

INSTITUTE OF CURRENT WORLD AFFAIRS

CHGO-9:  
A Chinese Conference on Tectonics.

4 Kotewall Road, 4/floor,  
Hong Kong.

August 20, 1962.

Mr. R.H. Nolte,  
Institute of Current World Affairs,  
366 Madison Avenue,  
New York 17, N.Y.

Dear Mr. Nolte,

The July 1962 issue of the Chinese language science journal "Scientia" (Ke Shyue Tong Baw) carried a report on the Geological Society of China's April meeting in Peking. This meeting was devoted to a general discussion of some problems in tectonics, and I originally translated the article as a language exercise. But since the article obviously reflects the general standard of tectonic research in China today, I thought that it may have interest for others, particularly for those who are earth scientists. It may also be significant for the signs it gives of a change in the Chinese Government's attitude towards science. I have therefore prepared the attached translation.

Judging from the report, most of China's senior structural geologists resident in the Peking area attended the meeting, and a wide range of subjects were briefly and rather superficially discussed. At least, the report creates the impression of superficiality, and occasional triviality, although this may merely reflect the inexperience of the recorders who were not always able to select the significant points in the discussion. Also some of the ideas expressed are curiously out of date. Curiously, because there is plenty of evidence that the Chinese have the latest Western literature in their libraries. Perhaps this indicates that the senior geologists do not have time to read outside their own immediate field, and that many of the younger geologists cannot read English. For example, it is stated as an agreed fact that the earth's crust under the Atlantic Ocean is of comparable thickness to that under the adjacent continents. This idea was prevalent in some Western literature about ten to fifteen years ago, but seismic and gravity studies carried out in recent years have proved it to be false.

Perhaps the most interesting section is the last one, in which the geologists frankly discuss the shortcomings of Chinese tectonic studies and make several proposals for future work. The suggested projects are well worthwhile, and if undertaken and the results published, would be of general interest to tectonophysicists throughout the world.

The main significance of the paper however, lies not so much in what was said on the various topics, as in the fact that these topics were discussed at all. For, despite the claims made in the report for the economic significance of tectonic studies, the

fact remains that many of the topics discussed are among the most academic of all topics in geology. To my knowledge this is the first time since the Communists came to power that the Chinese have published a report on a discussion of this subject. Some other events which seem to indicate that a basic change may be taking place in the Chinese Government's science policy are:-

- About 18 months ago the Chinese Communists began to introduce English language studies on a wide scale in schools and colleges. Prior to this Russian had been the chief foreign language taught.

- About 12 months ago, two Peking University professors with brilliant academic records in the physical sciences, but who had previously been considered "liberals", were promoted to vice chancellors of Peking University.

- In May of this year, Dr. Claude Bissell, President of the University of Toronto, visited China and was told by China's Foreign Minister, Chen Yi, that China must look increasingly to the West for technical co-operation.

- The June 1962 issue of Scientia Sinica, an English language Chinese science journal, carried an article on "The problem of genesis and classification of ore deposits". This is a paper in which the author seeks to understand the genesis of ore deposits by studying published reports on the geology of known ores. But, of the 62 references in the bibliography, only three refer to Chinese work and three to Russian work. The rest are mostly references to English language publications, including some as recent as 1961.

- A Chinese technical mission is currently in France studying the French petroleum industry.

I believe that two major trends are emerging. The first is a swing towards a closer study by the Chinese of scientific developments in Western countries, and the second is that more attention is now being given to basic research, with greater academic freedom for senior scientists to work on projects of their own choosing.

Yours sincerely,

*C.H.G. Oldham*

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A DISCUSSION ON SEVERAL THEORETICAL PROBLEMS IN TECTONICS

(A translation of a report from "Scientia" (Ke Shyue Tong Baw) No.7, 1962, pages 49-51).

During April, the Tectonics Section of the Peking Branch of the Geological Society of China held its first academic conference of 1962. At the meeting extensive discussions took place on several important theoretical problems in tectonics, and on the present trends and research methods in China's tectonic studies.

