ART. XXV.—*On the Delta-Plain, and the Historical Changes in the course of the Yellow River*; by RAPHAEL PUMPELLY.†

THE extent of the great plain of Eastern China is pretty well known from native and Jesuit authorities. It lies in a semicircle around the mountainous peninsula of Shantung. Its outer limit, as approximately given on the Jesuit map, begins in the department of Yungping (fu), and, running west, keeps south of the Great Wall till Changping (chau) N.W. of Peking. Thence, remaining east of the southern branch of the Great Wall, it follows a general S.S.W. course, passing westward of Chingting (fu), till it reaches the upper waters of the Wei River. Here it turns westward into Hwaiking (fu), and crosses the Yellow river in that department.

From the right bank of this river it trends a little east of south, passing west of Jüning (fu) (Honan), and then turning eastward it continues south of Kwang (chau) and north of Luhngan (chau) in Luchau (fu). Here an arm of the plain, in which lies the Tsau lake, stretches southward from the Hwai river to the Yangtse, and continues eastward on the right side of this river, occupying the region between the river and Hangchau bay. A hilly region, in the center of which is Nanking, rises, like a large island from the plain, to the north of this arm.

* Am. Association of Science, Burlington Meeting, August, 1867.

† From Geological Researches in China, Mongolia, and Japan, during the years 1862 to 1863, by Raphael Pumpelly. 144 pp. 4to. Smithsonian Contributions to Knowledge, No. 202, 1866.

The Shantung boundary of the plain begins at Laichau (fu), and after describing a great bow to the south it turns west at Shukwang (hien), and running thence to Changtsing (hien), in Tsinan (fu), it turns to the south and around to the south-east. Keeping this course it remains nearly parallel to the Imperial canal till the Kiangsu frontier, which it follows to the sea.

The greater part of the area included within these limits is a plain which seems to descend very gently toward the sea, and to be very generally below the high water level of the Hwang Ho. It is the delta of the Hwang Ho, and in part also of the Yangtse Kiang, and is remarkable for its semi-annular shape, half inclosing, as it does, the mountain-mass of Shantung.

The city of Peking stands on a raised border of loam, sand, clay, and gravel, which forms the northwestern skirt of the delta-lowlands, and seems to extend southward fringing the mountains along its western side. The name of the Talo lake (Ta, great, and lo, plateau or raised plain) seems to refer to such a border, and in the article on Kichau in Yukung it is said that "the Lo (plateau) was drained."*

The fact, also, that in historical times none of the arms of the Hwang Ho have approached the western mountain border of the plain, both north and south of Kaifung, within a less distance than from ten to fifty miles, seems to point to the existence of a recent sea margin, which would be perhaps due rather to the detritus brought down by local streams than to the delta deposit of the Hwang Ho.

All the important changes in the lower course of the Hwang Ho have been recorded from early times by Chinese historians, and their documents and maps form the most complete history we possess of the wanderings of any river.

The Yukungchuchi (Peking, 1705), written by Chin Hu Wei, contains a series of maps in which these changes are laid down for a period of more than 3000 years. M. Biot has given the substance of that part of this work that relates to the Hwang Ho, in a carefully prepared paper.†. I have, however, thought the subject to be one of sufficient interest to warrant the reproduction of the maps of Chin Hu Wei, with such explanations as will render them intelligible, without going beyond the limits of a work that is intended to give only my own contributions to the physiography of Eastern Asia.‡ For further information I must refer the reader to M. Biot's paper, of which I shall make use in explaining the maps.

* E. Biot, Sur le chapitre Yukung, Journ. Asiatique, 1842.

† Sur les changements du cours inférieur du fleuve Jaune, Journ. Asiat. 1843.

‡ The reader will have to refer to Mr. Pumpelly's volume for these maps.

In the Yukung, a chapter of the Shuking classic of Confucius, it is said that the course of the Hwang Ho was regulated by the Great Yu. Whether the works of Yu are to be understood as the labor of a single man, or as the results of the enterprise of a rising colony during several generations, there seems to be little doubt that more than 2000 years before the beginning of the Christian era the Chinese had brought this turbulent river under their control, by an immense system of dykes, and had begun to cultivate the extensive marshes of the delta plain.

Map No. 1 of the series, on plate 4, represents the course of the Hwang Ho as it existed, in the main, from the time of Yu down to 602 B. C.

Map No. 2 represents the course resulting from the first great change, that of the fifth year of the reign of Ting Wang (Chow dynasty), 602 B. C.

Map No. 3 serves to illustrate a passage in the writings of the poet Sse Ma Tsien, recording a diversion to the east and southeast. The easterly course, forming the Pien river, seems to have been the earliest recorded tendency of the river to follow its recent course. The opening of the first channels in this direction is given as occurring in 361 and 340 B. C.

The diversion, indicated on this map, through lake Yungtse to the southwest, happened, according to Sse Ma Tsien, toward the end of the Chow dynasty, during the third century before Christ.

Map No. 4 represents changes that occurred under Wutih (Han dynasty), about 132 B. C., when a great overflow toward the northeast took place, the river trending toward Kai (chau) in Chihli. At this time several arms were formed between Taming (fu) and the sea, which are also given. Previous to this, under Wentih, about 160 B. C., there was a breach formed at Yentsin near Kaifung.

Map No. 5 gives the second great change in the course of the "river of Yu," which occurred about 11 B. C., and was caused apparently by the blocking up of the channels leading to the Pei Ho.

