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SOIL CONSERVATION AND FLOOD CONTROL

by

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Gentlemen, I wish in the beginning to congratulate the Connecticut Engineering Congress for doing something that most people forget to do. This Congress has had the foresight to undertake preparation for the future by remembering the past. I refer to the disastrous floods which like other national tragedies, are all too quickly forgotten. Public attention is duly focused upon these disasters while they are taking place, and everyone agrees at the time that something should be done to prevent their recurrence; but with the passing of time, only a few months as a rule, our remembrance usually fades.

This Congress should be proud of the fact that it has not forgotten. In July it has not forgotten the tragic floods of March and April. It has set science and intelligent thought to prepare for the future--the Marchs and Aprils of 1937, 1938, 1940 and 1950--when in all probability we shall again meet the flood problem. Your Congress has recognized that an ounce of prevention is worth a pound of cure; that a permanent, constructive and complete program of flood control, functioning the year 'round, is eminently preferable to emergency programs for aid to flood victims.

Six months have gone by since floods were raging in the valleys of the Connecticut, Ohio and other rivers of northeastern United States. In that brief time many have forgotten the dreadful consequences of those scourges. Yet this year has been different from others. More people have remembered. More people are determined to do something about the problem. The engineers, as usual, are in the forefront, and calmly, scientifically, they are turning their best energies to a sound practical solution.

That is why I am here. It is my purpose to offer to this important segment of the engineering profession the support and cooperation of the agriculturist.

Recently there appears to have been some misunderstanding of this offer. Some have construed it as a criticism of the flood control engineer, or as an alternative to his work. Nothing could be more inaccurate. No one, I am sure, is more firmly convinced of the effectiveness of the work done by engineers along our great trunk streams than I am. No one is more firmly convinced that this engineering work must be continued, perhaps expanded.

For such work--the planning and construction of levees, reservoirs, revetments and spillways--there is no substitute. But there _can_ be reinforcements.

1. Address before the Connecticut Engineering Congress, Bridgeport, Conn., July 25, 1936.

Let me say a few words at this point in reference to our American habits of waste. The forces which drove our pioneering forbears westward in history's greatest march of agricultural occupation, gave rise to a misconception of the extent and durability of the land and other natural resources of this continent. It would be useless to dwell at length upon those earlier misconceptions with respect to the permanency of our soil, our streams, our forests and wildlife--misconceptions that have cost us much. Probably no nation or race has been so negligent and wasteful of its land. Civilizations have disappeared because the same kind of mistakes were made on the land during thousands of years. But think of the short time it has taken us to ruin 50,000,000 acres, seriously damage another 50,000,000 acres, strip the soil or most of it from 100,000,000 acres more and get the process of wastage under way on still an additional 100,000,000 acres! Think of the result of this wastage--of the tens of thousands of farmers reduced to the lowly level of bankrupt farming on land hopelessly impoverished by erosion! What has happened to Oklahoma is appalling: A new State with 13 million acres of its 16 million in cultivation already suffering seriously from erosion, half of it having reached the stage of gullying.

Think how quickly we slaughtered for their hides the millions of buffalo that formerly roamed the plains, and the very short time it took us to strip off the grass which for countless centuries had supported those roaming herds without serious damage to the land! I am sure we are not likely soon to forget the dust storms that have carried rich soil from the plains country at the heart of the nation to the Atlantic Ocean, then to the Gulf of Mexico, and again to the Pacific Ocean, according to the direction of the wind; nor are we likely to forget that it was our failure to safeguard the land against the winds that gave birth in this country to the same type of dust phenomena common to the regions bordering the Sahara.

Waste has characterized the use of most of our natural resources. The last passenger pigeon on the globe died in a Cincinnati zoo in September, 1914. I am sure that some of us here have heard our fathers say that in their time the very skies were dark with the flights of this beautiful bird. Specialists say that this species was one of the most abundant game birds ever known in any country. Within a few generations we have effaced the legions of this species from the earth, and should man dwell upon the earth millions of years he would never behold another passenger pigeon.

