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HYDROGRAPHY AND GEOGRAPHY OF THE PEARL RIVER BASIN

-COMMUNIST CHINA-

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HYDROGRAPHY AND GEOGRAPHY OF THE PEARL RIVER BASIN

[This is a full translation of an article prepared by Liu Ch'ang-ming and Shu Li-kung appearing in Ti-li Chih-shih (Geographic Knowledge), Peiping, No 11, November 1958, pages 488-493.]

I. The Pearl River Basin

The Pearl River is one of our three largest rivers, and it drains on area of 437,000 square kilometers. The river basin covers four of our provinces: Yunnan, Kweichou, Hunan and Kwangtung. In addition, it also covers the Kwangsi T'ung Autonomous and a part of the Vietnam Democratic Republic (about 11,450 square kilometers). The volume of its flow is very great, being only less than that of the Yangtze River, and it is about eight times that of the Yellow River.

The topography of the river basin is high in the west and low in the east, and it is full of mountains and hills. In the river basin, 50.3 percent of the area is covered by mountains of a height of 500 meters or more; 44.1 percent are hills between 50 and 500 meters; and 5.6 percent are plains with an elevation of less than 50 meters (that includes 0.1 percent of the area in the form of lakes).

According to the topography, the river basin can be divided into two regions: the K'o-ssu-t'e [a type of geological formation] and the non-K'o-ssu-t'e. The K'o-ssu-t'e topography is distributed in Yunnan and Kweichou provinces and in the Kwangsi T'ung Autonomous Ch'u, and it occupies the greater part of the river basin. The hydrology of the rivers in the region are all under the influence of the K'o-ssu-t'e development. Kwangtung Pro-

vince, a part of Hunan Province, and the Kwangsi T'ung Autonomous Ch'u are in the non-K'o-ssu-t'e region.

The Tropic of Cancer passes through the middle of the Pearl River basin and the climate is sub-tropical being warm throughout the year and with abundant rainfall. The coldest month (Janurary) has an average temperature higher than 12°C, and the hotest month has an average temperature of 28°C. The area is, consequently, free of ice and snow throughout the year.

The average annual rainfall in the river basin is 1,450 millimeters. This rainfall is greater than the amount which falls in any other of our great river basins, which accounts for the great volume of water carried by the rivers. The distribution of rainfall is uneven, however, being high in the east and diminishing towards the west.

The center of greatest rainfall is Ch'ing-yuan and Ying-te, Kuei-lin and Yung-fu, Hsiu-jen and Chao-fa, etc., all exceeding 2,000 millimeters. On the upstream sections of the North and South P'an Rivers, the rainfall is less plentiful and does not exceed 1,000 millimeters.

This river basin is warm and rainfall is plentiful, and agricultural products can be raised the year round. Many industrial goods and forest products can be successfully developed here. However, the cultivated land in amounts to only 79,070,000 mou. There is much uncultivated land and hill area; there are 120 million mou in Kwangsi alone. At the same time, the production per unit of cultivated soil can also be raised. The total population in the river basin is about 40,740,000. They are very industrious people and there is great potential for future development and increased agricultural production.

The basin is also rich in non-ferrous metals, especially in Yunnan and Kweichou. The tributaries of the Pearl River are a potential source of plentiful water power, and are very important for further industrial development. The condition of the rivers make them convenient for river transportation, since a survey shows that the navigable distance is about 12,000 kilometers.

