Some Recent Developments in Geoscience in China

Cheng-siang CHEN and Kam-nin AU*

With geography and geology as its backbone, geoscience or earth science is one of the sciences that has made the fastest development in China. As it touches on the nation's security, geography in particular, the research results are seldom released to the public. In recent years quite a number of foreign scientists visited China, but they did not have the opportunity of meeting Chinese geoscientists. In other words, at present Chinese geoscientists, unlike experts in the fields of physics, mathematics, astronomy, and engineering, do not make public appearances. Among the scientific journals which have resumed publication after the Cultural Revolution, only *Tili Hsüehpao* (*Acta Geographica Sinica*) and *Tichih Hsüehpao* (*Acta Geologica Sinica*) are not available outside China. Furthermore, *Acta Geographica Sinica* is under stricter control.

Because of the close relationship between geography and geology, in some of the most important comprehensive universities in New China, including Peiching University, Lanchou University, Hangchou University and Chungshan University in Kuangchou, geography and geology form a joint department, called the Department of Geology and Geography. Some central organizations such as the State Bureau of Surveying and Cartography under the State Planning Commission also serves both geography and geology. But generally speaking, the development of geology in China is obviously much faster than that of geography, while the academic institutions concerned are more numerous than those of geography and the number of trained professionals is far greater than those of geography.

The nation-wide academic institutions of geoscience usually belong to either the State Planning Commission of the State Council or the Chinese Academy of Sciences (Academia Sinica) and the Central Military Commission. For example, the State Bureau of Geology and the State Bureau of Surveying and Cartography are under the State Planning Commission while the Institute of Geography, the Institute of Geology, the Institute of Geology and Palaeontology, the Institute of Geophysics, the Institute of Geochemistry, the Institute of Geodesy and Geophysics, the Institute of Pedology, the Committee of Quaternary Research and the State Bureau of Seismology belong to the Chinese Academy of Sciences. The Chinese Academy of Sciences is a very large organization including many research institutes which have branch institutes in various provinces, municipalities

* Dr. C.S. Chen is professor of geography and director of the Geographical Research Centre in the Graduate School of the Chinese University of Hong Kong. Mr. K.N. Au is head of the Geography Department, Grantham College of Education, Hong Kong.

and autonomous regions. During the Cultural Revolution through the public appeal of "simplification of organizational structure", quite a number of research institutes were combined or closed. But in recent years, they are gradually being reinstated. Furthermore, some institutions, which had more or less ceased operation owing to the personnel having been sent to the rural areas for training, have now resumed function. Although these institutions are mostly located in Peiching, there are a number in other major cities such as Shanghai, Wuhan, Nanching, Hsian, Lanchou, Shenyang and Kuangchou.

Because of the important role played by geological science in economic construction, China had earlier set up a large-scale Ministry of Geology under the State Council, including many important affiliated research organizations, such as the Academy of Geological Science, the Institute of Geomechanics,[1] the Institute of Geophysical Prospecting, the Institute of Hydrology and Engineering Geology, the Institute of Mineral Resources. Such ministry of geology rarely exists in the government organizations of other major countries in the world. The most pre-eminent geologist Prof. Li Si-kwong used to be the head of this Ministry. In 1969 the government advocated simplification of organizational structure, abolished the Ministry of Geology, and combined its work with the successive State Bureau of Geology, but all the important research institutions still remained. In addition, there was an Institute of Geology in the Ministry of Metallurgy and the Ministry of Fuel.

The fact that both the Academy of Geological Science and the Institute of Geomechanics coexisted in the Ministry of Geology reflects a trend in the division of labour in geology, and this division of labour is related to the greater value of direct application inherent in geology. Geomechanics advocated by the late Prof. Li Si-kwong, had made contributions to the discovery of Tach'ing oilfield and promoted the rapid development of petroleum industry in China. That Chairman Mao Tse-tung invited Prof. Li to sit by his side to watch a Peiching opera is regarded as the highest honour in Peiching. In order to develop geomechanics, the Chinese Government had set up this specific research institute as early as 1956.

