From Indonesia to Africa: Borobudur Ship Expedition

By Philip Beale

The reconstruction of the Borobudur ship was an idea that I had as a student in 1982 when visiting the 8th century temple at Borobudur in central Java, Indonesia, where there are a number of reliefs showing various aspects of shipping traditions at the time of the temple's construction. I vowed that one day I would build a replica ship and sail it from Indonesia to Africa, to celebrate the achievements of ancient Indonesian mariners from the first millennium. (Fig.1)

The aims and objectives of the project were:

1. To build the first reconstruction of the type of large outrigger vessels depicted at Borobudur in a form suitable for ocean voyaging;
2. To recreate the first millennium Indonesian voyages to Madagascar, and to establish if it was possible for such voyagers to have reached West Africa;
3. To document the practical issues experienced in building a ship of this type;
4. To test the performance characteristics of the Borobudur ship under sail. These capabilities are likely to contribute to a better understanding of the nature of trade between the Indonesians and Africa during the first millennium;
5. To use the Borobudur Ship Expedition as a means of publicising the maritime skills and achievements of the ancient Indo-Malay peoples;
6. To publish a synthesis of the available evidence for linking Indonesia and Africa, and to provide this record for the benefit of Indonesian and African cultural heritage;
7. To provide a number of young adults (both Indonesian and international participants) with the opportunity to participate in a once-in-a-lifetime project to assist in the preservation of an ancient cultural heritage and for personal development.

Indonesian Maritime Power in the First Millennium

The Empire of Srivijaya, centred on Palembang on the island of Sumatra arose towards the end of the 7th century. Its economic strength derived not from the cultivation of the land, but from controlling the important sea borne trade between India and China and within Southeast Asia. The ships involved in that trade had to pass through the narrow Straits of Malacca between Sumatra and the Malay Peninsula. When the China trade, which had declined for several centuries owing to the political chaos in China, revived under the T'ang Dynasty, it was in the interests of China and traders from Arabia, Persia, India, Sri Lanka and Malaysia to centralise the trade on a single entrepôt in the Straits of Malacca region. Providing friendly

Fig 4. The Borobudur outrigger at Sea

Fig 2. Laying the keel

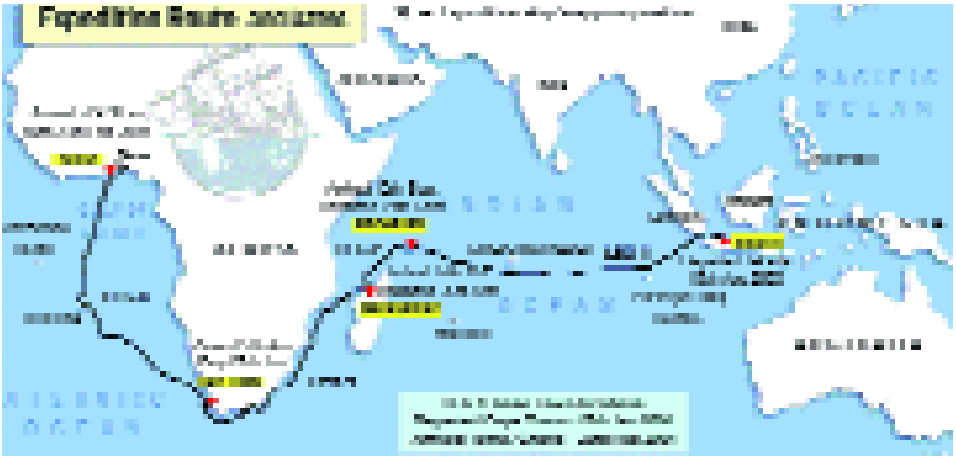

Fig 3. Route of the Borobudur outrigger

Fig 1. An outrigger at Borobudur temple

treatment to all merchants, Srivijaya became successful and powerful, and outstripped its nearest rivals in the region. Its success meant it was able to concentrate on the marketing and sale of commodities such as pepper and tree resins, and in servicing the huge numbers of ships that arrived annually to trade and make repairs. At the height of its power, the Srivijaya dynasty was said to have had between 2,000 and 4,000 ships at its disposal in the Indian Ocean, and could muster a maritime force with 23,000 men.

At about the same time as the rise of the Srivijaya empire was taking place, Borobudur - the largest Buddhist temple in the southern hemisphere - was being built. The reliefs on the walls of Borobudur provide a fantastic insight into life around the time of the 7th and 8th centuries in Indonesia. In particular, five reliefs provide an unparalleled study of the maritime technology of the time.