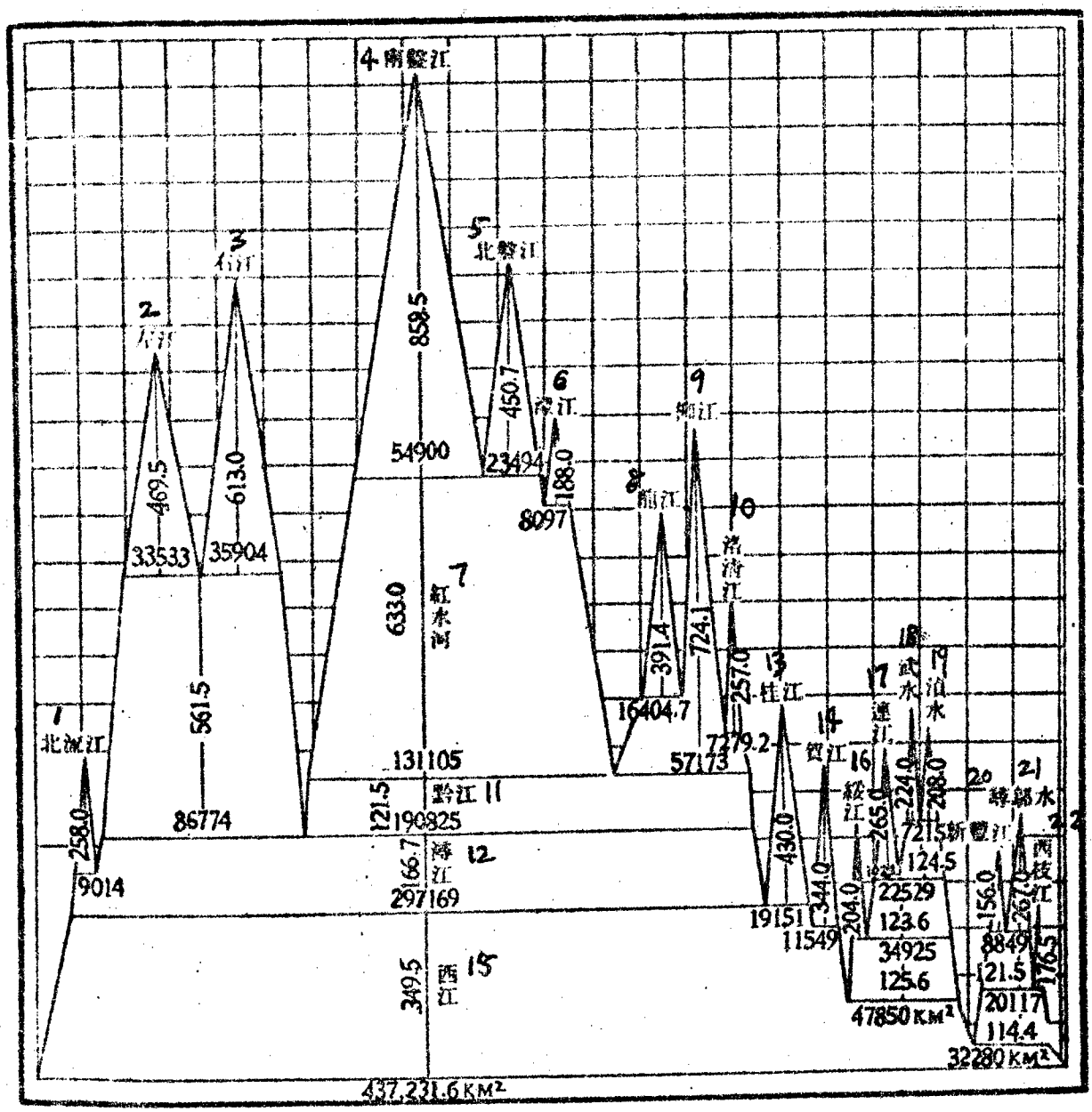
The volume of river transportation on the Pearl River is only less than that of the Yangtze River. As a result,

the river, which is our typical sub-tropical river, has special significance in science and economics.

II. The Hydrology and Characteristics of the Pearl River Basin

The Pearl River basin is roughly a rectangle elongated in an east-west direction that is formed by the West, North and East Rivers. The West River [basin] covers the largest area, namely 80.3 percent of the whole basin; while the [basins] of the North and East Rivers occupy 11.3 and 8.4 percent of the total area respectively. The length and area of the Pearl River tributaries are shown in Figure 1.

Figure 1. The Pearl River Basin Area and Length of Its Rivers



1. Pe-liu	9. Liu C.	16. Sui
2. Tso	10. Lo-ch'ing	17. Lien
3. Yu	11. Ch'ien	18. Wu
4. South P'an	12. Hsin	19. Chen
5. North P'an	13. Kuei	20. Hsin-feng
6. Meng	14. Ho	21. Hsin-wu
7. Hung-shui	15. West	22. Hsi-chih
8. Lung		

The hydrological development in the basin is not even. The density of the river network is higher in the east, with an average of 0.85 kilometers of river length per square kilometer of land (counting rivers with a basin of larger than 300 square kilometers); while the western basin average is only 0.61 kilometers per square kilometer.

The thinness of the river network in the west is partly due to the lesser rainfall, and also because the western areas are mostly under the K'o-ssu-t'e influence, and because the surface river network is often replaced by subsurface flows.

The most important river in the Pearl River system is the West River, with a main branch length of 2,129.2 kilometers. The main source of the West River is the South P'an River, which starts from the Ma-hsiung Shan in the Han-I District of Eastern Yunnan.

After it joins with the North P'an River it is called the Hung-shui River, which flows southeast to Kwangsi Province Shih-lung-san-chiang joining the Liu River, and there its name changes to the Ch'ien River. Then it meets the Yu River at Kuei-ping, after which it is called the Hsin River. It joins the Kuei River at Wu-chou and is then

called the West River. The West River meets the North River in San-shui-szu hsien, and then flows to the sea via Mo-tao-men.

The basin of the West River can be divided into three regions: upstream above the Hung-shui River, the river cuts through limestone plateaus, and the K'o-ssu-t'e character is well developed. In addition, subterranean flows, dragon grottos and hai-tzu are frequently seen. On the South P'an River, plains and gorges are alternately found.

In the plains, the slope of the river course is slight and it meanders, which is conducive to overflow during the existence of flood conditions. In the gorges, the slope is steep and the river swift. The North P'an River coarse consists almost entirely of gorges, and rapids and waterfalls are numerous. The celebrated Huang-kuo-shu waterfall is located on it. Also, there are many rivers without an apparent sources which enter the main stream.

After the North and South P'an Rivers join, the river cuts through limestone in gorges in Kwangsi, and shoals are plentiful. The river is deep between the shoals, being more than 20 meters even at the low water stage. However, the tributaries are short and few in number. Below the Hung-shui River, the Chien and Hsin rivers are in the middle portion of the West River basin.

There are some gentle plains along the Chien River, but gorges occupy half the total length. The Ta-teng gorge is 40 kilometers long and there the water is deep with the deepest point exceeding 85 meters even during the low water stage. It is the deepest point in the West River.