In this manner we have exhausted and continue to exhaust irreplaceable resources. The soil is one of these. When it passes out to sea--and more than a half billion tons enter the oceans every year--it is lost forever. Even that which washes no farther than from the upper to the lower side of a field is essentially lost, since under our American system it is not likely to be hauled back. Soil reproduces from its parent materials so slowly--probably not faster than an inch in 400 to 1,000 years--that we may as well accept as a fact that once the surface layer is washed off, land so affected is generally in a condition of permanent impoverishment.

In somewhat similar manner we have wasted and misused our water resources. That is really what I am to discuss tonight, although I shall proceed somewhat indirectly, or more along the line of discussing water control.

For some time, I have entertained and expressed rather definite views about flood control. I know that you, as engineers, have rather definite ideas of your own. On some points you may not agree with me; and I in turn, may disagree with some of your premises. Such disagreements, however, seem to me to be minor matters today. The very fact that you have set aside a portion of your time at this meeting for a discussion of soil erosion control in its relation to flood control, indicates that we are rapidly getting together. When we do, I am confident that we shall all be a great deal nearer to a permanent solution of the flood control problem.

Until a few months ago, the approach to that solution had been highly specialized. The whole difficult problem of flood control had been regarded as strictly an engineering problem, and as such had been turned over to the engineering profession. That was logical enough, for flood control had been regarded almost entirely as a matter involving the construction of downstream levees, dams, revetments and spillways. Within the limitations of available funds, the profession has met the responsibility thus placed upon it and has harnessed the channelways of a number of major streams with a marked degree of success.

But now, it seems to me that the flood control picture is changing. We in the field of soil conservation and erosion control feel that we have a very definite and important contribution to make to the control of floods. By that I do not mean that we have a conflicting or alternative program. What we do have to offer is an enlargement upon the existing program of the engineer.

I repeat that the importance of the engineer in the field of flood control and the value of his work are beyond question. This nation cannot afford to curtail construction or hamper the progressive design of engineering works for flood control. Such works are essential.

There are, however, several questions in my mind. Are engineering works alone sufficient from the standpoint of maximum effectiveness? I do not think so. It is true that downstream fortifications such as levees, spillways, and revetments meet the problem of flood waters at the point of greatest danger, where bulging rivers leave their banks to devastate lands, crops and property. But what about the point of origin of flood waters and accompanying loads of silt? I can't believe that we should wait until our rivers have become clogged with erosional debris and subjected to increased torrents pouring in from soil-stripped, gullied uplands before we begin to cope with floods on a basis of complete watershed treatment. I am convinced that from now on we should, and will, tackle the problem at its source--in upland fields and pastures and on other sloping parts of watersheds, where flood waters begin to accumulate and where silt loads are picked up.

I am proposing, gentlemen, a union of the engineer and the agriculturist in the war on floods. There is evidence to indicate that such a union would carry on closer to a solution of the problem, because then we would be dealing with the beginning, as well as the climax, of floods.

In the relatively few years since the country began to consider soil erosion a matter of major concern, there has been accumulated a large amount of data clearly pointing to the efficiency of improved agricultural methods and to wise land use in decreasing the volume and velocity of water poured into our trunk streams by their tributaries.

After all, floods are simply raindrops, infinitely multiplied and concentrated quickly in a single channel. If we can force this water, or any considerable part of it, to move slowly and evenly into the channels, it seems reasonable to believe that we shall have accomplished more toward the control of floods.

It so happens that the same agricultural practices leading to soil conservation and erosion control also apply to upstream flood control, and when the conservationist slows down the runoff of rainwater in order to halt erosion, he is also reducing the volume and velocity of water which might otherwise contribute to floods. At the same time, he is keeping the soil on the land where it belongs, and keeping it out of the streams where it serves to reduce the water-carrying capacity of the channels.

