1 21

JPRS: 19,037

6 May 1963

TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY

No. 34

(Articles from Geography, No 4 and 5)

U. S. DEPARTMENT OF COMMERCE
OFFICE OF TECHNICAL SERVICES
JOINT PUBLICATIONS RESEARCH SERVICE
Building T-30
Ohio Drive and Independence Avenue, S.W.
Washington 25, D. C.

Price: 1.50

FOREWORD

This publication was prepared under contract for the Joint Publications Research Service as a translation or foreign-language research service to the various federal government departments.

The contents of this material in no way represent the policies, views or attitudes of the U. S. Government or of the parties to any distribution arrangement.

PROCUREMENT OF JPRS REPORTS

All JPRS reports may be ordered from the Office of Technical Services. Reports published prior to 1 February 1963 can be provided, for the most part, only in photocopy (xerox). Those published after 1 February 1963 will be provided in printed form.

Details on special subscription arrangements for JPRS social science reports will be provided upon request.

No cumulative subject index or catalog of all JPRS reports has been compiled.

All JPRS reports are listed in the Monthly Catalog of U. S. Government Publications, available on subscription at $4.50 per year ($6.00 foreign), including an annual index, from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

All JPRS scientific and technical reports are cataloged and subject-indexed in Technical Translations, published semimonthly by the Office of Technical Services, and also available on subscription ($12.00 per year domestic, $16.00 foreign) from the Superintendent of Documents. Semiannual indexes to Technical Translations are available at additional cost.

JPRS: 19,037

TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY

No 34

(Articles from Geography, No 4 and 5)

This serial publication contains summaries or translations (as indicated) of selected articles on Communist China's science and technology, on the specific subjects reflected in the table of contents. The articles in this report are taken from the Chinese-language periodical, Ti-li (Geography), Peiping, Nos 4 and 5, 1961. Complete bibliographic information accompanies each article.

Table of Contents — Page

PROBLEMS CONCERNING THE DEVELOPMENT AND UTILIZATION OF THE INTERIOR OF THE GREAT T'A-K'E-LA-MA-KAN DESERT

/Following is a translation of an article by Chu Chen-ta (2612 7201 6671) in the Chinese-language periodical, Ti-li (Geography), Peiping, No. 4, 1961, pages 156-157, 192./

(TAKE THE REGION IN THE LOWER REACHES OF K'E-LI-YA RIVER IN YU-T'IEN COUNTY AS AN EXAMPLE)

(NOTE: Investigations were made jointly by representatives of the Institute of Geography, Academia Sinica; Hsin-chiang Office, Academia Sinica; Institute of Botany, Academia Sinica; Institute of Forestry Science, Ministry of Forestry; Department of Geography, Peking Normal College, and No. 2 Group of the Bureau of Hydro- and Engineering Geology, Ministry of Geology.)

The T'a-k'e-la-ma-kan Desert in Hsin-chiang, which occupies an area of 458,000,000 mou, is not only the largest in China but is also one of the best known in the world. Investigations were once conducted in the desert, but due to unfavorable physical conditions, it was felt that its development was rather difficult. It was even known as a "trap". However, from the work performed in the past two years in various regions in the desert interior — Yu-lung-ha-shih River, lower reaches of K'e-la-ha-shih, Pi-shan and Ni-ya Rivers, lowermost reaches of Ho-t'ien River, and lower reaches of K'e-li-ya River and the dry deltas at its terminal, it is clear that while efforts should be made to eliminate wind and sand disasters which seriously endanger farming activities and communications in the border regions, there are still abundant water and soil resources along the river valleys in the interior capable of being developed and utilized. In fact, since the 1958 great leap forward development campaign was launched under the leadership of the Party, the people of Ho-t'ien in the southern border have already built a number of new oases. Let us now proceed with a preliminary analysis of the development and utilization of the desert interior by taking the region in the lower reaches of K'e-li-ya River in Yu-t'ien County as an example.

We shall first analyze the development and utilization of the land resources. Although chains of shifting sand dunes are exposed in the southern part of the desert, flat uncultivated lands are extensively distributed along the river valleys in the desert interior. They are distributed mainly along river terraces, banks, dry deltas and edges of terraces where red willow treees are sparsely grown (density of water level being approximately 25 percent). These land surfaces are formed by fine sandy soil whose salinity is generally 0.15-1.5 percent. The total area of these uncultivated lands is estimated to be 740,000 mou. If calculation is made according to the nature and degree of improvement of the soil and by exclusing the areas to be occupied by forests and pastures, and for highway and channel construction and housing development, the total area of land in the lower reaches of K'e-li-ya River which can be used for agricultural purposes will be 300,000 mou.

As a result of the yearly effect by floods, satisfactory water supply conditions exists in this region, especially in the dry deltas where lakes and swamps areformed. Consequently, along the river banks, there is a dense growth of willow and popular trees and also natural pastures which cover a total area of approximately 300,000 mou which can be gradually developed. From these results, it is evident that this region is certainly not like the ones which former investigators believed it to be.

The region in the lower reaches of K'e-li-ya River possesses abundant heat resources which are advantageous to agricultural development. The annual accumulation of temperature is 4,000-4,500°C with a daily average of above 10°C; the total number of hours of sunshine is 3,000-3,500, and the frowing period for plants is 240 days. All these are suitable for the development of foodstuffs and cotton.

With regard to water resources, although the annual precipitation is scarce (an average of below 50 millimeters), especially in the T'ang-ku-tzu-pa-ssu-t'e region in the desert center (an average of two to three days per year), surface water from the upper reaches of the river in the K'un-lun Mountains is still abundant. Apart from the seepage in the river bed and water used for irrigating the old oases, the total amount of water which actually flows into the desert is estimated to be approximately 97,000,000 cubic meters. The degree of mineralization of the water in the Yeh-ying area in the desert interior is 1.167-1.43 grams/liter, which is still suitable for drinking and irrigation purposes. On the alluvial plain along the river, there is a one to two-meter depth of ground water whose degree of mineralization is 1-2 grams/liter depending on the locations in the north or south. At Yu-wen-t'o-k'e-la-k'e in the upper portion of the lower reaches, the mineral content is 1.518 grams/liter, while at Yeh-ying in the middle portion, it is 1.6 grams/liter, the chemical pattern of the water being $Cl'-HCO_3'-Na$ and $Cl'-SO_4''$, respectively. At the contact zone between the terraces and banks, there is an overflow of spring water of a relatively good quality with less than 1 gram/liter mineral content. By employing the method of calculating the rate of seepage in the river bed (since in a desert region, the source of ground water supply is mainly from the seepage), it is primarily estimated that there is a total of 175,000,000 cubic meters of active ground water deposit per year in the lower reaches of K'e-li-ya River. This serves as a major water source for the development of the desert.

From the above analysis of water and soil resources, it is clear that the desert interior is indeed worthy of being developed into an agricultural region. In order to study further the scope and procedure of its development and utilization, we should also carry out a combined analysis of the water and soil resources. According to estimate, the amount of water which can actually be used for agricultural purposes is 50 per cent of the total amount presently available (the sum of the amount of surface water and the deposit of active ground water). This is sufficient only for 178,000 mou of cultivable land. Since there is a total of 300,000 mou of cultivable land in the region, the amount of water available still falls short of that required, and therefore, further efforts should be made to utilize floods and exploit more ground water.

The above estimate applies only to the general condition existing in the region in the lower reaches of K'e-li-ya River. In fact, the condition will be different if analysis is made on individual areas. For example, on the dry deltas at Mi-sha-lai and T'ang-ku-tzu-pa-ssu-t'e in the lowermost reaches of the river, there is a total of 100,000 mou of cultivable land, with a preliminary estimate of only 20,000,000 cubic meters of surface water available. If calculation is made by allowing seepage and by excluding the amount to be used for raising 25,000 heads of sheep, the amount of water actually remaining will be 10,000,000 cubic meters, which, according to a rough estimate, is sufficient only for irrigating 20,000 mou of land. Hence appropriate measures should be taken to overcome the problem of irrigating the remaining 80,000 mou. But, in the areas between Yu-wen-t'o-k'e-la-k'e, Yeh-ying and Mi-sha-lai in the middle section of the lower reaches of the river, there is a total of more than 90,000 mou of cultivable flat land distributed on terraces, with 89,000,000 cubic meters of water available for farming use. In view of these abundant water resources, this area should be given a priority in future development and utilization programs.

From the results of the above evaluation of physical conditions and estimation of resources, it is evident that there is a possibility of developing and utilizing the desert region in the lower reaches of K'e-li-ya River. In carrying out these endeavors, consideration should be made according to the national economic development policy, which emphasizes agricultural production, in conjunction with the local physical features. The part of the desert within the Ho-t'ien region possesses several different types of physical features. First, there are the regions covered by wide river valleys running across the desert where transportation is convenient and water and soil resources are abundant. The regions located on the banks of Yu-lung-ha-shih River and K'e-la-ha-shih River are two of the examples. These two rivers discharge annually a total of 3,900,000,000 cubic meters of water, with 2,140,000,000 cubic meters actually flowing into the desert interior. The area of cultivable land in these regions totals more than 1,600,000 mou, which can be used mainly for growing foodstuffs and for producing cotton and oil-bearing plants. With a simultaneous development of forest and pastoral industries here, these regions will become an important agricultural center. Secondly, there are the regions deep into the desert interior covered by narrow river valleys where water and soil resources are less abundant, but dense growth of popular trees and natural pastures are distributed. These regions can be used for animal husbandry, with a combined development of agriculture, animal husbandry and forests. However, in certain areas in the upper sections of these regions where the land is flat and water supply condition is favorable, they should still be used for agricultural purposes. One of the examples which possesses this type of features is the region located in the lower reaches of the Ni-ya River. As to the region in the lower reaches of K'e-li-ya River, the physical features and condition of resources are somewhat in between the two above mentioned types. Here, the dense growth of poplar trees and wide pastures also facilitate forest and animal husbandry developments, and therefore, in planning for the utilization of this region, emphasis should be made on the combined development of agriculture, forest and animal husbandry. In production arrangements, due to the difference in physical conditions between the desert interior and its bordering regions and also in considering the economic aspects and transportation conditions, the region south of Yeh-ying should be used for agricultural, forest and animal husbandry developments while the desert center to the north should be devoted mainly to animal husbandry with agricultural and forest developments to be carried out simultaneously. The reason for these arrangements is due to consideration of the presently available water supply. The cultivation of vast areas of land requires yearly an abundant amount of water. While at the present time there is lack of a series of water conservancy projects capable of effecting full utilization of flood water, we have but to rely on minor facilities to accumulate some of the flood water and utilize part of the ground water for agricultural production, which will be mainly foodstuffs, to meet the demand of the local inhabitants and to avoid unnecessary distant transportation of foodstuffs from the Yu-t'ien county seat which is 220 kilometers away. But, if a number of small reservoirs is built on the plain in the upper and middle sections of the lower reaches of the river to accumulate flood water or if power equipment is available to facilitate the use of ground water, production of foodstuffs can still be expanded since, as stated above, there are 100,000 mou of land distributed over the dry deltas at T'ang-ku-tzu-pa-ssu-t'e. Regardless of the regions to the north or south of Yeh-ying, the development of forests should be made primarily for the protection of newly opened land from being damaged by winds and sand. In carrying out these developments, consideration should also be given to the future increase of population by additionally planting fruit trees and trees that can eventually be used as fuel. As to the presently existing poplar trees, those which are grown on the desert border should be carefully maintained to serve as a protective forest. Those which are healthy and fully grown can be used for future basic construction purposes while those which are decayed can serve as fuel and fodder.

From the results of the analysis of the physical conditions in the desert interior coupled with the change these conditions produced following the establishment of new agricultural regions, it is felt that in order to insure a stable development, effective measures should be taken to cope with problems that may arise following the development and utilization.

1. Problems concerning the full utilization of water resources. From the above analysis, it is obvious that the water and soil resources in the region in the lower reaches of K'e-li-ya River is unbalanced. In order to reach balance, we should endeavor to utilize whatever water resources are available, especially those surface water resources which are presently being exploited. Due to the unstability of the river flows originated from the K'un-lun Mountains which are mainly concentrated in summer, the discharge of K'e-li-ya River in the months of June, July and August occupies 62.4 percent of its total annual discharge, the largest flood discharge reaching 364 cubic meters per second. But, in the months of January through May when there is a demand of water supply for agricultural production, the discharge occupies only 19.7 percent. Consequently, in order to acquire a balance of water and soil, the key measures to be taken are: (1) to build a number of small reservoirs on the lowland of old dry river beds (such as the section between Pa-ssu-a-ko-le and Mi-sha-lai) or on the narrow sections between high terraces and river beds along the banks of the river valleys to accumulate flood water, and (2) to open up springs on the edge of terraces to acquire spring water or to dig vertical wells through terraces to obtain ground water to solve some of the water supply problems in the newly developed region.