Below Ta-teng gorge, the Hsin river flows at Kuei-ping-Wu-ling plains; below Wu-chou is the lower portion of the West River. The channel is wide there, being about 1500 meters. Shoals are often seen together with some gorges. Below Tu-chen, there are the San-yung and Ling-yang gorges where the river narrows to 300 to 400 meters. Then, after passing the gorges at San-shui it flows into deltas.

The important tributaries of the West River are the Yu, Liu, Kuei and [a few] other rivers. The Yu River is the largest, and its sources are the Yu and Tso rivers. The Yu river runs through a channel full of gorges above Pai-se, but below this point there are narrow long plains where the river bed is wide and shoals are prevalent.

The Tso river has a winding river channel and the K'o-ssu-t'e condition is seen on both banks. The second main tributary of the West River is the Liu River, which is called the Tu-yung River at its source. It flows through sandy shale formations and the river channel is changeable, with bank slides occuring frequently. The lower portion of the Liu river runs chiefly through plains and the riber bed is primarily limestone; thus its flow is more even than it is upstream.

The third tributary, the Kuei River, runs mostly across plains in its upper reaches. The river flows almost exclusively over limestone rock. Below there, more sandy shale is the rule in the river channel, and shoals and subsurface rocks are prevalent.

The main stream of the North River is 582 kilometers long. river source is at P'a-lan-chai in the Hsin-feng District in Kiansi Province. It is called the Chen River upon entering Ch'u-chiang in Kwangtung Province. Then it meets the Wu-shui which flows from Hunan. The river then flows south and is called the North River.

The main tributaries are the Nan, Weng, Lien, P'a, Pin, Sui and several others. The North River meets the West River at San-shui and then enters the sea via the Hung-ch'i-li and Sha-wan channels.

The upper reaches of the North River is surrounded by hills less than 100 meters high, and shoals are plentiful and the water flows slowly. Below Shih-hsing, there are high mountains near the banks and the river is deeper. Below Chu-chiang, the course of the river is mostly straight, containing Fei-lai, Mang-tzu and other gorges.

Except for when it passes through the gorges, the river is mostly about 400 meters wide. These gorges do control the river during flood periods and although the

farm lands are often innundated above the, the highest floods are thus regulated.

The main course of the East River is 503 kilometers long, It starts at Chieh-mei-kang in the Si-an-yun District of Kiangsi Province and flows south to the Lung-chou District in Kwangtung and then turns to the southwest and finally flows through Shih-tzu-yang and enters the sea alone. The main tributaries are the Hsin-wu, Hsin-feng Hsi-chih, Tseng and other rivers. Three-quarters of the rivers in the basin flow through mountains and hills.

On the upper reaches, the river is shallow and narrow and the banks are lined with steep hills. The middle portion develops slowly and below Hui-yang it flows into a plain. The river bed widens there and the flow slows down. Shoals are well developed and in periods of flood, they shift and cause great changes in the river bed.

III. The Direct Flow Volume of the Pearl River and the Distribution of Direct Flow Depth Distribution

The direct flow volume of the Pearl River is the highest amount of our great rivers. At the mouth, the yearly average flow rate is 12,400 square meters per second. That is one-third the flow rate of the Yangtze River(which is 32,700 square meters per second), but the area drained does not amount to even one-fourth of that of the Yangtze (which is 1,808,500 square kilometers).

The flow rate is also eight times that of the Yellow River (1,490 square meters per second), but the area drained is only three-fifths that of the Yellow River (745,100 square kilometers).

It is readily seen that the Pearl River basin water flow rate per unit of area is very high. This is due to the fact that the area has a bountiful rainfall and weak evaporation rate and because the mountainous character is also beneficial to accumulation of the flow.

Of the Pearl River tributaries, the West River is the longest and the area which it drains is the widest.

Hence, the Pearl River water volume comes mainly from the West River. The North and East rivers are short and small in drainage area, and their flow volume does not even compare with some tributaries of the West River. The flow volumes of the Pearl River system are given in Table 1 and Figure 2. It is not necessary to describe them in detail here.

The problem of flow volume and area distribution is more complicated. From this distribution we can understand the background of the flow distribution of the above described rivers. The Pearl River basin direct flow rate distribution in the various regions can be simply stated as: more in the east and less in the west.

The main body of the Liu River, the lower reaches of the Hung-shui River and the Yu River in the east all have a direct flow depth of over 1,000 millimeters. This also includes the Lo-ching, Kuei, Ho Pe-liu and other North and East river tributaries. The direct flow depth has its greatest center in the middle portion of the North River, and the Kuei middle and upper regions of the Kuei middle and upper regions of the Kuei River where it exceeds 1,500 millimeters. (See Figure 2).

