OLD SAWS

An "old saw" has two meanings in English and both of them have archaeological relevance. Literally, it means a cutting-blade with teeth; metaphorically, a maxim that goes on being repeated without being questioned. In archaeology, saw-blades appear very early: in scenes of ancient Egyptian ship construction. Saw-marks on ancient Mediterranean wrecks show that their planking was produced by sawing lengthwise through tree-trunks (instead of the trunks being split radially, then the segments adzed into parallel-sided planks)[1]. Metaphorically, "old saws" proliferate in archaeological footnotes for it is easy to re-quote available field-reports, without checking whether subsequent amplifications and modifications have appeared; the result is that newly discovered technical features are often either misinterpreted, or overlooked. Scholars interpreting unknown processes of engineering, through indirect allusions to them written in a dead language, run even greater risks of repeating old saws. In this respect field-archaeologists are on safer ground, because although they are as unlikely as "arm-chair scholars" to have training in engineering, anybody who actually handles objects in the field, is prompted by curiosity and bound by duty to search out their possible functions.

A general familiarity with the applications of engineering (which most people share) is no substitute for understanding the principles on which such applications are based. This may explain why the most significant constructional feature of the Marsala Punic Ship: a band of corrugations carved around the waterline of its otherwise smooth hull (fig. 1), has been overlooked during more than 20 years of published debate about this unique wreck. No such feature is present on the many other ancient Mediterranean wrecks examined hitherto. The Marsala hull does, however, differ from the rest in that it is the only known example of a "long" oared ship designed for speed, the others being "round" sailing ships designed for carrying bulky cargo. It is therefore logical to connect the curious corrugations round the Punic Ship's waterline with the uniqueness of its hull-shape... a line of enquiry that is supported by an engineering principle called "the Coander Effect", which explains why the smoothness of certain hulls needs to be broken.

During excavation, we first became aware of the band of corrugations when, after raising the 11th strake up from the keel (that is to say on reaching the level of this ship's waterline) we began to see what appeared to be the imprint of clinkers in the sand under the wreck. By then it was clear that the planking of the 3rd century BC Punic ship, in common with all other hulls of the period, was entirely united by mortise and tenon joinery. Consequently the overlapping of planks caused by nailing them one over the other was an impossibility. In fact, the imprint of "clinkers" on the bottom turned out to be a simulation of overlapping planking on the outside of the vessel, carved onto the lower edges of strakes at this particular level. The upper part of the hull was missing, but four of these carved waterline strakes survived before the break. The only person not to be mystified by this feature was the engineer and naval architect (Austin Farrar C. Ing. FRINA) who, shortly after this discovery, started working out the vessel's original shape from its surviving remains. He realized that the purpose of these corrugations was to deflect spray.

Spray-deflectors are needed only on fast vessels which have smooth hulls. Smoothness by itself, when not combined with speed, causes no problem but, when a boat is designed to travel at a rate of knots that is more or less equal to the square root of its length in feet, then the combination of speed with smoothness causes water to creep up over the sides and spill into the boat itself. The phenomenon, known to engineers as the "Coander effect", can be demonstrated by holding a spoon loosely between finger and thumb under a tap. Water flows round the bowl of the spoon, then the more the tap is turned on and the faster the flow, the more water will travel up the sides, until it gets into the hollow of the spoon. But if the spoon's outer smoothness is broken, for instance, by sticking a sausage of plasticise round it this break will throw the flow outwards, thus establishing the principle of deflecting water[2].

Given that water only spills into hulls that are both fast and smooth-skinned, it was not until motor-engines were combined with the smoothness produced by metal-sheathing, or by fibreglass, that spray-deflection became so significant that most modern designers had take it into account. A variety of solutions resulted. Metal-sheathed warships were the first vessels to have angularities built into their sides to throw spray outwards; fibreglass speedboats all have to have some form of built-in deflection, while a recent design of lifeboat has been given rounded spray-deflectors reminiscent of the sausage of plasticise illustrated in the demonstration of the Coander effect. It must, however be remembered that water does not run upwards in the same way over the corrugated surface produced by traditional clinker building.