The setting up of the State Bureau of Seismology as a separate department shows that the government has given special attention to the close relationship between earthquakes and construction projects.[2] In recent years many technologi-

1) According to an article published in No. 5, 1974 issue of *Scientia Sinica*, it seems that the Institute of Geomechanics is now subordinate to the Academy of Geological Science.

2) During the Great Leap Forward a large scale hydro-electric power station was built on Hsinfengchiang in Hoyüan Hsien of Kuangtung Province. The dam measures 105 metres high and 440 metres long, with a capacity of 11,500 million m^3. A month

cally advanced countries have sent delegations to China one after another to study earthquake forecast and exchange experiences. Again this shows that seismological science in New China, especially in the field of earthquake forecast, has made very outstanding achievements. Since 3,800 years ago, there had been official earthquake records in China. China's earliest Chronicle, *Chushuchinien* (竹書紀年) recorded that "in the 9th year of the reign of King *Fa* (1831 B.C.) of Hsia dynasty, *T'aishan* quaked." The earliest description of earthquake conditions was given in the 2nd year of the reign of King *Yu* (780 B.C.) of the Chou dynasty about severe earthquakes in Shenhsi. Volume 4 of *Choupenchi* (周本紀) in *Shihchi* (史記) contains the following description: "During the 2nd year of the reign of King *Yu*, Sanch'uan of western Chou all quaked. *Peyang Fu* (伯陽甫) said that the Chou dynasty would be exterminated? This year, Sanch'uan dried up and Ch'ishan collapsed." Besides, in *Shihching* (詩經) there are also descriptions of the swelling up of river water, quaking of ground and tremoring of mountains during sudden occurrence of earthquakes; and how high mountains became valleys, while valleys rose up as highlands. Since 1401 B.C. the Central Government of China had appointed officials in charge of recording major state affairs. It was the belief of the imperial court of all dynasties that earthquakes were "commandment of the Heaven" and they were related to the rise and fall of the imperial court. Hence the officials kept detailed records of earthquakes. The written records in Chinese history cover some 4,000 years. There are many descriptions about earthquakes in history books. Elsewhere many descriptions are given in *fang-chih* or local gazetteers.[3]. The new government of China advo-

after, in October 1959, the reservoir began to store water, the Kuangchou Seismological Station located at 160 km south-west of the dam began to record seismic activities of the reservoir region. Since then, following the rise in the water level, earthquakes became more frequent subsequently. This shows that there is close temporal and spatial relationship between the completion of the reservoir and the occurrence of earthquakes. In October 1960 construction of a seismic station began. After July 1961 a network of observation stations was finally set up. The Central Government instructed the ministries concerned, especially the Ministry of Geology, to form a geological survey team to prepare a 1:50,000 map to show the structural geology of Hoyüan area. The late minister Prof. Li Si-kwong personally visited there twice. In view of the significant relationship between construction projects and earthquakes, it was decided to set up a State Bureau of Seismology. Thereafter severe earthquakes occurred at Hsingt'ai in Hopei Province, Yangchiang in Kuangtung Province, and Tali in Yünnan Province. Hence seismic teams were set up in various large administrative areas to share the responsibilities among different provinces and regions under their administration, and to set up several seismic stations to undertake systematic seismological research and seismic forecast.

3) The book *T'aip'ingyülan* (太平御覧) published in early Northern Sung dynasty contains some 40 items of seismic records. This is the first book in China to list seismic records chronologically. *Wenhsient'ungk'ao* (文献通考) published in the early Yüan dynasty and *Hsüwenhsient'ungk'ao* (続文献通考) published in the Ming dynasty contain some 500 items of descriptions concerning earthquakes. *Kuchint'ushuchich'eng* (古今図書集成) published in early Ch'ing dynasty lists 600 items of seismic records.

cates "application of old things for modern purposes" and makes use of these valuable earthquake records to study the distribution and frequency of earthquakes throughout the history of China. They have significant reference value for the development of the present seismological science and the construction of factories and mines.