Table 1. The Direct Flow of the Pearl River Basin Tributaries

River System	River	Station	Basin Area (sq. km.)	Average flow rate (cu. m/sec.)	Direct flow depth (millimeter)	Year of survey
East	East	Hui-yang	25,100	957.2	1,205.2	1920-55
	Hsin-feng-shui	Hui-lung	5,870	233.5	1,251.6	1920-55
North	North	Shih-chio	38,200	1,496.8	1,237.3	1925-36,38,39 47,48,51-55
	Lien	Han-kuang	7,990	334.2	1,313.0	1951-55
	Weng	Huang-kang	4,700	187.9	1,251.0	1920-22, 31-39, 41,55
	Sui	Ssu-hui	7,030	320.5	1,437.0	1952-53
West	West	Wu-chou	328,000	8,049.0	775.0	1915,40-43, 46-49, 51-55
	South P'an	K'ai-yuan	16,400	120.0	230.2	1952-53
	North P'an	P'an-chiang-ch'iao	14,350	214.3	474.1	1953,55
	Hung-shui	Ch'ien-chiang	126,000	2,120.0	545.2	1937-41,48,49,52-55
	Ch'ien	Wu-hsuan	196,000	4,443.8	714.2	1936-43,47-55
	Hsin	Kuei-p'ing	289,000	6,467.3	704.7	1937,39-43,47-49, 51-55
	Liu	Liu-chou	45,600	1,356.0	914.1	1939-43,46-55
	Lung	I-shan	13,600	347.7	756.5	1937-43,53-55
	Lo-ch'ing	Lo-yung	6,720	225.4	1,054.0	1954-55
	Yu	Pe-se	18,050	347.9	607.7	1937-39,41-43,46-49,51-55
	Tso	Lung-chou	17,710	329.0	582.5	1937,38,42-44,46-55
	Yu	Kuei District	87,280	1,781.2	647.0	1943,46-49,51-55
	Kuei	Chao-p'ing	14,700	570.0	1,225.0	1937-44,46-55
	Ho	K'ai-chien	7,703	326.5	1,335.0	1952-53

