

## LIAO RIVER UNDER AN INTERNATIONAL ORGANIZATION.

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## INTRODUCTION

If we try to cite a good example of comparison between large and small nothing is more pertinent than to refer to the superficial comparison of Yantze with Liao, the former being one of the biggest rivers not only in China but also in the world while the latter ranks among the small rivers in China. The drainage area of Yantze is 720,000 sq. miles while that of the latter is only 60,000 sq. miles, so that the former is 12 times as great as the latter in so far as the drainage area is concerned.

If we carry calculation in another way, for instance compare Tone or Ishi-kari of Japan that is the biggest rivers in Japan with Liao which we hired in the above illustration as representing small river in China, we find for this time in contrary to the above case that the Liao is 10 times as great as our champions of Japan in so far as the drainage area is concerned, as they both that is our champions Tone and Ishi-kari drain only 6,000 sq. miles in round number. In other words small river in the above case turned into big one now. This is no wonder when we reflect upon the notable difference in the magnitude of the continent and the island which these rivers drain respectively. At any rate the Liao is a continental river.

Such being the case, to treat the Liao is to fight against the enemy 10 times as big and strong for us.

The Liao River is noted not only on account of its being an international river and has been an important com-

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mercial water way in Manchuria and Mongolia for centuries but is very interesting river when looked upon from strategic point of view in the history of great nations concerned not to mention the events in very old epoch and it is strange enough that such important river of magnitude remained practically untouched till present. It is from such conceptions that actuated the author to introduce this river to the Society and devoted a few pages here on the Minutes according to the request of the Society.

The following is a piece of the author's annual report of 1920 presented to the Upper Liao River Conservancy Board and hope it may cast some side light upon what is being done on the river under an international organization that is the Liao River Conservancy Board.  
Newchwang China. May 1921.

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### (1) Extent of Navigable-Reach of the Liao River.

The navigable-reach of the Liao River can be divided into two sections, according to the kind and size of vessels now sailing in the Liao. The first section extends from the River mouth to Chengchiatun (the present terminus of the Saupingkaï-Chengchiatun Section of the proposed Saupingkaï-Taonan Railway), about 350 miles, and the second section extends from Chengchiatun up to Tungliachien, about 150 miles in length.

The above-mentioned mileages are, however, nothing but the rough calculation, as no exact actual survey had not yet been made. In the first section, there are two kinds of junks sailing in the Liao River, one is called "Tsoo-Chuan" having broader hold space and the other "Nin-Chuan", which more resemble an ox in shape and is smaller in almost all cases than the former. They have carrying capacity of about 15 tons each, drawing about 2½ ft. at the fore. In the second section, small crafts having shallower draft of 6 in. specially made from the consideration of the depth of water are commonly used and are called "Tui-Tsao". In ordinary case, these crafts make a point of transshipping their cargo at Chengchiatun.

Accordingly, the scope of improvement of the Liao for the benefit of the navigation purposes must be the first section, that is, from Chengchiatun down to the River mouth.

The above is the section to which much importance is being attached for the navigation of the Liao. Accordingly, the major portion of the improvement plan to be described below has much important bearing upon this section. Refer to Plate I.

## (2) General Aspect of Navigable-Reach of the Liao.

Generally observing the above section between Newchwang and Chengchiatun extending 350 miles, the River meanders through a flat land of magnitude and the major portion of the section is left untouched, as it is, subject to the constant vicissitude of the river course.

There are occasional splitting of channels and formation of shoals here and there, such being of course obstacles in the way of navigation. This is aggravated by the fact that the volume of water gradually decreases in the upper reach, rendering the navigation more difficult. A unique riparian feature exists, however, for a length of 30 miles between Tangchiawopu down to Sanchiah. The majority of the volume of water of the Liao is escaping away at Tangchiawopu to Shaungtaizun Channel and this caused the water in the channel between the above mentioned points to be remarkably decreased, the channel itself forming a hard pass.

At Sanchiah, literally means "Three-Fork River" the Liao is joined by the River Fun and Taizun and this coupled with the fact that the River is being affected by the tide renders the navigation of vessels below thereof tolerably easy.