2. Problems concerning the prevention of soil from secondary salinization. As stated before, the agricultural regions to be developed in the desert are mainly situated along river terraces and banks. While at the present time the salinity of the soil in these regions is not high (the soil, 0-30 centimeters deep, in the dry delta region at T'ang-ku-tzu-pa-ssu-t'e has a salt content of 0.15-0.95 percent), it will be affected by secondary salinization when it is opened up and irrigated, since the ground water level will rise rapidly with an increase of the degree of mineralization speeding up the accumulation of salt in the soil. In the Yu-wen-t'o-k'e-la-k'e region, for example, the degree of mineralization of ground water in uncultivated soil is less than 2 grams/liter, but after the land is opened up and irrigated, the mineral content increases to 5-10 grams/liter. The ground water level will also rise, and within one to two years, it will have a rise of 40-100 centimeters as compared to that in non-irrigated regions. The main reason for this is due to the inadequacy in desalinization, the use of water in excess of the amount required and the lack of water discharge systems. Hence, in order to speed up the lowering of the level of ground water and to increase and stabilize the efficiency of desalinization, one of the important measures to be taken is to carry out salt washing by building water discharge channels and to improve the techniques for such operations. In levelling the soil, attention should be given to its quality by allowing the degree of desalinization to become even and preventing the forming of secondary salt spots. On cultivation techniques, medium ploughing and loosening the soil can cut down the rise of capillary water, and delay and also weaken the process of "resalinization". In certain saline soil with sodium content or in the process of salt washing when there is a noticeable increase of sodium, an adequate amount of gypsum should be used.

3. Problems concerning the prevention of wind and sand disasters. Due to the fact that the newly developed region is situated in the desert center, surrounded by chains of 5 to 30-meter high sand dunes of the shape of a new moon and the fact that agricultural development in the region is concentrated on narrow strips of land, from north to south, along the river valleys, it is often subjected to wind and sand attack. The winds are mostly northeasterly, followed by those from the northwest. The total number of windy days occupies one-third of the entire year, especially, in the windy season from April to July when the wind velocity reaches an average of 10 to 12 meters per second. These strong winds and sand flow will destroy or bury young plants while sand dunes shifting southwestward will endanger roadways, dwelling areas and water channels (at present, numerous water channels in the region run directly across sand dunes). At the same time, since there are mainly clay and fine sandy soil in the region, they will be affected by aeolian erosion causing the rich surface layer to disappear.

Consequently, for the sake of preventing the region from being damaged by winds and sand, the key measures to be taken are to maintain the presently existing plantations (red willow and poplar trees) on the region border and to build protective forests (mainly Hsin-chiang poplar and Elaeagnus angustifolia L.) around the farms, or to carry out block-type cultivation by utilizing poplar trees for protection.

From the above analysis of the region in the lower reaches of K'e-li-ya River, it is clear that there are possibilities for the development and utilization of the great desert, especially along the wide river valleys (more than 20 main rivers run into the desert from the north piedmont of K'un-lun Mountains) where agricultural production can be carried out. In the course of development, problems such as winds and sand and secondary salinization of soil will exist, but if appropriate measures are taken, a firm and rapid progress is insured. Under the guidanee of the three red flags -- the general policy of the Party, the great leap forward development and the people's communes, the T'a-k'e-la-ma-kan Desert will be rapidly changed into many new oases.

5705
CSO: 3550-D

THE MORPHOLOGIC CONDITIONS OF WEN-SHAN T'UNG AND MIAO RACES AUTONOMOUS CHOU IN YUNNAN PROVINCE AND THEIR RELATION TO AGRICULTURAL PRODUCTION

[Following is a translation of an article by Chu Ta-k'uei (2612 1129 1145) in the Chinese-language periodical, Ti-li (Geography), Peiping, No. 4, 1961, pages 168-169.]

The Wen-shan T'ung and Miao Races Autonomous Chou, situated in the northeastern part of Yunnan Province, is a plateau formed by the merger of numerous intermediate mountains. The highlands run in continuous succession and their pattern is not evident. The general relief lowers from northwest to southeast, gradually running into the Kuang-hsi basin. The southern border of the state joins the northern highlands of North Vietnam while the north and western parts are plateaus approximately 2,000 meters above sea level. The surface relief of these plateaus is relatively subdued.

The Wen-shan T'ung and Miao Races Autonomous Chou, being located near the Tropic of Cancer, is a transitional region between the tropical and southern subtropical zones. It has a great amount of relief fluctuation and frequent climatic variations, and therefore, the presence of vertical zones is apparent. In the low mountain and hilly region on the southeastern border (200-500 meters above sea level), the climate is similar to that on the northern border of the tropical zone, which is hot and humid with abundant rainfall but without frost or snow. In the southern part of Fu-ning Hsien, the climate is southern subtropical, which is sub-humid with little frost and snow. However, the majority of the regions in the autonomous chou has a southern subtropical climate, which is relatively dry with frost and snow originated from cold waves. Besides, due to the effect of the local landscape, there appears a special type of micro-climate, causing the climate of the state to become more complex.

The southeastern part of Yunnan Province is geotectonically a part of the Yunnan-Kwangsi syncline, having the characteristics of an activated platform. Since the Cambrian period, it has on numerous occasions been inundated, having accumulated thick overlying strata of sediment.

Since the Palaeozoic era, there have been strata formed in different periods, the thickest of which were formed from the Devonian to the Triassic period and were widely distributed. As for lithological characters, there are mainly limestone and sandy shale, with pyrogenetic and metamorphic rocks prevailing in certain local reiongs. Due to a long period of corrosion, the Karst topography has been developed in the limestone region. The extent of this type of irregularity differs according to the purity of the limestone. The surface relief of the sandy shale region is relatively subdued due to a long period of erosion and denudation. The growth of the weathered layers and the thickness of the earth strata are advantageous to agricultural production.

From the look of its form and origin and their characteristics with respect to agricultural development, the Wen-shan T'ung and Miao Races Autonomous chou can be divided into three morphological regions (see figure).

I. The intermediate mountain region in the northern part of the chou, comprising wide sandstone and shale valleys, low mountains and canyons, embraces the northern sections of Fu-ning, Kuang-nan and Ch'iu-pei Hsien, forming a banded zone stretching from east to west. It consists of mainly Triassic and Devonian sandstones and shale with certain minor areas covered with limestones. The eastern section of the region is located on the slopes on the eastern border of Yunnan plateau, having a wide distribution of hills and low mountains. In the central and western sections, the areas located near river valleys are dissected into intermediate mountain canyons while the plateaus (more than 1,500 meters above sea level) far away from these valleys are comparatively uninterrupted. Here, the relief is moderate with thick earth layers, abundant water resources and dense plantations. This type of "earth-mountain" landscape has advantages for the development of agriculture and forestry. On the valley floor plains, rice paddies can be developed while on the slopes of low mountains, tropical plants and trees, such as, coffee, banana and pineapple, can be grown. In localities of a higher elevation, tea-seed oil and tung oil bearing trees can be planted. Hilly areas and intermediate mountain canyons having a tropical climate are suitable for tropical plantations.

II. The intermediate mountain region in the central part of the state (1,300 to 2,000 meters above sea level), which has a strong Karst landscape, is a type of mildly dissected mountainous plain formed by different kinds of limestones. The thick layers of pure limestones accelerated the creation of the various types of widely distributed Karst phenomena. The eastern section of the region consists of numerous round peaks and marshes formed as a result of corrosion. The relative height of these peaks is 100-200 meters and between them are the marshes whose bottom is flat covered with thick layers of sediment with frequent accumulation of water suitable for development of rice paddies. Within these marshes, there are often rivers running through tunnels with an inlet (ponor) on one side of the mountain and an outlet on the other. In order to facilitate irrigation, dams can be built near the outlets to bring up the water level to form reservoirs over the marsh land. Construction of this type of semi-underground reservoirs will be simple and the advantages resulting from it will be great. However, the dams to be built should be made to connect the lowest layer of corrosion to avoid seepage. The extended area in the central section of the region is formed by numerous peaks, moderate hills and ravines, having a strong Karst phenomenon. Because of the great number, these ravines have formed into chains, with an accumulation of red-earth and Tertiary sediments. In places where there is a thick accumulation of these sediments, water is deposited forming tiny seas, with no serious problems of seepage when reservoirs or ponds are built. In places where the sediment layers are thin or where there is a presence of underground outlets, the seepage is serious, and the dry land surface presents difficulty to animals and plant life. Here, vast areas of land have become barren due to shortage of water. Methods for solution to this problem are (1) that reservoirs be constructed in the neighborhood of river valleys or underground water be utilized to facilitate irrigation, and (2) that since the bedded relief of the Yunnan plateau is clearly manifested, with a distribution of small marshes between mountain ridges surrounding the ravines, these marshes can be blocked up to accumulate water to form a series of small reservoirs, so that water can be led from the higher reservoirs through the lower ones into the fields. Running through a small number of ravines are rivers. Here, the fertile land is capable of being developed into a major agricultural region. The northwestern section of the region is a plateau of a convex tabular form consisting of moderate Karst type hills and funnels. The surface relief is moderate with a wide distribution of small round marshes (funnels). As a result of corrosion, the limestone layer has become the vesicular type of underground water channels with which flow northward and empty themselves into Nan-p'an-chiang. One of these larger underground channels is the well-known Liu-lang-tung River. Here, the land surface is affected by serious water shortage. However, the high relief and cool climate are favorable to the growth of corn and buckwheat and also the development of animal husbandry.

The area of the limestone region occupied by peaks, corroded furrows and protruding rocks is relatively large, and is at present mostly barren and less utilized. If appropriate reform is carried out, it could become useful. At the base of the conical peaks, there is an accumulation of thick weathered layers where fruit trees or corn can be planted (this work has already been carried out by a small number of communes). The carrying out of an adequate amount of maintenance work on these peaks will result in developing a dense plantation. After the individual solitary peaks are covered entirely with low trees and shrubs, the shady spots under them can then be used for planting various types of medicinal herbs, such as, fine "yellow herb" kua-ai-hung, rose and pinellia tuberifera. As a result, each solitary peak will become an orchard producing medicinal herbs and fruits. The relief of the areas where corroded furrows and protruding rocks are distributed is rugged. The furrows are covered with an accumulation of red earth where at the present time drought resistant plants are grown. Since there is a serious erosion of the soil in the furrows, the drought resistant plants should be gradually removed and replaced by fruit trees and oil bearing plants, with greens planted on the ground to prevent from further erosion. In places where the slopes are less inclined, adequate water conservancy projects should be built with a view to developing foodstuff production.

III. The intermediate mountain region in the southern part of the autonomous chou where sandy shale, limestones and metamorphic rocks prevail covers the entire Hsi-ch'ou and Ma-kuan Hsien and the southern part of Fu-ning County, having an elevation of 1,000-1,700 meters above sea level. In the vast eastern section of the region are interbedding layers of sandy shale and limestones with a wide distribution of the Karst topography. Due to the accumulation of weathered sandstones and shale around the peaks and slopes, the former appear to be of conical shape. Since the various types of Karst phenomena are covered by weathered elements, the land appears to be relatively subdued. The satisfactory water supply condition and the thickness of the soil layers present a "combined earth-rock" mountain landscape. The mountain land in Fu-ning hsien is the major aniseed production area in China; the local inhabitants are experienced planters. Henceforward, development of this product should be particularly carried out. The "combined earth-rock" mountain land is also suitable for growing tea seed oil bearing plants and walnut and chestnut trees. The moderate slopes and marshes are excellent farmlands. The valleys in the southern part of Hsi-ch'ou and Ma-kuan extend themselves southward down to a tropical region of a lower elevation above sea level. In certain sections of these valleys where soil and water resources are adequate, efforts should be made to develop economic tropical products. The western section of the region are high lands or intermediate mountain canyons formed by sandy shale and metamorphic rocks. The relief of these high lands located far away from river valleys is moderate. The wide river valleys mostly serve as bases for foodstuff production. On the high lands, the development of forests and animal husbandry is desirable, while in the deep river valleys of lower elevations, tropical plants can be grown.