Fig 2. Direct Flow Depth and River Flow Rate
of Pearl River Basin

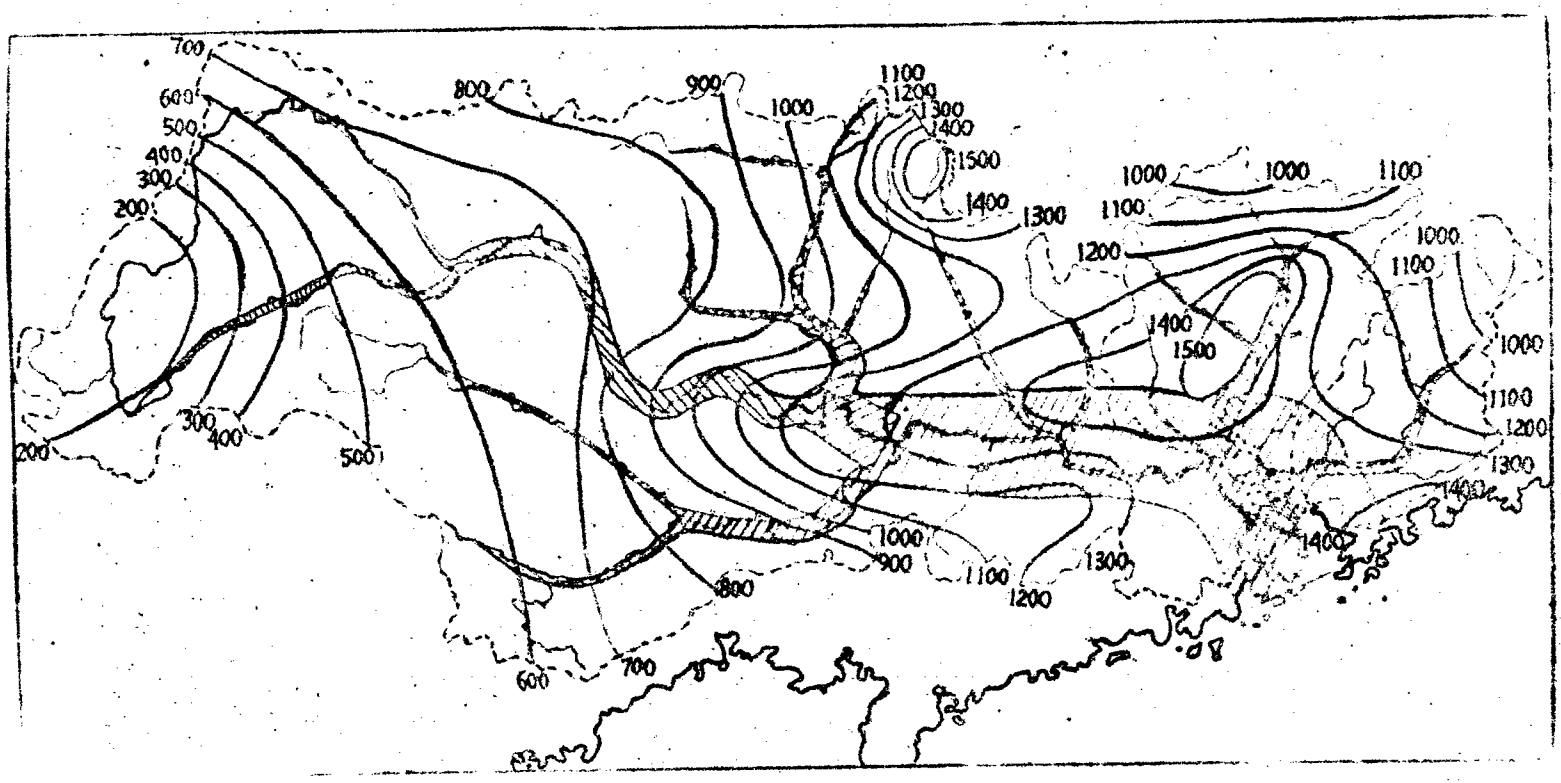
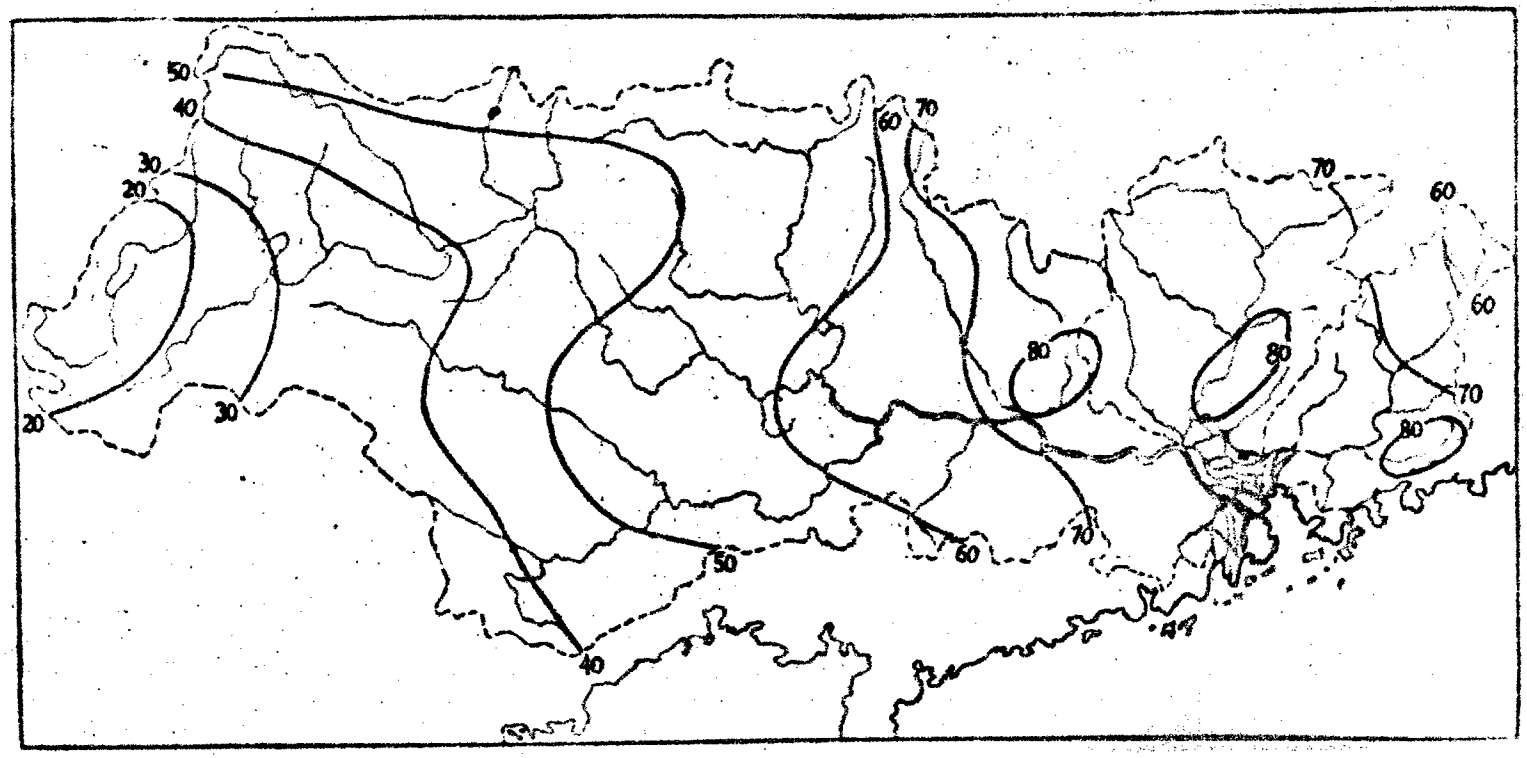


Fig 3. Pearl River Basin Direct Flow Coefficients



In this area, the annual rainfall is mostly above 1,750 millimeters, and it exceeds 2,000 millimeters in the flow volume center. The western part of the basin, including the Tu, Lung, North and South P'an, Yu, Tso and part of the Hung-shui rivers have a direct flow depth below 1,000 millimeters, and it gradually towards the west.

The smallest direct flow depth is in the upper reaches of the South P'an River where it is below 200 millimeters. This is attributed to the fact that the western basin has an annual rainfall of less than 1,500 millimeters. The upper reaches of the North and South P'an rivers has a rainfall below 1,000 millimeters.

The ratio of direct flow and rainfall is the direct flow coefficient. From the direct flow coefficient, it is easier to see the direct flow volume distribution. The high direct flow volume eastern basin has a direct flow coefficient of over 50 percent (that is, over 50 percent of the rainfall directly runs off into the river). It exceeds 70 percent in the case of the Ho River, and the North and East rivers downstream.

At the above described direct flow center, it exceeds 80 percent (See Fig 3). In the western basin, the coefficient is below 50 percent. On the upper reaches of the South P'an River where the direct flow is small, the coefficient does not reach 30 percent.