Thus, erosion control and upstream flood control are practically synonymous. You cannot control erosion in any far-reaching degree, it seems to me, without some incidental control of floods, and by the same token, unrestrained erosion cannot but contribute to the hazard of floods.

The conservationist utilizes both vegetative and engineering practices to retard the runoff of rainwater and to hold the productive and absorbent layer of topsoil in place against the wash of rain and the drifting of wind. Without stabilization of this absorbent surface layer, land sheds water at an astonishingly accelerated rate. We must remember that except for the oceans, there is no reservoir so vast and effective as absorptive soil. It is this great reservoir that the conservationist proposes to protect and utilize in his contribution to flood control.

Let me illustrate. When a pitcher of water is spilled on the surface of a tilted wooden table, the water rushes off immediately and forms a puddle on the floor. But what happens when the hard wooden table is covered with a blotter and then a heavy Turkish towel? Most of the water is absorbed; the excess is impeded and spread in its downward flow by the nap of the towel. The same principle applies to the land. When it is bare, the raindrops falling on it rush off into the nearest stream or river, just as the water rushed off the tilted table onto the floor. When the land is covered with rich absorptive topsoil, made porous by the hidden conduits of burrowing earthworms, insects and the roots of plants, as well as the natural granularity of such soil, you have a blotter for rain. And vegetation, like the nap of the towel, forms countless tiny impediments to the downhill flow of any excess rainwater which the soil is unable to absorb. Even before erosion has proceeded to a point where the subsoil has actually been exposed, vegetation and vegetative litter, functioning as a screen, serve to keep open the multitude of passageways into the soil by preventing their clogging with eroded material carried in suspension. This is true not only of forested areas whose surface is blanketed

with leaf litter, but of thickly grassed areas and land covered with other forms of dense vegetation.

Let me be more specific: When a drop of rain strikes ground that is covered with a dense blanket of vegetation, it breaks into a spray of clear water which slowly finds its way into the numberless channels that perforate the soil, but when a raindrop strikes bare soil, the force of impact causes fine soil particles to be taken into suspension, and it becomes a drop of muddy water.

As this muddy water attempts to sink into the soil, the fine particles tend to filter out at or near the surface, to form a thin, muddy film which chokes the pores of the soil. The result is that only a part of the water can percolate into the substrata. The other part flows over the surface--downhill.

That is the story of one raindrop falling on bare ground. Multiply that single drop several billion times and you have accumulated a superficial flow of filmy, soil-filled water. Little streamlets are formed and they enlarge. The velocity of the flow rapidly accelerates and erosive power is generated and progressively augmented. Soon rampant waters from torrential downpours are tearing away the surface soil from unprotected slopes and piling up in natural depressions and erosion-made gullies. From these gullies and natural lines of concentrated flow, water is discharged, as from gutters, into little streams, and so, with the swelling contents of numerous confluents, is poured with maximum speed eventually into the channels of major streams.

Picture an entire watershed with its central stream and numerous tributaries and sub-tributaries, and you picture the place of erosion control in flood control. Much of the land enclosing such a ramifying drainage system is in cultivation. If you study this land and find out how it is cultivated, or how it is used if it isn't cultivated, you will thus ascertain how much of it is subject to erosion, to what extent it is contributing to the flood hazard and to what degree this hazard can be reduced through practical erosion-control operations.

If you find bare, non-porous, unabsorptive soil without humus, or stiff "raw" subsoil, you find land that sheds water swiftly and helps in times of heavy precipitation to raise already swollen streams to raging flood-stages.

If you find porous, absorptive, humus-filled topsoil protected by a cover of vegetation, or, if cultivated, stabilized by strips of protective vegetation or a system of terraces and contour tillage, you find land that is absorbing rainwater and discharging smaller quantities of it into the streams.