The characteristics of the Liao in which it rather experiences a scanty amount of normal water as compared with its extensive drainage-area are brought to bolder relief by the fact that much water is being taken from the Liao the benefit of irrigation which has become to be largely practiced in recent years at various places along the River, showing an increasing tendency year after year. This has added another factor of trouble to the navigation in the lower portion of the Liao and forms one of the potent causes of the ebb to which the navigation of the Liao had sunk of recent years. In such a river as Liao which has smaller amount of normal water, it may be a matter of urgent necessity to make the amount of the normal water increase or at least to preclude the decrease of water in facilitating the navigation by im-

proving the rivers, because, if the water is scanty, the ordinary river improvement work, though conducted, will have poor effects.

There is no other alternatives for bringing about the facilitation of navigation without due amount of water enough to maintain the proper width and depth of stream than to either canalize the River or to build a parallel canal along the whole River.

Either of the above-mentioned methods requires an enormous amount of fund and is far from being realized.

Generally speaking, in such a river as the Liao where there is a small amount of water, the enterprise of conveying much water and navigation run counter to their own interests and are incompatible with each other. However, both the irrigation and river navigation are essential to the development of the interior within the drainage-area of the Liao and it forms a 'hard nut to crack' to the administrative policy that to which of them much importance shall be attached by victimizing one for the other.

How to deal with the case under notice, that is, the improvement of the Liao, in other words, how to get a medium method will be described below.

### (3) Reconnaissance for Reservoir Sites for Impounding Water for Irrigation Purposes.

The water in the Liao River is very scanty, partly owing to few rain-falls and partly to the irrigation by farmers almost everywhere along the river and it is a matter of serious importance to check the diversion of water and to prevent the water from being wasted recklessly in summer time when the water is necessary for navigation purposes, by providing the reservoirs for the farmers themselves to impound the water therein. The irrigation, though usually concerning the river navigation, is none the less important as the latter is, as far as the development of the interior is concerned, and it is proved, at the present state of experiences, that both may be harmonized by building reservoirs to impound water and by letting it out in a proper way and under wise control. The said control of river water being

the basis not only for the present condition but also for the further development of both irrigation and navigation, it is very easy to see that the investigation concerning the reservoirs is necessary as a preliminary to starting the work of confining the streams and also the dredging on a large and systematic scale in order to meet the purpose of navigation scheme.

How a large amount of water is being used for irrigation purposes and how the irrigation enterprise in South Manchuria is on an increasing tendency yearly may be demonstrated from the undermentioned table, which was investigated and prepared by the South Manchuria Railway Company during 1917, the total area of irrigated land amounting to altogether 7,875 *chio*:—

Table Showing Irrigated Land in South Manchuria.

Territories	Places	Irrigated Land (units being <i>Chio</i> )	Territories	Places	Irrigated Land (units being <i>Chio</i> )
Wafangdian	Wangshihang	10.0	Mukden	Nanshanli	36.0
"	Chutsai	22.5	"	Wangchihotao	23.0
"	Hsuehshatun	15.3	"	Hsinglungshiao	28.0
"	Taihsu	10.2	"	Sunehiatso	18.0
"	Sungshu	25.4	"	Taihsuan	260.0
"	Hsingyocheng	120.0	"	Shinshatun	0.4
"	South-east of North Manshuan	35.0	"	Chenchihuang	52.4
"	In front of North Manshuan	65.0	"	Peichenchihuang	1.0
"	Outside east gate of Mukden	2.1	"	Changwu	120.0
"	Wafangshuang	150.0	"	Yaoshenhotun	3.7
"	Hsianpu	40.1	Kaiyuan	Hsifengshien	97.2
"	Hsiehshatun	5.2	"	Hsianhsien	57.6
"	Hsichungshatun	165.9	"	Tungfengshien	1.8
"	Kuhshatun	60.0	"	Shantungshien	214.2
"	Chientakopao	2.4	"	Linhohshien	2,160.0