Now we shall discuss the cause of the small coefficient in the western basin. This area coincides with the well developed K'o-ssu-t'e topography. Generally speaking, the K'o-ssu-t'e condition is beneficial for the absorption of rainfall and thus it influences the direct flow. (This point is proven by comparing the direct flow of the Soviet Union's Wo-k'o and Wu-fa rivers).

Yet, the direct flow is reduced here. Thus, it is not clear at this moment as to what is the cause of this phenomenon and further investigation and study is yet needed.

It is necessary to point out further that the above described condition is mostly the average of several

years. In other years the conditions may be different. The rainfall in the Pearl River Basin areas is changeable and complicated. For instance, in the middle reaches of the Juei River, Hsiu-jen and Chao-p'ing in most years are rainfall centers, but in the years 1937 and 1938, the center moved to Kuei-ping and the T'eng District; and, in the years 1941 and 1942, it moved to the east and northeast into Fu-chou and the Ho District. Thus, during every year, the direct flow volume in area distribution is not the same.

Besides, the Pearl River Basin is subject to the influence of torrential rain, typhoons, and thunderstorms and the variation in local storms is very great. Two places several kilometers apart may have a daily rainfall difference of up to several hundred millimeters. Temporary local direct flow centers can be set up and influence the distribution.

IV. The Characteristic changes of the Direct Flow Volume of the Pearl River

1. Direct flow volume distribution within the year:

the rivers of the Pear River basin have relatively long seasons of high water or, in other words, the flooding period is long. In April or May, our northern rivers are mostly in the low water stage, sometimes even in their period of least flow volume (especially the rivers in North China.)

But in the Pearl River basin, the rivers begin to rise after April, and do not recede until October. The high water period generally lasts six months. The long period of high water in the Pearl River is chiefly due to the distribution of the rainy season.

Every year in April, pressure changes begin and the rainfall becomes plentiful. During and after July, although the rains cased by pressure changes have ceased, typhoon rains and thunderstorms are prevalent unitl September, when the rainfall decreases rapidly. The rise and fall of rivers corresponds with the distribution of precipitation.

For the separate tributaries, the rain comes at different times to the different areas, and the difference in amount can be great. The North and East rivers, and the Ho, Kuei, Liu and other small eastern rivers begin to rise in April and fall in September.

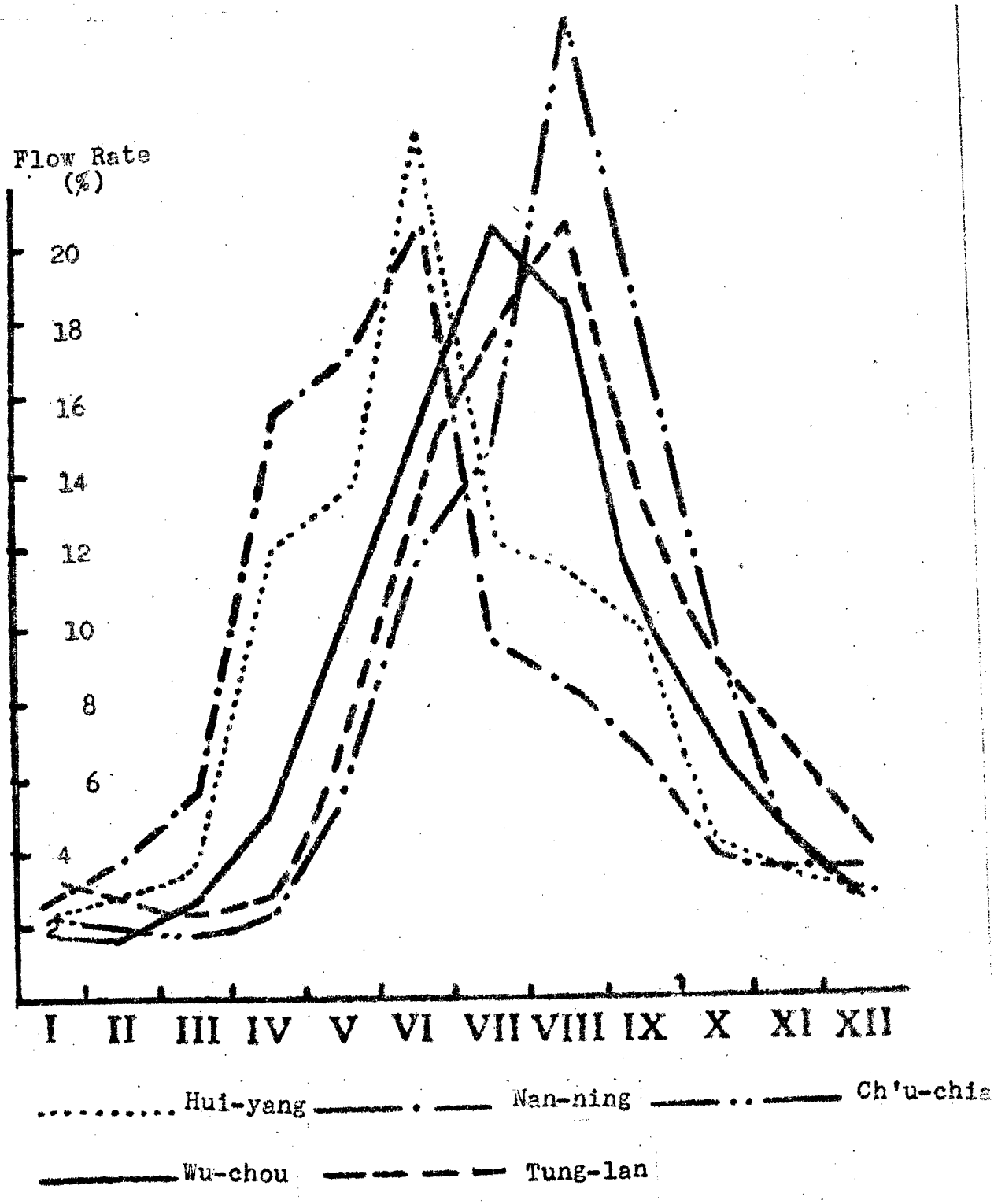
The South and North P'an, Yu, Tso and other rivers rise in May or June, and the fall is delayed unitl October. The main body of the West River receives the different influences of the eastern and western basins, and its condition is a combination of the two, since it rises in April or May and recedes in September or October.

