



The Borobudur Ship: recreating the first trans-ocean voyaging

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Indonesia is the cradle of trans-oceanic voyaging

The people of Indonesia are nearly all representatives of a large linguistic group called Austronesians or Malayo-polynesians. A maritime people, they moved out of mainland south China about 6,000 years ago, spreading southwards from Taiwan, through the Philippines into Indonesia, and from there they spread over seas and oceans to populate more of the world's surface than any other people in pre-modern times. The Maori of New Zealand, the Polynesians, Melanesians and Micronesians spread over the vastness of the Pacific Ocean – they all speak related languages and have related maritime technologies. It used to be assumed that the spread across the Pacific had occurred through accidental drift voyages, driven by storms, but the initial spread was to the east-south-east, against the southeast trade winds, and it was rapid. It was a deliberate exploration by prudent mariners who preferred to explore upwind so that they could reliably return home whether or not they found new islands. The cross wind exploration to Hawaii happened later, and the downwind expedition to New Zealand was the last major episode. Meanwhile, the populations that remained in the archipelagos of Southeast Asia developed increasingly sophisticated watercraft and engaged in trade around the Indian Ocean and the South China Sea.

Early Medieval shipwrecks from the region, such as the Intan wreck off Bangka Island, show ships of over 30m length and considerable capacity. Contemporary Chinese records of the Southeast Asian ships trading to China describe even larger, multi-masted vessels, centuries before Europeans developed similar technology.

Starting about 2000 years ago, mariners from Indonesia regularly made the trans-Indian-Ocean voyage to Madagascar off the East African coast, and it seems very likely that they sailed a direct route, perhaps calling at the southern end of the Maldives chain, rather than coasting via India and Arabia, though they were also voyaging to those regions.

The Malagasi people, descendants of the first population on Madagascar speak a language closely related to certain languages of southern Borneo, but with nau-

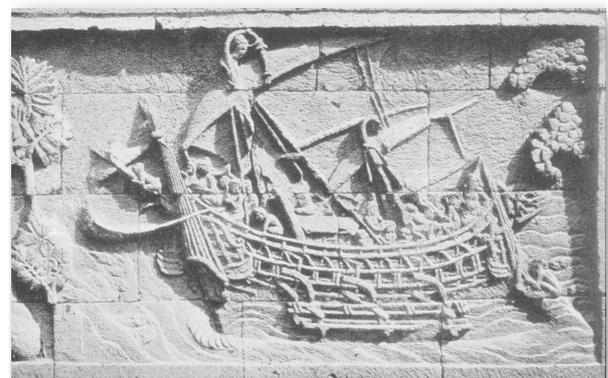
tical terms probably derived from the language of the Bajau – the so-called Sea-Gypsies of Southeast Asia.

The current theory about the Indonesian colonisation of Madagascar is that they went there for iron ore mining and smelting. Whatever the reason for their voyaging, there is no doubt that they reached Madagascar and undertook the first regular, purposeful, trans-oceanic voyaging. Direct contact between Indonesia and Madagascar continued for about 1000 years.

More controversially, some researchers have pointed to evidence from linguistics, musicology, metallurgy and archaeology suggesting that Indonesians established some sort of culture in equatorial west Africa by rounding the Cape of Good Hope.

British adventurer Philip Beale, a former RN officer who once sailed on EYE OF THE WIND, had an abiding fascination with that little known aspect of Indonesian maritime history and conceived a project to recreate the voyaging to Madagascar and onwards around The Cape to west Africa. In 2002 he asked me to design and supervise construction of a replica watercraft for the expedition.

The only known depictions of Southeast Asian ships of the early Medieval period are five bas-relief carvings at the 8th century temple Borobudur, in central Java. All five depictions are of ships very similar in design, but with variation in the styling and detail.



There can be no doubt that they are accurate depictions of real ships, but to say they are unusual understates the case – they approach Sci-fi weird.

There are reasons to believe that the ships depicted are war galleys, used to carry nobles and religious leaders. They have defensive screens at bow and stern,

covered galleries for oarsmen, and outriggers that probably served as platforms for men wielding paddles and as anti-boarding barriers. I suggested building a different type of vessel with a design based on the archaeological evidence (which only shows us the bottoms of hulls) and backward inference from later designs. Philip chose to order a replica of the Borobudur ship for which there is solid evidence, and which, he argued, was a more identifiable and marketable concept than a vague reconstruction of a generic merchant ship.

Previous attempts to replicate the Borobudur ship have been distinctly unsuccessful. A Japanese version capsized on launching (but then a Columbus ship replica achieved the same disconfirmation of its design) and another was condemned when it reached Singapore. Eric Pedersen published his reconstruction and then built a scale model which ... capsized on launching.