In Northern antiquity there was a Viking tradition of clinker building East of Jutland (as distinct from the Celtic tradition of carvel building west of this line).

Sea tests, for instance, show that the clinker built "Roar Eigg" , a faithful replica of a medieval Viking Ship (No. 3 of the group excavated at Skuldelev and now conserved in the Roskilde Museum, Denmark), automatically throws off spray when travelling at speed. This brings me back to the subject of saws, because, as on all early Northern vessels of its kind, no saw was used to cut the "Roar Eigg's" planks. There are various ways of cutting up tree-trunks; parallel sided planks are produced by sawing, whereas wedging produces radial segments, like elongated slices of cake, which then have to be trimmed with an adze to make them into planks.

It was a casual conversation with the architect of "'Olympias' the 5th century BC Athenian trireme", that made me realize that the way planks are cut may relate to a larger issue: namely, to basic methods of achieving a hull's strength and elasticity. In chatting about the Punic Ship, John Coates had suggested to me that the belt of corrugation round its hull might have been the unintentional result of using wedge-shaped, or radially split planks, which lazy Punic shipwrights might not have bothered to adze into smoothness. For anyone who had not seen the Punic ship, his suggestion is a logical possibility, but a glance at the vessel itself shows it to be mistaken for two reasons. Firstly, because saw-marks show on the planking[3]. Secondly, because the grain of the wood shows that several planks contained a tree's heart; indeed, these wider planks alternate up the side of the hull with with narrower planks which had been cut from either side of them and which match their heartwood.

With regard to strength and elasticity: sea-trials of faithfully replicated Viking ships have also shown that they owed much of their robustness to the radial cutting of their planks. In Sweeden, during the replication of one such boat, this observation was put to the test by half a dozen stalwart men jumping up and down on the middle of a radially cut plank which, unlike a sawn plank, did not snap; insteed it reacted like a trampoline under their crashing weight. This resilience can be explained by the fact that radial splitting leaves the fiberous structure of wood intact, whereas sawing cuts indiscriminately through the fibres. Ancient Mediterranean vessels also had considerable strength and elasticity (as the long sea voyage of the faithfully replicated "Kyrenia II" has shown), but their resiliance was achieved by different means: it was produced by their joinery, rather than by the quality of their planks. The "shell first" construction that characterises Mediterranean antiquity was made possible by mortise and tenon joinery. This is why "Shells" were relatively more important to the structure than the skeletal timbers that were put into them at a later stage. Professor Steffy has stressed the significance of this type of joinery, to the extent of suggesting that it would be more accurate to drop the description "shell construction", in favour of "tenon and peg construction".

Reverting to the Punic Ship: the existence of simulated clinkers leads up to an obvious historical question (to which there is, as yet, no answer). Where did Punic shipwrights see clinker-built craft throwing water outwards? Because, had they not seen the effect of clinkers on a fast vessel, they would not have copied their appearence round the waterline of a fast ship of their own. Instead of selecting this feature of a traditional form of boat-building, because it had a useful side effect, it would have been easier to adopt one of the many other simpler solutions to the problem, which can easily be observed by holding a smooth bowl-like object in fast flowing water (as Mr. Coander eventually did).

Historically, mentions of Carthaginian voyages to the North in search of tin are vague and second-hand. Archaeologically, it is not known whether clinker built craft existed in the North as early as the 3rd century BC. The 3rd century BC "Hjörtspring Boat" is, however, an interesting anomaly. Excavated in 1923, in a dismantled state, in a bog together with other ex votos it is now in the Copenhagen Museum. Although the boat is not clinker built, yet the outer smoothness of its hull does happen to be broken by a corrugation (caused by the way the parts are slotted together). Hopefully more 3rd century BC variants will be found in the North. Meanwhile, it is certain that the hull of the Punic Ship is not "round"; also that imitation clinkers encircle its water line; since the latter can serve no useful purpose besides the deflection of spray, their presence further confirms (were confirmation needed) that this hull was designed for speed.