Kayuan	Huinanhsien	180.0	Fushun	Wangchingmen	120.0
Kungchuhing	Tsingtsukou	6.0	Penchiha	Shangshihchiatzu	0.8
"	Helintzuho	13.0	"	Hsiangtzu	0.01
"	Wunohuwan	2.4	"	Taling	0.05
"	Wuchiatien	12.0	"	Mengchiapu	6.0
"	Chichiatun	18.0	"	Yackouku	5.4
"	Tayushu	3.0	"	Kaokitzu	4.3
"	Shifang	1.8	"	Hochiaputzu	4.3
"	Hochiatun	3.0	"	Kaochiaputzu	38.5
"	Kuangchingyung	0.6	"	Chuhaling	12.4
"	Wangyungshen	7.8	"	Chiehchiaputzu	38.2
"	Tsatsihin	6.0	"	Kaokuantsei	2.2
"	Tschiengyen	6.0	"	Hsiaochiahotzu	6.1
"	Heinohotzu	3.0	"	Kaoliyngtzu	2.1
"	Lianshankan	6.0	"	Shanunglingputzu	4.1
"	Peitachiengyen	8.4	"	Wanchengtsantzu	12.4
"	Poliengtzu	25.2	"	Chihhoeheng	14.6
"	Eptaokou	0.1	"	Sanchiatzu	15.0
"	Yangchiaweitzu	0.2	"	Wanliho	10.0
"	Santaokou	5.8	"	Fuyungtzu	6.4
"	Yuanchiaowpu	29.6	"	Chaochiatentzu	3.0
"	Tsaochiatun	0.2	"	Marial	2.1
"	Tungshe	61.2	"	Changtantzu	5.4
Fushun	Paochiatun	36.0	"	Shanhehiho	2.1
"	Tayingsutzu	25.0	"	Tsailichiai	5.4
"	Shanohangfian	10.0	"	Mapitun	6.1
"	Sanohiatzu	15.0	"	Hsiangmoputzu	7.0
"	Shahhsui	12.0	"	Pannitpu	1.8
"	Hsinminfu	100.0	"	Chungtsaitzu	0.5
"	Sutzuho	85.0	"	Chichiatun	1.1

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Territories	Places	Irrigated Land (units being <i>Cho</i> )	Territories	Places	Irrigated Land (units being <i>Cho</i> )
Penobihū	Shangniisimtai	5.8	Tatungkou	Hsinkeiling	475.4
Tsoohokou	Fenkanohiaputzū	6.0	Santaolantao	Santaolantao	6.5
"	Linchiabo	1.0	"	Wentzoukou	7.9
Fenghuangcheng	Fenkanohiaputzū	3.3	"	Taisinhou	26.4
"	Shantungkou	2.6	"	Shangpukwanglin	72.2
"	Tungkuushanzū	3.3	"	Chungankwanglin	23.4
"	Kuangchiakou	9.6	"	Hsiatankuanglin	39.9
"	Huanghitzū	6.9	"	Chiehshihū	50.4
"	Tapu	2.6	"	Tungliangchiapū	102.4
"	Yonohiakou	1.2	"	Hsiktangchiapū	52.5
"	Kaolinen	3.5	"	Laosanshu	19.8
"	Shihhiakou	1.3	"	Ohingtzupao	4.3
"	Hofu	0.6	"	Chushuchuan	3.9
Ankung	Tangshanaheng	275.0	"	Tangchitzū	69.2
"	Wurlungpei	206.8	"	Shuangkou	96.3
"	Fannatan	33.5	"	Panchiehkou	1.8
"	Along the Yalu	77.6	"	Wutiaokou	8.3
Tatungkou	Changshananzū	19.9	"	Santaokou	3.6
"	Tehochang	1.8	"	Eitsochanglin	45.6
"	Machiatou	3.6	South Manchuria Railway Area		205.2
"	Knowwanhou	266.6	Kwantung Leased Territory		274.6
"	Chaotzoukou	163.0	<b>Total</b>		<b>7,875. Cho.</b>

According to the calculation of the South Manchuria Railway Company's Experts in early 1920, the total area of the irrigated land in South Manchuria was 25,350 *cho* and is tabulated as under:—

(A) Area of Irrigated Land in South Manchuria. Within South Manchuria Railway Areas.



Under jurisdiction of District Offices at	<i>Cho</i>	Under jurisdiction of District Offices at	<i>Cho</i>
Wafangtien	29.87	Tiehling	54.00
Tsahihochiao	6.00	Kungchuling	5.90
Liao yang	1450	Fushun	0.80
Mukden	84.50	Ankung	22.99
Total	205.61		

(B) In Kwantung Leased Territory.

Under jurisdiction of Civil Administrations at	<i>Cho</i>	Under jurisdiction of Civil Administrations at	<i>Cho</i>
Dairen	14.80	Pitsunwo	179.70
Chinchou	32.83	Pulantien	26.90
Total	276.41		

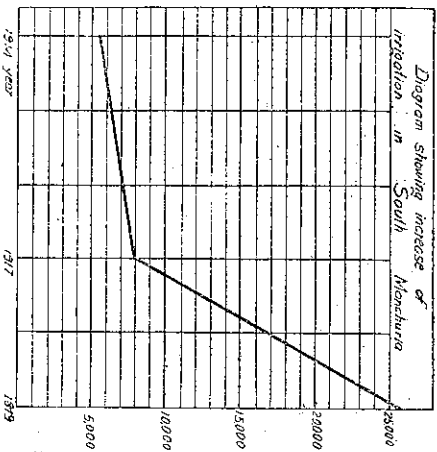
(C) In Other Parts of Manchuria.

