ART. XXIV.—Some Remarks on the recent Geological changes in China and Japan; by Albert S. Bickmore, M.A.

In the old and accurate description of China, compiled by du Halde in about the year 1725, from the full diaries and journals kept by the Jesuits, who between 1708 and 1717 traveled over and mapped out all that vast empire, I find these noteworthy remarks on the changes in the physical geography of China, since her earliest history.

"In the abridgment of Chorography entitled Kwang-iu-Ki, we find that the city Chantsien (the capital of Corea in 1694), where Kipe (the king of Corea at that time) resided, is in the territory of Yungping fu, a city of the first order in the province of Pechili."

"Now, supposing this to be true, one may reasonably conclude that the ancient Chantsien and Corea were contiguous, and not separated by a gulf till many ages after. For it is not to be imagined that a prince would fix his residence out of his dominions, especially if divided from them by a wide sea. This conjecture will appear the more probable if we carry our speculations a little higher (i.e., to a more ancient period).

"When Yu (whose memory is justly honored by the Chinese with the title of great) undertook to drain the waters, which under the reigns of Shun and Yan had overflowed the flat country, he cut a passage for the river Hwang Ho (or Hoang Ho), i.e., the Yellow river, through a mountain on the southern boundaries of Shansi and Shensi, which provinces that river separates, and makes a cataract here not inferior to those of the Nile. Thence he conducted it through the province of Honan, and following its channels along the province of Pechili, he drained the lake Talu (i.e., Pehlu) into which the Hwang Ho formerly emptied itself. This lake overflowed all that country which now includes the districts of Shunti fu, and Chauchau and Sinchau in the same province. At last to break its rapidity, he divided it into nine channels, which some imagine were again united before it disembogued itself into the sea. But whether they were joined, or if it was only the main channel that ran into the sea at the foot of the mountain Ki-she-shan, which was then made a promontory, this is certain, that since Yu began that great work (about 3921 years ago), this river has strayed so far from its ancient course, for instead of discharging itself into the sea as it did formerly in lat. 40° it now falls into the river Hwang Ho, a little above Hwaingan, a city of the first rank in the province of Kiangngan about lat. 34°.

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It is likewise observable, that the mountain Ki-she-shan, which formerly was united to the territory of Yungping fu, is now five hundred li (about one hundred and sixty English miles) distant in the sea from this city (and now, 1867, it probably forms one of the islands near the promontory north of the Miautau islands). So that the sea gaining on the land by degrees has at last overflowed all this tract of ground. It is indeed true that the Chinese history makes no mention of this extraordinary change of the course of the Hwang Ho, nor of this overflowing sea. But when alterations on the surface of the globe are brought about insensibly, and without alarming nature, they easily escape the observations of history, the difference that happens during the life of one man being not at all perceptible."

In October, 1866, after a long journey through the southern and central part of China, from Canton to the Tungting lake, and down the Yangtsee to Haukow and Shanghai, I took passage for Tientsin through the kindness of my good German friends Trautmann & Co., on their steamer, the "Nanzing." My object in part was to note what evidences might appear of recent geological changes in the plain of Pechili, and to visit the coal mines near the capital of the empire. From Tientsin I proceeded directly to Peking, and thence to the mountains on the north, and along the flanks of this range to the Nankau pass, and thence to the coal mines, a day's journey southward. And in entire accordance with Father du Halde's statements and speculations given above, everywhere there appeared evidences of a recent elevation above the sea. A consideration of the charts of the gulf of Pechili and the Yellow sea, farther showed me that the true eastern border of this plain is not the present sea shore, but that this plain continues out under the gulf and under the Yellow sea, on the north to Corea, and on the south of Shantung even to the Japanese Islands, the Lew Chews and Formosa. In other words, this plain extends out eastward to the mountain range which stretches along the proper eastern edge of the Asiatic continent, the true Pacific basin beginning only eastward of the islands just named.

If the north of China were to be raised but one hundred and twenty feet, the whole gulf of Pechili would become dry land, and if it were elevated as much more, in place of the Yellow sea there would be a continuous plain from Peking to Corea, and such a change is now actually going on. At Chefoo, on the northern side of the promontory of Shantung, there is a long sand-pit extending out from the mainland to a high headland, and forming the western side of the harbor. On this spit are seen two old sea beaches, as perfect as the present one.
The highest is but a few feet above the sea, yet it shows what kind of a change the surrounding area has recently undergone, and this is farther strengthened by the testimony of all the Chinese, that "the harbor is slowly filling up."

It is seldom possible to obtain data that will give us the rate of such changes, and therefore the following statements kindly furnished me by the Rev. Mr. Metier at Tungchau, are the more valuable.