Disastrous floods are not necessarily caused by excessive precipitation alone, they are not confined to regions of greatest rainfall. In parts of the Hawaiian Islands and Burma, where the total annual fall of water exceeds a depth of 600 inches, or 50 feet, floods, as we know floods, do not occur.

Dr. W. C. Lowdermilk, Associate Chief of the Soil Conservation Service, writing in the Journal of Forestry, in 1924, on "Erosion and Floods in the Yellow River Watershed," of China, pointed out that the flood problem in that country is most acute where the least rain falls. He wrote:

> "The greatest flood damage does not occur in the region of greatest rainfall but in the region of least rainfall in China. Factors other than the volume of water are responsible for the flooding. The floods of North China are intimately related to the erosion and the extensive loess deposits. The building of dykes alone is not sufficient to bring about a lasting solution to the control of floods . . . . Something must be done to reduce the widespread erosion in the loess uplands along with dyke construction in the planning of deposition."

The case in China is not an exact parallel of the case in the United States, but it certainly makes a significant point. That point is that upstream flood control cannot be overlooked in considering the answer to the flood problem of this country. For most nearly complete control we must direct our attentions not only to downstream construction, but to entire watershed areas, from the crest of the last ridge drained by the smallest tributary all the way down to the fields bordering the great trunk streams. In other words, we must utilize the great reservoir of the soil.

I want to take a few minutes now to point out some definite evidence in support of my contention that erosion control can make a major contribution to flood control.

At the erosion experiment station at Tyler, Texas, in a region of gentle slopes with an annual rainfall of 40 inches, clearing and cultivating the land increased the runoff 35 times and the soil losses 800 times on poorly managed land. Even on the better managed soils, the run-off was increased 25 times and the soil losses 180 times.

At Bethany, Missouri, the run-off from fallow land typical of the southern portion of the corn belt, was 7 times that from land covered with alfalfa, and the soil loss was 300 times as much.

Only $6\frac{1}{4}$ percent of the total annual rainfall was lost as surface run-off from land under native grass sod in the Appalachian hill section at Zanesville, Ohio. Fallow land in this area, however, shed 42 percent of the rainfall. Under continuous corn 33 percent of the rainfall was lost as surface run-off.

Thus, from the findings at Zanesville, we obtain significant data on soil losses under three different types of cover. At rates I have just given, native grass sod would protect the underlying soil so well that it would require about 5,300 years for erosion to remove 6 inches of soil, which is about the average depth of the topsoil of that region. Under continuous corn 31 years would be required for the top 6 inches to be washed away; and fallow land, of exactly the same slope and soil type, would lose its upper 6 inches of topsoil in the brief space of 33 years.

Measurements, made at the Guthrie, Oklahoma, Erosion Station on Vernon fine sandy loam--the most extensive, most important and most erosive soil of the 36 million acres embraced in the Red Plains Region--show that on the average, over a period of five years, the run-off from land cultivated continuously to cotton, on slopes of about 8 percent, has been 110 times greater than that from the same kind of land covered with ungrazed Bermuda grass, and that the soil loss has been 9,330 times greater. From unburned, ungrazed forest land 77 times less water has been lost than from cotton and 1,600 times less soil. From an area covered with native grasses, chiefly bluestem, there has been no run-off, and, of course, no soil loss, for two years.

It is interesting to note that these rates of soil losses indicate that to wash off the entire 7 inches of topsoil down to the poor clay subsoil characteristic of the lands of this locality, 46 years would be required where cotton is grown continuously, 198 years where a 3-year rotation is practiced, 3,000 years where Bermuda grass is grazed, 6,000 years where the native forest is burned over every year, 73,000 years where the cover is undisturbed forest, 300,000 years where it is undisturbed Bermuda grass, and infinity where it is native grass.