About Mukden	2,500 <i>Cho</i>	Eastern district of Sungshu	2,500 <i>Cho</i>
About Antung & Southern district	3,500 "	Interior of Fushun	7,700 "
Interior of Kaiyuan	7,000 "	Along Ssupingkaï-Chengdehntan Railway	100 "
Paintala	250 "	Other parts	1,800 "
Total	25,350 <i>Cho</i> .		

From the above-mentioned table it can be learned that the total irrigated area in South Manchuria were 25,350 *Cho* and those in the neighbourhood of Mukden, Fushun Valley, Kaiyuan Valley and Paintala only far exceed 10,000 *Cho*, that is, over 20,000 ares. The rate of increase of the irrigated land since 1914 is shown below:—

1914	5,571 <i>Cho</i>
1917	7,875 "
1919	25,350 "

The increasing tendency is very well understood from the following Diagram on which the curve shows a remarkable tendency to ascend:—



The irrigation for 20,000 acres of land will require over 1,000 cub. ft. water per second at the expense of the Liao.

Although the exact amount of normal water in the Liao is unknown unless the actual survey be made, yet it may be guessed as something like 2,000 cubic feet per second.

Then it may be easily inferred that one half of the whole volume of water in the Liao is being consumed for irrigation at present, not to mention the future when such tendency is on a gradual increase annually. We cannot but remain passive onlookers on the irrigation problem from the standpoint of the Conservancy which aims at conserving and improving the Liao. It is why we deem it most urgent to study and investigate matters concerning the Reservoirs, which plays an important role of harmonizing the irrigation and the navigation, both of which conflict in their objects and stand incompatible with each other without the medium of reservoirs.

My own opinion is not to make the Conservancy Board itself necessarily erect the Reservoirs but we do not like to commit ourselves to the folly of letting the Reservoir problem take its own course in supreme disregard of the object of the Conservancy in conserving or fostering the water resources of the Liao, in other words, regardless of its own self defence. Indeed it is my desire that the Board shall properly take efforts in selecting the suitable reservoirs or shall be able to make a proposal regarding the rough plan and estimates thereof.

Supposing that if such an administrative policy, partaking of an extreme complexion, as the irrigation is unneccess-

sary and is to be rather halboed, could be executed, it is quite a different problem for us to treat and I shall never say anything more about it.

Anyhow, the reconnaissance for the reservoir sites must be started without further loss of time.

However, I hope that, should the Board is in no position to make up the matter and should there be any way for letting other authorities commence the investigation concerning the Reservoirs, the Board would speedily open negotiations thereant.

#### (4) Investigation as to Flood Discharge of the Liao & the Extent of Loss and Damage Resulting from Flood.

We can find the levees, almost ubiquitous along the Liao River. These levees were built by farmers themselves along the River and mostly located very close to the bank of the winding river course with the object of protecting their own farms and life and property against the possible flood but they were only built regardless of the hydraulic principle and of course in no systematic and comprehensive way.

It goes without saying that the construction itself is temporizing and feeble, the levees being often liable to be breached by flood.

Supposing that the damage incurred by individual farmers could be tolerably borne, the breach itself may often result in the changes of the river courses, and the sweeping change of the contour of the riverbeds and induce the river to a disadvantageous position from the hydraulic viewpoint; moreover causing no less unexpected impediment to navigation.

In other words, it is essential to fix and show the people the rational standard to which the above shall be based upon to ensure the safety of the river courses. This is a proper method of defence for maintaining the river navigation and no less for the welfare of land.

It is why the investigation as to the flood is indispensable.

(5) **Investigation as to Land Improvement within the Sphere Affecting Hydraulic Relation of the Liao.**

Matters concerning the drainage and irrigation in the interior can no more be disregarded than the levees in maintaining the navigation can be lost sight of. Because, as the measures for improving the land, it is necessary to either drain the surplus water into river or draw the river water and these equipments, irrespective of those now existing or those to be done in future, have serious bearings upon the maintenance of levees and the regime of river. Therefore, it is essential to fix beforehand a suitable method for carrying on these matters after a close investigation in connection with the river within the sphere affecting the hydraulic condition of the Liao.

