Finally, there is the high probability of the original sea water being diluted by fresh water from rivers or melting ice. That this is quite likely is indicated by the presence in the clay of *Mytilus edulis,* which can withstand freshening of the water in which it lives. This species is frequently found living at the present time in large numbers far up estuaries that empty into the ocean along the coast of Maine.

ARTHUR S. KNOX

TUFTS COLLEGE

SOME OBSERVATIONS ON SLUMPING AND GULLY FORMATION

SOIL erosion and its prevention is an important problem to those interested in the conservation of our natural resources. In order to adequately solve the problem of soil erosion much information, obtained under various conditions, must be collected. Therefore, these observations are recorded as a contribution to the sum total of information already accumulated on this subject.

On the afternoon of Friday, October 9, 1936, in Muskingum County and neighboring portions of Ohio there occurred a severe rain-storm of the proportions of a cloudburst, which continued for perhaps one-half hour. After the torrent was over the rain continued to fall intermittently during the night. In the space of about 12 hours 4¼ inches of rain fell into a rain gauge just south of the village of New Concord, a large portion of which—perhaps as much as 3 inches—fell during the cloudburst.

On the campus of Muskingum College in New Concord there is a hill known as Flag Pole Hill which has been subject to severe slippage and gullying. The slipping was due to a clay layer about 11 feet above the Harlem coal and to another clay layer just below the coal. This hill had just been graded and manured in preparation for the planting of grass.

About one hour after the downpour the writer observed that a number of gullies had been formed by the run-off. When observations were first made a shallow gully with a funnel-shaped head 4½ feet across, narrowing to less than a foot, was observed. The head of the gully was just above the clay strata about 11 feet above the Harlem coal. In making the observations at this point the observer sank a foot or more into the mud. From time to time the water-soaked material above the head of the gully would slip into the gully and there mix with the water flowing in the gully. This material was of the consistency of a very viscous liquid, which could be seen to flow down the gully at the rate of a foot or less a minute. The advancing front of the sub-liquid mud measured at times an inch or two in height. Darkness terminated this observation, but early next morning the observations were continued.

During the night a slip 17 feet long had taken place on either side of the gully just described and at the level of the head of the gully. The slip had taken place when the soil and sub-soil above the clay had become saturated with water to the point that it could no longer hold together and slid down on the slippery clay strata. This slip extended 8 feet on one side and 9 feet on the other of the original gully. The material slipped down the hill for a distance of 3 feet and formed a terrace 2 feet high and 5 feet wide made up of soil and sub-soil which had slid down over the clay strata, which acted as a lubricant. Thus 170 cubic feet of material had moved 3 feet down the slope during and just after this one rain.

At the same level another smaller slip 26 feet in length had occurred but had moved down the hill only from 8 to 10 inches.

About 10 feet north of this large slip a large gully started about 13 feet below the top of the hill. From dimensions of a few inches it deepened and widened in the shaly sub-soil to 10 inches wide and 6 inches deep. On reaching the clay horizon it widened to as much as 22 inches and deepened to 8 inches or more. Several fall-like drops occurred in the bottom, as the water found more resistance in some layers than in others. At the level of the slip it widened to 4 feet, narrowing to about 30 inches in a distance of 5 feet, where it deepened to 18 inches. It has been calculated that this one gully alone has been formed by the moving of more than 60 cubic feet of material. This portion of the hillside can be classed as a "D" slope (more than 30 per cent.), from which most of the soil has been removed.

Other smaller gullies, 17 of which ranged upward to 7 inches in depth and 5 inches in width, were formed on this hillside during the few hours in which the water ran off during and immediately after the rain. These gullies were best developed in the clay below the outcrop of the Harlem coal. At one place where the hillside had been previously graded and was covered with a thick grass cover a slip 21 feet long had taken place on the clay just below the Harlem coal and slid 4 feet down the hill. The portion of the hillside in which this slip and the smaller gullies were developed can be classed as "C" slope (20 to 30 per cent.), from which most of the soil had been removed.

While the situation here described may not seem in itself important, yet when we consider that the erosion noted has taken place on a hillside having an area of less than one acre and during one rain the seriousness of the situation becomes evident.

ROBERT H. MITCHELL

MUSKINGUM COLLEGE