Map No. 6 shows the channels as they existed during the Tang, and five succeeding dynasties, till the beginning of the Sung dynasty.

A note on the map of Chin Hu Wei says, "the course of the river remained the same from the time of Ming Ti (Tung Han dynasty) A. D. 70 till under Jin Tsung, A. D. 1034, when a break occurred at Hunglung, and another, fourteen years later, A. D. 1048, at Changwu, and the river of the Han and the Tang was entirely destroyed. The map covers a period of 977 years."

Map No. 7 (Pl. 5) represents the courses, under the Sung dynasty, from A. D. 1048 to A. D. 1194, a period of 146 years.

Map No. 8 records the course during the Kin dynasty. All the former channels appear blocked up, and the river, after entering Lake Lo, near the summit-level of the present Imperial canal, is seen to flow off to the N.E. through the Tatsing river, and to the S.E. through the Sz river. Lake Lo appears from the observation of Clark Abel, and from Chinese measurements, to be about 150 feet above the sea.

Map No. 9 shows the condition of the river under the Yuen and Ming dynasties, together with the Grand canal, a condition which seems to have remained substantially the same till within the last ten or fifteen years.

In early times the Yangtse entered the sea by three arms called the Sankiang, i. e., "Three Rivers;" and Chin Hu Wei has given a map of these, founded on the opinions of early authorities. I have indicated them on map No. 1 of the series.

A glance at the nine maps of the delta courses will show how widely separated have been the limits of divergence of the arms of the Hwang Ho, within the past 3000 years. A mighty river, ever turbulent, subject yearly to an enormous increase in volume, an increase regulated rather by the amount of precipitation in the distant Kwenlun mountains, than by the local climate, it has ever been the terror of the countless millions through whose midst it flows.

From the earliest times an immense force has been at work to keep it from breaking through its dykes, or, when this has happened, to guide and retain it between new embankments. The quantity of solid material carried by the river and deposited along its course, is so great that its bed is rapidly raised, and appears to have been, before the last change, higher than the adjacent country.

Biot says, "it is certain that the bed of the river, from Hwai-king to the sea, is higher than the adjoining country."

Several times, during the great wars that have preceded the downfall of dynasties, this condition of the river has been turned to account as a weapon of offense. Breaking the embankments has been made to accomplish, almost instantaneously, by the destruction of hundreds of thousands of inhabitants, conquests that had been delayed by years of brave resistance.

From the earliest time of colonization on the delta-plain, the task of keeping the Hwang Ho within its bed has been the constant care of the rulers of China, both when the country was united under one man, and when it has been subdivided

into petty states. In the latter case in the treaties bordering on the Hwang Ho, the clauses regarding the regulation of that river appear to have been the most important and the most sacredly observed.

One of the most striking results of the official corruption that becomes general during the decay of a dynasty, is the breaking loose of this great stream as soon as the means for maintaining its embankments are misapplied.

The devastation caused by these overflows is awful beyond description. The loss of life is very great, and the destruction of the crops that form the means of support of millions, produces famine and the overrunning, by starving hordes, of the more fortunate districts of the adjacent country. The anarchy that rules in this struggle for life is almost beyond the conception of those who inhabit lands where the population is much below the capacity of the country, or which are easily reached by foreign supplies.

Within the last fifteen years one of these great changes has taken place, apparently from the same cause and with the same effect as above indicated. Instead of emptying into the Hwang Hai, or Yellow Sea, the Hwang Ho now has its mouth in the gulf of Pechele, which it enters through the Tatsing river. The old mouth of the river was found to be dry in 1858.

According to information furnished to the Rev. Mr. Edkins, by officials of the Board of Foreign Affairs at Peking, the principal break occurred at Fungpeh (ting) in Süchau (fu), the waters flowing away to the N.E. In Tsinan (fu), the capital of Shantung, the waters of the Tatsing river are increased to six times their original volume by the contributions of the Hwang Ho.

In 1863 the river had not yet determined a channel, but its waters were spread over large tracts of country, and the city of Wuting (fu), nearly sixty miles north of Tsinan (fu), was almost inaccessible.

The present course of the Hwang Ho is indicated, so far as known, on Map No. 10.

Owing to the great quantity of material brought down by this river, and to the absence of great oceanic currents, that might, if present, interfere with its deposition, the delta is rapidly increasing in size, and the adjoining seas are becoming shallower.*

Probably nowhere can the rate of growth of deltas be better studied than in China. Cities that were built on the delta plain of the Hwang Ho several thousand years since are still

* Barrow estimated the hourly discharge of sediment at 2,000,000 cubic feet.

in existence, together with the archives of their history. In the cases of those that were built near the sea, the distances from this are given ; and frequent mention is made of towns, mounds, and natural hills, washed by the sea, within historical times, which are now far inland.

Thus, in B. C. 220, the town Putai is said to have been one li west of the sea-shore, while in A. D. 1730 it was 140 li inland,* a yearly increase of 100 feet, more or less, according to the length of the li. Hienshuikau (on the Pei Ho, in long. 117° 32' E.) is said to have been on the sea-shore in A. D. 500,† and is at present about eighteen miles distant, an increase of about 81 feet per annum.

Along the southern shore of the gulf of Pechele the yearly increase N. E. of Shukwang since B. C. 220, seems to have been not more than 30 feet.

The sea-shore, according to local tradition, was near the present location of Tientsin (fu) during the Han dynasty.

It is also recorded that under the reign of the Han, the Hwang Ho entered the sea at Changwu, near the present Tsinghai.‡