In the early period of the founding of the People's Republic, organizations for seismological studies were expanded almost immediately, and working staff were strengthened. At first they perused 2,300 kinds of history books, 5,600 kinds of *fang-chih*, and collected 15,000 items or records concerning earthquakes. Basing on the date of occurrence of the earthquakes, and after the locations have been ascertained, they are arranged in chronological order and are systematically studied by provinces and regions. Among them some 9,000 destructive earthquakes were brought out, and after more precise analysis, isoseismal maps were drawn. For example, in the 7th year of the reign of Emperor K'anghsi (1668) of the Ch'ing dynasty, the severe earthquake occurred in T'anch'eng of Shantung Province was one of the most severe earthquakes in the history of China, which affected some 400 hsien and even the boats in Changchiang (Yangtze) were damaged. All the hsien affected were recorded in the hsien gazetteers. Isoseismal maps compiled from these 400 odd records and on the basis of the degree of damage done reveal clearly the locations of the earthquakes and their intensity. China is the only country in the whole world to have such complete earthquake data. The former regime did not make use of them. As the new regime utilizes them the seismological science has made rapid and outstanding achievements.

The two volumes of *Historical Materials on Earthquakes in China* and the one volume of *Earthquake Atlas* are the preliminary reports of this research work. Since then fruitful results are no longer released to the outside. Similarly, in recent years the geographical profession in China uses rich historical records to make many interesting studies of practical reference value, including climatic fluctuations; but due to space limitation it is not possible to give an account here.[4] This kind of research is basically impossible to carry out in those countries with a short history.

Although the administrative divisions above the provinces, municipalities and autonomous regions have been abolished, yet the specific research institutes of geoscience set up in various regions still exist. They include Northern Institute of Geological Science set up in Tienchin, Northwestern Institute of Geological

4) Chu Ko-chen, "A Preliminary Study on the Climatic Fluctuations during the Last 5,000 Years in China", *Scientia Sinica*, No. 2, 1973; Chen Cheng-siang, "Geographical Evaluation of the Chinese Fang-chih", inaugural address of the Chair of Geography at the Chinese University of Hong Kong, Chinese University of Hong Kong Press, 1965.

Science in Hsian, South Central Institute of Geological Science in Ichang, Northeast Institute of Geological Science in Shenyang, South Central Institute of Geography in Kuangchou, and Northeast Institute of Geography in Changchun.

Various provinces, municipalities and autonomous regions have set up Bureaus of Geology under which there are many geological teams responsible for general survey and prospecting work on regional geology and mineral production, as well as special survey concerning hydrological projects, civil engineering projects, seismology, geomorphology and geo-structure. In addition, there is an Institute of Geological Science at the same level as the geological teams in administrative management, but of a leading position in scientific techniques. The large, important geological bureaus in the provinces, municipalities and autonomous regions have more than 10,000 workers. For example, Kuangtung Province has set up 703, 704, 705, 706, 723, Hainan, Chaoch'ing, Chanchiang and Shant'ou geological teams, and regional survey teams, a central laboratory, a geological school, No. 1 hydrological team and No. 2 hydrological team. Below the teams there are subteams. The Institute of Geological Science in Kuangtung Province has a director, a deputy director, and a chief engineer, whose subordinates are the sections of fundamental geology, mineral resources, information, geophysics and chemical prospecting, with about 200 members of staff, and publishes *Geological Technology of Kuangtung* for exchange with related research institutions in the country.

As regards education in the higher colleges and schools, apart from the geology and geography departments in the above-mentioned, well-known comprehensive universities, the regional universities have only established either geography departments or geology departments, such as the Geology Department of Nanching University, the Geology Department of Northwest Unviersity, the Geology Department of Chungching University, the Geology Department of Kunming Technical Institute, the Geology Department of Nankai University in Tienchin, the Mining and Geology Department of Chinan University in Kuangchou, the Geology Department of Kueichou Technical Institute, the Petroleum Geology Department of Szechuan Petroleum Institute in Nanchung, the Petroleum Geology Department of Northeast Petroleum Institute in Shenyang, the Geology Department of the Institute of Mining in Hofei, the Coal Geology Department of the Institute of Mining in Peiching, and the Geology Department of South Central Mining and Metallurgical Institute in Changsha. However, the normal universities and normal colleges in various places mainly have geography departments but no geology departments. For example, the well-known ones are the Geography Department of East China Normal University in Shanghai and the Geography Department of Peiching Normal University. In the teaching of geology, there are a number of

special colleges of geology, including Peiching College of Geology, Changchun College of Geology, Chengtu College of Geology, and the newly established Hopei College of Geology, which also have trained many professionals in geology.