Indonesian Influence on Africa

Since Roman times, writers such as Pliny have recorded that cinnamon came to Europe via East Africa by way of epic sea journeys across the Indian Ocean. Initially these journeys were probably made by rafts and double-outrigger canoes. As the trade developed the sophistication and size of the vessels would probably have increased over the centuries. The ships depicted at the Borobudur temple would have been sophisticated, prestigious vessels used to transport important personages. Whilst the Indonesians would have brought mainly spices to African shores, they would have returned via India and Sri Lanka with ivory, iron, skins, and in some cases slaves. These perilous round-trip journeys may have taken anything up to 3 years to complete. (2)

There were also very significant migrations of Indonesian peoples to Madagascar. It is widely believed that Madagascar was an uninhabited island when the migrations took place

during (and possibly before) the 1st millennium AD. Today the Malagasy people recognise that many of their ancestors were from Indonesia, and this is reflected in the Malagasy language, the physical features of many Malagasy and their traditions and customs. (3)

While it is widely accepted that Indonesians voyaged to eastern Africa, there is no hard evidence that they travelled around the Cape of Good Hope to west Africa. However, there is some circumstantial evidence that can be used in hypothesising that such dangerous voyages took place. (4) Evidence can be adduced from the cultural influences that remain in West Africa today, such as the xylophone. Additionally, there are botanical introductions evident in parts of West Africa. (5) Examples of the botanical introductions that reached West Africa by the 1st millennium include yams, plantains (bananas), Asian rice and the betel nut. These botanical introductions may have come by sea rather than overland from East Africa.

There is certainly a feeling that the level of trade activity along African shores was much greater in the 1st millennium than has been generally acknowledged, and through archaeology and other disciplines, more will undoubtedly be rediscovered in the years and decades ahead.

The Design of the Ship

The intention was to reconstruct the type of large outrigger vessels depicted at Borobudur in a form suitable for ocean voyaging and recreate the 1st millennium Indonesian voyaging to Madagascar and Africa. As far as possible it was built using construction techniques from 1st millennium south East Asia: the hull was built plank-first with planks edge-doweled together and multiple through-beams were fitted to strengthen the hull structure.

The design assumed that the vessels engaged in voyaging to Madagascar would have been capable of transporting some 25-30 persons, all necessary provisions, stores and a cargo of a few cubic metres volume. The total stowage space was some 13 cubic metres, and the weight calculated was approximately 8.5 tonnes. Such capacity would have allowed a vessel, a sizeable crew and migrants to undertake a voyage of just over 3,000 nautical miles from Java to Madagascar in a period of about three to four weeks. Depending on design, the vessel might also have needed to carry a tonne or two of ballast.

Outriggers: Single or Double?

There are vessels without outriggers depicted at the Borobudur temple, but the five different large vessels depicted in detail all have outriggers. Following van der Heide, we used the plate numbers from van Erp's paper to identify the Borobudur ships. (6)

In four of the five Borobudur ship depictions only the windward side of the vessel is shown. Whether the vessels are double outriggers with another outrigger on the leeward side, or single outriggers carrying a flying outrigger on the windward side only, cannot be determined with certainty. However, Erp 10 has its sail partly furled and that sail is on the side of the viewer, which suggests that we are looking at the leeward side. Four of the five depictions show the port side of the vessel but Erp 9 shows the starboard side, so outriggers are seen on both sides of the hull, though not simultaneously.

Most single outrigger vessels are designed to tack by 'shunting' so that the outrigger remains on the windward side when they change tack. When a vessel tacks by shunting, it reverses direction and reverses ends — the bow becomes the stern and vice versa — the steering gear must be shifted from one end to the other and reconfigured to steer at the opposite

end. Such vessels are necessarily longitudinally symmetrical — the ends are very similar — and they have a simple rig usually with the mast positioned amidships.

The Borobudur ships do not exhibit longitudinal symmetry and do not have rigs that could be easily reversed. It therefore seems unlikely that the Borobudur ships were single-outrigger craft. Double outrigger canoes are not widely used on the coasts of Java but they are more common on neighbouring islands, including Madura and Bali, where sophisticated designs exist. The Borobudur outriggers have a number of characteristics that make them significantly different from the outriggers of more recent sailing canoes.

The Borobudur ships appear to be fairly large. Sizes up to 25m have been posited for the largest example. Heide offers a more sober estimate of 12-15m based on the number of oar ports. This allows about 1m for each oarsman. (7) An obvious problem was that the Borobudur ships were much larger than the largest sailing outrigger vessels in more recent times, although outrigger fish trapping platforms *(bagan)* have been built at a similar size.