(6) **Proposed Inauguration of Waterway Connecting the Liao with the Sungari.**

The proposed plan inceptive to the construction of a canal between the Liao River and the Sungari River seems to have been conceived by great men of resourceful mind in former days and the problem was also taken up by the late Mr. W. R. Hughes. M. Inst. C. E., Engineering-Chief of the Liao River Conservancy, Newchwang, and by the Tuchun (Military Inspector) of the Three Eastern Provinces of Manchuria. In the event of the proposed waterway connection scheme between the two great Rivers having been realized, the interest of the river navigation will be raised to a higher level and the value of the river improvement will be much appreciated seen from the standpoint of the Liao River Conservancy Board. Therefore, it deserves not only to attach much significances to the problem but also by means of the above waterway connection (vide the attached map PLATE I) it is most probable that the river water in the Sungari can be easily led into the Liao, thereby relieving the difficulty with which the Liao River is now being vexed

by the scarcity of water. I believe that the above serves to cast light upon the river navigation problem of the Liao and it is why I lay emphasis upon the investigation in concrete form concerning the canal in question together with the Reservoir problem above referred to.

(7) **Dredging between Tangchiawpu and Sanchiaho.**

At Tangchiawpu about eighty miles above the mouth of the Liao River the majority of water in the Liao is now flowing into Shantungtaizu Channel emptying itself into the Gulf of Pechili.

The main stream of the Liao from the point of diversion down to Sanchiaho extending about thirty miles in length is now being gradually deposited with mud and sand from the reasons of the roundabout course it takes and a slack gradient of the River contour and the above coupled with a scanty amount of water forms a great impediment to the navigation of vessels.

This section of thirty miles along is the most hard pass for vessels even of shallow draft to pass through in the lower reach of the Liao and, as necessary remedial measures thereof, we tax our utmost capacity to the dredging at present.

This is, however, in no way the fundamental work and it may be a rather temporizing measure to be adopted. But the measure now we are being resorted to must be indeed unavoidable pending a permanent and rational substitutes waterway be constructed.

Two Dredgers are now engaging in the operations are inadequate to cope with the situation and as for the increase and supplement of more dredgers and the proposed construction of the permanent, the matters are now under consideration by the Engineer himself. As to the method of diverting the water to the main stream of the Liao from Shantungtaizu Channel, the late Mr. Hughes planned to construct a consolidated stone dam all across the Channel at

Liangchiawopu a little below the point at "T" of diversion at Tangchiawopu, thereby intended to dam up the water level to a certain height, letting surplus water flow into Shaungtaizun Channel over the Dam.

The late Engineer seemed not to have planned the construction of a lock to the benefit of vessels sailing in the Channel. These works were, however, made targets of criticisms and incurred a stout opposition of the local peoples concerned towards the latter stage of the work in the shape of the suspension of work by force. To complete the catalogue of evils, the excitement by which the peoples along the Channel were driven finally culminated in the destruction of part of its construction. The Chinese authorities concerned at that time seemed to have given an implicit consent to the opposition raised by the people as may be evidenced from the fact that the damming work was wholly abandoned and the late Mr. Hughes was compelled to give up the resumption of the construction.

Consequently, he changed the plan to adopt the method of dredging the main stream of the Liao, quite independently of the remaining work at Liangchiawopu. Thus the dredging work has continued up to the present. The reasons of opposition were said to be as follows :

- (1) the work of damming up the whole River breach gives bad effect upon the Upper Reach in case of flood.
- (2) lack of a lock in parallel to the Dam construction might cause a fatal blow to the navigation in Shaungtaizun Channel,
- (3) the taking-away of a greater volume of water to the Liao might deal a telling blow to the irrigation enterprises then established along the Lower Shaungtaizun.

We have no exact data to give any definite reply to these reasons and we avoid discussing upon the matter at present.

But the Engineer believe it his own duty to fully investigate matters concerning either the proposed opening of a rational and permanent waterway for a reach of 30 miles long, between Tangchiawopu and Shanchiaho or reverting the water in Shaungtaizun Channel to the original main stream of the Liao and to submit the result of investigation to

the Board.

I may reiterate here that the present dredging of the above-mentioned section is a matter of vital importance to the Liao River Improvement Problem at least for the time being.