A) The structural characteristics of the Atlantic and Pacific Oceans

Based on the data now available we can say that the geological structure of the Atlantic and Pacific Oceans is absolutely different. The Pacific Ocean is a huge primary crustal structural unit, in which the sialic layer is either very thin or absent, and the total crustal thickness is small. Around its periphery are Mesozoic and Cenozoic folded mountain ranges, and on its western margin are the characteristic island arcs. There is an andesite line which is accompanied by deep ocean trenches. It is an area of violent earthquakes and recent tectonic activities. On the other hand, the Atlantic Ocean, which extends in a north-south direction, cuts across different structural lines of different ages on the two bounding coasts (European and American). There are no island arcs and there is no andesite line. Along its central belt there is a submerged mountain range whose strike direction is the same as the elongation of the Atlantic Ocean. The sialic layer under the Atlantic is comparatively thick and is approximately equivalent to that under the two bounding continents. These are facts which everyone recognizes. Sun Yu-Chu (1) pointed out that from the special features of paleontology it has been verified that both the Atlantic and Pacific Oceans existed in ancient times. The Atlantic Ocean's greatest marine transgression occurred in the Cretaceous period, since then it has been completely submerged under

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Translator's Notes:

(1) Sun Yu-Chu is a paleontologist, about 70 years of age. He was Professor of Paleontology at Peking University for more than 25 years, and was a close associate of Professor A.W. Grabeau. He is now Vice Director of the Institute of Geology of the Ministry of Geology\*, responsible for geological education. His specialized field is Paleozoic fossils of China.

\* There are two Institutes of Geology in China, one under the Ministry of Geology, and the other under the Academia Sinica. The former carries out geological mapping and does research on practical problems raised by the field teams, and the latter tackles special problems, but there appears to be considerable rivalry and over-lap between the two groups. For example, both groups have recently compiled "A Tectonic Map of China". The Academia Sinica's map being on the scale of 1:4,000,000 and the Ministry of Geology's map on the scale of 1:3,000,000.

the sea, and here none of the phenomena of continental drift has occurred. Wang Yüeh-Lung (2) pointed out that if we say the Pacific Ocean is primeval, then further argument therefrom, that it is perpetual and unchangeable, would be inaccurate. This is because the various parts of the earth's crust are all continuously changing, and the differences lie only in the amount and nature of the changes. The Pacific Ocean is no exception.

Many speakers at the meeting paid attention to the distribution of island arcs and their geological structural characteristics. Huang Chi-Ch'ing (3) considered that the deep oceanic trenches along the Pacific Ocean island arcs are frequently accompanied by high mountain uplifts, this fact and the conformity of the andesite line with the belt of earthquakes, suggest the existence in these areas of super deep faults which extend into the mantle (4). This kind of fault is one of the greatest characteristics of the oceans. Ch'ien Hsiang-Lin (5) also referred to the structure of island arcs. He pointed out some interesting problems: In the Pacific Ocean many island arcs are separated at their junctions by east-west trending structural lines. But an exception is the Mariana arc which directly intersects with the mid-point of the Japanese arc in the vicinity of Tokyo. Besides, in the Chinese coastal provinces of Chekiang and Fukien and other places, there were violent volcanic activities in Mesozoic and Cenozoic times. Did they have any connection with the extension of the Japanese arc towards the southwest? On the subject of the structural features of the Atlantic, the Pacific, and continental margins, Chang Wen-Yu (6) presented some new opinions. He pointed out that in the

