, 1936—37.

[3] Personal communication.