

point, the view of Lyell), through the pressure of the surface deposits on a layer of mud which overlies the Port Hudson clay, or older alluvium of the river. Some carbo-hydrogen gas is given out, arising from the decomposition of animal or vegetable matters in the mud. The mud-discharges tend to increase the shallowness of the waters and push out the land into the Gulf waters. Mr. Hilgard states, in 1871, that Morgan's mud-lump, in the marsh of Southwest Pass, had been active for 25 years, and during the time the bars had moved gulfward a mile and a half. He closes his paper with a remark (vol. i. 435) relating to the distance to which the Southwest Pass must extend in order that there shall be no danger of mud-lumps within the channel. The Eads jetties have since then been made along this pass, in order to give it greater depth. It has secured the depth; but with danger from this source still existing, as Professor Hilgard has observed.

According to Humphreys and Abbot, the outer crest of the bar of the Southwest Pass, the principal one of the Mississippi, advances into the Gulf 338 feet annually, over a width of 11,500 feet; and the erosive power is only about $\frac{1}{16}$ of its depositing power. The depth of the Gulf, where the bar is now formed, being 100 feet, the profile and other dimensions of the river, in connection with the above-mentioned rate of deposit, give for the difference between the cubical contents of yearly deposit and erosion 255,000,000 cubic feet, or a mass 1 mile square and 9 feet thick: this, therefore, is the volume of earthy matter pushed into the Gulf each year at the Southwest Pass. The quantities of earthy matter pushed along by the several passes being in proportion to their volumes of discharge, the whole amount thus carried yearly to the Gulf is 750,000,000 cubic feet, or a mass 1 mile square and 27 feet thick. As the cubical contents of the whole mass of the bar of the Southwest Pass are equal to a solid 1 mile square and 490 feet thick, it would require 55 years to form the bar as it now exists, or, in other words, to establish the equilibrium between the advancing rates of erosion and deposit. Hilgard has shown that, about New Orleans, the modern alluvium has a depth of only 31 to 56 feet, there existing below this the alluvial clay, etc., of the Port Hudson group.

The delta of the Hoang Ho (Yellow River) extends along the coast from near Peking, on the north beyond the Pei Ho, to Hung-tse Lake, on the south, where it joins the plains of the Yang-tse-Kiang. The distance is 400 miles; but the mountainous coast-province of Shan-Tung is to be excluded. From the coast, the delta extends westward for 300 miles. The river is here useless for navigation. The whole delta region would be under water during flood seasons except for drainage by artificial dikes and canals of great length; and these have required constant supervision. At long intervals, the great river has broken loose and swept over the immense area with devastating floods, and ended its mad career with change of channel from the river Pei Ho, or some place near it, on the north, to a southeast route; or the reverse. In 1820 it occupied a southeast channel, emptying into the Yellow Sea, near latitude $33\frac{1}{2}^{\circ}$ N. By 1858 this channel was dry; and after some years of uncontrolled waters, it took a new channel into the Gulf of Pe-chi-li, 300 miles north. In the autumn of 1887, a new break occurred near Kai Fung, in Ho-Nan; but the waters instead of resuming the old channel which they left after 1852 took a course south from Kai Fung to the Cha, 70 miles, and then struck off east-southeastward to the Hoei Ho and the sea. The Chinese have succeeded in leading off the upper part of the wandering waters into the old channel mentioned above, leaving the more southern part in its new channel. The first of such changes recorded in Chinese annals occurred in 2293 B.C.; a second, owing to Chinese care, not until 602 B.C. Several have occurred since. The Mississippi has its disastrous floods, but no chance for such changes.

(4) **Lakes.** — The discharge of lakes, like that of rivers, is (1) evaporational or upward; (2) gravitational or downward; and (3) surficial,¹ sea-

¹ The word *superficial* is too various in its significations to express the right idea. *Surficial* is like *surface* in having for its prefix the French abbreviation *sur* in place of *super*.