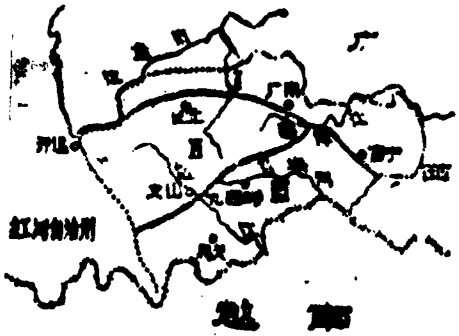
The different types of morphologic phenomena in the Wen-shan T'ung and Miao Races' Autonomous Chou (especially in localities where no limestones are distributed), which have impressed us deeply and which, at the same time, are closely related to agricultural production, are the plateau surface, the layer type morphology and the widely distributed red weathered layers. Besides, the effect of the new tectonic movement on the morphology is extremely evident. We shall now introduce the relationship between these morphologic phenomena and agricultural production as follows:

The plateau surface was formed as a result of a long period of denudation during the stable stages of the earth crust movement. Thereafter, in the period of the Himalayan movement, the elevation of the great Yunnan region resulted in the emergence of the plane of denudation to become the plateau surface. During that period, the speed of the uplift was great and the time was short. The speed of the river descension was lower than the uprise of the earth crust. Consequently, in the central part of the plateau, large areas of old denudated plain were still maintained, while the bordering regions were dissected into intermediate mountains and hills. The regions where the plateau surface were perfectly maintained are mostly 2,000 meters above sea level. Because of the high elevation, the climate is cool, which, together with the moderate relief, produce excellent forests (fir in the south and Yunnan pine in the north) and pastures. At the same time, the dry land can also be used for producing such foodstuffs as corn and buckwheat.

Due to the fact that the uprising of the earth crust in this region was intermittent, the surface was denudated during the stationary period of the earth crust movement, forming a series of denudated platforms. Since the elevations (above sea level) of these "ladder type" platforms are different, there is a variation of the local climate. The lower level platforms possess mostly the southern subtropical climate characteristics suitable for growing tropical and subtropical plants while the upper level ones are often excellent forests of aniseed, tea seed oil and tung oil bearing trees. Places where the water supply condition is satisfactory can be turned into farmland for foodstuff production.

As a result of a long period of weathering and denudation during the formation stage of the Yunnan plateau, thick weathered layers of earth were produced. Following the forming of the plateau's morphology, due to the corrosion incapable of reaching the river origins, the old weathered layers were not damaged. Thus, two types of effect were produced. The first type, which is favorable to agricultural production, is that thick earth layers prevail over the thick weathered layers and are widely distributed on mountain tops and slopes where plantations can be developed. The second type of effect, which is unfavorable, is that once the plantations are damaged, the weathered layers will be washed away by mountain floods causing serious soil erosion. From observations made on the landscape where various types of turbulent flows prevail, it is clear that this type of phenomenon does exist. Hence, in regions, that is, on the upper level platforms, where weathered layers are distributed, measures should be taken to maintain and restore plantations. In artificial formation of forests, consideration should be given to the coverage of plants on the ground beneath the trees to strengthen the maintenance of water and soil.

The influence of the new structural movement upon this region is extremely evident. The result of the uprising of the movement caused the river valleys to have steep gorges and pits. Hence, the valley often has a wide cross-section in the upper part with several steps of platforms, and a steep gorge in the lower. Due to the fact that the steep gorges were formed within a relatively short period, there is a lack of weathered layers, but there is an accumulation of rocks and debris or diluvial deposits. Because of the deep cuts in the wide river valleys, there often appear small areas of land of low elevation which are warm and are not affected by wind and which are suitable for the cultivation of tropical and subtropical plants. In the plateau's surrounding regions, corrosion caused by river sources is serious. As a result, low mountains and hills are widely distributed and are favorable to the cultivation of tropical and subtropical plants.



Map showing the Wen-shan T'ung and Miao Races Autonomous Chou, Yunnan Province.

I. The northern intermediate mountain canyon region.
II. The central Karst type intermediate mountain region.
III. The southern intermediate mountain region.

5705
CSO: 3550-D

SOME FUNDAMENTAL PROBLEMS CONCERNING ECONOMIC GEOGRAPHY

/Following is a translation of an article by Ts'ao T'ing-fan (2580 1694 5672) in the Chinese-language periodical, Ti-li (Geography), Peiping, No. 4, 1961, pages 172-177./

(NOTE: This article constitutes a part of the introduction appearing in Chapter I of the newly compiled, "A Summary of Economic Geography". It is published here for the benefit of all economic geography workers in China.)

What is the object of studying economic geography and its mission? What is the nature of this field of science in itself? All these problems are involved in the prospect of its progress and in the culture of cadres. Dealing with these problems, the economic geography community within the country has undergone many years of discussion, but so far, different viewpoints still exist. At present, Comrade Ts'ao T'ing-fan has introduced his concept, which is published here for the purpose of encouraging academic debate and speeding up its progress. It is hoped that all comrades who are interested in this field of science will participate in the discussion -- Editorial Department.

I. The object, contents and nature of economic geography.

(1) The object of economic geography: Economic geography, to speak of it as a field of science, is still one of those recently developed. It has only several tens of years of history in Soviet Russia, not to mention a much shorter period in this country. Because of its newness, people are as yet unfamiliar with the object of its study, and constant divergence of opinion still exists. However, the concept which up to the present has been agreeable to most of the people is that economic geography is the science of studying geographical arrangement (distribution for production in various countries and territories according to their development conditions and characteristics. This interpretation with respect to the object of studying economic geography was made in the resolutions of the second planary conference of the Soviet Geographical Society held in 1955, and was accepted by most of the people in the geographical society in this country.

The word "production" mentioned here has a strict scientific sense in Marxist-Leninism; that is to say, production means the unity of production strength and production relationship. According to the theory of Marxist-Leninism, production (that is, in terms of material production) includes both the elements of production strength and production relationship (production strength is the core and production relationship is the appearance), without one of which, production will be unable to be carried out. Production strength is formed through the combination of labor strength, labor supplies (mainly tools and equipment) and labor objectives (natural resources, raw material and material already processed), pointing out mainly the relationship between man and nature. Production, regardless of when or how carried out, is always for the society. Production relationship means human relationship created in the course of production. Production is always an activity carried out under fixed human relation by using fixed production tools and equipment to process or change fixed labor objectives to satisfy the demand of the people. Production arrangements are geographical arrangements for production in this sense. To interpret production arrangements as arrangements for production relations is certainly erroneous, and likewise, to take it as merely arrangement for production strength is also erroneous. Moreover, to say that production arrangement is arrangement for both production strength and production relations is inaccurate.

Productinn of material supplies includes that of necessities for life (such as, foodstuffs, clothing, dwellings, fuel and daily commodities) and that of production supplies (such as, various types of tools and equipment, raw materials and materials already processed). With regard to different fields of production, there are agricultural and industrial as well as communication and transportation elements that are closely related to these two main fields of production. Production is always carried out at a fixed locality or in a fixed territory, and that is the problem of geographical arrangement for production.

Production arrangement is a part of production. It appears as production appears and develops as production develops. Once separated from production, production arrangement will become meaningless. Likewise, if production is set apart from production arrangement, its development will be unimaginable.

Production arrangement on the one hand has a phenomenon of change of time. In a nation, for example, the production arrangement in the socialist society is different from that in the past capitalist society, and that in the capitalist society is not similar to that in the old feudal society. On the other hand, there is a variation in different territories, such as, one nation or one territory has one type of production arrangement while another has another type. Thus, economic geography is the science of studying production arrangement phenomenon with respect to the rules of changes developed both in times and at intervals.

Production arrangements are not only governed by general but also by specific rules. The former govern the geographical arrangements for all productions in a society while the latter control only a particular type of production. Furthermore, the conditions (economic and natural) for the development of production in each nation and territory are different, and therefore, under the restriction of the general and specific rules, the production arrangements in each nation and territory still have their own characteristics. In the light of the numerous differences in production arrangements in various nations and territories, one who is unable to grasp the meaning of the rules is like having fallen into a sea of mist. Similarly, it is also unimaginable if one, being familiar with the rules, does not carry out a detailed study of the production development conditions and characteristics of the nation or territory involved. Consequently, economic geography is not only the study of the rules of production arrangements but also the study of production development conditions and characteristics of individual nations and territories. Rules for production arrangements are found in the course of studying the production development conditions and characteristics of individual nations and territories, and under the guidance of these rules, efforts are made to study further the conditions and characteristics of the individual nations and territories. The repeating of this process to acquire gradually a deeper understanding of the subject is the entire secret and process in the study of economic geography.

(2) Comprehensive economic geography and departmental economic geography: From the scope of study of different objects, economic geography generally can be divided into two categories -- comprehensive economic geography and departmental economic geography.

Unified economic geography is the study of the rules of arrangements by treating production as a whole. The type of economic geography generally referred to is unified economic geography. Due to the different scope of its study, unified economic geography can be divided into two categories -- general economic geography and territorial (or national) economic geography. General economic geography is to treat the world as a whole to study the problems of its production arrangements. It is not only the study of the rules of arrnagement of the entire society, but also the study of those of the capitalist and the socialist society. The book, "A Summary of Economic Geography," mentioned in the beginning of this article, is connected with this type of economic geography. Territorial (national) economic geography is the study of the production arrangements of a certain territory, a certain nation or a certain region in a nation, such as the economic geography of China, of a certain region in China, of Soviet Russia or of a certain region in Soviet Russia. General economic geography is closely related to territorial (national) economic geography. The latter is not only fundamental but is also a step forward toward the study of the former, while the former is not only a theoretical generalization but is also a theoretical guide to the study of the latter. Due to the fact that economic geography is still considered as a newly developed science in this country, the study of general economic geography is presently very limited. Consequently, territorial or national economic geography has now become our primary subject of study.

Departmental economic geography is the study of the rules of arrangement of a certain field of production, such as agriculture, industry and transportation. Further, it is the study of a certain aspect of the production condition, such as population, and of a certain specific phenomenon, such as inhabited areas. As stated before, since economic geography is still a newly developed science, the study of departmental economic geography is still not popular. According to the different scope of its study, department economic geography can also be divided into two categories -- general departmental economic geography and territorial (national) departmental economic geography. General departmental economic geography is the study of the rules of arrangement for a certain field of production by treating the world as a whole. It is not only the study of the general rules of arrangement for a certain field of production in the entire society, but is also the study of the specific rules of arrangement for a certain field of production in the capitalist as well as the socialist society. Territorial (national) departmental economic geography is the study of the arrangements for a certain field of production in a certain territory or nation, such as agricultural geography or the industrial geography of China. The type of department economic geography which is presently referred to is mainly of a territorial nature, while the study of general departmental economic geography is still very limited. General departmental economic geography and territorial departmental economic geography are also closely related to each other. The latter is not only fundamental but is also a step forward toward the study of the former, while the former is not only a theoretical generalization but is also a theoretical guide to the study of the latter.

Unified economic geography and departmental economic geography are closely related to each other. The former is known as the whole while the latter is referred to as a part. The study of departmental economic geography should be based upon the rules of arrangement for general production adopted in unified economic geography while the study of unified economic geography should be carried out according to the rules of arrangement for a particular field of production practiced in departmental economic geography. With the knowledge of unified economic geography as a guide, the study of departmental economic geography is like "walking in the fog." Similarly, without the knowledge of departmental economic geography as a foundation, the study of unified economic geography will hardly be progressed. Within the close relationship between unified economic geography and departmental economic geography, a much closer relationship exists between general economic geography and general departmental economic geography, and between territorial economic geography and territorial departmental economic geography. Within the close relationship between the various types of economic geography, general economic geography occupies the center position.

The conditions presently existing in this country are that the study of departmental economic geography is still very limited while that of unified economic geography is as yet below standard. In order to meet the need for socialist construction, efforts should be made to the development of unified as well as departmental economic geography, with a priority to be given to the latter subject.

(3) The scientific nature of economic geography: Production of material supplies is a type of social phenomenon. Production arrangement, which is one of the aspects of production development, is naturally also a type of social phenomenon, its development being governed by the rules of social development. Consequently, the fact that economic geography is a social science has been recognized by the majority of the people. However, up to the present time, it is still vague as to which type of social science it belongs, and different viewpoints concerning this still exist. Some people consider it as a part or a branch of political economics, which is obviously erroneous, since political economics is the study of production relationship (economic relationship) which is one aspect of production, while economic geography is the study of production arrangements which is another aspect of production. In his paper "On the Division of Sciences" (see Hsueh-hsi i-ts'ung (Translated papers on study), No. 10, 1955), Kaitelov (phonetic) classified economic geography as a social science, without connecting it with economic foundation (economic science) or higher structure, but including it as an additional type of social science. This concept is worthy of attention and study.