The outriggers shown on the Borobudur ships are not like the long outriggers of the large outrigger vessels of the 20th century. They appear short and small relative to the size of the ships. The comparatively small outriggers of the Borobudur ships, with their short projections forward and aft of the booms, would be robust but they would provide little buoyancy and stability relative to the size of the ships and their sail area.

The outriggers of Indonesian vessels, including those first depicted by Europeans in the late 16th century, have generally been similar in length to the hulls of the canoes they were fitted to. In many cases they are longer than the hulls. All the Borobudur ships have outriggers shorter than the waterline length of their hulls. Erp 6 (which appears to be the largest vessel) has an outrigger of only 0.54 the length of the hull. Erp 8 has the longest outrigger at 0.79 the hull length; it has four outrigger booms while the other vessels have three.

On all but one of the Borobudur ships the outriggers are doubled. There are two outrigger components which we presume are bamboos, one on the inboard side of the outrigger boom/connective, one on the outboard side.

Some of the Indonesian vessels recorded by Captain Paris in the 19th century had outriggers of relative lengths that fell within the range illustrated in the Borobudur ships. They were mostly from the Moluccas and neighbouring regions of eastern Indonesia where outriggers have remained relatively short in more recent times. Light weight timber rather than bamboo is often used for outriggers in eastern Indonesia (in some areas suitable bamboo is unavailable) and outrigger craft depends on movable human ballast for stability.

By contrast, in areas closer to Java (e.g. Bali, Madura) outriggers are usually significantly longer than the canoe they are fixed to. Typically, relatively large and fast sailing canoes have a crew of only one or two persons and depend on the buoyancy and hydrodynamic lift of the lee outrigger for stability.(8)

In a survey of sailing vessels the shortest outriggers (0.525 relative to hull length) were on a large *kora kora* from Dorey off the western end of New Guinea.(9) The *kora kora* had a fairly capacious planked hull and a length beam ratio of less than 4:1 which could sail without outriggers if properly ballasted. Most outrigger craft have a quite different type of hull, built up from an unexpanded dugout canoe, and therefore of very narrow beam and not suitable for sailing without outriggers.

The Building of the vessel

The ship was built on the island of Pagerungan Kecil by a team of highly experienced Indonesian shipwrights under the leadership of As'ad Abdullah, a master shipwright and trader born on Pagerungan in 1934. Construction was overseen by the designer Nick Burningham because the traditional shipwrights were not used to working from detailed drawings. A scale model was provided to help the shipwrights with conceptualisation of the design. The ship was built using the traditional building techniques with no nails or iron.

The construction work began with a keel laying ceremony on 20th January 2003 (Fig 2) and proceeded very efficiently to launching on 26th May 2003. This was followed by the fitting of the outriggers on 11th June 2003 and rigging. The construction work employed ten shipwrights, two dowel-makers/cleaners, and at times extra men were employed for caulking and fairing the hull. All the shipwrights were from Pagerungan.

The keel is 17.29m long and the hull about 19m overall with a beam of 4.25m and a moulded depth of 2.25m. The sailing draft was approximately 1.5m. The ship was propelled by two *layar tanja* ('canted rectangular sails'). The hull planking was *bungor* (sometimes called 'benteak') and decks were teak.

Expedition Members and Route

Expedition members were selected through a variety of means and from various sources. In the case of the Indonesian crew members, three members (Muhammad, Sulhan and Sudiman) were from the Island of Pagerungan where the ship was built. The other members of the Indonesian crew applied for positions and were selected by the Indonesian Navy out of some 1000 applicants. The international members were selected through recommendations and discussions amongst the senior members of the expedition. In total 27 people participated in the expedition and were drawn from nine nationalities.

The ship sailed from Jakarta to Sunda Strait, past Krakatoa into the Indian Ocean. Then, westwards in 10ºS until two thirds across the Indian Ocean where the course was changed to the rhumb-line for the Seychelles. (Fig 3) The reason that the Seychelles was chosen was because it represented a position close to the East African coast where Indonesians certainly made contact, although no evidence of Indonesian presence on these islands have yet been found. From East Africa the Indonesians are likely to have explored further south, and eventually have reached Madagascar.

	Jakarta	Seychelles	Madagascar	Cape Town	Accra
Arrival	-	12.9.2003	14.10.2003	5.1.2004	23.2.2004
Departure	15.8.2003	29.9.2003	26.10.2003	17.1.2004	-

The voyage to Madagascar was then completed by sailing from the Seychelles, past the Comoros to Madagascar. From Madagascar the ship sailed southwest to Richards Bay in South Africa. The passage around the South African coast to the Cape of Good Hope and Cape Town was made with calls at Durban, Port Elizabeth and Mossel Bay, making it possible to avoid adverse winds to some extent.

