

Can floods be prevented? Can the great rivers of the Nation, which annually overflow their banks, bringing waste and desolation to millions of acres of farmlands and thousands of homes, be brought within their meandering banks and made to stay there?

What will such a program cost the Nation? How many rivers would be involved? How long would it take to put such a program into effective operation? What program shall be followed? Re-forestation? Overflow basins? Who would do it?

Congressmen, State legislators, Governors, Mayors of cities and hundreds of thousands of homeless and suffering people each year in the great river basins of the United States ask these questions. They are seeking an answer to them, for the answer means security and prosperity to all whose lives the rivers touch.

UNITED STATES army engineers who, since the foundation of the Government, have met the rivers on their own raging grounds and fought it out with them, hold the answer to these questions. Congress holds the purse strings to their accomplishment.

Taking these questions one by one, let us outline the rivers that would need to come under a permanent and successful flood control program for the United States; show what would need to be done in the way of dams, levees, spillways, overflow basins to harness these rivers effectively. Let us examine the labor of the problem from a permanent basis standpoint and the number of men and years to put the program into effective operation.

Floods on the rivers of the United States in the sense of recurring high river stages cannot be prevented, but the destructive effects of such high waters may largely be eliminated.

A major flood on a great river system is not the torrential rush of water from hillside and tributary valleys, but is the slowly rising, long continued outpour of the drainage of a vast region.

With the occurrence of certain meteorological conditions the river basins of the United States from the Atlantic to the Pacific and from the Gulf to the Great Lakes have received in the past and will again receive great volumes of rainfall. The resulting volumes of water must pass to the sea and the river systems are their highways. Periods of high water on our rivers may therefore be expected so long as the law of gravity is in force.

However, the destructive effects of these tremendous overflows, which now devastate large areas where suitable control works have not been provided, can generally be prevented or greatly reduced by the construction and operation of carefully designed flood control.

The execution of a nation-wide flood-

control program could only be handled by the Federal Government. Floods are no respecters of State sovereignty, and State pacts and agreements would be necessary to forward the efforts of the Federal agency. With the establishment of whatever local co-operation may be required by law, actual construction could begin. This would undoubtedly call into play all methods of flood control which have proved themselves effective and economical.

Of the four methods of controlling floods, the construction of levees is the most direct and surest method. The flood elevations to be protected against are reasonably well known, the levees necessary to afford the needed protection can be designed and estimated for with reasonable accuracy, and the remedy is applied where the trouble occurs.

Reservoirs constructed at localities distant from areas damaged by floods are not so determinate as to effects, and the benefits of reservoirs become smaller and smaller as distances from the reservoir sites increase. As a consequence, a dollar spent for levee construction is more likely to be a dollar well spent than a dollar spent for other methods of flood control.

On account of the space necessary for levee construction, thickly populated localities are likely to desire distant protection by reservoirs because of the expense of levee rights-of-way as well as the inconveniences of levees or flood walls to business and other human activities.

However, both levees and reservoirs afford protection to human lives as well as protection to lands affording a means of livelihood. Both of these methods, as well as channel enlargements and diversions, would have place in a comprehensive flood-control program.

The effects of reforestation and improved land use upon the control of floods have not as yet been proved. Their influence would come to bear gradually over a long period of time. The benefits of such measures from the standpoint of conservation of important natural resources are unquestioned and any incidental benefits they may effect in the improvement of flood conditions of the Nation's watersheds will be useful as an additional factor of safety. However, such measures cannot take the place of direct control of flood waters by engineering structures.

The most important thing necessary to accomplish flood control is to have an able executive agency in charge of the works throughout the United States. Any distribution of responsibility and control among a number of commission authorities will simply result in waste, extravagance and failure of accomplishment.

How much will a nation-wide flood-

control program cost and how many rivers are involved?

The army engineers have for many years been engaged in a study of the flood problem of the rivers of the United States and, upon authorization by Congress, have formulated flood-control plans of all of the principal rivers in conjunction with plans for their most suitable development for navigation, the development of hydro-electric power and the needs of irrigation.

These comprehensive investigations cover more than 200 rivers. As a result of these studies it is possible to prepare basic plans and detailed projects looking to the preparation of a comprehensive nation-wide flood-control program.

The construction of such a program would be a vast undertaking, and estimates of total cost must necessarily be approximate and such a program would extend over a considerable period of time with changing conditions. It is believed,

however, that a general program of flood control may be estimated to cost about \$3,000,000,000.