The activities in field work constitute another outstanding feature of the rapid development of China's geoscience in recent years. China has a diversified physical landscape with the world's highest peak, deep depression, typical loess, vast deserts, huge glaciers, large marshes, extensive karst landforms, and tropical rain forests. There are many objectives for observation. Improved communications, and political unification have enabled the geoscientists to do freely what they like. This is quite contrary to the situation in former times. These field investigations have grown in ever greater numbers and the topics have become more and more diversified, especially in the remote frontier regions, but the results are so far not disclosed.

Just to take the region around Mt. Jolmo Lungma as an example. In 1960 the Chinese mountaineers climbed up the highest peak from the northern slope for the first time. During the period of mountaineering activities, *i.e.* from 1959 to 1960, a scientific investigation team undertook extensive survey on the northern slope of Mt. Jolmo Lungma and collected a lot of information in the field of hydrology, meteorology, glaciology, and geomorphology. In 1964 the scaling of Mt. Hsiapangma and the scientific observations of the region provided new insight into the recent glaciers and ancient glaciers of the quaternary period in the vicinity of the peak. In the period 1966–68 the Academy of Sciences again organized an investigation team to carry out comprehensive, multi-disciplinary scientific observations to the west of Yatung, east of Chilung and south of Yalutsangpuchiang, in an area of 50,000 km^2 surrounding Mt. Jolmo Lungma at some 7,000 metres above sea level. As regards recent glaciers and related problems, more thorough study and observations were undertaken and unique features of the highland glaciers in the low latitudes were discovered.[5] In this respect, the Institute of Glaciers, Tundra and Deserts of the Academy of Sciences stationed at Lanchou has achieved very outstanding performance.

The deserts and the Gobi in the northwest and north of China cover an area of 1,095,000 km^2 (of which deserts cover 637,000 km^2 and the Gobi 458,000 km^2), which constitutes about 11.4 per cent of the total area of the country, or about 2.9 times the area of Japan. After the power of the great T'ang empire had declined, the deserts were no longer tamed. Since then the situation continued to deteriorate and wherever the sand had advanced the people were obliged to retreat. As

5) The Research Section of Glaciology, Lanchou Institute of Glaciers, Tundra and Deserts, Academy of Sciences, "Basic Characteristics of the Glaciers in Mt. Jolmo Lungma Area in the Southern Tibet, China", *Scientia Sinica*, No. 4, 1974.

regards scientific research and study, nothing had been done. There were only some scattered and trifling data left by foreign explorers. After the founding of the new government, emphasis was placed on the transformation and utilization of the deserts. The various nationalities and the Construction Corps[6] in the deserts upheld the spirit of self-reliance and hard struggle to dig canals for irrigation, to plant trees for afforestation, to control the sand for protecting the fields, and to stop the windblown sand for opening up vast areas of farmland in the deserts and the Gobi, so that the landscape of the desert regions has been transformed markedly.

As regards scientific research, the Chinese Academy of Sciences first founded a special institution for desert study (the Sand Control Team of the Academy of Sciences, later renamed Desert Research Section of the Institute of Glaciers, Tundra and Deserts) which together with various production departments and colleges undertakes scientific observations and experimental research on deserts to find out certain basic characteristics and pattern of the natural resources and physical conditions of the deserts in China, so as to fill the gap in the desert science of China.[7] Aerial topographic maps at the scale of 1:100,000 were used to produce China's desert distribution maps at the scale of 1:1,000,000.

