The rise and fall of the tide mill

by Roger H. CHARLIER, Loïc MÉNANTEAU and Marie-Claire P. CHAINEUX

Abstract

Tide mills played an important role in the industrial and port development of Europe, particularly in the West. They were often sited on the coast, but also on estuaries. The technique of tide mill building and utilization was exported to the Atlantic coasts of North America. These mills were gradually supplanted by the advent of newer technologies, though several remained functional, and at work, well after the end of the Second World War. They may be justly considered the forerunners of modern tidal power plants. A renewed interest in tide mills has been generated by maritime and industrial heritage historians, and praiseworthy efforts at safeguarding and rehabilitation have blossomed, particularly in France and the United Kingdom. But is only history at stake?

Key words
tide mills, maritime heritage, cultural tourism, conservation and restoration, tidal

Introduction

Mankind has been awed by the sea, but not enough to refrain from trying to harness its forces. Since the latter half of the first millennium, people have put to work the energy of the tides. The industrial revolution introduced new sources of energy (e.g. steam, using coal) while the 20th century brought increasing dependence on oil, gas and electricity, even nuclear power. The excesses of 'progress' have also led people to reassess the past and to take a new look at tide mills. For some, they are part of the valuable maritime heritage that must be saved, for others a source of inspiration in the search for an environmentally benign source of energy.

The tide mill (also known as the sea mill) of the past has inspired engineers' dreams and, after lengthy and varied tribulations, became a genitor of tidal power plants. There are many suitable sites to build what the French (the first [1] to construct one) call 'centrales marémotrices', but such plants are still rare, except

thinking 'big', as with the Chausey Islands scheme in Normandy (France) or the multiple-basins projects of Passamaquoddy (USA/Canada), they have thought of local needs which could be satisfied by small plants. Catering to local demands for power was the idea behind the tide mills that once dotted the coasts of England, Wales, France, Portugal, Spain, Canada and the United States.

The Persian Gulf was long regarded as the probable site of the first tide mills (Boithias and de la Vernhe, 1988). The Arab geographer, Al-Muqadassi describes the mills found at Basra in the Tigris-Euphrates delta (Iraq) and how water turned the wheels as it flowed back to the sea (Al-Muqadassi, 10th century). In Europe, the earliest recorded mill, mentioned in the *Domesday Book*, built (1066-86) at the entrance to the port of Dover on the English Channel (Wailes, 1941), was also frequently cited as the oldest in Europe. All that has changed since the discovery of a tide mill at the Nendrum Monastic site on Stanford Lough on the east coast of Northern Ireland. In 1999, archaeologists investigating what was thought to be a fishpond discovered millstones and indisputable traces of a tide mill. The dendrochronological study of the timbers first dated the mill to 787 AD, though later work suggests that it could have been built as early as 619 AD and twice rebuilt over the next 200 years. The Christian community at Nendrum flourished between the 7th and 10th centuries.

This paper provides an overview of tide mills throughout the world with emphasis, however, on recent research in the Iberian and the restoration of several mills in Brittany (France) over the last decade or so. Today, some are derelict (Fig. 1), many have disappeared without leaving a trace and efforts to save this industrial archaeological heritage are, on the whole, still timid. Until recently there were no molinological societies (González et al., 1997) endeavouring to preserve and restore tide mills, such as those that have long existed for the far more numerous wind- and water mills. In Brittany (France) there were a mere 90 tide mills compared to 3000 water mills and 5000 wind mills (Le Nail, 1982), and in Asturias (northern Spain), in the 18th century, there were 4529 water mills and just a handful of tide mills (Graña García and López Alvarez, 1987).

Tide mills: past and present

The ideal location of tide mills obviously is on coasts with a wide tidal range. Nevertheless, tidal range does not appear to be the sole determining factor, even if considered a major one by Gibrat, the 'father' of the Rance Plant. The Iberian Peninsula had the highest concentrations of tide mills in the world (some 100 mills in both Cantabria and in the Tagus Estuary) despite a limited tidal range not exceeding four metres for the northern, Cantabrian, coast and a mere three to four metres for the rest of the Peninsula during an average equinoctial spring tide. Indeed, in the Gulf of Cadiz, both in the Algarve and in Andalusia, the range is often

Fig. 1. Vestiges of the upper floor of the Beltrán Mill at Ayamonte, built where a tidal creek, the Estero de la Nao, joins the Guadiana River (Atlantic Andalusia, Spain). Note the outline of the international bridge over the Guadiana in the background. *(Photo: Loïc Ménanteau, March 1996)*

earliest European mills were built, in Guyana, or on the Caribbean, the range is under three metres.

Mills also need indented coastlines with inlets and small estuaries which can easily be blocked off by a dyke or causeway or with marshes drained by numerous channels. This means that rectilinear coastlines, whether rocky or alluvial, even if the tidal range is favourable, are not ideal places for the implantation of tidal mills (e.g. the coast of the Landes area in France). Some, known as mixed mills, have been placed on rivers, capturing both the flow of the river and tidal energy (Fig. 2, next page), others in bays, using tidal currents or on estuaries using the tidal flow.

retaining basin (Fig. 3a and 3b, next page). It is much more common to find mills on estuaries or 'rías' (submerged coastal valleys or estuaries resulting from a rise of sea level) and the 'cove' or tidal channel can be several kilometres from the coast, though necessarily subject to tidal influence. During the flood tide, water flows into the pond or basin through sluices (water- or floodgates). With the ebb tide, the water flows out of the pond thus activating one or more wheels (Fig. 4, next page), the blades of which produce the mechanical force required, e.g. to grind cereals. These traditional tide mills produce energy once in a tidal cycle, though some (double-effect mills) could provide mechanical power with both ebb and flood tides. The Rance power station could be