Geomorphology

Watermills and meanders (*March 2008*)

The classic notion of a floodplain is that the streams responsible for it meander to create point bars, overbank muds and all the other paraphernalia of the fluvial sedimentologist. River authorities seeking to restore floodplains see the meandering stream as the ideal to aim for and as a means of natural flood amelioration. All this may turn out to be illusory following publication of a study on long-vanished human activities (Walter, R.C. & Merritts, D.J. 2008. Natural streams and the legacy of water-powered mills. *Science*, v. **319**, p. 299-304; DOI: 10.1126/science.1151716). By mapping and dating alluvial deposits along 1st to 3rd order streams in the north-eastern USA, in relation to milldams recorded on 19th century maps, Walter and Merritts of Franklin and Marshall College, Pennsylvania found that up to 5 metres of sediment had accumulated behind the dams from the 17th century up to the abandonment of watermills.

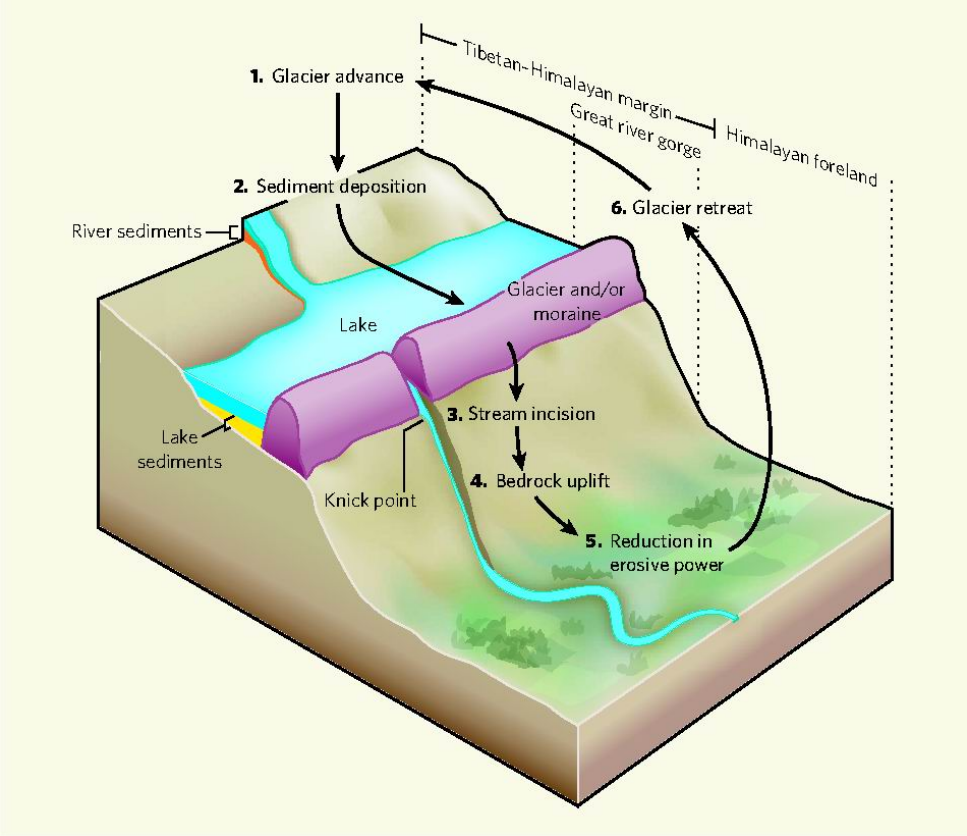
Their conclusion is that mill dams together with increased sediment load following deforestation for agriculture created valley flats on a vast scale – three counties in Pennsylvania had over a thousand mill dams. In places along the north-eastern Piedmont the density of water mills reaches as many as one per square kilometre, and the median density of around 1 per 10 km^2 involved more than 22 000 mills out of a total in 1840 of >65 000. Once the mills were abandoned, either because their dams had silted up or milling turned to larger facilities powered other energy sources, streams developed meanders that gradually incised the artificial flood plains. The situation now is that the small floodplains rarely flood, spates being unable to spill over the current bank height. Consequently, many of the low-order streams in major river catchments discharge floods quickly to the larger streams and rivers, which themselves burst their banks to cause floods with major social and economic consequences.

Walter and Merritts' findings are also based on their analysis of the kinds of sediment that accumulated before European colonisation. In most small valleys these indicate extensive forested wetlands with multiple small channels and drier islands. A major influence over this earlier state was the formation of logjams, and perhaps beaver lodges, that spread normal and spate flows. Slow steam flow carried less sediment than nowadays, and the older Holocene alluvial deposits are organic rich. In addition, stream flow, once directly connected to groundwater, has become disconnected thereby reducing both recharge and the flood balancing achieved by truly natural streams.

The whole of Europe had a history of milling around five times as long as that in the eastern USA, as well as higher population densities. In addition, urban mill dams for metal forging and textile manufacture were on a larger scale. The UK's National River Authority, Environment Agency and Phil Woolas, the Minister of State (Environment) need to read this study with care, as another flood season is almost certain in the summer of 2008 or the winter of 2008-9. As far as I can judge, it demands a reassessment of flood prevention 'best practice' in any populated humid-temperate landscape. Whatever, Walter and Merritts' study forces a new look at the European lowland and upland geomorphology used for teaching at all levels.

Does glaciation preserve the Tibetan plateau? (*November 2008*)

At first glance this section's title seems absurd, for glaciation has the highest potential for erosion that there is on Earth. Yet it seems that at the eastern edge of the Tibetan Plateau the long-term potential for river erosion has been impeded by glacial action (Korup, O. & Montgomery, D.R. 2008. Tibetan plateau river incision inhibited by glacial stabilisation of the Tsangpo gorge. *Nature*, v. **455**, p. 786-789; DOI: 10.1038/nature07322). The accepted wisdom is that in the course of powerful rivers, such as the Tsangpo, steep stretches or 'knick points' focus erosion that proceeds headwards to drive a wave of dissection towards the sources of the main river and of all its tributaries. The Tsangpo has had the better part of 40-50 Ma since the India-Asia collision to eat away the vast Tibetan Plateau, but it has failed, as have other, lesser river systems. Repeatedly emplaced moraine dams, seem to have locked the knick points associated with the Tsangpo catchment at around 260 separate locations.



Moraines protect valley floors from erosion by sedimentation (Credit: Owen 2008; Fig. 2)

See also: Owen, L.A. 2008. How Tibet might keep its edge. *Nature*, v. **455**, p. 748-749; DOI: 10.1038/455748a.