To the south of the desert belt is the loess region which was the cradle of Chinese civilization. With special geographical landscape and covering a total area of 635,280 km^2, (excluding North China Plain and the loess-like rocks of the Changchiang Basin) it constitutes 4.9 per cent of the world's total area of loess and loess-like rocks. The loess in China is widely distributed, well developed and most typical. Hence it is the most typical area for the study of loess in the whole world. In order to meet the requirements for production construction and theoretical research, the Quaternary Geological Research Section of the Institute of Geology in the Academy of Sciences and the Geomorphology Section of the Geology and Geography Department at Peiching University decided to carry out a study of loess and loess-like rocks in various places of China and to produce a loess distribution map of the whole country. Basing on the results of this research, Liu Tungsheng wrote a book entitled *Loess Deposits of China* in 1963, which is the most important work on loess in China at present.[8]

6) The organization of such corps was intended to serve a double purpose: to preserve a massive fighting force alert against any possibility of war and to reinforce the frontier area in the form of mass settlement. The members of these corps were mostly soldiers who were demobilized under a programme of streamlining the army so that the state might be less burdened with a massive standing army and huge military spending.

7) Desert Research Section of Lanchou Institute of Glaciers, Tundra and Deserts, Chinese Academy of Sciences, *A General Study of the Deserts in China*, Science Press, 1974.

During the period 1955–1958, the Quaternary Geological Research Section of the Institute of Geology in the Chinese Academy of Sciences made a study of the loess in various places of the middle course of Huangho; compiled a draft map of the loess distribution in the middle course of Huangho; and in 1964 it published *A Survey Report on the Quaternary Geology of the Huangho Middle Course.* Besides, the Geomorphology Section of the Geology and Geography Department at Peiching University had also carried out a number of researches on the loess in Shanhsi, Shenhsi and Kansu Provinces. On top of this basis, in 1959 the Quaternary Geological Research Section also carried out supplementary survey of the Huangshui Valley and Ch'aitamu Basin in Ch'inghai Province, the Hoshi Corridor in Kansu Province, the eastern and northern parts of Shantung Province and the northern part of Hopei Province to collect a large amount of practical data on the loess and loess-like rocks in various places. For the other areas such as the Northeast and Hsinchiang, information was derived from the comprehensive geological maps, hydro-geological maps, and quaternary geological maps held by colleges, seismological teams, and provincial geological bureaus of the Ministry of Geology. Basing on such information, draft maps were produced from the base maps at the scale of 1:1,000,000. Then in September 1959 they were reduced to the scale of 1:2,000,000 and after partial revision, they were published at the scale of 1:4,000,000.

The most fundamental and outstanding development in meteorology and climatology in China is the great increase in the number of weather stations which include many high mountain weather stations. In recent years photographs of China's high mountain weather stations such as Huang Shan, Hua Shan and Ch' angpai Shan, appear occasionally in newspapers and magazines. Although the total number of weather stations in China is not known, yet the following example may shed some light on this matter. According to a report of China News from Nanning on 10th June, 1973, Kuanghsi Chuang Autonomous Region had already set up a network of weather stations at various levels from the autonomous region to production brigades, which acted as "consultants" for agricultural and fishery production. At present the entire autonomous region has already established 98 weather observatories and stations. There are weather observatories in each region (originally called special district) and weather stations in each hsien. There are altogether 1,200 professionals. The people's communes and production brigades have set up weather outposts and some 2,000 weather units. In Old China there were only 4 poorly equipped weather stations in Kuanghsi with 15

8) Liu Tung-sheng, *Loess Deposits of China*, explanatory pamphlet for the loess distribution map of China, Institute of Geology, Chinese Academy of Sciences, Science Press, 1965. Liu Tung-sheng *et al. Composition and Structure of the Loess*, Science Press, 1966.

members of staff.

Following the development of meteorological work, it is necessary to bring up observation staff who have to undertake scientific training since they are very young. Now primary school pupils, under the guidance of their teachers, learn the functions of weather instruments and the methods of using them. This was not done in the past. The Weather Station of Little Red Guards reported in Ta Kung Pao on 24th May, 1974 is described as follows: "With the support of the school, the Weather Station of Little Red Guards was set up in 1964 by the Little Red Guards of Lucky Road Primary School at Hungchiangchen in Ch'ienyang District of Honan Province. The Little Red Guards who took part in weather observations, under the guidance of the teachers, insisted on making observations of weather changes thrice daily in the morning, at noon, and in the afternoon. The work continued for 10 years without interruption. Through these activities in weather observations, the Little Red Guards have acquired much knowledge about natural science, and have cherished the good habits of an ardent love for science and labour."