From Cape Town the ship ran to Saint Helena and thence direct to Accra, Ghana. If 1st millennium Indonesian voyagers did indeed sail to West Africa, they are unlikely to have called at Saint Helena and probably followed the South African coast more closely.

The Voyage

The expedition was launched by the then President of the Republic of Indonesia, Megawati Soekarnoputri, in Jakarta on 15 August 2003. Light winds were encountered on the north coast of Java and Sunda Strait. In the Indian Ocean strong southeast trade winds were experienced, as expected in August-September. (Fig 4) There were also periods of light wind, calm and some squally weather from the northwest. In the southeast trades the ship often made seven knots and better. There were four noon-to-noon runs of over 175 nautical miles and a very creditable daily average run of 133 n. m. on the crossing of the Indian Ocean. At times the seas ran five and six metres on the port quarter. The outriggers rolled deep into the sea in those conditions, causing the ship to slew, but steering, using the starboard quarter rudder, was never compromised and never particularly difficult. The Borobudur ship's voyage is probably the longest voyage made by a vessel steered only with quarter rudders (like Classical era ships) in several centuries. (The Viking replica 'Saga Siglar' fitted a sternpost rudder as well as a quarter rudder on her circumnavigation.)

The expedition reached the Seychelles in mid September 2003 and, following a fairly protracted stay in the Seychelles, reached Madagascar in mid October after a mainly light-wind passage. In the southern Mozambique channel a fairly severe storm struck the ship. The mainsail was irreparably damaged and a spare was bent. Some severe conditions were also experienced when running towards the Cape under a storm sail. At no time did the ship display a want of sea-keeping ability.

From Cape Town the expedition enjoyed another trade wind run to Saint Helena. Approaching the equator some light, variable and squally conditions were experienced, but the rate of progress was still impressive. The ship reached Ghana in West Africa on the morning of the 23rd February 2004, showing that it would have been entirely possible for such ships to have reached West Africa in the 1st millennium.

The traditional *layar tanja* rig was very powerful but was heavy to hoist, very awkward when changing tack and effectively impossible to furl in a strong wind. It was necessary to lower the sail, yard and boom before furling. On occasions, it could only be handled at all thanks to the strength, agility, courage and skill of the seamen from Pagerungan.

Upon arrival in Tema, the crew worked very hard dismantling key pieces of equipment and removing excess stores from the ship which were given to a local orphanage. *Samudra Raks*a was then taken out of the water to await arrangements for shipping back to Indonesia. After many months delay the ship was eventually shipped to Indonesia in late 2004.

The opening of the Ship Museum in Indonesia took place on 31st August 2005 by the Minister for Culture of the Republic of Indonesia. It is located within the grounds of the Borobudur Temple and is just a hundred or so yards from the great temple itself - a fitting tribute to the crew and all who worked with and supported the Borobudur Ship Expedition. The task of erecting her and placing her in the new museum was started in July 2005 by Pak As'ad, the original builder of the ship.

In April 2004 the six Indonesian crew members who completed the entire voyage and myself as the Expedition Leader were awarded a medal for services to Indonesian Culture from the President of Indonesia. In 2005, the Indonesian Government published a set of stamps commemorating the Borobudur Ship Expedition. The website www.borobudurshipexpedition.com hosts all details of the expedition and remains as an online memoir of this voyage.

Conclusion

The Borobudur Ship Expedition successfully completed the main objectives of the project, and the performance characteristics of the ship under sail proved its capability for sailing around the Cape of Good Hope to West Africa, providing evidence that it would have been possible for such voyagers to reach West Africa. Hopefully the expedition has made a small contribution to the greater interest in, and understanding of, the relationships that took place across the Indian Ocean over one thousand years ago.

Footnotes

1.This paper is largely derived from a report on the Borobudur Ship Expedition submitted to the Royal Geographical Society by Nick Burningham and Philip Beale in March 2006.

2. Innes Miller (1969). *The Spice Trade of the Roman Empire*. Oxford: Clarendon Press.

3. Innes Miller 1969. See Gwyn Campbell, 'Malagasy origins revisited', *ZIFF Journal* 2 2005:5-14.

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6. Heide, G.J. van der, (1927). 'De samanstelling van Hindoe-vaartuigen: iutgewerkt naar beeldwerken van den Boroboedoer', in Nederlandsch-Indië Oud en Nieuw, 12:343–57. Erp, T. van. (1923). 'Vorstelling van vaartuigen op de reliefs van den Boroboedoer', in Nederlandsch-Indië Oud en Nieuw, 8:227– 57.

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9. Paris 1841