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- (2) Wang Yüeh-Lung is a geologist, about 60 years of age. He was long associated with the former National Geological Survey of China, and is now with the Institute of Geology of the Ministry of Geology. His main interests are general geological surveying, and ore deposits.
- (3) Huang Chi-Ch'ing (T.K. Huang) is a structural geologist about 60 years of age. Formerly he was Chief Geologist and Director of the National Geological Survey. Now he is one of the Vice Directors of the Institute of Geology, of the Ministry of Geology. His special field is the tectonics of China, and petroleum geology. He is the author of the book "On Major Tectonic Forms of China" and several other papers of a high academic standard on the tectonics of China. He has a high international reputation as a structural geologist.
- (4) The term used for mantle in this article is "earth-meat". In a footnote the authors of the paper explain that there has been some confusion in China on the translation of the term "mantle" into Chinese. Some geologists have used "earth-curtain" but because the mantle lies between the "earth's core" and the "earth's skin", they prefer to use Professor Chang Wen-Yu's term - "earth-meat".
- (5) Ch'ien Hsiang-Lin. I can find no bibliographic material on this man. Presumably he is not one of China's senior geologists.

newly compiled Soviet 1:10 million tectonic map, two independent units, the Pacific Ocean type, and the Atlantic Ocean type are differentiated. This he felt was independent corroboration of the Chinese view point. Moreover, he recognized that with respect to the recent stress field, the Pacific Ocean has been subjected to the effects of compressional forces and the Atlantic Ocean has been subjected to the effects of tensional forces. The widespread, large amplitude sinking of the Pacific has been accompanied by local emergence phenomena. For example, on the western coast of America there are huge uplifts approximately parallel to the Coastal Ranges. These uplifts are cut across by approximately x-shaped transverse and oblique faults. He further pointed out that it appears that although island arcs are curved, they are actually the folded form of the overburden, and the formation of island arcs is controlled by basement faulting. It is possible that the andesite line might be the product of the mutual action of the continental and oceanic crusts.

B) Surface distribution of structural lines, and the mutual relationship between the formation of folds and faulting.

Wang Yüeh-Lung recognized that students of tectonics at the present time can be divided into two schools: one school is the "linear" school, and the other is the "curved" school. The former, from the view-point of lineation, consider that structures of any kind are all triangular or polygonal shaped, and folding is derived from faulting. The latter consider that continental mountain ranges, plains, oceanic islands, etc., all have a circular, oval or arcuate shape; all structures are curved, and there are inlaid structures. Actually some structures are linear and others are curved. Huang Chi-Ch'ing held an opinion fundamentally similar to the aforesaid view-point and pointed out that the manifestations of linear and arcuate structural lines on the surface of the crust are different.

With regard to the relation between the formation of folding and faulting T'ien Ch'i-Tsun (7) considered that deep faulting is often produced at the junction of rising and sinking areas, and is induced by tensional forces. This kind of rising and sinking movement, which is connected with the activity of material in the mantle, proceeds very slowly, and the formation of faults is such that they develop gradually towards greater depths. Geosynclines may also be produced in this way. He emphasized that he could not agree with the view-point held by many scholars that

- (6) Chang Wen-Yu is a structural geologist, about 55 years of age. He is Vice Director of the Institute of Geology of the Academia Sinica, and is in charge of the laboratory of Structural Geology and Tectonophysics. His special interest is in the tectonics of China.
- (7) T'ien Ch'i-Tsun is a stratigrapher and paleontologist, aged about 60. He was Director of the former Provincial Geological Survey of Hunan Province. He is now with the Institute of Geology with the Ministry of Geology. His special fields are the geology of Hunan Province, and the Devonian stratigraphy & paleontology of China.

first there are faults and later there are geosynclines. The order of events should start with geosynclinal down-warping and uplift and only then can there be faults. Subsequently, but at an early period in the development of geosynclines, a considerable thickness of spillites, quartz porphyries and other extrusive magmatic rocks are produced along the faults. This indicates that at that time the faults were not yet covered by overburden. Afterwards, due to the continued sinking of the geosynclines and the accumulation of sedimentary material to form overburden, the faults became covered, and therefore basic or ultra basic intrusive bodies were formed. In any case, we cannot indiscriminately consider that all geosynclines must be related to former deep major faults; at present we still lack proof. He subsequently pointed out that he similarly could not agree with many peoples' opinion that folding is controlled by faulting. There are many field examples which show that folding occurs first, and then is followed by the formation of strike slip faults, reverse faults and transverse faults.

