ABSTRACT OF LECTURE

FLOODS ON THE MISSISSIPPI RIVER.

By Thomas Hill.

The author, passing along the Mississippi River in June, 1927, while collecting data on the recent developments in navigation on that river, was impressed by the profound effect on all classes made by the recent floods of unprecedented severity. He obtained much very valuable and official data upon this catastrophe from engineers and departmental officers of the United States, and he wishes to acknowledge his appreciation of the courtesy of all those gentlemen who so willingly furnished him with the information from which these brief notes are collated. The incidence of certain conditions on the causation of floods, such as the behaviour of beds of rivers controlled by levee banks, effect of melting snow and deforestation give the problem a universal interest and a local significance.

The area drained by the Mississippi is 1 1/2 million square miles of United States' three millions. Australia's area is about the same, but our large river, the Murray, drains only 400,000 square miles, and the average annual precipitation over the former is 30 inches compared with only 13 inches for the Murray. Again, the normal annual discharge of the Mississippi is 500 million acre feet, while that of the Murray at Morgan is only eight millions.

Floods on the Mississippi are not of recent origin. A reference to "Engineering News Record," of 26th May, 1927, shows that during Ferdinand de Soto's expedition his party encountered serious floods on the river in 1543. The historian referred to in the article gave fourteen years intervals between serious floods. More recent investigations, however, mention 9.5 years at St. Louis and 4.07 at New Orleans, and the two greatest floods of 1922 and 1927 were five years apart; that of 1922 was a record and the flood of 1927 was greater still. Records show that the effect of snow on the floods was negligible. During the third week of January there was a melting of an average cover of four or five inches of snow, equivalent to 1/3 inch of water north of the Ohio River, and by the end of February there was no remaining snow in the Mississippi catchment except in high altitudes; and this prevailed in March, while the flood was in April.

That floods occurred in 1543 prior to deforestation is sufficient evidence that deforestation is not the whole cause of the floods. Reafforestation would take many years to restore original conditions on vast denuded lands unfit for
crops. But the retardation of flow off might prove disadvantageous, through holding back discharges from upper areas and delivering into the lower river at a time when the heavy rains over the lower course requires the full capacity of the channel within the levee banks to convey the water to the Gulf of Mexico. It is also notable that the greatest flood past St. Louis was in 1844, when the basin of the Upper Mississippi was primeval forest.

The control of flow by reservoirs—useful for navigation, power and irrigation, and for regulating local floods—has received much attention. The St. Lawrence River—generally regarded as the best-regulated river in the world—has natural reservoirs in its immense lake system, but it is considered that for the same regulation the Mississippi, with three times the flow of the St. Lawrence River, would require 30,000 square miles, an area greater than that requiring protection. Using levees, however, the area of the reservoirs need not be so great as in this extreme case. Levees themselves constitute a huge reservoir, and moving back and straightening them are receiving consideration.

Meteorological reports show that all great floods on the Mississippi have occurred when a flood on the Ohio River has been augmented by subsequent rains over contiguous areas of the central basin, which rains, favourably distributed and properly timed as to occurrence and duration, have delivered greater volumes of water than can be carried off by the channel as restricted by man. It is considered that melting snows in the Rockies and the contributions of the Missouri and Arkansas Rivers play little part in the floods of the lower basin. The floods are mainly due to the excessive rainfalls on the middle and lower Mississippi and Ohio Rivers which, arriving simultaneously at Cairo, where during the week ending 17th April, 1927, fourteen inches of rain fell at New Orleans in thirty-six hours and six to eight inches at Memphis and Little Rock. The floods on the White and Arkansas Rivers arrived at Arkansas City on the Mississippi River at the same time as the rest from Cairo. These conjunctions caused an excessive rise in the river, probably eight feet above any previous flood.