### (8) Short Cut Work.

The Shanungaitzu Channel is shorter in river course than the main stream of the Liao and has a direct water course to the sea. Moreover, due to a rather steep gradient it has as compared with the Liao, the Channel has naturally increased the amount and depth of its water since it diverted from the Liao some decades of years ago and, as it stand, the Shanungaitzu River naturally serves as a splendid channel.

Whilst, as a result of the main stream of the Liao is naturally situated inadventagously in the form of a slack with a proportionate decrease of water. The above is indeed a natural course of things and the dredging as well as the short cut have to be applied to the main stream of the Liao, so as to extend the sphere of the River to be influenced by the rise and fall of a tide, thereby remedying the natural handicap, with which the Liao is now feeling, and maintaining the river channel.

As to the short cut below Sanchialo, the late Mr. Hughes found it necessary to carry out the work and the location, thereof was plotted on a plan. The short cut is not, however, limited to the River below Sanchialo only but a careful consideration must be also expended to the necessity of a similar work in the Upper Reach. As already described in (7), the short cut between Tangchiawopu and Sanchialo must be taken into the reckoning. It must be borne in mind that, as a result, of the execution of short cut, there will be attendant benefits of the flood discharge capacity being promoted and the distance of navigation being shortened. How much money is to be required for the short cut will be fixed after conducting a survey in order to know not only the actual contour of the river course but also the

undulations of land follow, as they influence the amount of earth work.

The above are the data necessary for drafting the total estimates involving the equipments necessary for the execution of work and also the running expenses.

### (9) Necessary Equipments.

Among the principal equipments which we feel most necessary for the time being is counted the proposed erection of a field telephone between Yingkon and Tangchihowpu.

The reason why it stands in need of speedy erection is as follows:—

We may enumerate below a several instances, of which we are now experiencing owing to lack of the above service:—

- (1) Loss of mail matters;
- (2) Delay of mail matters;
- (3) Menace to life and property;
- (4) Impossibility of acquainting with details concerning the progress of river work, whenever deemed necessary;
- (5) No supervision over the work with responsibility can be expected.
- (6) In order to know the real condition of work when such Telephone service is lacking, the engineer of the Upper Liao Conservancy will be often compelled to inspect the work and on this occasion a round trip between Yingkon and the work sites requires more than a several days at the quickest.

It can be gleaned from the above-mentioned times that the lack of Telephone service, above referred to, surely tends to cause loss of time and wasting-away of money and also to course the Engineer unable to display his full ability and to supervise the work under him with due responsibility.



As to the loss and delay of mail matters as above mentioned, a few words must not be lost sight of.

On one occasion, ordinary mails posted near Shaling could hardly reach Yingkou within a week and in other instances a mail posted thereat really failed to reach this port.

What I stated above as the menace to life and property means the rampancy of bandits along the Liao and all workmen, Chinese and otherwise, on board our Dredgers and junks are exposed to the danger of being 'visited' by them.

As to the necessity of the Telephone service as one of the attendant enterprises of the conservancy work, it is too well established to reiterate here by myself. No conservancy work on an extensive scale like ours can be conducted and yielded any satisfactory results without the aids of a telephones or other suitable means of reliable and speedy communications.

It is indeed unavoidable to cause the Board to lose more or less time and money consequent upon the lack of the Telephones to the benefit of the work.

#### (10) Personal Item.

The Technical Staff under control of the Taoyin was handed over to my own supervision but, as it was necessary to keep on board each Dredger a superintendent of work equipped with both the professional knowledge and experience, we engaged two Japanese experts in the person of Messrs. T. Trutsui and S. Kuramoto for that purpose. As a preliminary to drafting a plan for dredging work and the plans and estimates concerning the Short Cut and other river improvement works, the plan survey and the levelling have to be conducted in parallel to several hydraulic investigations proper to the Liao River.

In order to do this, our Office got the employment of Messrs. K. Sakamoto and T. Nagaoke from Japan and also took into service as assistant surveyor Mr. K. K. Loo, fresh graduate of the Government Conservancy Engineering College at Nanking.

## (II) Ten Day's Trial Operations.

prior to the taking-over of all the interests of work from the Taoyin Yamen, I conducted ten day's trial operations over the works towards the latter part of last July for the purpose of making a close study concerning the running condition of several appliances and the actual expenses to be required for the transportation of principal materials.

The transportation of coal upriver deserves a special noting among others connected with the operations.

In dredging operations coal price and the freightage occupy the major portion of the working expenses. We made negotiation with the South Manchuria Railway Company to directly supply us coal at the same price, at which the Custom House is buying, without the medium of coal agents, to which proposal the Railway Company gave a ready consent.