"I have learned with some degree of probability that in the Ming dynasty, some 250 years ago, the water from the sea came up the bed of what is now a small creek, past the city, and extending as much as three li (one mile) from the present beach. I also learned that at that time, the water in the basin of the "Water city," was at least fifteen Chinese feet deep where now it is not three feet deep. This difference of twelve Chinese (14.1 English) feet is the least that will account for the water running up to where it is said to have done. At a later date, the water came up outside the water city to the bridge near a li (one-third of a mile) from its present beach. The decline has been so gradual, that there is now no way of telling exactly when the junks quit coming. It is said that there was originally no dry land in the water city, save the very least close to the wall. It was built by a man named Chi, as a depot for the government junks, and was not intended to include any place to build upon, but to be a safe depot, where pirates could not come."

This elevation of at least 14.1 feet in 250 years, gives a mean rate of nearly five feet in a century, and to realize the whole elevation of the bed of the gulf of Pechili, we must add to this rising, an estimate of the quantity of sediment probably brought down by the Yellow river, the Peiho and minor streams.

"If this area had subsided 14 feet during the last two centuries and a half, instead of rising 14 feet, of course it would have been 28 feet below its present level, and probably one-third of the low, thickly populated parts of China would then be beneath the sea."

About Peking the plain of Pechili is composed of stratified clays, that form in the dry weather a fine, light dust, from two to five inches deep. When the heavy winds of autumn and winter set in with violence, this dust rises in one continuous mass to the very clouds, and forms the dust storms for which Peking is so justly famous.

As I journeyed over the plain, I noticed in many places considerable quantities of clay stones closely resembling branching corals, for which, indeed, they have been mistaken. But instead of being of marine origin, they are formed by the water trick-
ling down along the grass roots, which in this way receive a series of concentric layers from the surrounding clay. And as the water follows the various branches of the roots, these clay stones necessarily take a branching form. Frequently, where the strata have not been disturbed, these roots can still be seen with the concretions around them.

In the Nankau pass, and for some distance about the place where it opens out to the plain, there appear large quantities of transported boulders. These were probably borne near to the places they now occupy by an old glacier that once filled up this pass, and brought them down from the neighboring mountains, or perhaps even from the southern borders of the high plateau of Mongolia, on which this river of ice probably took its rise. But a short distance from the mouth of the pass, in every direction over the plain, these boulders completely disappear. Many of them have been gathered by the farmers to make walls of their houses, but as few are to be seen in the clay banks, the question naturally arises, whether the materials that now fill the Peking basin have not been so completely sorted and resorted by the action of the waves as the land has rose and sunk from the level of the sea, that the larger boulders are mostly resting on the rocky floor of the basin, or at least at a considerable distance below the present surface of the ground.

As we followed the flanks of the mountains, southward, we came to a remarkable depression in the plain, evidently the bed of a lake that had recently been drained off, not over the plain toward Peking, but through some rent in the mountains toward the west, into the present channel of the Yang Ho, and along the course of this river to the gulf of Pechili. Farther down the Yang Ho, a small stream comes in on the southwest from a valley where are located the coal mines of Mun-to-kow. This minor valley is bordered with a terrace of 40 or 50 feet in height. Besides these evidences of the late presence of the sea in this region, I was shown at Peking, some shells from banks in the vicinity, and I believe they were all of the same species as are now to be found in the gulf of Pechili.

All these changes have occurred without especially attracting the notice of the people, but it has been far otherwise with the Yellow river, whose irregular wanderings and destructive floods have gained for it the well merited title of “China’s sorrow.”

All rivers after they have worn out their channels to a certain depth, have a tendency to deposit in their own beds a part of the mud and sand they are bearing along, and this tendency is greatly increased by preventing them from overflowing their banks by artificial levees or dikes. The Po in this way has raised its bed until the surface of its water is above the tops of the
houses of the peasants, and it has already once deserted its old channel and formed a new one, and this is in short the whole history of the Yellow river. When it had filled up its old channel to the south of Shantung, and succeeded in making a breach through its artificial banks, it followed very nearly its previous course north of Shantung to the gulf Pechili. The whole plain through which it flows in the lower part of its course being of alluvial origin, and completely intersected by streams and canals, its waters would readily find a lower channel which their momentum in coming down from the higher level of their old bed would enable them to quickly enlarge. The elevation of the land along the sea coast at the rate of five feet a century, would have a tendency to render its current more sluggish, and consequently the quantity of sediment deposited in its own bed, greater than if it remained stationary or was somewhat subsiding. But this tendency may have been partially counteracted by an equal or greater relative elevation of the area along its upper course, and it is perhaps worth remarking in this connection, that one of the latest changes that has taken place where the Asiatic continent joins that of Europe has been one elevation and that the Aral Sea, and the lakes east of it being merely remnants of one great internal, depressed sea, whose bed has probably undergone a considerable elevation.