Not all of the projects, which aggregate such a total cost, are now economically justified. Probably about 50 per cent of these approach economic justification at this time or involve the lives and social security of the people and the general welfare. Future consideration can be given to additional works when the growth of population, cities, towns and industry and the need for more agricultural land indicate them to be of economic and social value.

A general program of this kind would involve all the great rivers of the country and many smaller ones. Among these may be included rivers of the Northeast

engineering division of the United States Army, and shows a complete flood-control project for the entire country. The legend drawn as part of the map is self-explanatory

such as the Merrimack, Connecticut and Susquehanna, and many others; with rivers of the Southeastern slope such as the Potomac, James, Roanoke, Tar, Cape Fear, Yadkin-Peedee, Savannah and Altamaha. Such a program would also include the rivers which flow to the Gulf of Mexico such as the Apalachicola, the Alabama system and the Trinity, Brazos and Colorado of Texas.

The present project on the Mississippi would be pushed to completion as authorized by law and a comprehensive system for the Ohio River Basin would be a prominent feature. The other great tributary basins of the Mississippi such as the Red, the Arkansas, the White, the Yazoo, the St. Francis, the Illinois and the Missouri would be included.

The numerous streams of the Pacific slope, in many cases, have serious flood problems. Among these are the Santa Ana, Los Angeles and Sacramento-San Joaquin in California and the Willamette, Columbia, Puyallup and Skagit of the Pacific Northwest.

The magnitude of a nation-wide flood-control program is indicated when it is considered that the building of the levees, which now protect from overflow the great Mississippi Valley, required more than twice the amount of earth excavated from the Panama Canal. The water which the Ohio River discharged into the Mississippi in a day at its crest during the recent flood would fill four storage reservoirs each the size of the District of Columbia to a depth of twenty feet each.

WHO would carry out a nation-wide flood-control program? The army engineer organization has developed through more than a century, in which period it has principally been engaged in the study and execution of river and harbor improvements, and the plans which have formed the basis for all programs of watershed improvement heretofore set up have largely been extracted from the reports which the army engineers have made known as "308 surveys."

This organization covers the entire United States. The country has been divided into ten engineer divisions, which in turn are subdivided into forty-two engineer districts within the continental limits of the United States and three territorial engineer districts.

These districts, distributed from Jacksonville to Seattle and from Boston to Los Angeles, are decentralized, self-contained administrative units, all responsible through the division offices to a single administrative authority, the chief of engineers. The sizes of the individual districts are limited so that excessive overhead may be avoided and the maximum efficiency may be obtained. The districts themselves are divided into areas in which the actual work is carried on.

During the years of the depression the

army engineers were frequently called upon to undertake public works upon very short notice so that employment could be afforded to thousands of people in need of work. The organization proved adaptable and the emergencies were met.

In the past the construction of the Panama Canal and the enormous requirements of World War service amply demonstrated the possibilities of expansion which this organization was capable without losing effectiveness and economy.

CAN the great rivers of the Nation which annually overflow their banks, bringing waste and desolation to millions of acres of farmland, be brought within their meandering banks and be made to stay there?

It is not generally economical and in many cases it is not necessary to reduce flood flows of the rivers so as to hold them within their banks. To accomplish this would require a vast outlay of money and, in a number of cases, it is not physically possible.

Results of great practical value can be achieved by the protection of cities and towns where concentration of population and property intensify the flood hazard. In almost all cases the protection of cities and towns will necessitate levees and flood walls, supplemented in some cases by other protective works.

In addition, large areas containing important agricultural lands, manufacturing districts and railroad and highway systems may be relieved from damaging flood stages by suitable combinations of control works such as storage reservoirs and channel improvements.

On the other hand, over long reaches of river there are thousands of acres of farmland, woodland and swamp where even frequent overflows do little if any harm and where floods may be reckoned with other acts of God such as wind, frost and hail. In many cases the more frequent overflows do not occur during crop seasons and little damage is caused. For such areas it is not economically feasible at this time to provide protection by confining flood waters or reducing their height to bank-full capacity.

When the development of the Nation reaches a point where more complete flood control for all areas appears economical and necessary, such additional control can be provided.

HOW long would it take to put such a plan into effective operation? The development and execution of a comprehensive flood-control program can easily be accomplished by the plans which the army engineers have already set up.

At present it does not appear to be urgent to initiate flood-control plans everywhere in the United States. The army engineers have prepared a complete plan for the Ohio Basin, including necessary modifications of the Mississippi plan to further insure its safety.

The progress toward execution of such a plan would depend largely upon how funds were made available by Congress.