THE CONTROL OF RIVER FLOODS.*

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THE subject of land drainage is intimately associated with that of river improvement. The cultivation of the soil largely increases the amount of sediment entering our streams; the direction of the furrow markedly affects the amount of rainwater that flows from its surface, and every ditch or subsurface drain promotes a more rapid flow into our rivers during floods and possibly affects their discharge during low water. On the other hand, no satisfactory system of land drainage can be accomplished in a country subject to periodic overflow by river floods. In the Mississippi Valley protection from floods is absolutely required before any regular system of drainage can be inaugurated. The overflow is so great and the amount of sediment carried by the river so large, that the drains would be annually destroyed or filled. The floods not only insure the destruction of any crops that might be planted, but also usually occur at such times as to prevent the harvesting of a second crop the same year.

Sources of Floods.—Before entering upon such a discussion of the means of preventing these floods, it is desirable to have a clear conception of the sources from which floods arise. The greater Mississippi Valley is bounded on the east by the Appalachian chain and on the west by the Rocky mountains. These mountain ranges exert a great influence on its floods. The winds blowing from an easterly direction deposit most of the moisture they absorb from the Atlantic Ocean on the eastern slope of the Alleghenies, and therefore cause little rain in the Mississippi Valley; the Rocky Mountains intercept the moisture from the Pacific Ocean. While showers occur from winds blowing over the Great Lakes, the original source of the floods of the Mississippi is to be sought in the Gulf of Mexico.

During the winter and spring the land of the Mississippi Valley, no matter what its soil or the nature of its covering, is cooler than the waters of the gulf, and a southerly wind becoming saturated with moisture as it passes over the water will precipitate that moisture on the land in copious rains, or in snow when the temperature is sufficiently low. A wind from the southwest sweeps up the Ohio Valley; one from the south carries moisture to the Upper Mississippi; one from the southeast to the valleys of the Arkansas and the Missouri; but in all cases there is a tendency for the greatest rainfall to occur near the coast, and gradually to decrease as the wind currents travel inland.

Generally speaking, the rainfall is very unequally distributed over the Mississippi Valley, being least at the upper sources of the tributaries, and rapidly increasing as the main stream is reached, though an exception is to be noted in the southern tributaries of the Ohio, whose sources are nearer the gulf than are their outlets.

The maximum discharge of the Upper Mississippi River is estimated at 450,000 second-feet; the Missouri, 900,000; the Ohio, 1,400,000; the Arkansas, 450,000; and the Red, 220,000. There is also a large discharge from the Yazoo, St. Francis, White, Tensas, and Ouachita rivers. The maximum discharge of the Mississippi during the flood of 1912 was about 2,000,000 second-feet at Cairo, and 2,300,000 at the mouth of the Red River. It overflows its natural banks when the flow exceeds 1,000,000 second-feet.

While the influence of forests on stream flow has received little attention in this country until recently, the scientists of Europe have discussed the subject pro and con during the past forty years. It is generally accepted by both sides that the leaves falling from forest trees as they decay form a humus which has a large capacity to absorb water, and that when the forests are felled this humus is seriously injured by forest fires. It is also admitted that snow is more rapidly melted when it is exposed to the direct rays of the sun in an open field than when sheltered from such action in the forest. In fact, it has been found by the United States forestry service from experiments recently made in the White Mountains that the flow from cleared fields under such conditions is about twice that from forests. The forest advocates claim that this is sufficient proof that forests absorb water during flood periods, which percolates through the ground and flows from springs later in the season, thus reducing flood heights and increasing the low water flow of rivers. Its opponents do not admit that the problem is thus easily solved. They claim that floods do not arise from the melting of snows by the direct action of the sun; that this process is so slow that the water which flows off would not raise a river to mid-stage; that floods occur when on a layer of snow there falls a copious supply of rain, and both the rain and melted snow enters the stream simultaneously; and that under such conditions the forest, instead of being beneficial, is injurious. On cleared land the wind tends to blow the snow from the ridges and piles it in immense masses in the ravines, while in the forests the snow is uniformly distributed. A few days of sunshine dries out the ridges in the open field and melts sufficient snow in the forest to saturate with water the underlying humus.

If a heavy rainfall then occurs, the forest humus, being saturated, can absorb no more water, and the combined rain and snow of the forest flows into the streams, while in the cleared land, the ridges having dried out, absorb a large portion of the rainfall, and the snowdrifts expose a much smaller surface to the action of rain. Moreover, during periods of great drouth the forest humus and long, deep tree roots also absorb more water than grass and farm crops, and retard the run-off at a time when it is most needed for low water navigation. They therefore maintain that a forest is a fair-weather friend of some use in regulating the mid-stages of a river, but an utter failure when most needed—that is, during extreme floods or extreme low water. While I consider this discussion valuable, my objections to reforestation are not based solely on a scholastic argument.

It requires from twenty to fifty years to produce a good forest growth, and over a century for the leaves of that forest to decay in sufficient quantities to produce the humus which will be satisfactory as an absorbent of rainfall. We can not afford to delay the drainage of the Mississippi Valley even to produce the forest growth, without taking into consideration the time required for the humus to form. We are more vitally interested in the height that the river will attain in the next few weeks than in what will occur in the year 2013.

It is also pertinent to this discussion to determine what would be the extent of the forest reservation which would be required to reduce the flood heights on the Mississippi River a given amount. To solve this problem

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