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NOTES

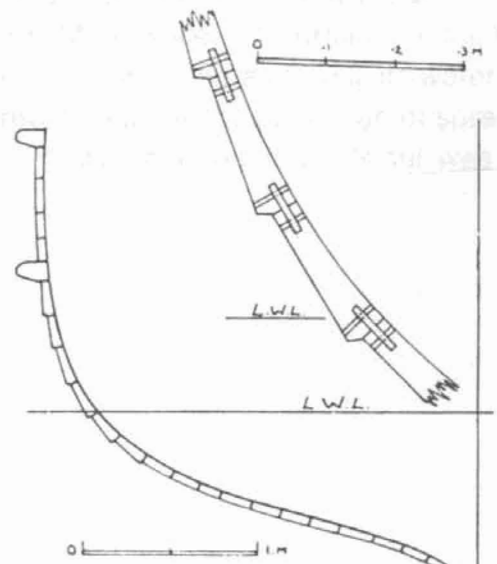
1. I am obliged to Richard J. Steffy and Patrice Pomey for answering my questions on the point.
2. Again, I am grateful to my collaborator, the engineer and naval architect, Austin Farrar, for information; see "Spray Deflectors", *MM* 73,3,271-2 (1984) and the "Sequel", *MM* 74,2, 160-162 (1988).
3. With the exception of the two unusually thick garboard strakes which, although they may originally have been cut from a trunk by sawing, were subsequently shaped by adzing in order to give the basic curve of the hull. This because the Punic Ship is of the category of ancient vessel whose tenons remain at the same angle throughout the length of the keel rabbets. The simulated clinkers, or spray-deflectors, were shaped with an adze, used on the outside only, after the planking had been sawn.

ILLUSTRATIONS

1. Detail showing the imprint of the spray-deflectors on the bottom under the Punic Ship.
2. Sketch by Austin Farrar showing the simulated clinkers at the waterline of the Punic Ship.
3. The "Coander effect": A and B, a spoon held under a flowing tap; C, the same but with a roll of plasticine which deflects the water outwards from the bowl of the spoon.
4. Spray-deflectors on a warship.
5. Spray-deflectors on a speedboat.
6. Spray-deflectors on a lifeboat.

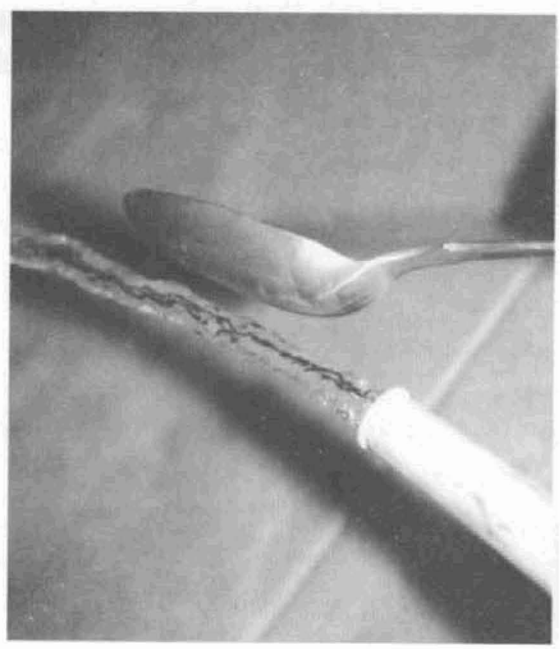
FIG. 1

FIG. 2



Sketch of Section in parallel, mid-part.