The problem is the outriggers. Outriggers are a great invention, particularly if you have access to giant bamboo (*Gigantochloa aspera*) which grows well in Indonesia and can have diameter of 250mm or more. But outriggers work well on sailing vessels within a limited size range. Typically the outriggers of a sailing vessel are longer than the long, narrow hull in order to provide sufficient buoyancy and thereby provide stability. Giant bamboo grows very big, but it doesn't grow big enough to provide outriggers for vessels over about 10m hull length. The number of oarsmen and the minimum space necessary for an oarsman to operate makes it possible to calculate that the larger Borobudur ships were 15m or more in length. The Borobudur ships' outriggers are short, much shorter than the hulls.

Clearly our Borobudur ship had to be designed to derive stability from its hull form. In traditional design, where you don't employ tricky devices with a lump of lead on the bottom, stability comes largely from beam. I didn't want to give our ship too much beam. The original could be propelled by oars or sail, and galleys are usually relatively sharp, narrow designs. More worryingly, a beamy, stable design, when rolling in a big ocean seas would roll the outriggers in and out of the water with very considerable leverage. The outriggers would almost certainly break up.



In December 2002, Philip and I took a scale model of my proposed design to Indonesia, looking for a master shipwright to undertake the construction. We went to the little coral islets lying to the east of the Kangean group, where, I hoped, a mix of Javanese, Sulawesi and Bajau maritime cultures would provide the cultural background best suited to interpret my design. After a couple of days in a muddy, mosquito-infested bay where no one really seemed to have the enterprise or expertise we were looking for, we were rescued by Pak Asad from the lovely, pristine, white sand and coconut glade island of Pagerungan Kecil.

Asad was confident, almost brazenly so, and definitely knew what he was talking about. He undertook to build our ship within six months. The hull planking would be *bungur* (*Lagerstroemia speciosa*) the keel *kesambi* (*Schleichera oleosa*), the frames could be any suitable timber, the big outrigger booms would be *ulin* (*Eusideroxylon zwagerii*) the toughest iron-wood, and decks would be teak.

We made a small down-payment so that Asad could start buying timber (which he did within the hour) and it was agreed that construction would start when I returned early in the New Year.

I returned, as appointed, to find three massive pieces of *kesambi* scarfed, ready to be joined in a keel laying ceremony almost a soon as I'd put some film in my camera. But Asad had an indulgence to ask first. The design was for a hull 17m in length, but he preferred 19m and had made the keel accordingly. I was concerned about the size of the rig implied by the increase in length, but it

was too generous an undertaking to be refused.

The keel was huge. In reality it was a keel and the garboard strakes all in one – a vestigial dugout canoe. The lower planks were 7 and 8 cm thick and very long.

The ship was built in the traditional Indonesian manner – plank first, with all the planks edge-dowelled together by ironwood dowels at about 120mm between centres. The Pagerungan shipwrights were absolute masters of that difficult technique: the best I have ever seen. To make things more difficult, and to conform with archaeological evidence, the ship was built without stem and sternpost. Instead the ends were carved from big baulks of timber, termed *salureh*, with the hood ends of two or three strakes stepped onto each



one. Lifting the *salureh* into place for trial fitting was always achieved without any lifting gear, by those small muscular, wiry men, balanced on precarious staging, always bare footed. There was no accident at any time during construction, not even a crushed finger and yet construction was incredibly rapid. Pak Asad had promised completion within six months, but he said he'd try for launching within three months, and, in fact, the ship was ready for launching eleven weeks after the keel was laid. The lines were beautiful. Sharp as a tea clipper, with hollow deadrise and a firm turn to the bilge. But there was a lot of superstructure including those rowing galleries and I was a little concerned about stability when she was launched without ballast. With 800 men hauling on hawsers, she went into the water like a train. A fast launch, for technical reasons, increases the risk of capsize, but she rode the water upright and proud as a lioness, notwithstanding the scores of men climbing up onto the galleries.



On Jakarta bay with the small sails but still making an excellent speed

Over the following month we fitted the outriggers and spars, and also the heavy five-metre long rudders carried on each quarter. We were unable to get sufficient supplies of cloth made from *kororo* palm leaf for traditional sail making and ended up making one set of cotton sails, one set of polyweave sails, and one set of kororo-colour tetron sails which were cut a couple of metres short for the anticipated strong southeast trades on the Indian Ocean in August.

The rig, for which we have no name in English except "tilted rectangular sail", is a form crab-claw sail; the type of sail shown in wind tunnel experiments to be the most efficient of all (I'm not joking). It has significant advantages and disadvantages. It really does pull like nothing else, and it pulls in the right direction. As the wind gets up you can ease the sheets. Hard on the wind, with the vang hauled taut, you can ease the sheets till they hang in a bight but the sail won't luff.