Although economic geography is regarded as not being included in the field of economic sciences, it is still a science of strong class distinctions. This is because of the fact that production arrangements, regardless of the type of social system, are generally made according to the production demand of the people. In slave and feudal societies, production arrangements are chiefly made according to the wishes of the masters and feudal lords. In capitalistic societies, they follow mainly the demand of the propertied class. In a socialist society, they obey the demand of the people of the entire society. Thus, there exist no production arrangements that will agree with the demands of both capitalistic and socialistic societies. The type of economic geography practiced by the propertied class generally describes its production arrangement phenomena in terms of the natural conditions, denying class distinctions in production arrangements and thus also denying those of economic geography. The type of economic geography talked about in Marxism-Leninism describes its production arrangement phenomena mainly according to the rules of socialistic development, confirming class distinctions in production arrangements and thus also confirming those in economic geography. These are the two basic differences between the two systems. Therefore, those who are concerned with economic geography should carry out their work with their political belief as their vanguard and Marxism-Leninism and Mao Tse-tung's concept as their guide.

Furthermore, due to the fact that production arrangement phenomena possess an obvious regional sense and that these phenomena are complicatedly related to various types of social economic and natural conditions, economic geography can also be considered as a field of science having a regional sense as well as unified characteristics. With these two aspects, it is seen that economic geography is quite similar to physical geography. However, it will be a gross mistake if one attempts to use these views as a basis of combining economic and physical geography into something called "united geography."

II. The duty and purpose of economic geography.

Regardless of any field of sciences, its duty is to present the rules of development of the object of study. The duty of the science of economic geography is simply to present the rules of production arrangements and the conditions and characteristics of production development in various nations and territories.

The study of these rules, conditions and characteristics, on the one hand, is important to the progress of our culture, and on the other, serves a great purpose in our economic construction. It will enable us to know the cause of the numerous differences and development changes in the production arrangements of the nations and territories involved, so that we may clearly understand their past, present and future and may not be deceived by their erroneous and reactionary viewpoints, such as those concerning the determination of geographical environments, racialism and Marcus (phonetic) theory of population. For example, if we learn about the unbalanced rules of capitalistic production arrangements and the conditions and characteristics of production development in various capitalistic nations and territories, we will be able to understand clearly why production in some of these nations is progressive and that in some is backward, and whether progress and backwardness are determined by geographical environments or racial conditions. At the same time, we will have a full realisation of the different kinds of contradictions within the capitalistic world, such as contradictions between imperialism and colonies and semi-colonies, between one imperialism and another, and between cities and farms. We will also know the corruptness, unreasonableness and eventual extinction of capitalism. All this knowledge will enable us to have a deeper comprehension of Mao Tse-tung's well-known judgment that imperialism is nothing more than a paper tiger, and this will lead us to better equip ourselves theoretically. Another example is that if we are well familiar with the balanced rules of socialistic production arrangements and with the conditions and characteristics of production development in various socialistic nations and territories, we will be able to realise why production in a backward nation in the socialist camp can rapidly surpass that of a progressive nation, why a backward territory can speedily catch up with a progress territory and why production in agriculture, industry, and communication and transportation within a nation or a territory is closely dependent upon each other, and not like those in capitalistic nations where everything is independent of each other. All these will strengthen our knowledge of the superiority of the socialist system, and our spirit of patriotism and internationalism. They are the contributions of economic geography to the progress of our culture. The teaching of economic geography in school and the dissemination of this knowledge through books, newspapers and periodicals belong to the cultural nature.

To familiarize ourselves with the rules of production arrangements, especially those in a socialist nation and with the conditions and characteristics of production development in various nations and territories, especially those in the various regions in China, we shall be able to utilize their knowledge for practical work in our economic construction. During the eleven years since liberation, especially during those years since the beginning of the great leap forward campaign, people who are concerned with economic geography have participated widely in numerous tasks involving the problems of production arrangements. They have participated in the investigation and selection of railroad lines, in the mapping out of plans for river valley developments, in the planning of unified development and utilization of various regions, in the appropriate arrangements for industrial development, in the planning of building river networks, and in the work of mapping out production plans for people's communes and of adequate adjustment and reform of inhabited areas, all of which have produced remarkable results. In addition, they have, on a scientific basis, made appropriate arrangements between regions for agricultural production and those for other fields of production. All these are proofs that economic geography has served a great purpose in economic construction. The viewpoint of certain people that economic geography only has a significant meaning in the progress of our culture and not in our economic construction is evidently erroneous.

Economic geography has an equally important effect upon culture and economic construction. To consider one of these aspects oblivious of the other is a disaster of the whole. The effects of economic geography on culture and economic construction are mutually related to each other and their progress is likewise mutually accelerated. The more effect economic geography produces on culture, which will enable the numerous cadres and the masses to acquire more knowledge on the subject, the greater accomplishment economic construction will bring, since, under these conditions, not only will the professionals produce an effect on economic construction, but also those cadres and masses who are familiar with the knowledge will be able to participate in the tasks. Similarly, the more effect economic geography produces on economic construction, the more effectively we can devise solutions of economic problems. Thus, the coverage in economic geography will gradually be more abundant, the level will be higher, and its effect on culture will be greater.

III. The relation between economic geography and its neighboring sciences.

The relation between a field of science and its neighboring sciences is determined primarily by the relation between the object of its study and the general matters surrounding it. The relation between economic geography and its neighboring sciences is determined first by the relation between the production arrangements and general surrounding matters. Production arrangement is one aspect of production development, which, on the one hand, is closely related to production relationship and on the other, to production strength. It is also connected with physical conditions. Thus, economic geography is defined as being closely related to the field of economic sciences which studies production relationship, to various fields of technical sciences for production which studies production strength, and to that part of physical geography which studies the rules of development and changes in nature as a whole. In order to make satisfactory achievements, one who is concerned with economic geography should equip himself fully with a knowledge of economic sciences and of technical sciences for production and physical geography. Among these three fields of sciences, the relation between economic geography and economic sciences is fundamental. That is to say that the latter, in relation to the former, is the soul, the dominant factor and the core. As to technical sciences for production and physical geography, they are the fundamental knowledge necessary for the development of economic geography.

(1) The relation between economic geography and economic sciences: Among economic sciences, the closest relation is between political economics and economic geography. Political economics is the science of studying production relations (that is, economic relations) and economic rules. Economic rules control the production and distribution of material supplies and also govern the rules for production arrangements. If disassociated from the fundamental rules of political economics, the rules for production arrangements lose their backing and become meaningless. Consequently, economic geography should be developed according to the fundamental rules of political economics, using them to analyze production arrangements and then to derive fundamental rules for these arrangements. Economic geography will not exist as a science once it is separated from political economics. However, it will be improper on account of this to arrive at some other conclusions by saying that it is a part of political economics, or is actually political economics, or is the political economics of various nations and territories, which are obviously erroneous. Political economics is the study of production relations while economic geography is the study of production arrangements. They are sciences of two different natures. We should, on the one hand, observe the close relationship between the two and, on the other, also realize the difference between them. It is wrong to disregard their close relationship and the important effect of the former upon the latter, but it will also be a mistake not to realize the difference between them.

Apart from being closely related to political economics, economic geography is also closely related to departmental economics, since it is not only the study of the rules of production as a whole, but is also the study of those of the different departments of production. Hence, there are close relations between departmental economic geography and departmental economics, between agricultural geography and agricultural economics, and between industrial geography and industrial economics.

Economic geography is also closely related to economic history. Since it is not only the study of present production arrangements but is also the study of the origin of these arrangements, the knowledge of economic history is required.

Besides, the study of economic geography also involves the knowledge of economic statistics and economic cartography.

(2) The relation between economic geography and physical geography: Physical geography is a field of natural sciences while economic geography is one of social sciences. They are two types of sciences of a completely different nature, and therefore, any attempt to confuse their boundaries is erroneous. However, while realizing the different nature between these two sciences, we must also observe the close relationship between them. The relation between economic

geography and physical geography is determined primarily by the relation between production and production arrangements and natural conditions. Production is always carried out by using fixed natural matters and under fixed natural conditions. Therefore, production and production arrangements cannot but be affected by natural conditions. This determines the relation between economic geography and physical geography. It also shows the absolute necessity of using the knowledge of the latter to understand and explain the production and production arrangement phenomena of the former. To ignore the significance which physical geography has on economic geography is wrong, although regardless of the amount of effect natural conditions bring on production and production arrangements, they are not the deciding factors. Consequently, to over-emphasize the effect of physical geography on economic geography is also wrong. It will be a gross mistake if one considers combining economic geography with physical geography into a field called united geography.

Similarly, economic geography also has an important effect on physical geography, which cannot be disregarded. The reason for this is that production and arrangements for production undertaken by human beings are always carried out by utilising and changing the natural conditions, so that the development and changes of these conditions cannot but be affected by human activities. In many instances, once separated from the effect of human activities, the development and changes in natural phenomena will become something that are difficult to comprehend. Consequently, in dealing with physical geography, the study of the changing rules of development of the natural body, one must not disregard the importance of the effect of human activities on the natural conditions. That is to say that physical geography cannot but utilize the knowledge of economic geography to develop itself. At the same time, the object of studying physical geography is not designed solely for the sake of study, but for the bettering of the utilization and reform of nature. This again proves that the study of physical geography should be based upon the knowledge of economic geography in order to understand more clearly the object of study and to avoid inclination toward pure naturalism.

(3) The relation between economic geography and production technology: In geographical arrangement for production, which is carried out under the logical premises of fundamental economics and subject to the restriction of the existing natural conditions, production technology, in most cases, has the decisive effect. For example, the production of rice is carried out indeed because of the people's demand, and because of the existing natural conditions suitable for its growth. But these two factors alone are not sufficient to warrant the task. We should also endeavor to acquire the technical knowledge concerning the production, such as the characteristics of the product, and its growth in relation to heat energy, water, soil and labor conditions. Without this knowledge, we will be unable to plan for a

general arrangement, not to mention a precise arrangement for the production. Another example is the production of iron and steel which is carried out in certain regions simply because of the people's need and because of the existing natural conditions suitable for such production. But, in addition to these two factors, we should also be familiar with the technical knowledge involved, which are the characteristics of the production, the raw and processed materials and fuel needed, the technical process, and the relations between the production and the labor condition, transportation and other fields of industrial production. Without this knowledge, we will be unable to understand a general production arrangement, not to say a precise production arrangement. Technical knowledge provides us an understanding of the technical relationship within the production sphere and the relationship between production and natural conditions. Consequently, economic geography should utilize all knowledge concerning production technology in order to acquire progress and development. The study of agricultural production arrangements should master agricultural production technology; the study of industrial production arrangements should be familiar with industrial production technology, and the study of communication and transportation production arrangements should understand communication and transportation production technology.

While production technology covers a wide scope of knowledge, there is still a lack of a course that is devoted solely to the study of this subject. Consequently, apart from pursuing extensive study from books and magazines, the most effective means of acquiring such knowledge is to participate in inspections and practical work.

IV. The Method of Study of Economic Geography.

(1) Dialectical materialism and historical materialism are the foundations of the methodology of economic geography: Dialectical materialism is the reflection of the transformation of all phenomena in the universe. It is the foundation of the methodology of all sciences and is naturally the foundation of the methodology of economic geography. Dialectical materialism recognizes that all phenomena in the universe are in continuous transformation, the source of this transformation being the unity of and the struggle among contradictions. The course of the transformation is from the change in quantity to the change in quality, and the tendency of its development is from a lower to a higher level. Production arrangement phenomena naturally cannot be considered as an exception. Therefore, we should carry out our observation of these phenomena according to the viewpoint of dialectical materialism. Historical materialism is the function of dialectical materialism within the scope of social phenomena. It is the reflection of the transformation of all social phenomena. It is the foundation of the methodology of all social sciences and is

naturally the foundation of the methodology of economic geography. Historical materialism acknowledges that while social phenomena are a part of the united materialistic world governed by the general rules of dialectical materialism, they are different from natural phenomena and have their own specific rules. Historical materialism also recognises that the development and changes in all social phenomena are after all determined by the development and changes in material supply production undertaken by human beings, by those in production methods and those in production strength and relations. Production arrangement phenomena are one of the aspects in the development of material supply production; its development and changes are naturally subject to the restriction of the general rules of social development carried out according to historical materialism. Consequently, we should carry out our observation of production arrangement phenomena according to the viewpoint of historical materialism.