These indicated long periods of time required for removal of the topsoil really mean, in all probability, that soil is being built from beneath about as fast as it is removed from the surface, or, in other words, that a balanced or stabilized soil condition is maintained under

natural conditions of vegetation. Of course, we can not grow our cotton and corn in the woods or harvest our wheat from the unbroken sward of the prairies and plains. However, we can and should turn millions of acres of the steeper and more erodible slopes now devoted to these intensely cultivated crops to permanent grass, to legumes, shrub or forest.

Results similar to those obtained in Oklahoma have been secured at the Clarinda, Iowa, Experiment Station, where the loss of rainwater and melting snow from land planted continuously to corn has averaged 25 percent of the total precipitation over a period of 5 years. The maximum loss from a single intensive rain amounted to 85 percent of the precipitation. At the same station, however, where the same kind of land was seeded to bluegrass, the corresponding losses have been only 2 percent of all rains and 14 percent from a single maximum rain. It is also interesting to note that at the same station 100 percent of the precipitation from a single torrential rain ran off a corn field having a slope of somewhat greater length than the other fields referred to.

In further reference to maximum rains, it is well to observe that summaries of water losses from all storms, both heavy and light, may be deceptive in the accurate consideration of possible flood flows. To obtain a more exact picture, it is necessary to study the effects of various types and densities of land cover on runoff from individual storms of high intensity. During the past five years much data of this type have been collected at the erosion experiment stations of the Soil Conservation Service, located in various distinct agricultural regions of the country.

For example, on May 8 of this year, the most intensive rain on record fell at the experiment station near Tyler, Texas, with a total precipitation of 5.13 inches. From an area of grass sod, on a 16.5 percent slope, only .35 of one percent of the precipitation ran off, and no soil was lost. From an adjacent field of exactly the same kind of soil, occupying the same slope, but devoted to cotton, the water loss was 31 percent of the precipitation, or nearly a hundred times as great, and the soil loss was 63 tons per acre, as compared with a loss from the grassed field so small it could not be measured. From a fallow plot, on a 8.75 percent slope, 35 percent of the rainfall was lost in runoff, and soil was washed away at the rate of 44 tons per acre. A forest plot with a 12.5 percent slope, lost only 0.86 of one percent of the rain in runoff and the soil loss was almost negligible, washing at the rate of 0.01 tons per acre, or 20 pounds per acre. Similar large reductions result from terracing, contouring, strip cropping and other protective measures of land treatment.

You will be interested, I believe, in a recent report by Dr. F. B. Howe, of Cornell University, on the relationship between erosion and floods in New York State. Studies carried on near Ithaca, according to Dr. Howe, showed that a single acre of corn land lost as run-off 127,000 gallons, or 6.37 inches, more water during one growing season than an acre of comparable meadow land on another part of the same slope.

In an imaginary watershed of one million acres, planted entirely to corn, land of the same kind would, with the same precipitation, pour 134 billion gallons of water into drainage channels during the growing

season. Run-off from the same area in meadow, would amount to only 7 billion gallons.

Other measurements at the Ithaca erosion experiment station during the period from March 1 to 19, 1936, or just preceding the 1936 flood on the watershed of one of the upper tributaries of the Susquehanna River, are equally indicative of the effectiveness of vegetation in controlling run-off. Water losses from two potato fields amounted to 75 and 82 percent of the precipitation, respectively, on land having a slope of 14 percent. Of 9.47 inches of rain and snow, 7.1 and 7.85 inches, respectively, were lost as run-off during this critical period. In contrast, the corresponding losses from neighboring forested areas, with a gradient of 27 percent, were less than 0.5 percent of the precipitation. The soil beneath the forest litter was not frozen; the ground conduits were still open. The soil of the potato fields was frozen.

Flood levels seem to be rising along numerous streams. Nine years ago the Mississippi rose out of its banks in the wildest rampage of which we have any record. Water rose to 45.8 feet on the gauge at Memphis--the highest mark ever registered there. The preceding highwater mark registered on the same gauge was 43.4 feet in 1916. Before that, the highest reading was 35.6 feet, back in 1890. (Floods in the United States, p. 320, Water-Supply Paper No. 771, U. S. Geological Survey, 1936.) Mississippi flood levels are rising, it appears, in spite of all we have done along that stream to hold floods in check. New records of flood heights were established along many waterways this year. Levees were thrown up over night at Washington in March in order to protect Government buildings, and they performed the service asked of them. Pittsburgh and other cities were less fortunate; levees couldn't be built in time.