The distribution of the direct flow volume on a monthly basis is the highest in July, August and September for the South and North P'an, and the Hung-shui and Yu rivers (including the Tso and Yu rivers). The very highest month is August when the volume of the flow is one-quarter of the yearly total. This is due to the fact that the rainfall in these basins is higher in July, August and September with the highest of all in August. The least flow volume occurs in February, March and April, the total for those months being only 5-8 percent of the yearly total. The very lowest month can be March or April when it averages up to only 2 percent of the yearly total.

The East, North, Ho, Kuei, Liu and other rivers in Kwangtung, plus other small rivers, are located in areas with an earlier rainy season. The months of the highest rainfall are April, May, June and July, when the four months' total exceeds 60 percent of the yearly total. The highest month is also earlier, coming in May or June when the flow volume exceeds one-fifth of the yearly total. The lowest is in January or February, being only 2 percent of the yearly total.

The main stream of the West River has characteristics which are midway between these two. Since water from the upper reaches comes later, the months of greatest flow are June, July and August, during which up to one-half of the yearly total occurs. The highest month is July, which accounts for one-fifth of the yearly total. The lowest is in February, which accounts for 2 percent. The above described three conditions are illustrated by the data

Fig 4.


Flow Rate
(%)
20
18
16
14
12
10
8
6
4
2
I II III IV V VI VII VIII IX X XI XII
Hui-yang
Nan-ning
Ch'u-chia
Wu-chou
Tung-lan

collected at Tung-lan on the Hung-shui River, at Nan-ning on the Yu River, at Ch'u Chiang on the North River, at Hui-yang on the East River and at Wu-chou on the West river. The monthly flow distribution of each is given in Fig 4.

If the above described distribution is to be used as a basis to divide the rivers into types, surely the eastern and western areas of the Pearl River Basin must be divided into two different types.

(a) The first are those in which the greatest flow volume usually occurs during the months when water is most plentiful. The East, North, Ho, Kuei and other rivers have the largest flow volume in April, May, June and July, and mostly in May or June. But this does not always coincide with the months when water is most plentiful. The reason is that its appearance is mainly due to a most intense rainstorm, but the most intense rainstorm does not necessarily occur during the month of most rainfall. The largest flow is generally 10 times yearly average.

The Liu and Yu rivers have the largest uniform flow. It appears during May, June, July, August and sometimes in September, but most likely in June, July and August. The flow rate is then 10 times the yearly average. The Liu, the western part of the Yu, and the upstream tributaries of thw West River have a later high volume of flow since the rainy season comes later.

The heaviest flow usually appears in June, July, August and September, and then amounts to 15 times the yearly average. The peak flow period in the year among the major tributaries shows a definite pattern of coming early in the east and gradually later in the west.

As to the absolute flow rate over the years, the Pearl River Basin occupies a high place among our country's large rivers. For example, at Wu-chou the West River reached a peak flow rate of 58,700 cubic meters per second on July 10,1915. This is equivalent to the ordinary yearly peak flow rate at Ta-t'ung Station on the lower reaches of the Yangtze River.

Thus, the Pearl River is alone second to Yangtze River in the nation. The West River tributary, the Liu river, reached a peak flow of 27,300 cubic meters per second in 1949 at Liu-chou station. The peak flow rate of the North River was reached in 1951 near Ch'ing-yuan Station (according to the presently available data), where it exceeded 10,000 cubic meters per second. The East River Hui-yang station recorded a peak flow in 1953 of 5,860 cubic meters per second.

(b) The smallest flow volume usually appears each year in a low stage month sometime after December, but it appears at different months in each river. The Hung-shui, South and North P'an, Yu, Tso and Yu rivers are influenced by the K'e-ssu-t'e subterranean flow with the lowest rate occuring in March and April; but not at the months of least rainfall which are December and January.

The other rivers have their lowest flow in January or December, which does coincide with the months of least rainfall. The K'e-ssu-t'e areas have a large supply of subterranean water, and hence have a relatively more abundant supply of water during the low stage. In addition, the water level is more steady.