The science of economic geography is created and gradually developed according to the foundations of the methodology of dialectical materialism and historical materialism. Once separated from these foundations, it will be open to infilitration of various types of false theories practiced by the propertied class on the subject, and will return to the old concept and be unable to serve the proletariat and the construction of socialism.

(2) Some concrete methods of study of economic geography: Apart from the foundations of the methodology of dialectical materialism and historical materialism, the study of production arrangement phenomena should also be pursued according to a number of concrete methods. The methods which are constantly in practice are statistics, mapping and field inspection.

Production development and arrangement conditions are usually shown by large figures obtained from the use of the statistical method. These figures are one of the important sources of material for the study of economic geography. Therefore, we should, from an economic geographical viewpoint, adjust, analyse and study all statistical material available so that we may be able to understand the conditions and then the rules of production development and arrangement. Apart from using figures, the statistical method also expresses its results by means of statistical charts.

The recording of statistical materials on a map after they have been adjusted, analyzed and studied is called the mapping method. This method, as compared with the statistical method, is clearer and more accurate in showing the conditions of production arrangement. From an economic map, we are able to observe more clearly the characteristics of individual regions and the relations between production arrangements and various factors involved, and thus to conveniently understand the rules of these arrangements. Consequently, in the study of economic geography, full utilization of the mapping method should be made.

The study of the conditions of production arrangement by field observation is called the field inspection method. This method, which is used in conjunction with the statistical and mapping methods, will on the one hand provide us a deeper understanding of the object of our study, and on the other supplement our knowledge acquired from the other two methods. Apart from field observation, the general method of field inspection also includes visits, discussions and collection of related materials.

The methods of statistics, mapping and field inspection are equally important in the study of economic geography. They all have their own individual characteristics and effect. They can supplement each other but cannot substitute for each other. Hence, to discard any one of these three methods is erroneous and will jeopardize the progress of study of economic geography. In practical work, there exists a tendency of either giving more attention to the statistical method than the mapping and field inspection methods or putting too much emphasis on the latter two methods than the former method. It is hoped that these practices will be avoided.

(3) The use of some other methods: In addition to the three above mentioned methods, there are also the comparison as well as the analysis and unifying methods, which are important and generally used in the study of economic geography. These two methods, which are used jointly in many other fields of sciences, are particularly significant here since economic geography possesses regional as well as unified characteristics. The conditions and characteristics of the production development of various nations and territories are one of the main factors in the study of economic geography. If the method of comparison were not employed, it would be difficult to distinguish these different conditions and characteristics. Economic geography is accomplex field of science that involves an extremely wide area of study. If the analysis and unifying method were not used in determining the relations within the field, it would become a simple combination of physical, economic and technical knowledge and would not be considered as a science. In order to have a proper unification, an effective analysis should first be made on the complex relations within the field. Without analysis there will be no unification.

The use of the comparison and the analysis and unifying methods should be made throughout the process of each of the statistical, mapping and field inspection methods. At the same time, the purpose of using these latter methods is to clarify the many different aspects in the production development and arrangements so that a comparison, an analysis and a unifying effort can be made to show the rules, conditions (advantageous and disadvantageous) and characteristics of the production developments of various nations and territories.

To sum up, the study of economic geography should be based upon the foundations of the methodology of dialectical materialism and historical materialism, and on the basis of these foundations, the use of the statistical, mapping, field inspection, comparison and analysis and unifying methods should be made. It will be erroneous to disregard any of these factors.

5705
CSO: 3550-D

CHANGE OF RIVER COURSES IN SOVIET RUSSIA

/Following is a translation of an article by Arnotov and Karbov in the Chinese-language periodical, Ti-li (Geography), Peiping, No. 5, 1961, pages 224-225./

Since ancient times, the inverse flow of rivers toward their sources was considered as a symbol of natural calamities. In this modern era, this phenomenon is no more a presage of danger and bad luck. Geographical workers often plot at "unreliable" localities on a map certain light blue curves to show the course of "new-born" rivers. But, even in our time, the enormous engineering plan for the change of river courses is still very much impressive. In this paper, we shall present a plan for the change of the flow of Po-shao-la (phonetic, presumably Pechora) River and Wei-ch'ieh-ke-ta (phonetic) River.

Ancient Rivers

The Po-shao-la and Wei-ch'ieh-ke-ta Rivers originate from the rock canyons in the Ural Mountains and Ti-man (phonetic) ridges in the vicinity of latitude 61°. Starting from the two villages, Pei-t'e-lieh-ts'u-fu and Ch'i-lieh-po-no-fu (both phonetic), on the steep slopes in the upper reaches of K'o-erh-wa River (the northermost river in the Kama River basin), the brooks which can be seen at an interval of almost every kilometer are suddenly replaced by marshes. But if one only passes a distance of 15 kilometers, he will again observe river bends, where he has already crossed the divide of the two largest basins (Kama and Po-shao-la Rivers) in northern Europe.

In ancient times, people attached particular importance to river courses, since along these courses, they could travel to far away places, evading the dense and inaccessible forests. Along the banks of Kama River, people traded sable, sea otter and sequirrel skins, Persian rugs, and Pa-chan-t'ing (phonetic) satin and utensils. Since the olden days, people had been trying to open up a short cut between Kama River and Wei-ch'ieh-ke-ta River, a tributary of Pei-te-wei-nei River. As early as in the beginning of the nineteenth century, an 18-

kilometer long canal was already built linking the Chu-li-ch'i River in the Kama river basin with the Pei-k'ai-t'e-mu River, a tributary of Wei-ch'ieh-ke-ta River. However, this canal was later abondoned as impractical.

In the early 1930's, the talk on the northern rivers was again resumed when the so-called greater Volga River Plan was made by the Hydroelectric Power Projects Planning Institute. During that time, the idea of changing the river courses in the north into flowing toward the Volga river basin was created. This idea was to rectify the obviously unbalanced natural distribution of water resources in the northern and southern part of Soviet Russia. In the European part of Soviet Russia, almost 80 percent of the rivers run toward the north, flowing through the cold and then humid regions in the Taiga forests and on the moss plains. In the hot summer season, the land in the south can only receive 20 percent of the total surface flow. To regulate the annual distribution of river water by changing the course of some of the rivers in the north into flowing toward the dry areas in the south will indeed attract public sentiment. But this is not the only idea that attracted the attention of the planners. Other necessities of life have also brought another major problem - the Caspian Sea problem.

In 1925, along the banks of the A-p'u-hsieh-lun (phonetic) Peninsula, there were still wooden sheds standing over the water surface. These sheds were once occupied by traders from Persia, India and other kingdoms in the Orient and Middle East Asia. The infiltration of sea water gradually covered up the strong walls and towers. However, during the past 30 years, the Caspian sea level has declined by some 2.5 meters. This naturally has worried the seamen and fishermen in Ku-li-yeh-fu (phonetic, possibly Guryev) as well as other inhabitants along the coast, since the Caspian Sea has retreated further from their towns and villages. With its water surface stretching almost 400,000 square kilometers, the total amount of water evaporated is more than that acquired from rivers, rain and underground. Consequently, the plan for changing the river courses to raise the level of the Caspian Sea is extremely important.

The Process of Mapping the Plan.

The material accumulated by the Water Conservancy Projects Planning Institute shows that there have been numerous historical plans and attempts to change river courses.

Within the past 25 years, there has been several tens of plans made to solve this problem. Only through the joint effort of many experts in the fields of hydrography, dynamics and economics, as well as construction engineers, could such a precise and adequate plan be made to solve this major national economic problem. We shall summarize this plan as follows: The Po-shao-la and Wei-ch'ieh-ke-ta Rivers are to be made to flow through Kama and Volga Rivers into the Caspian Sea, suppling annually a total of 40 cubic kilometers of water. It is pointed out that this amount of water is equal to that of the Dnepr River flowing into the Black Sea annually.

In order to bring this plan into realization, we should build a series of huge river conservation structures. In the vast area from Solikamsk to almost Po-shao-la city, there will be a huge reservoir whose area will be 1.5 times larger than that of Ku-pi-hsueh-fu (phonetic) Sea, and will be second only to Lake Ladoga in the northern European part of Soviet Russia.

To faciliate reservoir construction, several earth dams should be built on Po-shao-la River, on the divide between Ni-pieh-erh (a tributary of Po-shao-la River) and I-jih-ma Rivers, and on Wei-ch'ieh-ke-ta River. A canal should also be built to run through the divides between Wei-ch'ieh-ke-ta and Po-shao-la Rivers and between Kama and Wei-ch'ieh-ke-ta Rivers so as to link the different lakes together into one reservoir, in the vicinity of Solikamsk on the upper Kama River, a series of projects - a 700,000-kilowatt capacity hydroelectric power station, navigation facilities, concrete overflow dams, and a 5-kilometer long earth dam--will be built. The second stage of the plan will call for the construction of water conservancy networks on Po-shao-la and Wei-ch'ieh-ke-ta Rivers. Thereafter, plan will be made to open up a combined channel leading from Volga River to the Barents Sea and White Sea.

Although at present the plan for the change of river courses from north to south only exists on paper, it has already created a tremendous effect on the national economic plan. It should be noted that when the rivers flow southward, they will be confluent with the Kama as well as the Volga River. This total force will be capable of operating several huge hydroelectric power stations.

One of these power stations - the Kama Hydroelectric Power Station located in the vicinity of Pei-erh-mu (phonetic) City, has already been completed. It was pointed out in the Soviet Communist Party's 21st Congress that the capacity of the Fu-t'e-chin (phonetic) Hydroelectric Power Station, another huge project in the lower Kama River, was not 540,000 kilowatts as had been previously planned but was 1,000,000 kilowatts.

While passing along the corridor of the Water Conservancy Projects Planning Institute, one can see the sign "Lower Kama Hydroelectric Power

Station" on the door of one of the offices. Here, work is being carried out on the design of another water conservancy network of the Kama River. It was learned from computation that the total amount of water from the northern rivers which will past through the dams of the present and future hydroelectric power stations on the Kama and Volga Rivers will produce the same amount of electricity as the world's largest Volga-Lenin Hydroelectric Power station now produces.

Our ancestors once also built dams and dikes. But the work of changing river courses from north to south, regardless of its scope or effect, is without precedent. This work will have a great effect on the natural conditions and climate of the vast northern region.

Huge Machines.

The engineering work on the water conservancy structures will be carried out in huge construction sites. The situres for the different projects on Po-shao-la, Wei-ch'ieh-ke-ta and Kama Rivers will be a thousand kilometers apart. All these projects will call for the cutting down and transportation of 80 million cubic meters of lumber, which is three times the total amount of production of one of the nation's largest lumbering regions - western Ural mountains. They will also call for the pouring of one and one half million cubic meters of concrete and 700 million cubic meters of earthwork, which will exceed three times the amount undertaken when the Volga-Lenin Hydroelectric Power Station was built. This enormous amount of earthwork to be carried out prompted the planners to study the production of new efficient machines. While the largest mud cranes that are presently used in water conservancy projects are capable of transporting 1,000 cubic meters of earth per hour, those which will be used in the projects on the divides of Kama, Po-shao-la and Wei-ch'ieh-ke-ta Rivers will triple this efficiency (3,000 cubic meters per hour). These new machines will also be capable of delivering earth 100 meters away. With the development of these machines, the complicated piping system for the transportation of mud is not needed.

The clearing away of the forests to provide a site for the future reservoir will not be completed before the water is filled, but this does not present any difficulty to the planners. On the water surface, floating lumbering and assembling combines will be used to cut down the trunks of pines and firs and process them into materials of various specifications. The combines will not be operated by coal or oil, but by lumber waste.

Excavators that have an efficiency of 15 cubic meters and 30-ton trucks that are equipped with automatic loading devices will be provided to the engineers as soon as the construction projects begin.

When will the plan for the change of river courses become realized? The construction work for the water conservancy structures will be completed within the next 15 years. By that time, a great majority of the Kama/Po-shao-la/Wei-ch'ieh-ke-ta Reservoir will be filled. This is to say that by the end of the next seven-year plan, the water conservancy system will be put into production, gradually guiding more and more water from the northern rivers into the dry Volga region and the Caspian Sea.

Extraordinary Changes.

At present, at the Water Conservancy Projects Planning Institute, one can often encounter representatives of the Pei-erh-mu National Economic Council, workers of the Volga Bureau of Navigation, experts on marine products from A-ssu-t'e-la-han (phonetic) and lumberers from the K'o-mi (phonetic) Republic. Their presence at the Institute is due to the fact that the plan involves the individual interests of ten different Soviet economic regions. Not long ago, a meeting of exports in the fields of geography, geology, hydrography, forestry, economics and chemistry was called by the Soviet Academy of Sciences to discuss the problems of bettering the utilization of the natural resources of the Caspian Sea, and at the same time, to find a possible way of avoiding the Sea from gradually becoming shallower, since the latter case would bring serious damages to navigation, the mining of precious raw chemical materials, and to the fishing and petroleum industries.