With a view to learning the actual expenses of coal transportation, we took with us three coal junks, each fully laden with Fushun Coal, to Tangchinawopu under my personal supervision as trial conveyance.

The above formed a foundation of fixing the standard price with a view to fighting shy of being charged with an extortionate rate when the coal transportation is to be done by contract in future. Very short as the period of the trial operations was, I obtained the following conclusion:—

As the initial step to know the actual freightage on coal, we got tenders from local contractors for coal transportation. One of them claimed G. Y. 6.60 per ton for the transportation and the other G. Y. 8.80 per ton. In order to ascertain whether or not the above rates are tolerable and also to study how coal can be actually carried to the sites upriver, we carried on board our own junks a full cargo of coal and after a close study it was found that the actual cost of transportation amounted only to G. Y. 3.00 per ton, inclusive of the interest on the capitalised cost of junks.

We came to the conclusion that the above was the minimum limit.

## (12) Work and its Effect.

It was really after August 1st last, when the work of the Upper Liao River Conservancy came under my personal supervision and after a lapse of only three months the closing season of work already set in. During this brief space of time, we realized more or less results of dredging by means of two Dredgers in a section between Tangchiaowpu and Sanchiaho extending thirty miles which is now regarded as the worst pass of the Liao River and I am confident to say that our dredging gave a fair amount of effects upon junks sailing in this bad pass. I may describe it in the following:—

One of the two Dredgers which are placed at our disposal was at Tangchiaowpu at the uppermost extremity of the worst channel, that is, a point of diversion of Shaungkaizu Channel from the main stream of the Liao and is of the Priestman Crab system being installed on a floating pontoon.

This Dredger is assigned to a duty of going up and down the inlet channel extending about one thousand feet at the uppermost part of this worst pass, dredging its river bed, and maintaining the depth of water at the entrance to this pass by providing a channel having a breadth of 40 ft. with an average depth of 4 ft. at ordinary stage of water.

The other is a Bucket Dredger having mud chute of 40 ft. long and can sail under her own steam. She floats on the lowest point of the said worst pass and is charged with a mission of dredging beginning from the lower part then gradually advancing upstream and arrived at Chichiaowpu. The length of water route which she dredged was 1,869.5 feet with an average depth of 4 ft. and a breadth of 40 ft. and she concentrated her energy in maintaining the above depth and breadth in the ebb at ordinary spring tide. Through the effort of dredging we had been able to restore about one fourth of water from Shaungkaizu Channel to the Liao during the operation.

## (13) Progress of Work.

The progress of work done by the above-mentioned two Dredgers is collectively shown on the following tables:—

總 經 理 報 告 LIAO RIVER UNDER AN INTERNATIONAL ORGANIZATION.

遼寧省 地 LIAO RIVER UNDER AN INTERNATIONAL ORGANIZATION.

Progress Record.

Work done by Dredger "Tao Ho".

Site of Dredger	Chidhiawopu.
Advance Distance of Dredger	2,117.5 ft.
Amount of Dredged Materials	314,442 cub. ft.
Breadth of Dredged Channel	40 ft.
Average Depth of Dredged Channel	4 ft.
Length of Dredged Channel	1,869.5 ft.
Total Actual Working Hours.	298.4 hours.

Progress Record.

Work done by Priestman Dredger.

Site of Dredger	Tangchiawopu
Advance Distance of Dredger	1,220 ft.
Amount of Dredged Materials	179,730 cub. ft.
Breadth of Dredged Channel	40 ft.
Average Depth of Dredged Channel	4 ft.
Length of Dredged Channel	1,120 ft.
Total Working Hours	600 hours

(14) Survey.

As a prelude to fix the improvement plan of the Liao River, surveys of various category have to be conducted, to



The results of survey and several investigations therefrom shall be published in the next Annual Report.

It deserves mentioning specially in this Report that at a point a little above Sanchisho, say, about fifty miles above the River mouth we conducted a series of day and night observations in the hope of determining the influence of tide by the side of the dredging operations and could record the tidal range for 41 days and nights in succession and the results attained were as shown on PLATE 2.

The tidal range at H. W. O. S. T. was 3.07 ft. with ordinary flow of river, the mean tide level there being 1.59 ft. higher than that at Newchwang.

From the above, we can find that the influence of tide in the tidal compartment of the lower Liao is quite conspicuous.