2. Direct flow volume varies over the years:

The Pearl River basin may have a very ample direct flow, but is not constant over the years and drought conditions are well known. Generally, for the Pearl River tributaries, the direct flow in a wet year is more than double the amount that it is in a dry year. At the source of the East River, the flow in a wet year is 2.3 times that of a dry year. The ratio is 2.4 at Shih-chiao on the North River, and it is 2.02 at Wu-chou on the West River.

The largest ratio is on the Yu river, according to data recorded at Pai-se, which reached 3.7. This phenomenon is caused by the variation of rainfall of each district through the years.

V. Silt Content of the Pearl River Tributaries*

The amount of silt carried by the Pearl River basin tributaries is the smallest among our large rivers. Comparing the West River at Wu-chou with the Yellow River in the Shan District, the annual average silt content of the former (0.406 kilograms per cubic meter) is only 1/90 of that of the Yellow River (36.52 kilogram per cubic meter).

Comparing with the silt content of the two stations in terms of the unit drainage area, the figure at Wu-chou (266 tons per square kilometer each year) is only 1/10 of that in Shan District (2,559 tons per square kilometer each year). The paucity of silt in the Pearl River basin is connected with the distribution of limestone.

Generally, the Pearl River basin tributaries have little silt, but the amount for each differs. The largest carrier of silt is the Hung-shui river, which has a yearly average of 0.5-1.0 kilogram per cubic meter.

According to data recorded at Tung-lan on the Hung-shui River, it is 0.762 kilogram per cubic meter. The waters which carry the least are the Kuei in its upper reaches the delta area of the rivers. At Kuei-lin the Kuei River has an average yearly silt content of 0.034, and the rivers in the delta areas have an average of 0.06. The silt content of the East and North rivers is generally about 0.1-0.2 kilograms per cubic meter (See Table 2).

The heavy silt content of the Hung-shui River is due to the fact that both banks are lined with mountains that are devoid of any vegetation cover. Eroded red earth covers the mountains, and it is washed down by the rain. This is lost to the land, and it causes the river to change color, which the reason for its name.

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* The silt figures are principally from 1954 and 1955 surveys.

Table 2. The Silt Content of the Principal Tributaries of the Pearl River Basin

River	Station	Silt content (kilogram per cubic meter)	Quantity transported per year (mil. tons)	Greatest silt content (kg/cu meter)	Erosion Number (ton/sq cu.kilom)	Year of Survey
West	Wu-chou	0.406	86.00	2.830	266.0	1954,1955
North(branch)	Ch'ing-yuan	0.143	5.14	0.857	--	1954,1955
East	Hui-yang	0.139	2.45	0.624	97.6	1954
Hung-shui	Tung-lan	0.762	42.90	5.290	390.0	1954,1955
Yu	Nan-ning	0.226	8.01	0.808	106.0	1954,1955
Liu	Liu-chou	0.222	9.93	2.050	217.0	1954,1955

Below the Hung-shui River, the many tributaries of the West River join the main stream, which raises the water volume and decreases the silt content. Also, after that point the land becomes flater. This is why the silt content downstream from the Hung-shui River gradually decreases.

The reasons why the upper Kuei River and the delta area rivers have a low silt content are that the upper Kuei benefits from banks that are almost entirely of limestone and have a good vegetation covers; that the delta areas have weak carrying power due to a profile.

VI. Water Conservancy Problems in the Pearl River Basin

It has been described that the direct flow volume distribution of the Pearl River is uneven and that short periods of heavy flow concentration often cause floods. And, in all sections of the West and North rivers there are flood problems.

The Pearl River delta area, with its low lands and the tidal action of the sea, especially gives rise to the most serious flood damages. The other factor is that in its flow to the sea the Pearl River runs directly against the path of typhoons, which retards its flow. Therefore, if the high water period coincides with a typhoon, especially serious flood damage is possible. The flood of 1915 broke the dikes both in the downstream and delta areas and 5.4 million mou of farm land were damaged and the city of Canton was flooded. Also, there are 1,690,000 mou of land in the middle and downstream areas of the East River that often suffer flood damage. Therefore, flood prevention is a very important problem.

After the Liberation there were repairs of dikes in whole areas. But the elimination of flood damage requires regulation of the direct flow. In the low water stage which exists outside of the flood season, one can understand the drought season as being a result of the low stage direct flow conditions. Irrigation is, therefore, very necessary.

According to surveys in Yunnan, Kwangsi, Kwangtung and other provinces, the farm land affected by drought exceeds several million mou, and when there is added to this the need for developing unused farm land, the irrigation problem becomes even more acute.

The rivers of the Pearl River Basin have a large flow and form a dense network, and hence offer good conditions for navigation. But at the present, navigation is limited to the downstream sections of the large rivers and the delta areas. The upper and middle reaches of the rivers are full of shoals which must be removed before full navigation becomes possible. The heavy water flow of the Pearl River is not only favorable to navigation, but also it is a rich source for potential water power. According to one survey, the rivers of the Pearl River Basin have a potential of 28,370,000 kilowatt of potential water power. In addition, the rivers have narrow gorges that are good dam sites. Thus the future for the development of water power is great.

Among the great rivers in the country, the Pearl River has comparatively little silt, while according to our data, the Hung-shui River has the most silt. Thus, conservation work in the Hung-shui River Basin is of very special significance.

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