The guiding of northern waters into the Caspian Sea will increase the so-called "healthy" area in the northern part of the Sea, which is at present a shallow region. This will bring about an increase in the production of sturgeons, and will also save a tremendous amount of annual expenses for dredging work.

The northern part of Soviet Russia will also have a great change in the future. On the banks of the Kama-Wei-ch'ieh-ke-ta/Po-shao-la Reservoir will stand factory buildings of the new lumber processing and chemical enterprises. Forest highways running through the vast border between the subranges of northern Ural Mountains and the K'o-mi Republic will also be constructed.

Regardless of the tremendous amount of investments to be put into the project, they will be regained within approximately five years after its completion.

The change of the courses of Po-shao-la and Wei-ch'ieh-ke-la Rivers does not imply that these north-bound rivers will gradually become dry. The building of combined canals, dikes and locks will, in the future, aid in the opening up of a combined channel that will connect the Volga

River with the Barents and White Seas. The coal produced in Po-shao-la and apatite mined in Mo-erh-man-ssu-k'e (phonetic) will be economically transported to the enterprises in the industrialized south, while products -- metals, potash fertilizer, cement, cellulose, alcohol, plastics and petroleum products, made in the factories in the Urals and along the banks of the Volga River -- will be able to find shorter ways to reach the northern seas.

In the future, construction plans for dams, reservoirs and canals on the uninhabited land that has been scorched by the radiance of the sun, there will emerge dense green forests and fruit and grape orchards, exhibiting a bright prospect -- the profile of communism.

Text supplied by the Soviet Embassy.
Translated by Yang Yu-hua.

5705
CSO: 3550-D

PRELIMINARY ACHIEVEMENTS IN STUDY OF DRIFT-SAND CONTROL BY CLAY BARRIERS IN MIN-CH'IN*

/Following is a translation of an article by Keng K'uan-hung (5105 1401 1347) in the Chinese-language periodical, Ti-li (Geography), Peiping, No. 5, 1961, pages 200-205./

Control of drift-sand is one of the principal measures taken in taming a desert. Experiences have proven that while control of drift-sand by plantings is fundamental, it must be pursued with mechanical foundations.

In recent work carried out in Communist China, many different types of mechanical sand barriers have been used. It is therefore desirable to pursue a systematic study of these facilities to determine the most economical means of installation and to obtain the maximum efficiency.

In 1960, a systematic study of those facilities was carried out jointly by workers in the fields of climatology, pedology, and forestry at the Min-ch'in Drift-Sand Control Testing Station. The results obtained showed that clay barriers were rather effective. In order to extend the use of this type of barrier, this paper discusses the preliminary achievements made in the study, reserving certain advanced problems to be solved in future experiments.

---

* The author is indebted to Comrades Ho Yueh-ch'iang (Institute of Geography, Academia Sinica) and Liu Ti-Hsiang (Kansu Provincial Academy of Agricultural Science) for the data for this paper and for their participation in discussions, and to Mr. Chao Sung-ch'iao for his guidance.

Installation of Clay Barriers.

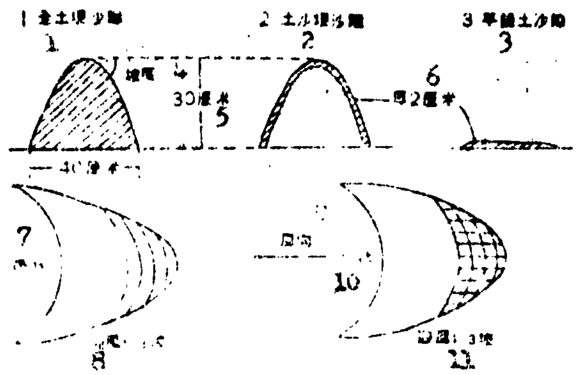
Clay barriers were developed according to experiences gained in the building of pressed clay-sand dunes by the people of Min-ch'in, and from the study and tests made in clay-sand barriers at Teng-k'ou Drift-sand Control Testing Station in 1959. These clay barriers whose method of installation is shown in Figure 1 are divided into three different types:

1. Pure clay barriers: Built entirely with clay, the height of the barriers is 30 centimeters, the base width, 40 centimeters, and the top width, 10 centimeters: The slope on both sides is approximately 30-45°.

2. Mixed clay-sand barriers. The mound of this type of barrier is first built with sand and then covered with a two centimeter-thick layer of clay; the diameter of the covering lumps of clay is 0.1 - 0.5 centimeter; the height and width of the barriers are similar to those of the pure clay barriers. Note that when building the mound, sand must not be taken from the foot of the barrier to avoid instability of the foundation and thus the waste of clay. While a smaller amount of work is involved in building this type of barrier than the pure clay barrier, the former are less stable than the latter (Note: After experiencing the severe wind and sand storms in the winter of 1960 and spring of 1961, most of the clay-sand barriers collapsed while those of pure clay remained intact).

3. Flat clay barriers: The sand surface is directly covered with a two-centimeter-thick and 40 centimeter-wide layer of clay; the diameter of the covering lumps of clay is 0.1 - 0.5 centimeter. A much less amount of work is involved in this type of barrier, but the stability and effectiveness are beyond compare with the others.

In order to level the sand dunes to enable them to become useful, the installation of barriers can be carried out in two different stages. The first stage is done on the lower part of the windward slopes (approximately below 1/3 of the slopes) to stop sand flow. By doing this, the air current, after passing over the barriers, will have a larger sand-carrying capability, carrying with it the sand accumulated on the upper part of the sand dunes so that the aeolian accumulation effect on top of the dunes will turn into aeolian erosion so that the sand dunes will gradually become levelled. The second stage of the installation is done by putting up barriers over the levelled sand dunes.



1. Pure clay barrier
2. Mixed clay-sand barrier
3. Flat clay-sand barrier
4. Angle of slope
5. 30 cm
6. 2 cm thick
7. Band form
8. 2/3 windward slope
9. Wind direction
10. Block form
11. 1/3 windward slope

Figure 1. Installation Plan for Clay Barriers

Sand barriers are installed in two different forms: the band form and the block form. Barriers installed in the band form should be normal to the direction of the prevailing sand-carrying wind; otherwise, a negative result will be produced when the wind passes between the bands. Specifications for the installation of barriers differ according to the intervals between bands (or blocks). According to Soviet experiences, barriers are generally two meters apart. Since the economic value and effectiveness of this specification has yet to be determined in China, apart from installing different types of barriers at two-meter intervals for comparison purposes (see Table 1), clay barriers have also been installed at 1, 1.2, 1.5, 2, and 3 meter intervals for the same purposes.

Effect of Control of Drift Sand by Means of Mechanical Barriers.

Practical work has proven that the control of drift-sand by means of mechanical barriers is only temporary, since they will eventually be damaged and become ineffective after a certain period of time. Consequently, from a long-range point of view, they should serve as good foundations for the control of drift-sand by plantings. They will not only be effective in the control of wind and sand but will also provide help for the growth of plants, guaranteeing the retention of their moisture. Hence, the control of wind and sand and the retention of the moisture of plants are two important features of mechanical barriers.

1. Wind and Sand Controlling Effect of Mechanical Barriers.

Experiences have proven that "when the wind blows the sand will flow and when the wind ceases the sand will be still." Wind is one of the principal factors of sand flow; therefore, to control the latter, one must first prevent the former.

In the surface atmospheric layer, the force of wind becomes greater with the increase of height. This is due to the fact that the surface frictional resistance against the air current decreases as the height increases. Hence, at a certain height contiguous to the ground surface, the force of wind is equal to the force of friction; the wind velocity thus being zero. This height is meteorologically known as the height of roughness, which explains the structural feature of the ground surface. The rougher the ground surface, the greater the frictional resistance and the higher the zero point of the wind velocity.

On the surface of drift-sand, there is less roughness. According to R. A. Pai-ke-no (Wind and Sand and Desert Sand Dune Physics, The Science Press, 1959), it is approximately 1/30 of the diameter of a sand granule (an average of 0.0025 centimeter according

Table 1

DIFFERENT TYPES OF TESTED SAND BARRIERS

Type of Barrier	Material	structure	Height of Barrier (cm)	Form Specifications	Position of Installation	Condition after Test
Tall grass	grass from sea shore	Ventilating, sparce	40	Band, 2 meters	Windward slope and top of dune	Damage to part within barrier where sand is accumulated
Branch	Tree branches	"	10	"	At point 1/3 of the windward slope	Partial accumulation of sand within barrier
Short grass	Grass from wheat field	"	10-15	Block, 2 X 2 meters	"	Barrier actually buried by sand
Block form	Clay	Non-Ventilating, solid	35	"	"	Aeolian erosion within barrier
Band form	Clay	"	40	Band, 2 meters	"	"

to actual determination). If we base on the diameter of 0.025 centimeter, the roughness is equal to 1/10. This shows that the movement of air current over the sand begins almost on the ground surface (Keng K'uan-hung, "Sand-Carrying Wind and Drift Sand", Ti-li Hsueh-pao /Acta Geographica Sinica/ Vol. 25, No. 1, 1959), with the result that an extreemely close relationship exists between the wind and sand. If the wind velocity only reaches the extent of sand-carrying (the wind velocity at two meters above the ground is generally five meters per second), the sand will start to drift.

The installation of sand barriers is for the purpose of changing the smoothness of the surface of the sand, causing it to become rough and thus producing a greater frictional resistance and raising the zero point level of the wind velocity. The raising of this level differs according to the features of the barriers. In general, as compared to the surface of the sand, tall grass barriers increase the roughness by 12 times; tree branch barrier, 27 times; short grass barriers, less than 6 times; and clay barriers, approximately 200 times.

The rise of the zero point level of the wind velocity directly reduces the effect of the air current on the sand, severing the close relationship between them and at the same time, weakening the force of the wind. According to field observations, at the same height level (two meters), the force of wind is weakened by 30 to 40 per cent by grass and branch barriers and by more than 40 per cent by clay barriers (see Table 2). The wind force at a 20-centimeter height level is reduced by 8 to 40 per cent in the former types of barriers and by approximately 30 per cent in the latter type.

Table 2

WIND VELOCITY 20 CENTIMETERS HEIGHT INSIDE AND OUTSIDE SAND BARRIERS (m/sec)

Sand Barriers	Tall Grass	Tree Branch	Short Grass	Block-form Clay	Band-form Clay
Inside of Barrier	1.5	2.4	2.5	3.3	3.7
Outside of Barrier	2.6	2.6	3.0	2.4	2.5
Reduction Rate	0.42	0.08	0.17	0.27	0.33

Conversely, the critical sand-carrying wind velocity in the barriers is thus increased. When the velocity of the sand-carrying wind is five meters per second at a two-meter height above the sand surface, the sand in the barriers is still. The result of observations shows that within most of the barriers, the sand moves only when the wind velocity reaches six to seven meters per second.

Apart from direct wind pressure, the movement of sand is also affected by eddy currents. Eddy currents are the vertical vortex motion of air currents, their orientation being normal to the ground surface and thus affecting the ascending and descending motion of the sand. They can roll up the sand or press it onto the ground.

The effect of eddy currents on the one hand is determined by the stratification of the force of wind and the atmospheric temperature, and on the other, by the roughness and, the ground surface structure. The roughness affects their intensity while the ground surface structure influences their structure. According to computation of the intensity of eddy currents with respect to the roughness, when the wind is at a critical sand-carrying velocity at a two-meter height, and depending on the neutral stability of the stratification of the atmospheric temperature, we obtain the results shown in Table 3.