The routes of our survey may be traced from the sketch (PLATE 3) roughly projected on a map of old survey though the map itself may not show the real state of river as it is now as the river might have made great changes since then and we are to make a new survey in the year 1921 for the river proper. These routes taken together cover the location of the entire survey accomplished in 1920 with a view to get a general idea as to the slope of the river as a whole up to Shwanhaiizu.

The results concerning the progress of survey are shown below:—

Progress Record.

Plans Surveying Levelling & Gauge Observations.	
Levelling	45.03 miles
Chaining	15.9 "
Topographical Survey	2.78 "

Cross-Section Survey	575 cross-sections
Fly Levelling	36.3 miles
Establishment of Temporary Gauge Stations	5 gages
Day Observations	41 days
Night Observations	41 nights
Goniometering	14.42 miles
Triangulation	17 triangles

More detailed information will be obtained during the coming season and a report made.

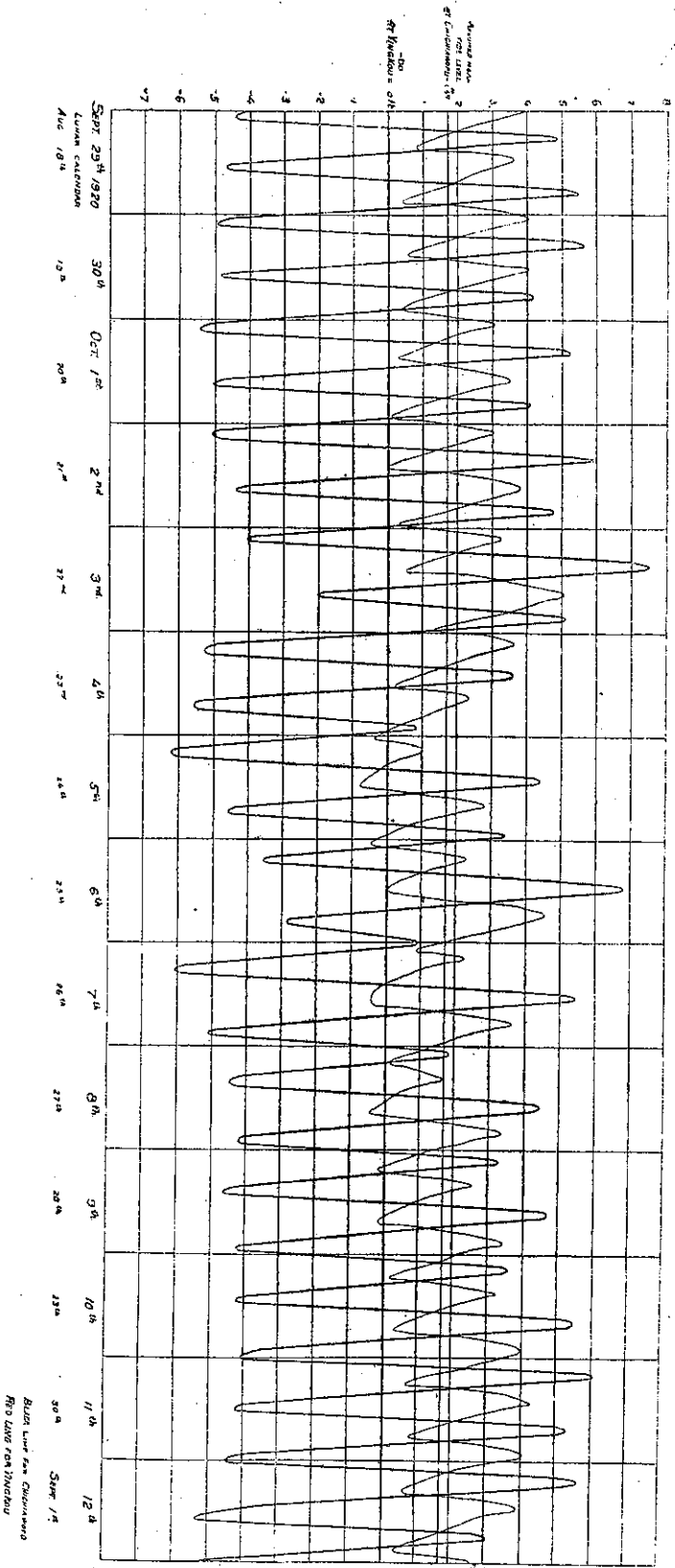
—(THE END)—





TIDE DIAGRAM OF LING RIVER

PLATE. 2.



(上海會館第七號附圖)