Great protective works have been in course of construction for years. Until 1879 State Governments and private parties had spent large sums, but their work was poorly coordinated; then the Federal Government took over the work, and the Mississippi Commission was formed, which was composed of three U.S. engineers, one from the coastal survey and three from civil life. The Commission's function included improvements for navigation and for flood control. It made an exhaustive study of the problem, and co-ordin-
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ated State effort and carried out Federal works. It was found that the river at full bank carried one million cusecs, whereas the flood was \(2\frac{1}{2}\) millions; and it was necessary to reduce the width of flow from fifty miles to one mile. The only practicable remedy was the construction of stronger levees. Accordingly standard cross-sections and works of protection from wave-wash and erosion were formulated. Great levees have been raised on the main river, and also for a distance up the tributaries. Dredging has proceeded, and revetments in the low-water channel have secured a navigable way nine feet deep from the sea up as far as Cairo. The Commission has increased the size of the levees in one place from eight feet high and 31,500 cubic yards per mile to 22 feet high and 420,000 cubic yards per mile. Of the 522 million cubic yards to be constructed in the complete scheme, only 50 millions remained to be done prior to the 1927 flood. Only one of the Commission's standard levees failed, and this was due to an eddy caused by a neighbouring dyke running at an angle to it. The remaining breaks were on levees below standard dimensions or due to overtopping. Altogether 18,000 square miles were inundated out of the 30,000 to be protected, but the more fertile lands were saved. The total loss of crops, live stock, suspension of business and damage to levees amounted to 70 million pounds, and is described as the greatest economic disaster in the history of the United States. The Commission spent £35,000,000 up to June, 1926, of which 16\(\frac{1}{2}\) millions was allocated to improvements in navigation and 18\(\frac{1}{2}\) to flood control. The latter includes the States' contribution of 3\(\frac{1}{2}\) millions.

It is now the general opinion of men of value that the main reliance must be on levees and spillways. General Jardine, chief engineer, in his address in Chicago, happily quoted Holland's reliance on dykes. During the flood the levees received a very severe test when only partially completed, and with many subsidiary banks not of standard construction. But when the scheme of levees on the Mississippi and its tributaries to carry about 2\(\frac{1}{2}\) million cusecs is completed, one authority considers that safety will be assured. Another authority recommends in addition additional spillways and relief channels.

A body known as the Plan Commission has been appointed, consisting of General Jardine (Chief of Army Engineers), the President of the Mississippi Commission, and civil engineers from private practice to consider various schemes and report to the President, whose decisions will be final.
The President moved a hearty vote of thanks to Mr. Hill for his paper. He said Mr. Hill had just returned from America full of information, and it was gratifying to the Institute that Mr. Hill had come forward to give members the benefit of the information he had obtained.

Mr. J. Sarvaas said he had listened with great pleasure to Mr. Hill's paper. What was most astounding was the tremendous area of the Mississippi. The rainfall and catchment areas were stupendous as compared with Australian rivers.

Mr. Wm. Chas. Rowe said he was especially interested in the matter of the silt brought down by such a high flood. What took place on the flooded land by the deposit of silt?

Mr. A. Lewis asked whether the township of New Orleans had a dyke all round. After fourteen inches of rain in thirty-six hours what happened in the town?

Mr. W. R. Pollock asked if there was any afforestation taking place on the completed levee banks.

Mr. T. Hill, in reply to Mr. Rowe, said he thought little trouble was experienced from siltation. It was in such a state at the time of his visit that it was difficult to distinguish between the original silt and the new deposit. The flow there was much the same as in the main stream, and therefore any soil in suspension was carried on. Generally speaking, the deposit was very small. As regarded growth on the banks, it was encouraged as far as possible to prevent erosion. After seeing the levees one came away impressed with their ability to withstand the strain. They were constructed in some cases with timber sheeting. Only in some of the minor dykes had there been trouble. As to New Orleans, the township was high above the bed of the river, and could be drained effectively. What was guarded against was the flood coming down on its way to the sea. Other cities were similarly guarded. The town was not entirely surrounded by dykes; they were simply placed above the town to deflect the down-coming flood. Some levees were necessary to confine the river for navigation purposes. The development of navigation in the last few years had been astounding. With the increased cost of railway construction the river traffic was now competing successfully with the rail carriage of goods.
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