Summarizing, there is a startling gap between the amount of run-off from small areas under natural vegetation and similar areas under cultivation. We have much to learn as to how applicable these computations are to the flood flows into trunk streams. Certainly our information to date commands us to investigate further. It dictates a scientifically coordinated attack, involving the services of the engineer, the agronomist, forester, economist, and soil technologist. By the same token, the very importance of the problem requires the whole-hearted cooperative participation of Federal, State and local governments, as well as private agencies, technical societies, universities and individuals.

In view of the small loss of rainwater from land having a good vegetative cover, together with the greatly reduced water losses where cropping practices are supported by protective strips of vegetation and by other adaptable control measures, including the retirement of the highly erodible associated lands to permanent cover, I am convinced that we can largely reduce flood hazards on numerous streams. What has already taken place on some streams where the greater part of the watershed was treated by adaptable erosion-control measures, together with the information collected from the erosion experiment stations, leads me to believe that it will be entirely practicable to reduce the peak of floods along numerous streams by as much as 15 to 20 percent and along some streams by as much as 25 percent, or possibly more. This, of course, can not be done over night. I simply make reference to what seems to be the practical possibilities

of a long-time program carried out on a thoroughly coordinated and cooperative basis by the various specialists having anything to contribute to a properly balanced flood-control program.

This is the kind of program now in operation by the Soil Conservation Service on many millions of acres scattered through various distinct agricultural regions in 41 states. Briefly, this program is a coordinated one, which calls for the use and treatment of the many different kinds of land, subject to various rainfall intensities, in accordance with the specific needs and adaptabilities of these diverse lands, making use of all practical measures of control and prevention that we know about.

This type of land treatment has already resulted not only in a large reduction of flood heights on a number of streams, but in reviving summer flow in some streams that have been dry at this season for more than a decade. To give an example: During the severe flood of June, 1935, at Stillwater, Oklahoma, both Stillwater and Council Creeks ran high over their banks and flood-plains, while West Brushy Creek in between did not top its banks at all. All three of these closely associated streams are of the same type, draining the same class of lands and being used for the same type of agriculture. The rainfall was practically the same over the three watersheds. Stillwater Creek has been treated by erosion-control measures to the extent of about 15 percent of its watershed, Council Creek had received no treatment, but the watershed of West Brushy Creek had been treated with a coordinated erosion-control program over 90 percent of its area.

Before finally turning from the results of the Red Plains erosion station let me point to one other very pertinent finding. The measurements already referred to related to the topsoil, not to subsoil, such as has been exposed over some millions of acres in Oklahoma since the beginning of large-scale agriculture in that State, following its opening to settlement in 1889. It has been shown at this station that under cotton cultivation the run-off from erosion-exposed stiff, red clay subsoil averages practically twice the run-off from the mellow, absorptive topsoil, or 29.5 percent of the total precipitation from subsoil, as against 15.3 percent from topsoil. The corresponding soil loss--subsoil loss rather--has been at a rate 25 percent greater than from the area still retaining a layer of topsoil.

In other words, erosion speeds up as the soil is stripped off. The subsoil washes faster than the surface soil and loses more of the rainfall. This fact, considered in connection with the enormous lead erosion, has taken ahead of our combat operations, and also in relation to a probable loss of about 15 to 35 percent of annual precipitation as immediate run-off from sloping cultivated and overgrazed lands, according to condition of soil, degree of slope, type of agriculture, etc., and a further additional loss of moisture by evaporation and transpiration amounting to probably 20 to 35 percent or more of the precipitation, should stimulate all of us, I think, to the realization that we have a great battle ahead of us--a fight that challenges our imagination and our spirit for action. It is a combat, gentlemen, which we shall probably have to engage in whether we wish to or not, that is, if we are to conserve our indispensable farm lands and to control the waters that fall on these lands and associated lands.