China's meteorological work has been developed out of the Central Weather Bureau which functions as the nucleus. The Central Weather Bureau is subordinate directly to the State Council. In the administrative system, it is equivalent to a ministry, under which is the Institute of Meteorology. There are weather bureaus in the provinces, municipalities and autonomous regions. In the more important localities there are local institutes such as Shenhsi Institute of Meteorology in Hsian. The Chinese Academy of Sciences also has an Institute of Meteorology. In addition, Shanghai has an Institute of Meteorology and Geophysics which lays more emphasis on theoretical research. Nanching seems to be an important centre of meteorological science in China. In 1963 the Department of Meteorology at Nanching University became an independent college named Nanching College of Meteorology.

What the outsiders are most concerned about appears to be the development of map making in New China. As far as the experience of the first author of this paper goes, whether on occasions of international conferences or in letters of enquiries from friends, the most frequently raised question is about various maps published in China. Because of the foreigner's excessive "concern", China has undertaken very strict measures to keep maps in secret. In recent years maps which are allowed for export consist only of 1:4,000,000, 1:6,000,000 and 1:9,000,000 maps of the People's Republic of China which are all published by the Cartographic Publishing House. Other more important maps of a larger scale are all not available to the general public.

China is originally the world's most advanced nation in map making. In the early years of the Chou dynasty, in order to build the wall-city of Loyang, people

were sent out first to undertake reconnaissance for planning purpose. Recently China's earliest extant waterway map — the source of Hsiang Chiang and Li Chiang — was unearthed in the Han tomb at Changsha. P'ei Hsiu (223–271) of the Chin dynasty and Chia Tan (729–805) of the T'ang dynasty were also the world's most outstanding cartographers. But during the dark age of the last two centuries, China's cartography like other sciences was deeply buried in humiliation, and was either intentionally or unintentionally ignored by Europeans. At present the popular books and articles on cartography can only be regarded as European cartography. If the world's cartography, especially the history of cartography, is to be written seriously, all must be written anew.

It is a fact that old China did not have good maps and as a result we had all suffered greatly from it, while the government had also made itself a laughing-stock.[9] During the early stage of the founding of the People's Republic, because of the pressing need for economic and national defence construction, priority was given to the development of mapping. In a short period quite a large State Bureau of Surveying and Cartography was established. Bureaus of surveying and cartography were set up in all provinces, municipalities and autonomous regions to undertake surveying and drawing of topographic maps of all provinces, municipalities and autonomous regions. Below the State Bureau of Surveying and Cartography there are the Institute of Surveying and Cartography (Peiching) and the Colleges of Surveying and Cartography (Wuhan, Shanghai and Changchiak'ou). Furthermore, secondary professional schools in various places, such as the Schools of Geology at Nanching, Hsian, Changchun and Chungching all have established surveying and mapping professions to train a large number of surveying and mapping personnel.

Prior to 1956 when the new topographic maps were not yet available, topographic maps at the scale of 1:50,000 and 1:25,000 of some areas produced by Kuomintang government and Japanese army were used.[10] These old maps are very simple and the sheets are not divided in accordance with the international

9) In 1938 the Kuomintang army was defeated in the war of defence on the outskirt of Wuhan. At that time the shells fired by artillery bought from Germany and Italy had always not been able to hit the Japanese army. A probe into the matter afterwards revealed that the scale of the military maps was wrong ! It was reported that Chiang Kai-shek in a moment of anger had shot dead several high officers concerned in succession.

