additional storage room is provided to lower the crest of these extremely high waters.

The Levee System .- A history covering the development of the levee system of the Mississippi Valley would be interesting reading. On the banks of many rivers and bayous, large and small, are found evidence of this development. Small levees constructed by planters for their private protection have long since become obsolete. It was found to be necessary to construct one large levee to protect the entire area beyond either bank of the river. Not a few planters of mature age and judgment in different parts of the Mississippi Valley informed the writer that in their opinion the people would be better off if there never had been a levee constructed. Without the levee system the soil was formerly enriched by the sediment deposited by the annual overflow. They also stated that the flood water was distributed over such large areas that the damage to crops was but slight. Very good crops are being raised outside of the levees in spite of the fact that there is always danger of the crops being entirely ruined by the traditional "June rise."

Whatever the arguments may be for or against the levee system, the levees are here to stay and the question of vital interest to the present generation is, how shall they be constructed and maintained so as to protect this large fertile valley from periodical overflow. Disastrous results do not frequently occur from a break in the levee system, but when they do occur they usually reach such proportions that steps should be taken to reduce the number of floods to a minimum, and this result will be obtained by creating additional storage capacity through the use of a part of the comparatively worthless low lands. Those of us who are unfamiliar with the Mississippi levee system would probably expect to see a levee on each bank of the river plainly visible from a steamboat in the main channel, while as a matter of fact, the levees are seldom visible except where the river has shifted its bed so near to the levee as to place it in danger of being destroyed by the caving bank. New levees, when properly located, are seldom placed within a mile of the river bank, except where property is extremely valuable or for the protection of a town or city, in which case the river bank must be protected from the action of the current.

Bank Protection .- Caving banks on the Mississippi River and some of its tributaries, particularly the Arkansas and the Missouri, have been the source of great expense in connection with the levee system. If the levees could be built and completed for all time, with the exception of additional raising and reinforcing at times, they would not be a matter of such great concern as they otherwise are. The lakes throughout the lower Mississippi are positive evidence of the shifting of the bed of the river. Planters who were at one time wealthy have been reduced to poverty because of the changing condition of the streams due to caving banks. A trip on a Mississippi River steamboat will convince one of the facts in this case. Remnants of the old levees may be seen and the progress of the development of the levee system may be studied step by step by the observer as he notices these remnants on the caving banks. Many methods have been employed in attempting to control this changing of position of the rivers. As yet little bank protection work has been done on the Mississippi, except at excessive cost, which can be considered permanent work, and so long as bank protection work does not reach a higher stage of development it is essential that the expensive new levees should be located a sufficient distance back from the river bank to

insure their protection from the encroachment of the river for many years to come. The control of the Mississippi River is a problem of such magnitude that bank protection work has been done at only a few places where cities were threatened with being cut off from water transportation and where the damage due to the changed location of the channel would have been greatest.

Canalization.-It is rather doubtful if the great task of maintaining the Mississippi River navigable to a depth of, say, 9 feet, as proposed, would justify the necessary expenditure if canalization alone were to be considered, and a general scheme of bank protection on account of its great cost would be justified only in connection with canalization. Canalization would assist in reducing flood damage by carrying off the flood waters more rapidly. Bank protection which would be necessary as a part of the general scheme of canalization would also serve as a protection for the levee system. If the Mississippi River can be kept in approximately a fixed location even at great first cost and a reasonable cost of maintenance the expense will be justified. With an approximately stable location of the river assured, the cost of maintaining a levee system would be greatly reduced since the levees would no longer be exposed to caving banks. The Arkansas River some ten years ago had but one line of boats operating on it, and during the greater part of the year (except during high stages of the river) specially constructed boats were used which could navigate on a minimum depth of three feet of water. Navigation on most of the tributaries (except possibly the Ohio) is probably about on a par with that on the Arkansas. Canalization should not be undertaken until after systematic and thorough studies have been made and until it can be shown that it is a paying proposition to the country in general.

Many people are now advocating the control of flood waters by reservoirs, proper forestation, levees, channel improvements and other works, all of which are recognized aids in flood protection, but their effectiveness can be determined only by careful study of all conditions. Many serious floods are now being caused by encroachments upon river banks, drainage ditches, etc. In different parts of the drainage area in question vast areas have been covered with drainage ditches. Where formerly the precipitation from these areas reached the streams very gradually it is now delivered in large volumes and is one of the direct causes of the disastrous floods. In view of these floods which have occurred recently throughout different parts of this drainage area, there should be no further delay in establishing a complete system of river control in which there should be systematic co-operation between the National Government, the states, the municipalities and local interests.

## HIGHWAY ENGINEERING INSTRUCTION AT CORNELL UNIVERSITY.

In view of the growing demand for instruction in highway engineering. a short ccurse will be given from February 15 to 20 inclusive, at Ithaca, N.Y., by the college of Civil Engineering of Cornell University, with the co-operation of the New York State Highway Department, the Federal Office of Public Roads, and a number of expert highway engineers from other organizations. A series of practical, instructive lectures will be given covering the fundamental principles of highway engineering. Practical highway engineering experts will discuss the most recent practice and developments of each type of road construction and maintenance and the erection and care of highway structures.