I feel that nothing is to be gained by an endless presentation of our respective theories. I believe we understand here that agriculture is not proposing a substitute for flood-water fortifications downstream. On the other hand, agriculture is offering a multitude of reinforcements upstream on the land where floods begin. The immediate task ahead is to agree upon a simple procedure of cooperation and coordination, whereby the engineer and agriculturist will be working and thinking along the same lines and for a common purpose. When such a procedure is mutually established, I am convinced that we shall then be moving in the right direction.

It was only a little more than a month ago that the President approved an Act of Congress which officially recognized, for the first time, the place of erosion control in flood-control work. As far as the Federal Government is concerned, the engineer and the agriculturist have joined forces.

I would like to quote a part of that Flood Control Act. Section 2 reads in part:

"..... hereafter, Federal investigations and improvements of rivers and other waterways for flood control and allied purposes shall be under the jurisdiction of and shall be prosecuted by the War Department under the direction of the Secretary of War and supervision of the Chief of Engineers, and Federal investigations of watersheds and measures for run-off and waterflow retardation and soil erosion prevention on watersheds shall be under the jurisdiction of and shall be prosecuted by the Department of Agriculture under the direction of the Secretary of Agriculture....."

The same Act also states: "..... that it is the sense of Congress that flood control on navigable waters or their tributaries is a proper activity of the Federal Government in cooperation with States, their political subdivisions, and localities thereof; that investigations and improvements of rivers and other waterways, <u>including watersheds thereof</u>, for flood control purposes are in the interest of the general welfare; that the Federal Government should improve or participate in the improvement of navigable waters or their tributaries, <u>including watersheds thereof</u>, for flood control purposes....."

There is a historic significance in this Act, for it is the first time, to my knowledge, that the part of the agriculturist in flood control has been officially and definitely recognized by this Government. It is, however, in keeping with the general tenor of the times. More and more thought is being given to the role of erosion control in the solution of flood control. Without diminishing the importance of construction work on the major trunk streams, the merit of expanding flood control activity to the "Little Waters" of the nation is taking on increased stature.

Some people are inclined to scoff at the importance of watershed improvement and investigation. They question the statement that the denudation of land contributes in any considerable degree to floods. They hurry to point out that this country experienced floods long before the axe and plow were known to America; and that when DeSoto first saw the Mississippi, it was in flood.

I agree in part. The flood record is plain. We have always had floods, and until some cataclysmic change upsets our existing regime of climate, I don't doubt but that we always shall have them. Geologists will tell you that the whole mass of material forming the alluvial plain of the Mississippi was deposited and spread out by floodwaters through a process of slow land development--sedimentation--which had its beginning millions of years before DeSoto discovered the river.

The meanderings of the Mississippi through its self-built plain since infinitely ancient time is recorded in the geological characteristics of this alluvial material. The records show beyond any question that there have always been floods along this mighty stream, as along every other stream bordered with an alluvial plain. But the records show considerable more than that.

Overlying the old alluvial soils of numerous streams throughout the United States--the material laid down by timeless floods--is a different kind of alluvium. It consists of sediments spread out by floodwaters since the beginning of our agriculture--since the axe and the plow were introduced to America. These sediments reveal unmistakable proof that, generally, they were spread over the flood plains by waters much more violent than those which laid down the vastly older material beneath.

