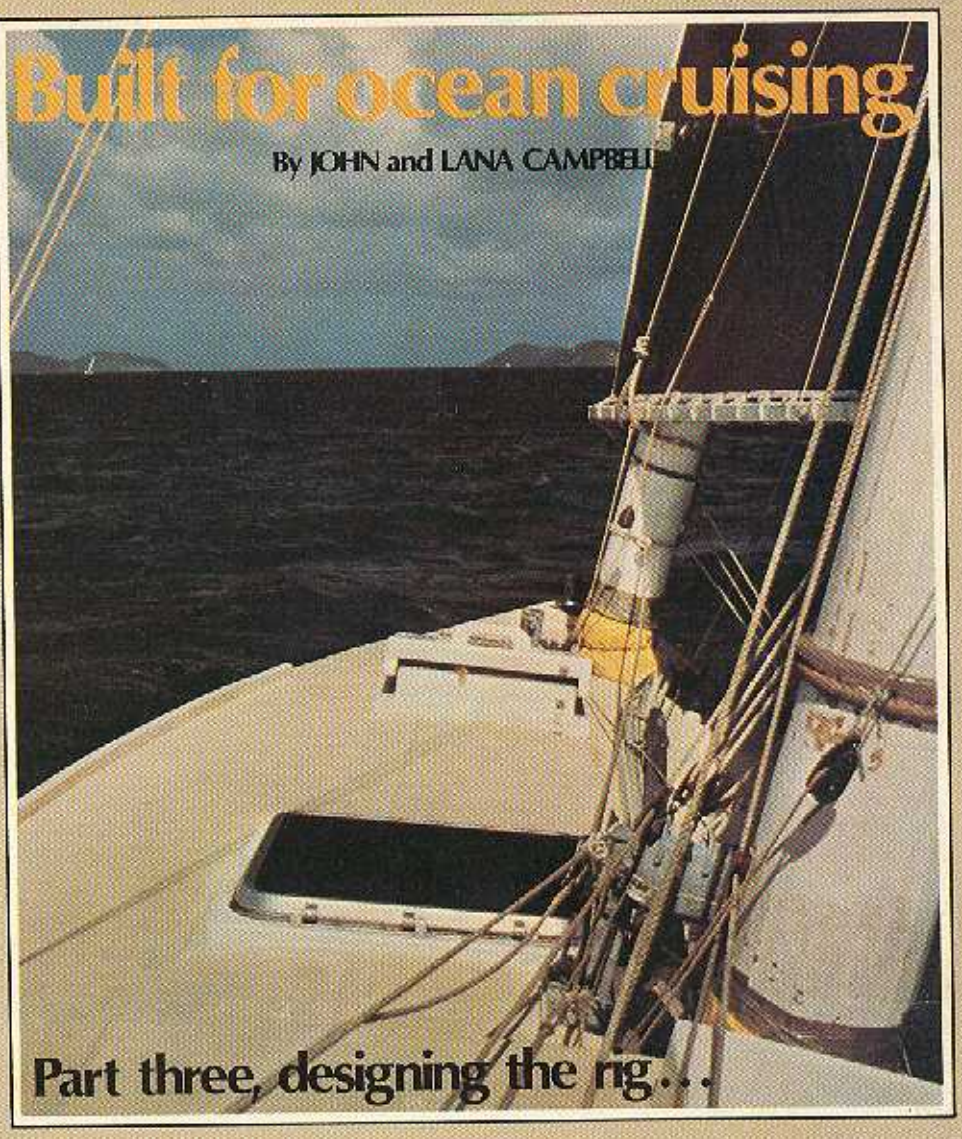
Built for ocean cruising

By JOHN and LANA CAMPBELL



Part three, designing the rig...

WHEN WE STARTED thinking about the design of *Papilio Rufa*, almost the first decision that we made concerned the rig. We opted for a Junk rig or, to give it the technical title, the Chinese Lug Rig.

Our reasoning went along the following lines, although not necessarily in the order given. A major consideration throughout the planning and building of the boat was cost. We spend so much of our time cruising that there is very little left to devote to earning money. We wanted a rig whose components we could make ourselves, as cheaply as possible. Junk met this criterion well. With our schooner rig we have only two sails, and we made them ourselves, fittings were all simple to make, there were no big expensive winches to buy, and we were even able to make the masts ourselves, but more of this later.

We live on board the boat, so space is at a premium. Many boats devote an enormous proportion of their internal space to stowing a large wardrobe of expensive headsails. The sails for the junk rig are permanently bent on, so we effectively got a bigger boat for our money.

We are lazy sailors. We sail to arrive; neither of us enjoys sliding around on a wet foredeck wrestling with flogging sails. The legendary ease with which the junk rig could be reefed and unreefed had an obvious appeal. Provided we could make reasonably quick passages in the greatest possible comfort, we were happy not to seek the last ounce of performance from the boat. In practice, though, we have found that we make passages as fast as anybody else, expecially in changeable conditions. So often in the past we have been lazy about shaking out a reef, yet with this rig it is so easy that we tend to keep the boat sailing more efficiently.

Having decided on the rig, how did we set about building it? The first job was to contact Jock McLeod whom I had met briefly a couple of years previously. He was formerly in partnership with 'Blondie' Hasler, and these two have developed their own version of the junk rig which is now slowly becoming more widely accepted.