10) Prior to the publication of the new topographic maps, for certain remote frontier areas, *e.g.* Hsinchiang, aerial photos were used as topographic maps or drainage maps were used in place of the topographic maps. At that time the aerial photos of Hsinchiang were taken by the Soviet Union while the drainage maps were drawn from aerial photos.

system, and they are mostly in one colour. Rivers in blue were added to individual sheets or those areas surveyed by photogrammetry are superimposed in red. The method of representing relief, surface features was simple. Apart from cities, settlements, and the zone along the principal communication lines which are more accurate, other areas, especially mountain areas are all inaccurate and there are grave errors in distances and relative positions. Moreover, many unsurveyed places are left blank. Now these old maps are no longer in use throughout China. New topographic maps are available, but the control on them is very strict.[11]

The new topographic maps at the scale of 1:50,000 and 1:25,000 compiled by the State Bureau of Surveying and Cartography of the People's Republic of China are very accurate and well printed, being equal to the best topographic maps of the same scale in the world. These new map sheets are all divided in accordance with the international system and are multi-colour (usually seven colours)[12]. The relief, surface features, distances and relative positions are accurate. The precision in the representation of complicated landforms is very high. The interval of the contours is 5 metres for the 1:50,000 topographic maps and 2.5 metres for the 1:25,000 topographic maps. Special symbols are used to show meanders, oxbow lakes, old meanders and waterways to the deltaic landforms. They are very clear and easy to read. Since 1956 they have been made available for use throughout the country. The year of completion for various areas is not the same. As far as Kuangtung Province is concerned, these two kinds of topographic maps have all been published by 1962.

Besides, there are topographic maps at the scale of 1:100,000 and 1:200,000 but they are not widely used. The 1:100,000 topographic maps are basically reduced compilation of the 1:50,000 topographic maps. Generally, they are used as the base maps for preparing the 1:200,000 geological maps. Each map covers

11) The threat of being invaded and interfered with which confronts China is not yet really over. These large-scale maps are very detailed and accurate, for example, the width of the river cross-section, the depth, direction of flow, discharge, and crossing characteristics — whether they can be crossed on foot or by ferry — and even the condition of the landform and surface features, such as natural overhanging rocks or man-made outcrops, earth tombs or stone tombs can all be read out from the maps. Because of national security these maps have to be put under strict control.

12) The seven colours are black, blue, green, brown, dark brown, yellow and red. The map outline, notes, meridians and parallels, settlements and names, railways and various landforms and features are in black; rivers, lakes, seas, marshes and their names in blue, while the depth of the sea is differentiated by line shading; contours showing relief and elevation figures are in dark brown; mountain highlands, natural and artificial rock outcrops in brown and elevations are differentiated by line shading; vegetation cover, forests, grasslands in green; plains, terraces and tablelands in yellow; roads, provincial, regional and international boundaries and cities in red; the snow clad areas above the permanent snowline are in white.

30′ of longitude from east to west and 20′ of latitude from north to south. The 1:200,000 topographic maps are reduced compilation basing on the 1:50,000 and 1:100,000 topographic maps to serve as topographic base maps for the final 1:200,000 geological maps. Each sheet measures 1° of longitude from east to west and 40′ of latitude from north to south.

In order to undertake a thorough survey of the nation's underground resources, China has stepped up completion of the 1:200,000 geological maps. This set of maps consists of three kinds: geological, geomorphological, and mineralogical, all are superbly printed in multiple colour. Each sheet is accompanied by a detailed survey report and a concise explanatory pamphlet. The whole set consists of 1,400 full sheets. The progress for various provinces and autonomous regions varies somewhat. All sheets of Kuangtung Province have been published by the end of 1974. The reports for some sheets such as K'aip'ing, Yangchiang, and Loting sheets all consist of two thick volumes in the size of 19×26 cm. The printing cost alone of such a set with its accompanying report and explanatory pamphlet is about RMB 2,000,000 or equivalent to some US$1,000,000. This shows that the government pays little regard to the cost of publishing fundamental research works. Those who are familiar with the 1:200,000 geological maps published by the Geological Survey of Japan agree that both have many similarities. The only differences are that the 1:200,000 geological maps of China include cross-sections on the bottom of each sheet; the colours are more harmonious; all are in Chinese; references are not given; and they are printed on thicker paper.

The 1:3,000,000 geological maps of the whole nation completed in 1972 consists of 4 sheets which are reduced compilation basing on the 1:200,000 geological maps. Over the Tibetan region there still remain some blank spaces. This set of geological maps is mainly intended for use in teaching, conferences and seminars, and is not yet available to the public.