FIG. 3a



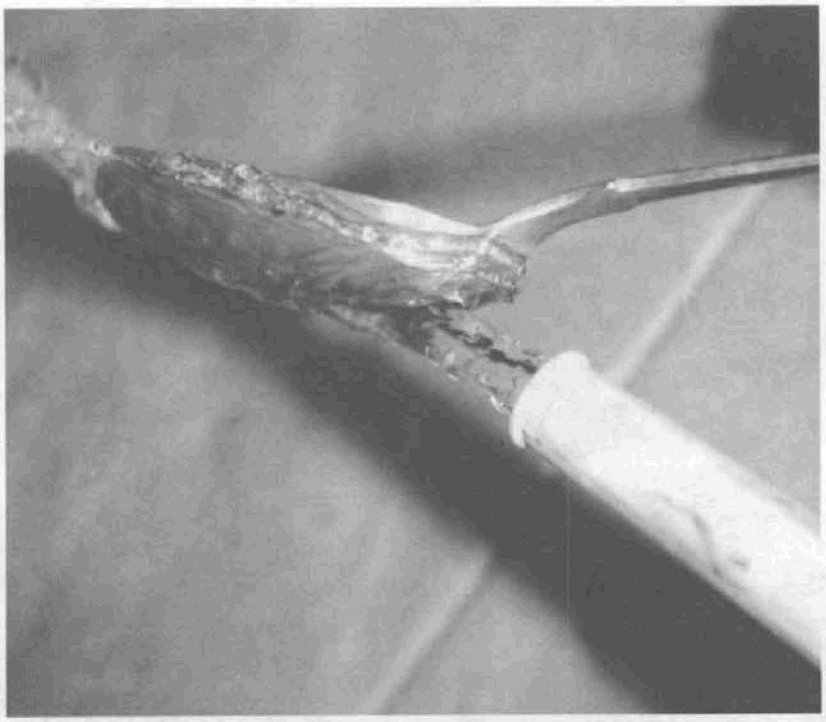


FIG. 3b

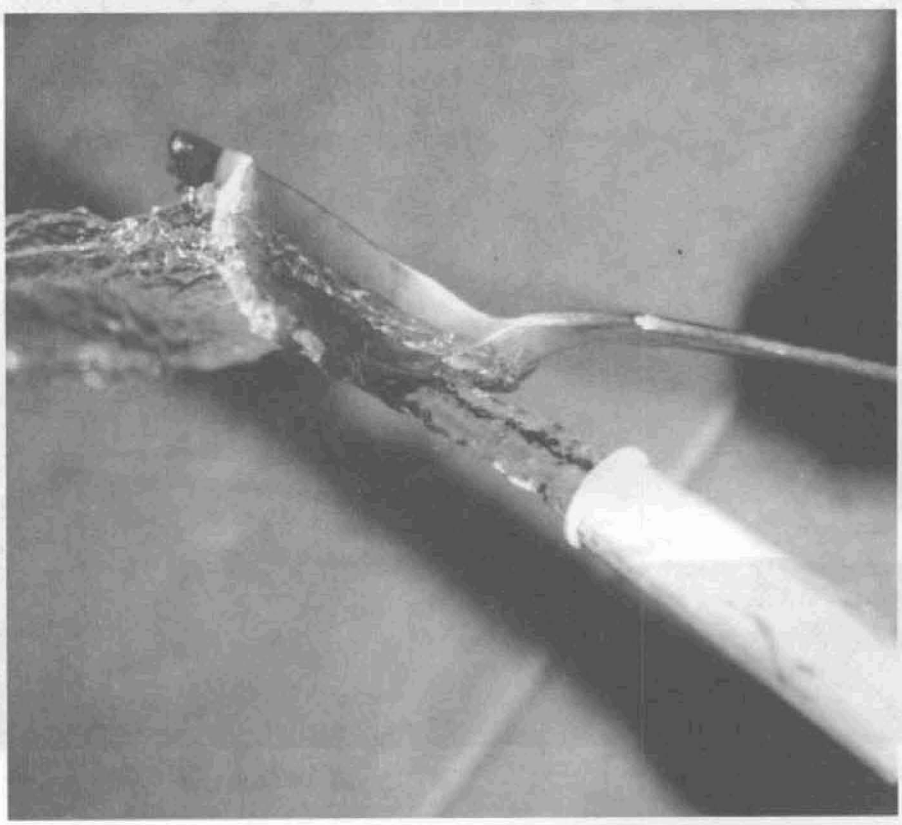


FIG. 3c

FIG. 4

FIG. 5

FIG. 6