Chang Wen-Yu said that from the point of view of mechanics, the general procedure in the deformation of rocks is from plastic deformation to fracturing, i.e. from folding (plastic deformation) to faulting. He emphasized that the structural development processes of the basement and overburden should not be mixed up. Although both are from folding to faulting, they belong to two structural stages. After the basement rocks have hardened (which can be approximately compared with work hardening in the mechanics of materials) they assume a protective effect on the overburden. The application of stress then causes the basement to fault and the overburden to fold. At this phase in the entire development process there appears the phenomenon of the control of overburden folding by basement faulting, just as the Soviet scholar A.V. Peive suggested. It is impossible to deny the objective existence of this fact. If the stress is increased further still, then it will result in the production of faults in the overburden. It is possible that these faults are not only the continuation of basement faults, but also are controlled by the effect of the overburden folding, depending on the actual geological conditions existing at the time and place of their formation. Not only must we consider the continuous development and continuity of structures, but also we must distinguish between their phases and consider their discontinuity. Only in this way can we have a full understanding of the structural development process.

C) The relations between horizontal and vertical movements; and other problems.

These problems, which have been debated for a long time, also received the attention they deserve, at this meeting. For example, Wang Yüeh-Lung pointed out that there also existed fundamental differences between the structural geologists of the "linear" school and those of the "curved" school on the relationship between horizontal movements and vertical movements. The former only recognize vertical rising and sinking movements and consider horizontal movements to be secondary and derivative. On the other hand the latter consider that crustal structural movements are mainly

horizontal movements and that vertical movements are secondary. They excessively emphasize the importance of horizontal movements - to the extent that they hardly recognize vertical movements at all.

Ch'ien Hsiang-Lin referred to the fact that horizontal movements had occurred in both the Alpine and Caledonian folded belts. He considered that although at the present time both the "horizontal" and "vertical" schools pay attention to the physical and chemical conditions of the material in the interior of the earth, due to their different starting points, their conclusions are not the same and they may even be fundamentally opposed. The "horizontalists" emphasize the convection of the material in the deep places, whereas the "verticalists" emphasize the role of differentiation of material. He also pointed out that when the analytic methods of rock facies, rock formation, etc. of classical tectonics are used, then it should be especially noted that the crustal movements of every geological period, both vertical and horizontal, are all manifested through the differentiation, transportation, and deposition of geologic material. To judge the intensity and amplitude of vertical rising and sinking movements simply from the thickness of sedimentary rocks is not thorough, and is unreasonable.

Wang Yüeh-Lung said that the earth is continuously revolving around the sun and is related to the movements of the other planets in the solar system; it is also rotating about its own axis. Therefore crustal movements must be very complex. Apart from vertical and horizontal movements, there are also tangential movements produced by the earth's rotation. Also, the conditions of crustal movements all over the globe, from the equator to the poles, are different.

Many speakers especially emphasized that the investigation of the types and causes of crustal movements is a difficult and complicated problem. Not only must the effect of external causes be considered, but even more important, the conditions in the earth's interior must be considered. Special attention should be given both to the characteristics of the material which constitutes the mantle under high temperatures and pressures, and also to the manner of movement of this material. Huang Chi-Ch'ing pointed out that the significance of research into the structure of the upper parts of the mantle lies in the fact that the activity and change of the material there, directly influence the movements and changes in the earth's crust; and it is not the crustal movements which directly influence the activity of the mantle material. T'ien Ch'i-Tsun held a similar viewpoint. He emphasized the importance of the theory of isostasy, and considered that there is an uneven distribution in the earth's crust of the sial and sima. The variation in depth to the 'Moho' discontinuity is also related to the effects of isostatic adjustment in the mantle material. Deep ocean trenches on one side of island arcs, large-scale crustal up- and down-warping, formation and rejuvenation of geosynclines, etc., are all due to the effects of equilibrium adjustment in the mantle material.