Although the geographical profession is not as systematic as the geological profession in the compilation of specific maps and regional maps and the number of professionals participated in the work is not as numerous as that in the geological profession, yet in recent years many national maps, including land use maps, have been completed. The nation's land use maps are compiled from data provided by 72,000 people's communes. Although the first author has seen individual land use maps of the communes, yet he is not quite sure of the extent and standard of the final completed maps. Similarly, the completion of soil maps and vegetation maps of the whole country has relied on assistance provided by a vast number of commune members.

Following the progress in cartography and geodesy, the small scale maps, especially the 1:4,000,000 map of the People's Republic of China, which are for

sale semi-publicly outside China show improvement in each subsequent edition. If the 1964 and 1974 editions are compared it will be seen that not only there are quite a number of corrections in the altitude of peaks above sea level, but also the water routes are quite different. They are the results of continued adjustment and improvement. All these maps from the scale of 1:25,000 to 1:25,000,000 are compiled and reduced from the same data and printed by the same organization. The specifications and degree of precision are standardized. This demonstrates the merit of national unity.

The situation in the compilation of atlases seems to have changed. In July 1958 an editorial committee of national atlas formed jointly by the Academy of Sciences and the State Bureau of Surveying and Cartography had planned to compile five big volumes of the *Atlas of the People's Republic of China* and held preliminary discussion on the design of general maps and physical maps. In December of the same year with the Cartographic Publishing House and the Institute of Geography as the backbone and with the assistance of the departments of geography, and cartography and geodesy in many higher institutions (*e.g.* Nanching University, Peiching University, East China Normal University) a strong line-up of editorial department was formed to expedite the lauching of preparatory work. According to the original plan the national atlas should be completed by 1968. In coordination with the launching of editorial and compilation work of the national atlas, a committee on the translation of place names was also formed.

Firstly, in order to tighten up restriction, and secondly as there is no urgent need for the compilation of large atlases, thereafter there has been no further news about large atlases of China. At present the atlas in use is still the *Atlas of the People's Republic of China* published by the Cartographic Publishing House in 1958, for which information was up to 1956.[13] It is divided into two parts: the first part consists of general maps including geographical location, administrative divisions, relief, geology, climate, soils, vegetation, and distribution of population and nationalities. The second part consists of regional and provincial maps which shows settlements, communications, drainage and relief in greater detail. There are no explanatory notes. The A type edition includes an index to place names. So far it has been the best middle grade general atlas in China. A similar atlas are intended for domestic circulation. They are seldom circulated outside China.

Publications on geoscience had suspended during the Cultural Revolution.

13) The introduction to the preparation of this atlas mentions that "planning for this atlas commenced in January 1956; drawing was completed by the end of September; and at the end of the year printing blocks were completed and mock-up copies were ready".

Most of them resumed publication only after 1973. They include *Scientia Geologica Sinica, Acta Geologica Sinica, Acta Geophysica Sinica, Acta Geographica Sinica* and *Geographical Knowledge*, all of which are published by Scientia Press. Besides, *Scientia Sinica, Acta Botanica* and *Kexue Tongbao* (*Scientia*) and even *Wen Wu* and *Kaogu Xuebao* (The Chinese Journal of Archaeology) all occasionally publish articles on geoscience. In the past the number of copies printed for each issue was indicated. For example, for Vol. 23, No. 1, 1957 issue of *Acta Geographica Sinica*, the number of copies printed was 5,990. This number increased to 8,200 copies prior to the Cultural Revolution[14], but at present the number is no longer given. However, it is likely to be on the increase. Among them *Geographical Knowledge* being more popular is printed in large quantity. For the No. 4, 1974 issue, 293,350 copies were printed. This reminded the first author of the *Acta Geographica Sinica* during the period of Sino-Japanese war. If he can recall it correctly, the journal was printed only once a year and 200 copies were printed for each issue, of which 40 copies were sent abroad. The difference in the number of copies printed also reflects the difference in the speed of the development in geoscience between the two very different periods.

14) Chen Cheng-siang, "Ups and Downs of *Acta Geographica Sinica*: Some Personal Observations, *Geographical Review*, the American Geographical Society, January, 1967