Table 3

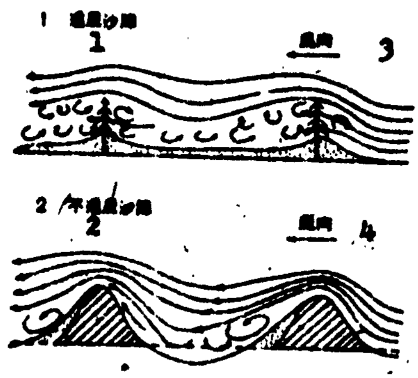
EDDY CURRENT INTENSITY AT DIFFERENT HEIGHT LEVEL WITHIN SAND BARRIERS

Type of Barrier	Roughness (cm)	10 Centimeters above the ground		1 centimeter above the ground	
		sq cm/sec	Drift sand surface	sq cm/sec	Drift sand surface
Tall grass	0.0294	4.65	1.05	0.52	0.20
Branch	0.068	4.27	0.96	2.17	0.83
Short grass	0.0144	4.63	1.02	2.12	0.81
Block-form clay	0.4923	3.83	0.84	0.59	0.22
Band-form clay	0.4923	4.78	1.06	1.18	0.45
Drift sand surface	0.0025	4.53	1.00	2.62	1.00

From Table 3, it is obvious that the greater the roughness inside the barriers, the lesser the intensity of the eddy currents contiguous to the ground surface, and at the same time, the intensity increases rapidly along with the increase of height. Hence, at the one centimeter height level, the intensity of the eddy currents inside all barriers is less than that on the surface of drift-sand, but the case is almost opposite at the 10-centimeter height level. The variation of eddy current intensity along with height is most intense in tall grass barriers, and is also great in clay barriers.

As is known, sand flow is generally concentrated within the 10-centimeter atmospheric level above the ground. Therefore, within this level, the variation of eddy current intensity has a great effect upon the sand flow. This effect also determines the eddy current structure since it functions along the direction of the sand movement.

Because of the structural differences in barriers, there is also a great variation in the structure of eddy currents. Grass and branch barriers are ventilating and have a straining effect on air current. When the wind blows, a portion of the air current passes over the top of the barriers while another portion penetrates through them. These two portions of air current meet at the intervals of the barriers and create a mutual interference, forming numerous small scattered vortices. Although this does not produce any variation in the eddy current intensity as a whole, the mutual cancellation of the effect of the vortices evidently weakens the sand-carrying capability of the air current. Hence, when the sand-carrying wind passes through the barriers, a part of the granules is retained. Clay barriers are not ventilating. When the wind blows, the air current can only pass over the top of the barriers without penetrating through them. The air current is compelled to uplift itself on the approach of the barrier and lowers after passing over it. This is similar to the case of water flowing over a dam. After passing over the barrier, the air current proceeds to strike on the sand surface a short distance from the rear of the barrier. A part of this air current then becomes a large individual eddy current, acting on the lee side of the barrier and absorbing the granules which passed over this barrier to form an accumulation. The other part of the air current, after striking, continues forward carrying with it sand activated from the strike to pass over another barrier. These sand granules can possibly be absorbed by another eddy current on the lee side of this barrier to form another accumulation and can also be carried away by the air current. Hence, unlike ventilating barriers which work only (or principally) on sand accumulation, the clay structures effect sand accumulation as well as aeolian erosion. These conditions are shown in Figure 2.



1. Ventilating barriers
2. Non-ventilating barriers
3. Wind direction
4. Wind direction

Figure 2. Structure of Eddy Current Resulting from Air Current Passing Over Different Types of Barriers.

The different effects of eddy currents on sand flow are the results of the combined effect of their intensity and structure. Hence, the effect of the intensity on ventilating barriers is the acceleration of sand accumulation, while non-venting barriers effect sand accumulation as well as aeolian erosion. These two types of effect oppose each other, their strength generally being equal, and thus can possibly cancel each other. The result will only produce significant changes in the sand surface within the barriers, the center being hollow while the two sides are protuberant. Speaking in terms of drift-sand control, there is actually no sand flowing in and out of the barriers.

Although a quantitative concept by overall observation and determination has yet to be drawn on the above inference, a satisfactory amount of proof has already been obtained from practical operations. In the 25 observations made between April and July, it was found that there was an accumulation of sand in all the ventilating barriers, the average thickness of this accumulation being from 6 to 10 centimeters and the thickest, 10 to 20 centimeters on a single occasion. The central part of the non-ventilating clay barriers was, without exception, a hollow caused by aeolian erosion, the average depth being from 2 to 3 centimeters and the deepest reaching over 10 centimeters on a single occasion. But on the lee side of the barriers, there was always an accumulation of sand whose position changed along with the direction of the wind.

It is worthy of note that since the former type of barrier (ventilating) always works on sand accumulation, it follows that the thickness of the accumulation increases continuously; although at a time, depending on the different conditions of the wind, a part of it would be blown away. In the latter type of barriers (non-ventilating), while there is aeolian erosion in the central part, the variation in depth is not great since it is always supplemented by the accumulation on the side, especially when the wind blows from the opposite direction. Although, as shown in Table 4, the accumulated depth (April to July) can reach 10 centimeters, it is extremely natural as far as newly installed barriers are concerned, since, according to the above-mentioned air current conditions, it is obvious that the originally flat sand surface in the barriers should change into a hollow shape. This is exactly the position to be used for measuring the activities of the sand surface.

Hence, it is obvious that in the control of drift-sand, there is a difference between the two types of barriers. While ventilating branch and grass barriers are effective, the accumulation of sand resulting in the continuous rise of the sand surface within the barriers and in burying them gradually will quickly reduce their sand control efficiency. In short grass barriers, for example, there is a quick accumulation of sand after their installation, and by the latter stage of the experimentation, the entire area of installation becomes higher than the surrounding sand surface. From a distant observation, it has a conspicuous resemblance of a low protruding platform, where the barriers have acutally lost their sand controlling effect. Clay barbiers have both aeolian erosion and accumulation effects, which generally cancel each other, and thus retain a much longer period of effectiveness. However, in areas where there is a katabatic wind, their effect is lesser than that of the grass and branch barriers.

Table 4

DEPTH OF SAND ACCUMULATION AND AEOLIAN EROSION IN SAND BARRIERS (cm)

Location of Observation	Average	Maximum	Accumulated Depth (According to Scale)
Tall grass barriers	10	15 to 20	50
Branch barriers	8	11 to 14	10
Short grass barriers	6	10	25
Block-form clay	3	11 to 16	10
Band-clay barriers	2	10 to 14	8

2. The Retention of Moisture by Mechanical Barriers.

The lowering of the wind velocity and of the eddy current intensity on the surface layer within barriers can reduce evaporation over the sand surface and is favorable for the concentration of precipitation, and is thus also advantageous to the deposit of moisture in the sand. However, due to the tremendous effect of the sand flow, there is actually a greater difference in the moisture condition of the sand within the barriers. According to the general data shown in Table 5, only the moisture content in the sand within the clay barriers is higher than that in drift-sand; the moisture content in the sand within all other barriers is lower. This clearly shows that improvement of the moisture content in the sand can only be made within all other barriers, the moisture condition will deteriorate.

Table 5

MOISTURE CONTENT IN THE SAND

Location of Observation	Total Moisture Deposit in 0 to 50-cm Sand Layers (mm)	Depth of water penetration within 1 minute following precitation (cm)	Depth of Dry sand Layer (cm)
Tall grass barriers	Below 7	-	20
Branch barriers	Below 10	-	18
Short grass barriers	Below 10	-	18
Block-form clay barriers	16.02	35.6	8
Band-form clay barriers	16.65	28.2	10
Drift sand	13.35	20.7	16
Pressed clay-sand barriers	7.73	-	-

It should be pointed out that all ventilating barriers possess a sand accumulating feature. The accumulated sand naturally is absolutely dry, thus allowing the dry sand layers to gradually become thick, which is the fundamental reason for the loss of moisture in the sand, especially in the initial growing stage of plants when the moisture condition is even worse. Consequently, the plants grown in these barriers are difficult to sprout. As to the pressed clay-sand barriers which are being used by the masses, due to the fact that the sand surfaces are entirely covered with clay, water cannot possibly penetrate into the sand, and therefore it either flows away or evaporates. Hence, except for the surfaces, the supply of water cannot reach the sand under the clay, which is another reason for the worse moisture condition. In an inspection tour made on this type of barrier in 1958, it was found that desert plants only grew at the foot of sand dunes, indicating the type of moisture condition we have discussed.

One aspect of the improvement of the moisture condition of the sand in clay barriers is attributed to aeolian erosion, which causes some of the dry sand on the surface to be blown away and the layer to become less thick. Another aspect, which is more important, is created by the penetration of clay into the sand. According to physical nature, the coarseness of sand granules allows them to disperse, and the rougher the capillaries of the sand layer, the stronger the perviousness of water and the weaker the retentiveness of moisture. The physical nature of clay is just the opposite. Hence, the mixing of sand with clay will change these natures, supplying whatever is lacking in one or the other. According to experiences gained by farmers in northwest China, the mixing of sand with clay or the pressing of sand together with clay has been one of the principal measures taken in the improvement of soil conditions and the increase of agricultural output. This has led to a common saying, "A pressed clay and sand block is more precious then a gold plate," which has been proven by scientific experiment. Experiments show that the institution of these measures improves the physical structure of the soil and thus increases its moisture retentiveness (See Lu Chung-shu and Ch'en Pang-yu, "Study of Sand-flats in Kansu," Chinese Journal of Agriculture, Vol 6, No. 3, 1955).

Hence, the penetration of clay into sand will also create a similar effect. After clay barriers are erected on the drift-sand, the long period of wind and rainfall will cause the clay to gradually penetrate into the sand, filling in the rough pores and thus allowing the loose sand to form a pseudo-crumble structure. Due to the fact that there are fine pores in this type of structure, the moisture retentiveness of the capillaries increases. At the same time, since the structure still retains a relatively large number of rough pores, there is no significant change in the perviousness of water. Hence, after the penetration of clay, the sand layer should possess excellent water perviousness as well as satisfactory moisture retentiveness; that is, the penetration of clay into sand can improve the latter's moisture retentiveness. This type of inference has been proven by the actual determination of moisture in the sand. as pointed out in Table 5, the depth and velocity of rain water soaked into the sand in clay barriers are greater than in drift sand. In the band-form clay barriers, for example, the depth of water soaked into the sand reaches 28 millimeters per minute, which is 36 per cent greater than that soaked into drift sand; the rate of seepage is 0.47 centimeter per second, which 0.12 centimeter greater. The seepage of water in block-form barriers is especially significant. This, apart from being affected by the concentration of water in clay barriers, can also be attributed to the rough pores in the crumble structure. Table 6 shows that the moisture content in the various sand layers within a barrier is higher than that in drift sand. This is especially true in the 0 to 5-centimeter layer where the moisture is doubly higher.

Table 6

MOISTURE CONTENT IN SAND OF VARIOUS DEPTHS

Location of Observation	Depth (cm)						
	0	5	10	20	30	50	Average
Pressed clay-sand dune	0.52	0.38	0.56	1.67	1.76	[illegible]	1.06
Clay barriers	0.23	1.43	2.54	3.00	3.17	2.96	2.17
Drift sand-flats	0.14	0.99	1.86	2.52	3.85	1.34	1.78

The growth of plants within barriers is affected directly by the moisture retentiveness of the sand in those barriers, since the moisture required is totally dependent on that contained in the sand. The plants, apart from requiring the protection from damage by wind and sand storms, particularly need the guarantee of moisture. In the extreme dryness of the desert, the water itself constantly faces survival difficulties. Consequently, the moisture condition within the barriers cannot but be strongly reflected by the growing condition of the plants. This growing condition is a means of determining the moisture of the sand within the barriers.

For instance, from observation made on the desert plants - "so-so" /A type of fast growing plant/ sown in June 1960, it was found that those growing in clay barriers were healthy and the rate of survival was high, while in other types of barriers, the case was worse than that on drift sand where there were no barriers. In tall grass barriers, for example, the plants sown did not sprout; in branch barriers, although the plants did sprout in the early stage, they were gradually buried by sand, with only three decayed ones remaining in the later stage. This clearly shows that these sand accumulating barriers create a serious obstruction to the growth of plants, while the clay barriers provide advantages for them. The effect of the control of drift-sand of all these barriers is shown in Table 7.

It must be pointed out that the disadvantages created by the ventilating and sand accumulating grass and branch barriers will obstruct future plans for the control of drift-sand by plating and for the development of agriculture and animal husbandry. Hence, from a long-range point of view, careful consideration should be given to the use of this type of barriers.

Table 7

THE CONDITION OF GROWTH OF SO-SO INSIDE AND OUTSIDE SAND BARRIERS

Location of Observation	Rate of Survival (%)	Height of Plant (cm)	Area of Plant Top	Remarks
Tall grass barriers	0	-	-	-
Branch barriers	only 3 remaining	-	-	Unsatisfactory
Clay barriers	83	42.6	2682.6	Healthy
Drift sand	44	25.2	1584.0	Satisfactory

Forms and Specifications of Clay Barriers

Due to the different conditions existing from the planning stage to actual operation, the types of clay barriers to be installed will be various. These various types of clay barriers will naturally lead to different effects on the control of drift-sand. Hence, it will be extremely important that these effects should first be examined.