The last change in the course of the Yellow river occurred when the Taiping rebels were approaching and threatening Peking, and is supposed to have been caused by a breach made either by them, or as is more probable, by the Imperialists, to arrest the progress of their formidable enemies. All accounts agree that this change is complete and that its old bed is dry, but this is merely another way of stating as fact what has just been assumed, namely, that the river continued in its old channel until that had become as high or higher than the surrounding country.

Dr. Martin of Peking informs me it now leaves its old channel a short distance below the city of Ifung, and passing northerly near Tsau-chau and Poh to Fam, it flows in a northeasterly direction to Tungping, and thence to Tsinan fu, the capital of Shantung, and down the bed of the Tatsing river to the gulf of Pechili. This course is just about at a right angle with the old one to Hwaingan; and the distance from its present mouth to where it emptied before into the Yellow sea is more than 380 miles in a straight line and more than twice that distance along the sea shore. Perhaps we can better appreciate how great a change this must have been, if we suppose that at some time the Mississippi, on reaching the city of Natchez, should sud-
denly desert its old channel to the Belize, and taking a more easterly course, pour out its waters into Mobile bay.

Probably no other river within historic time has wandered so far and so frequently from its old channels as this Yellow river, but also probably, no other river on the whole globe flows out on to a plain of such wide extent at right angles to its own course, and at the same time of such a perfect and continuous level. The Imperial or Grand canal indicates how remarkably low and how uninterruptedly level the surface of this plain must be. No other country has ever had such an artificial water communication, but what other has such wondrous natural facilities for one of such a length, and like this at right angles to the courses of its two greatest rivers? While the Mississippi, the Ganges and the Nile flow out through many mouths, the Hwang Ho now confines itself to one, though a part of its waters appear to escape southward through the Imperial canal.

Farther southward, the region about the mouth of the Yangtse Kiang has also been lately raised, though it may now be in a state of rest. This change is clearly shown by the bank of recent shells, described by Dr. Lamprey in his paper on the "Geology of the Great Plain."

The mouths of the Yangtse themselves have changed greatly, and Tsung Ming island, which now has a population of half a million, did not exist in the fourteenth century.

The Tunting and Poyang lakes, which act as immense reservoirs for this river, receiving a part of its surplus waters during the floods and pouring them out again during the dry season, are slowly filling up with the sediment brought into them by their streams on the south. It has been noticed, that near each of these lakes high mountains appear. This fact probably indicates the origin of their basins, for they are merely the lowest parts of large depressions, and where the strata have been so folded that the crest of the undulation is remarkably high, the depression of that undulation must be correspondingly low. This is what has occurred where these lakes and their neighboring mountains have been formed. On my way through the interior of China I crossed Tungting lake, and found its waters to be quite shallow, and that they spread out widely over the low, swampy lands along its southern shores in the time of the floods. When I reached Siangyin, I found the whole adjoining country overflowed, and that we were already standing by the lake, although according to the map, it ought to have been dry land for more than twenty miles farther.

The basins of these, and the other lakes scattered over the great plain, may be places of a slight local subsidence, but it
is far more probable that they are small areas not yet filled up with the alluvial deposits of which the whole plain is composed, and which has been brought down from the mountains mostly by the Yellow river and the Yangtse.

At Foochow and about the mouth of the river Min, I believe there is an area that has for some time been slowly subsiding. While all the other rivers in China flow out through a low delta, that they have formed themselves, the Min at once empties itself into the sea; no delta is seen, yet the Min has one, as much as the Peiho, the Yellow river, the Yangtse, the Tsientang by Hanchau and the Sikiang by Canton. Its delta consists in the small and dangerous banks about its mouth, and if the deltas of these other rivers were to subside as fast as, or faster than they are raised by the deposit of sediment over their surfaces, each would present a phenomenon strictly analogous to that of the Min. When I visited Foochow, I noticed these indications of a late subsidence, and Mr. Dunn, of Hedge & Co., kindly gave me these corroborative facts. In digging a well in their compound, "at a depth of from twenty-five to thirty feet below the surface of the ground, there were found two boards about four or five feet long and one foot wide, nailed at the ends to a post. At the same depth was found a quantity of broken crockery of the same kind as that now used by the lower classes of Chinese, and a number of pieces of half-decayed wood. The earth in which these things were found was a rather loose mixture of mud and sand, bearing a close resemblance to what is now seen along the river banks at low water. The impression upon my mind at the time, was that we had struck the remains of a Chinese house, and the workmen were of this opinion. The tide here has a rise of about 12 feet at high springs, which would place the post about twelve feet below the present low water level. According to the Chinese, what is now the navigable branch of the river (i. e., between the city and the foreign settlement) was some 900 years ago too shallow for junks and large boats. The south branch was then in general use. The long bridge at the head of the island (opposite the city of Foochow), and the remains of dikes and flood gates in that vicinity, lend an air of probability to this statement."