The leach will flutter but the forward part of the sail keeps drawing and most of the aft part of the sail pulls nearly straight upwards. Downwind it is like being dragged along by a giant kite. Changing tack and furling are fraught operations, not for the faint-hearted or the uninitiated. You always wear round to change tack, shifting the whole sail and its spars around the mast-head as you go. To demonstrate the manoeuvre, we'll wear round from port tack to starboard tack (with the mizzen furled to make things simple). Since we've been running with the sail set square, the first thing is to move the tack back to its belaying position on the ship's centre-line, in the bow. Then we put the helm up to bring her square before the wind. The vang is eased out and the sheet is taken right off the cleat where it was belayed on the starboard side. With the sheet slack, the sheet hand carries the sheet forward and eventually right around the bow to bring it around with the sail to the port side. On the foredeck two or three strong and agile men haul down on the line from the heel of the yard trying to bring it vertical. It's important that the hand on the vang keeps control and doesn't let the top end of the yard go too far forward, because if he does the heel will fetch up against the mast or worse, crush someone against the mast. The heel has to be hauled down and then swung across to the starboard side which will bring the top end of the yard to port and therefore to leeward on the new tack.



As soon as that's achieved, the vang hand hauls in as hard and fast as he can while the sheet is belayed and trimmed. Reasonably simple except when it's blowing a gale and so dark you can hardly see that there is a sail.

Furling is a very much more terrible undertaking. The tack is loosed and a big wooden bar inserted in the heel of the boom, the yard is hauled vertical, and with the sail flogging, the boom is rotated to roll up the sail. Very neat in theory, and fine on a small vessel, but with a boom some 15m long and a big sail fighting to get away, it takes three strong men to rotate that boom, and

if it should get away from them, the spinning bar could cause serious injury.

We had some big westerners in the crew, but only the wiry little men from Pagerungan could furl the sail in a blow.



Dear old Bapak Bul in a new T-shirt and hat

On initial sailing trials, and during voyaging to Bali and up the length of Java we were fortunate to have in the crew Pak Bul from Pagerungan – the only man who remembered sailing with *lama tanja*, as he called the rig. Most of the islanders are fairly slender but of Bul it was fairly said “tinggal hanya tulang dan kulit” (remains but skin and bones). It was literally true, when his foot got cut in fight with the main yard there was so little flesh that no blood came out! Yet, Bul was the strongest and bravest man on board whenever there was a sail to furl or tack. He was also one of the funniest, most anarchistic and kindest men I’ve ever met.

For the Indian Ocean, the Cape and South Atlantic there were just three Pagerungan islanders in the crew. Sulhan who I had originally rejected as too old, and too long a skipper, but who was always the first man aloft when that was necessary, Muhamad who doubled as engineer because we replaced the oarsmen for manoeuvring in confined waters with two longshaft eggbeaters mounted in the galleries; and young Dirman who always had a grin, no matter what, and was our onboard shipwright. They were tough but gentle men, polite and deferential except at chess where they thrashed all comers without ever seeming to take the game seriously.

I sailed as far as the Seychelles, at least notionally as sailing master. Alan Campbell was master, and Captain Putu from the Indonesian navy represented the Indonesian government’s interest in the project, but in truth the Pagerungan men carried us all as passengers.

We had a good crossing of the Indian Ocean to the Seychelles, averaging 133 n.m. per day despite some headwinds and calms. Our best day’s run was 187

miles and we made 177 on two or three days. At times we were running before very stiff trade winds with big and fairly steep seas piling up. Steering with the quarter rudders (sometimes erroneously termed steering oars) was never a problem. It did call for timing. There was no point in trying to shift a rudder while running down the face of the wave. You did it in the lull at the top or bottom of a wave.



Niken Maharani looking confident on the helm despite big seas on the quarter and making better than eight knots

Those outriggers did roll on and out of the water, making a lot of noise and splash, creating quite a lot of drag, and causing the ship to slew slightly – not enough to be a danger but irritating to the helmsperson. Whether she would have rolled more without outriggers, I can’t say, but she would certainly have been faster without them. In smooth water they were no problem, they flew clear of the water. On a beam reach the lee outrigger didn’t touch the water till there was some 15 knots of wind, and then the ship would be making six to seven knots.

We never fitted the high screens in the bow and stern. They could have been made fairly easily from timber battens and the woven bamboo lathe sheets called *deg* or *bedeg*, but we would have contravened the regulations concerning watch-keeping at sea – indeed it would have been like driving with a screen on your windscreen.

From the Seychelles, the Borobudur ship had a light wind passage down to Madagascar. After Madagascar she met some severe weather in the Mozambique channel and carried away a suit of sails. She rounded The Cape in good style under a tarpaulin storm sail. And from Cape Town sailed up to St Helena and on to her final destination in Ghana. She sailed well: “never put a foot wrong” as Philip wrote in his final journal entry. She has been shipped back to Indonesia to become a museum exhibit at Borobudur. Meanwhile, Pak Asad is building a larger version for the regional government of Banyuwangi, East Java.