Among the three types of clay barriers mentioned earlier in this paper, the roughness of the flat clay barriers is approximately 0.01 centimeter which is only four times greater than that of drift sand. The increase of the frictional resistance is not great (approximately [illegible] per cent as compared to that of drift sand), and the weakening effecy on the wind velocity and on the eddy current intensity contiguous to the ground surface layer is limited; the eddy current structure is similar to that on the drift sand. Hence, except for the temporary control of that portion of sand covered by clay, these barriers are not effective and are generally not adequate for use. As to the installation of the other two types of clay barriers, only the stability and the amount of work involved are different. Pure clay barriers are enduring but require more labor, while mixed clay-sand barriers are just the opposite.

The more important considerations to be given to these barriers are their forms and specifications, since the difference in these two aspects will bear different effects on the control of drift-sand, the retentiveness of the moisture of sand, and finally the growth of plants.

On the control of drift-sand, the changes in the sand surface layer within a barrier gives a unified result in the effect of the control. To render a convenient comparison, we give an illustration by using the greatest variations. A shown in Figure 3, in the band-form barriers, due to the passing of some air current along them, the effect of the spacing is limited, but the depth of the sand surface caused by aeolian erosion is great (above 10 cm); however, in spacings of more than 2 meters, the erosion appears to be more intense and the lowering of the sand surface is much greater. The case is just the opposite in the block-form barriers since the effect of the length of the spacing is very much evident. This type of effect shows that the greater the spacing, the deeper the sand surface caused by aeolian erosion. However, in spacings of less than 1.5 meters, the effect is rather moderate. Hence, we will find that in terms of the form of barriers, the control effect of the band-form is no greater than that of the block-form. With regard to specifications, if the spacings of the band-form barriers are less than 2 meters, there is no significant effect of these spacings; if those of the block form barriers exceed 1.5 meters, their effect on sand control is greatly reduced.

The moisture retentiveness of clay barriers is manifested by the moisture contained in the sand and the thickness of the sand layers. As shown in Figure 4, at the same depth (15 cm), the moisture content in the band and block-form barriers is higher than that in the drift sand. But the moisture content in most of the band-form barriers is lower than that in the block-form; the former also show that when the spacings are less than 2 meters, the effect of these spacings on the moisture content is not evident, as indicated by the moderate and irregular curve in the figure. When the spacings exceed 2 meters, there is an increasing trend of the moisture content in the sand, which is obviously caused by the intensification of aeolian aerosion and the decrease of the thickness of the dry sand layers, as clearly shown in Figure 5. Figure 5 shows that the thickness of the sand layers decreases noticeably in barriers that have larger spacings. In block-form barriers, the curve shows relatively great but irregular changes in moisture content. In general, the moisture content in the sand decreases along with the increase of the spacings, and when the spacings exceed 2 meters, the moisture content in these barriers is even lower than that in band-form barriers. This is also clearly shown in Figure 5, where the thickness of the dry sand layers in the block-form barriers increases linearly along with increase of the spacings from 1.2 to 2 meters, but when the spacings reach 2 meters, the thickness of the layers is close to that of the band-form barriers of a similar ca-

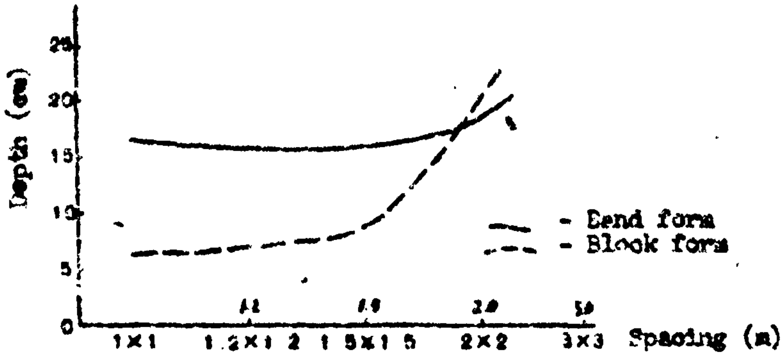


Figure 3. Maximum Changes in Different Forms of Clay Barriers Resulting from Aeolian Erosion in the Early Stage.

(April - July)

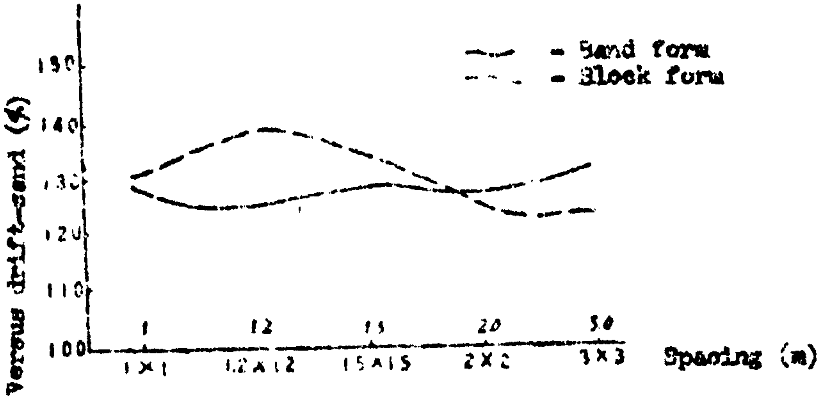


Figure 4. Moisture Changes in the Sand in Different Forms of Clay Barriers at 15-cm Depth

(April-July)

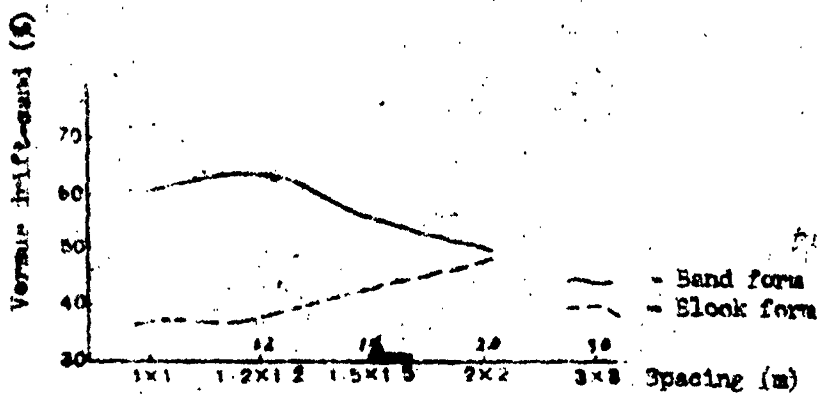


Figure 5. Changes in Thickness of Sand Layers within Clay Barriers of Different Specifications

(April - July)

specification. From the trend of the curves, when the spacings exceed this measurement, the layers in the block-form barriers can be thicker than those in the band-form barriers. Hence, it can be easily concluded that if the spacings are less than 2 meters, the moisture retentiveness in block-form barriers is more satisfactory than that in band-form barriers, but the case is reversed if the spacings exceed 2 meters. The moisture retentiveness in block-form barriers appears to be most effective when the spacings are 1.2 meters. But due to errors which are not negligible in the observation and determination of moisture content in the sand and the irregularity of the curves showing the moisture content and the spacings, a final conclusion will not be given to this effect.

From the above discussion, we will find that although grass and branch barriers are effective in drift-sand control, their effectiveness will quickly diminish with the continuous accumulation of sand. Also, because of these sand accumulations, the moisture content in the sand gradually deteriorates and the sand layers become thicker, which are disadvantageous to the growth of plants. Hence, the installation of these types of barriers will create difficulties in furthering our plan for a long range control of drift-sand by means of plantings. Moreover, due to the fact that the desert is a place where plants are scarce and difficult to grow, the materials to be used for these types of barriers can hardly be obtained locally. These must be imported from other localities. In Sha-po-t'ou, for example, the amount of grass needed for the installation of barriers (2 X 2 meters) covering an area of one mou was more than 400 catties and cost approximately 100 yuan. Such an expense obviously cannot be arranged for by an average locality.

Clay barriers can produce immediate advantages as well as long range benefits. They can lay down reliable foundations for the long range control of drift-sand by plantings and for the future development of agriculture and animal husbandry. The material required for the installation of this type of barrier is abundant. In the oasis regions on the desert border, there is generally an extensive distribution of clay. In the desert frontiers, such as, Min-ch'in, Teng-k'ou, and the many oases along the southern border of the Nan-chiang Desert, there are abundant clay deposits. On the desert border along Min-ch'in, the lowland in between sand dunes is all covered with thick layers of clay, which are ready for use once installation work is started.

On the amount of labor involved in the installation of sand barriers, although at present to complete grass barriers (2 X 2 meters) covering one mou of land requires only 13 working days (by hand), the installation of block-form clay barriers of the same specifications requires 15 days, which is five times greater, but if the installation is calculated in terms of cost (adding material and transportation), the latter are two to three times more economical than the former. The cost for installing mixed clay-sand barriers is still more economical, which is four to six times lower than that for installing grass barriers. Besides, in comparison to the amount of labor involved in erecting pressed clay-sand dunes, it is less by over ten times.

Existing Problems

1. Stability and Durability of Clay Barriers.

In this case, stability implies the period from the beginning to the end of aeolian erosion after installation of the clay barriers; i.e., the time required for the sand surface within the barriers to start changing to the final stage of stability. While aeolian erosion within the barriers is generally not serious, on certain days when a fresh gale prevails, it is still harmful to the plants. Therefore, it will be most suitable to start planting when the sand surface within the barriers finally becomes stable. For this reason, the time required for the sand surface to become stable should depend on the form and specifications of the barriers. Primarily, it is believed that the time required by the band-form barriers is longer than that by the block-form barriers, and in the latter barriers, the narrower the spacings, the shorter the time required for the sand surface to become stable. It is estimated that generally the sand surface within clay barriers should become more or less stable after one windy season. According to the climatic conditions in the deserts in China, it is most ideal to install clay barriers in the latter part of one year and start planting in the summer and fall of the following year.

The word durability mentioned in the beginning of this section means the length of period in which the barriers remain effective in maintaining the control of drift-sand. This is primarily determined by the solidity of the barriers. Naturally, barrier will deteriorate gradually as a result of wind and rain. The question is whether the period during which the barriers are being damaged and becoming ineffective is long enough for the growth of the plants whereby the plants themselves are capable of resisting the damage of wind and sand. This period, on the one hand, is determined by the intensity and frequency of the sand-carrying wind, and on the other, by the erosion resistance of the barriers. In Teng-k'ou, for example, the majority of the block-form clay barriers installed two years ago are still intact. The plants within these barriers are generally over 50 centimeters tall and are healthy and wind resistant. It is firmly believed that clay barriers can remain intact for more than three years, thus allowing sufficient time for the growth of plants.

2. Forms and Specifications of Sand Barriers.

The conclusion on the forms and specifications of clay barriers mentioned earlier in this paper was arrived at according to the climatic condition of Min-ch'in, and therefore, it is not a general conclusion. To plan for the forms and specifications of barriers, considerations should first be given to the local wind and moisture conditions as well as the position in which the barriers are to be installed. In general, in localities where there are variable wind directions, the use of block-form barriers are adequate; in places where the sand-carrying wind prevails from one direction, band-form barriers are more suitable. In regions where the velocity of wind is high and the period of continuity is short, and where the position of the barriers is low and levelled, the width of the spacings should be more than 1.5 meters; in the opposite case, the spacings should be less than 1.5 meters. In places where rainfall is relatively abundant and the sand-carrying wind is not too intense, the barriers to be installed should generally be low and the stability be maintained. This also applies to places where barriers with narrow spacings are installed.

3. Problem Concerning Mechanizing the Process of Installation of Barriers.

Regardless of the limited amount of labor involved in installing clay barriers, due to the vast area of the desert and labor shortage in that region, the use of manual labor alone to install barrier will be far from adequate to effect an overall control of drift-sand. Consequently, apart from carrying out the policy of effecting control in certain localities, special considerations should be given to mechanizing the process of installation, especially the acquisition and transportation of clay.

4. Directions toward Which Further Study of the Subject Should be Made.

Although the efficiency of clay barriers has been primarily determined, it is still inadequate and further study should be made toward their improvement. Hence, in the course of study, particular attention should be given to the soil structure in the sand, changes in moisture and the microclimatic conditions within the barriers, and also to the suitability of the growth of different types of plants. Only be doing this can the effect of clay barriers on the control of drift-sand be further improved.

5705
CSO: 3550-D

- END -