In the plain about Foochow, as indicated above, the river Min frequently changes its bed by washing away one bank and building up the opposite one. And at the foreign settlement a number of lines of stakes are placed in the edge of the river to catch this changing sand and clay, and gain land on that side. At first it might appear that this post with its boards had simply sunk on one side of the river channel and been
covered by the sand mud from the opposite bank, but the fact that it appeared to be a part of a house, and was found with pieces of crockery ware, shows it had probably not floated to the place where it was found. The simple fact that twenty-five feet of sand and mud had been deposited over these works of human hands, proves in itself their high antiquity, as plainly as in the case of the canoes taken out from a depth of twenty feet beneath the streets of the city of Glasgow.

In the south of China, Dr. Legge informs me that along the East river, he has seen a large bank of shells filled with specimens of shells which he believes will prove to be of living species.

Passing from the continent to Formosa, Mr. Swinhoe informs me that Castel Zelandia, a fort built by the Dutch in 1634, on what was then an island, is now some distance back from the river and in the center of the city of Taiwan fur; also that at Takao, recent crabs and recent shells are found at a height of 1,111 feet above the present level of the sea.

During my travels in the north of China, I came to Chefoo on the northern side of the promontory of Shantung, and Capt. Shufeldt, of the U. S. ship Wachusett, kindly took me over to the mouth of the Tatung river, near Sir James Hall's Islands on the west coast of Corea. That river was found to debouch into a large bay, and along the northern side of this bay is a gradually ascending plain, from which a mountain range rises up abruptly. An indication of the recent period in which this plain must have been raised above the sea, is seen in the fact that all the streams that flow over it from the valleys among the neighboring mountains have as yet only worn out for themselves shallow beds in the loose soil. The height of this elevation I estimate at from 300 to 500 feet.

Passing over to Niphon, we find on the western side of the bay of Yedo, a plateau some 200 feet high, its top as level as if made by the hand of man. A short journey from Yokohama back to Kanasawa, hence across to the bay of Kamokura, and up the Tocaido to Kanagawa, showed me that all this area is also of very recent marine origin. The highest place we passed over I judged to be from 500 to 600 feet above the present level of the ocean, but terraces up to twice that height will probably be found among the neighboring mountains. Most of the "hills" in this region have been formed by the streams washing out gulleys in the plateau. These have enlarged into valleys, and these again have widened until only sharp ridges are left of the once continuous plain.

In the bay of Kamokura is the island Inosima. At present it is connected to the main land by a sand spit, about half a
mile long, two hundred to five hundred yards wide, and from two to five feet above high water level. This I suspect is the island mentioned under the name of Kamokura, by Kaempfer, in the year 1691, while on his way from Nagasaki to Yedo. He describes it as follows: "Off the shores of the outer bay of Jedo, was seen the Island of Kamokura, with high rugged shores, but of which the surface was flat and wooded. It was not above four miles in circumference, and was used like several other islands, as a place of confinement for disgraced noblemen. There being no landing-place, the boats that carry thither prisoners or provisions must be hauled up and let down by a crane."

North of Niphon, on the island of Yesso, terraces line the northern shore of Tsugar strait and Volcano Bay, and what has already been described in Corea, again appears there, but on a much grander scale. The greatest height to which I have been able to trace the recent action of the sea, is 1,180 feet. This was found on the flanks of the mountains north of Hakodadi, but when foreigners are allowed full liberty to travel where they please over the Japanese Islands, similar phenomena will undoubtedly be found at a still greater height.

As I passed up the gulf of Tartary, I touched twice on the western shore of the island of Saghalien, and continued to find terraces to a considerable height. Again, the village of Nikolaifsk, at the mouth of the Amoor River, is situated on a bluff that appears to have been recently elevated from 30 to 50 feet above the present level of the river.

All these facts considered in connection with the dry beds of friths and bays along the Siberian borders of the Arctic ocean, and the remnants of the old gulf that once washed the eastern flanks of the Ural, give us some idea of how the Asiatic continent has increased her area within the later geologic times.