There is a marked difference between the old and the new material. The finer texture and more uniform composition of the pre-agricultural deposits show that they were developed under conditions of moderate overflow. This is not true of the newer deposits. In many instances, the depth of the new material is greater than the entire depth of the deposits lying underneath, even though the former was accumulated in many places within 25 to 75 years, whereas the buried material probably required tens of thousands of years for its deposition. Generally, the deposits of the agricultural stage are not only coarser in texture, but far more diverse with respect to textural composition and color characteristics through the profile and over the surface. The line of separation between the two types of alluvium--the pre-agricultural and the agricultural--is so sharp that it is usually possible to photograph it without any difficulty.

Today the Bureau of Chemistry and Soils of the U. S. Department of Agriculture is mapping a number of new alluvial soils entirely different in character from those of pioneer days. We have the history of these soils and know definitely that they have been formed since the agricultural occupation of this country. There is also ample proof that these later deposits were laid down by more violently flowing waters than those of former times.

And then, of course, floods are gradually climbing to higher levels. Records were broken last year along various streams and again this year on others. The ascending marks on the Mississippi River gauge at Memphis are significant, I think.

I am mentioning these matters simply to reassure those who are skeptical of some of the things our soil conservationists are saying. We are not separating ourselves from careful, technical investigations of the premises upon which we base our convictions, our plans, and our earnest desire to be understood, to help and to be helped.

On September 22 and 23, in Washington, the problems of upstream engineering in relation to flood control and land conservation will be discussed at a conference of representatives from the United States and foreign countries.

This Conference, I believe, will add to our general knowledge and understanding of the many problems and methods associated with the more comprehensive attack on floods. As a member of the organizing Committee, I extend to all of you the most cordial invitation to this Washington Conference on Upstream Engineering.

In this connection, you may be interested in a letter from the President which the Secretary of Agriculture made public in announcing the Conference. It sums up the need for coordinating land use principles with the existing knowledge of downstream engineering methods in Federal planning for flood control and land conservation.

The President's letter, dated June 16, of this year, follows:

"My dear Secretary Wallace:

Up-stream engineering will have a major part in efforts to save the land and control floods, and for that reason it offers a broad field of opportunity for the engineering profession. I am, therefore, in hearty accord with your suggestion that there be held an open conference on the subject in the early fall. The date might well be in proximity to that of the Third World Power Conference in September, in the hope that some of the distinguished foreign engineers attending the latter may be interested also in contributing to the proposed conference.

There are indications that a substantial body of technical information on the control of little waters is now available in the scattered records of American experience--Federal, State and professional. The urgent problem is to bring these data together into a coordinated body of engineering knowledge so that public officials and engineers may have a more definite picture of up-stream engineering as an important field of public and professional activity.

There is a wealth of experience and data as to down-stream engineering and works required for navigation, power development and flood control--levees, large dams, great reservoirs and channel improvements on major streams. But necessary as these are for the safeguarding of those who live in areas subject to destructive floods and of property located therein, it must be remembered that down-stream waters originate largely in up-stream areas. The objects of up-stream engineering are through forestry and land management to keep water out of our streams, to control its action once in the stream and generally to retard the journey of the raindrop to the sea. Thus the crests of down-stream floods are lowered.

In accordance with your further suggestion, I am appointing as a committee to organize and promote such a conference or institute; Hugh H. Bennett, Chief of the Soil Conservation Service, Department of Agriculture; Morris L. Cooke, Administrator of Rural Electrification Administration; and F. A. Silcox, Chief of the Forest Service, Department of Agriculture.

Very sincerely yours,

Franklin D. Roosevelt."

This conference should develop another forward step in the coordination of downstream engineering methods on the navigable waters with upstream control methods which may be prosecuted largely on the land. It is, in short, a step toward a more comprehensive attack on this great national problem and toward closer coordination of our best available resources.

We must start our attack at the point of cause and carry it through, step by step, to the point of effect. Flood control must begin at the crests of the ridges and extend down across the slopes to the stream, and then to the great trunk rivers that empty into the sea. All of the time, of course, our downstream operations must be vigorously prosecuted.

We must ally our forces to defend ourselves against erosion and floods, for they are also allies--allies in destruction.