

The foregoing conclusions have been arrived at only after careful consideration, and the question has been discussed at some length in view of possible future contention between the controlling bodies on the north and south sides of the river as to responsibility for damage by erosion.

It will be noted on the longitudinal profile of the new north branch of the river (plan No. 4) that the river-gradient rapidly flattens out below the top of Coutt's Island, and for the last five miles of its course is flowing through the flood-plain on what is technically known as the "base level of erosion." Where such a condition exists the future development of the river must inevitably consist in a gradual building-up of its bed on the flatter portion, and at the same time a corresponding "corrosion" or erosion of its bed in the steeper portion, thus tending to equalize the gradient down to the sea, and to do away with the somewhat sudden transition from a steep to a flat gradient between the top of Coutt's Island and the Empire Bridge. The river-channel is already too constricted near the Empire Bridge to permit of the passage of a big flood-discharge on such a flat gradient, and consequently the flood-waters are ponded up at this point and tend to overflow the flood-plain. Should shoaling or building-up of the river-bed in this vicinity increase, the conditions causing ponding of flood-waters would, of course, be aggravated.

In regard to the deposition of silt, it is no doubt certain that the enormous amount of north-bank erosion, referred to elsewhere as being about 15,000,000 cubic yards, has greatly assisted in the shoaling of the river as it exists at present, although a great portion of it, being very fine material, may have been carried out to sea.

Evidence goes to show that the toe of shingle deposit (not sand) in the river-bed, which formerly tailed out some distance above the Empire Bridge, now extends down below the bridge; also that the south branch from Templar's Island down has been building up its bed, until now it carries very little water as compared with the new north branch. It is also in evidence that the shingle has been accumulating in the new north branch during the past thirty-five years, and is now of considerable depth. As an explanation of this fact the general opinion has been expressed that a greater quantity of shingle is coming down the river from the higher reaches than formerly. In our opinion this conclusion may be a totally wrong interpretation of the facts. The movement of shingle—as distinct from sand—in the bed of a river depends wholly on the bottom velocity of the current, the shingle being either rolled and dragged along the bed or else lifted by vortex or eddy-action and carried a short distance down-stream, or until the force of gravity deposits it again on the bed. This bottom velocity increases—other things being equal—with the depth of water, so that it is mainly during freshes or floods that there is any tendency to disturb or transport any but the very lightest form of detritus. Under ordinary river conditions the transportation of shingle by freshes and floods is comparatively small; were it otherwise we should find a heavy shingle accretion deposited during falling floods right down to the river-outlet, instead of which we find in the present case no shingle deposit much below the Empire Bridge. An extension down-stream of either shingle or sand deposits may be due simply to the number of freshes or floods within a given period being much above the average number, or the normal number of floods may have been of greater intensity or of longer duration; any one of these three causes would extend the shingle-toe to some extent, and would also, probably, on the average, shift the whole surface bed of the river a little farther down-stream. On the other hand, it is possible for sand or small gravel to be disturbed and transported a greater distance with a much less bottom velocity of current; and no doubt the shoaling of the river referred to by witnesses is mainly due to this form of material, and not to shingle. In some respects the accretion of fine material forming sand and gravelly shoal-banks is worse than if formed of heavier shingle, since the former when exposed at low-water stages becomes a ready habitat for vegetation of all kinds, thus making the shoal-banks more stable and non-erosive by subsequent floods. We therefore consider that the present shoaling of the bed already referred to is not due to any excess of rock material thrown into the upper reaches of the river, and which might take a thousand or more years to work its way down to the lower reaches, but we are inclined to attribute any increased shoaling of the river-bed in the vicinity of Templar's and