Chang Wen-Yu considered that the earth's rotation and its expansion and contraction are the main factors in the production of a structural stress field. (The general development process of

the earth consists mainly in contraction, with expansion as secondary; but the expansion and contraction of the core, mantle and crust is uneven). In this unified stress field vertical and horizontal forces exist at the same time - they are two aspects of a unified force of action, changing with time, space, and conditions. At a certain time, in a certain place, and under certain conditions, some forces are manifested mainly in the form of horizontal movements, and some mainly take the form of vertical movements

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At the meeting an enthusiastic discussion on China's present day tectonic research trends and methods was also carried out. All the participants considered that in recent years China's tectonic research has developed comparatively rapidly, with much work being done and certain accomplishments achieved. But shortcomings are evident, for example: The "practical spirit" (8) has not been fully developed; There is insufficient basic work being done on micro structures and stratigraphy, and as a result several mistakes have been made in the classification of structural units in some regions; Only continental areas have been studied; There has been insufficient development of work on deep exploration, etc., etc..

Relevant to these shortcomings the participants suggested many valuable proposals about the central problems for future research and the research methods themselves.

The main problems are:

- i) Intensify study of the oceans, especially geological structural studies of China's continental shelves and shallow water areas.
- ii) Continuously accumulate deep exploration data and carry out high temperature, high pressure experiments in order to lay down a solid foundation for the development of geological research on the earth's interior.
- iii) Develop China's Mesozoic and Cenozoic structural studies.
- iv) Carry out a study of the geological characteristics of, and the mutual relationship between, the Pacific belt and Mediterranean belt.

With regard to research methods, Chang Wen-Yu again emphasized the importance of co-ordination and combination of the following sets of analytic methods: The analysis of geologic history with the analysis of geomechanics; The analysis of rock

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(8) The phrase which I have translated as "practical spirit" is an old Chinese saying which Mao Tse-Tung has promulgated.

formation with the analysis of rock re-formation; The analysis of formation with the analysis of deformation; The analysis of overburden structures with the analysis of basement structures. He also said that attention must be paid to model experiments and that tectonics must be established on the foundation of the research on small scale structures. Research steps must be: from near to far, from shallow to deep, from surface to interior, from new to old. Huang Chi-Ch'ing, Hsieh Chia-Yung (9), Sun Tien-Ch'ing (10), and others, pointed out that tectonics is a subject which deals with the movements, changes, and development of the crust, from different angles and sides. Therefore first of all we must accumulate data from many different fields - stratigraphy, paleontology, structural geology, geomechanics, geophysics, geochemistry, and even astrophysics. Afterwards these data must be organically connected with each other in order to obtain rules. This is the first step. The next step is to search for an explanation of the origin of crustal movements, and other theoretical problems.

Finally everyone expressed their hope that all departments concerned would strengthen their co-operation; would exchange information and data, would strive to collect important foreign scientific literature, would raise the standard and quality of regional survey work, and would concentrate some talent to carry out composite analysis, to discover problems and develop theoretical work. After striving for several years we will even further advance our country's tectonic research work, and for the cause of the fatherland's reconstruction, we will make even more contributions to the search and forecasting of mineral deposits and to the foundation problems in engineering projects.

(Remarks: This report is based on the corrected notes of the meeting. They have not been read by the speakers, therefore it is quite possible that there are omissions, or their original meaning may not have been apprehended correctly. These faults are the responsibility of the writers.) (11)

Chang Pu-Ch'un (12)  
Chang Chiu-Hai (13)

- (9) Hsieh Chia-Yung is an economic geologist in his late 60's. In pre-1949 days he was Professor of Economic Geology at Peking University. He now works for the Institute of Geology of the Ministry of Geology. His special field is ore deposits, but he has also worked on the tectonics of China, particularly in its relation to mineral deposits.
- (10) Sun Tien-Ch'ing is a structural geologist about 50 years of age. He is Vice Director of the Institute of Geomechanics of the Ministry of Geology. His special fields are tectonics and Quaternary glaciation.
- (11) This apology is humbly echoed by the translator.
- (12) & (13) Chang Pu-Ch'un and Chang Chiu-Hai. I can find no bibliographic data on these two recorders of the meeting. Presumably they are young geologists.