

brought down by the water, prevents the carriage of gravel and rock to the stream below, and prevents erosion.

Bracing Up a Stream Bed.

At other times when branches are not available barriers of faggots, sods and stone are constructed at frequent intervals across the bed of the stream, the purpose of which is to hold up the water, catch sediment and prevent the cutting of the stream bed or banks. The barriers are rendered permanent by planting with shrubs or with cuttings of such species as willow and alder, which strengthen the banks, protect the bed of the stream, and form a living network of branches and roots to hold back flood waters and their burden of earth and rock.

Those portions of streams in which a large volume of water is flowing, where the bed and banks are rapidly cutting, and where torrential characteristics have already developed, require more serious treatment. In such cases masonry walls are built with the object of impounding the products of erosion, checking the headlong flow of water, preventing the cutting down of the bed of the stream, supporting unstable banks. The bed banks and flow of the stream are carefully studied before work is begun, and walls and barrages, as they are called, are designed to meet the requirements of each particular case, both so that the masonry itself may meet the stresses to which it will be subject, and further that the detritus accumulated by the masonry will prove an indirect support to shifting banks and a valuable means of decreasing the grade and checking the speed of the stream. According to the gravity of conditions, the barrages vary from simple dry stone sills set across the bed of the stream a few feet apart to mortar-set stone walls three feet or more thick, fifteen feet high, crossing the stream from bank to bank set so close together that the top of one wall is level with the base of the next barrage above it.

Sometimes it has proven easier to pave stream bottoms, canalize the waterflow, or create new stream beds than to correct the torrent by barrages; where necessary this is done. Occasionally also the constant sliding in of stream banks crushes the strongest barrages. Draining is then resorted to on a large scale in order that the banks may be fixed.

Preventing Snowslides.

The prevention of avalanches and snowslides is also undertaken. Snowslides usually follow definite courses. Stone walls five to six feet high, two and a half feet thick, are built across the upper courses of dangerous snowslides beginning at the point where the avalanche usually takes its start and continuing down the slope in ranks to the point below which snowslides are unlikely to start. When stone walls are impracticable, the desired results are secured by low banks of loose rock or earth disposed in the same manner. When conditions permit of it, plantations of trees or shrubs are made under shelter of the walls or banks.

There have been very few torrents upon which work has been done by the French National Government upon which some or all of the above corrective works constructed up to 1909 exceeded the cost of reforestation on the same streams, being over \$6,560,000, including maintenance to the same date. The question of maintenance is a serious one. All the works require constant upkeep, and some have had to be rebuilt several times.

The opposition of the mountain population has been overcome in various ways, by employing them on the works by money grants for pasture improvement, and by subvention to creameries and co-operative dairy associations. The total amount of such expenditure is about \$35,000 chargeable to the fund for the correction of torrents.

The work which the French have undertaken, re-clothing the drainage basins and remodelling the beds of