Jock McLeod publishes two folios which cover every aspect of the rig. They are not cheap, but they saved us their cost many times over. We found them very comprehensive, and included everything we needed to know about designing, building, and even sailing the rig.

Folio number one deals with technicalities of the design. It starts by explaining how to achieve balance between the rig and the hull, which is essential if the finished boat is to sail well. The first job is to establish the so-called centre of lateral resistance of the hull. For convenience, this is taken as the geometric centre of the underwater profile. For the boat to balance, the centre of effort of the sail area must be ahead of the centre of lateral resistance, by an amount known as the lead. The lead varies with the chosen sail plan, but will be between 1 and 12 percent of the waterline length. All these processes are described in meticulous detail in the folio.

We estimated that the loaded displacement of *Papilio* would be a little over seven tons on a waterline length of almost exactly 30 feet. We decided on a sail area of 700 square feet. This is perhaps higher than one might choose for the working rig on a bermudan rigged boat, but then we cannot set big genoas to increase the area in light weather, and the sails are easily reefed.

For sail areas under 350 square feet, a single-masted rig is normally used, but a two-masted rig could be used. Above 450 square feet McLeod recommends a two (or more) masted rig, though Alan Boswell's Sunbird has a 560 square foot Chinese Lug on a single mast.

We drew up a sail plan for a schooner rig with the usual proportions of two thirds of the area in the mainsail and one third in the foresail. The first problem appeared. Our foremast was just about exactly on the stemhead fitting when the centre of effort was in the right place (Figure 1). Obviously, that was impractical.

Jock McLeod suggested several alternatives. The one we chose was to increase the foresail size in relation to the mainsail. So the proportions that we ended up with were 400 square feet for the main and 300 square feet for the fore-

Anyone interested in obtaining information on the Chinese Lug Rig and the folios titled *Design your own Chinese Rig*, should write to Jock McLeod, Hawk Hill, Rosemarkie, By Fortrose, Scotland. The costs in February, 1980, are as follows:
Introductory pamphlet, CR/1: £1.50 in the UK; £1.50 in the rest of Europe. Folio No. 1: £14 in the UK; £15 in the rest of Europe. Folio No. 2: £30 in the UK; £32 in the rest of Europe.
These prices include postage.

sail. This moved the combined centre of effort of the sails forward, which then enabled us to move the whole sail plan aft on the hull to keep the lead between CE and CLR the same. The foremast was now at about the forward end of the waterline. We felt there was enough boat there to enable the mast to be well supported, so drew our final sail plan on this basis (Figure 2).

While building the boat we gave careful consideration to the loads that the masts would impose on the hull and deck. Since the masts are unstayed, all their support is derived from the step at the bottom of the mast, and the partners where each mast passes through the deck. The force is not just sideways, but also fore and aft when the boat is running, and as she pitches into a head sea. The steps and the partners had to be well supported in all directions.

We had done these preliminary drawings before the hull was built, so we asked Tyler Mouldings to incorporate two foam-cored frames in way of each mast, some eighteen inches apart. These frames run from gunwale to keel, and form the basis of a ring-type structure to join the partners and mast-steps together.

The mainmast is sited immediately forward of the main bulkhead, which (in ¾ inch ply) was bonded to the after frame using eight layers of 1½ oz mat on each side. The mat was generously overlapped on both the hull and bulkhead and the bulkhead was stiffened by gluing a deck beam to its after face.

The forward foam frame coincided with a deck beam. This beam is supported by two enormous hanging knees, 1¼ inch thick, which reach down below the waterline. We bonded them to the frame, again with eight layers of mat each side.

The lower ends of these knees were glued to half bulkheads which reach down to the level of the sole. They form parts of the berths on either side of the saloon, and they too were bonded to the frame.

Below the sole, a plywood floor was bonded across to join the two frames together. Effectively, a circle had been formed between partners and keel, eighteen inches ahead of the main bulkhead.

The step was built on top of the ballast, between the bulkhead and the floor. A two-inch thick block of wood was bedded in resin, for the mast to stand on. The sides and front of the square step were built up by gluing and screwing blocks to the base. The whole lot was then well bonded to the hull with eight layers of mat.

The partners were built up between deckbeam and bulkhead. A three-inch board, some two and one-half feet long, was glued and bolted between the bulkhead and the beam (Figure 3).

Strengthening for the foremast was treated in a similar way. The foremast is stepped immediately abaft the most forward bulkhead, which is bonded to a foam-cored frame, and stiffened with a deck beam. The next deckbeam aft is supported again by very large hanging knees which are bonded to the other frame. They are joined together at their lower ends by a plywood floor. The triangular area ahead of the half bulkhead was filled with resin and chopped up waste mat to sufficient depth to give a flat base upon which to build the step. The step itself was built in a similar way to that of the mainmast, and again it was securely bonded to the hull. The partners were also built in a similar way and, once more, the ring structure between partners and step was achieved (Figure 4).

For the masts themselves, Jock McLeod recommends building hollow wooden spars from sitka spruce. That sounded like two very major projects. He does discuss alternatives, including solid grown spars, alloy tubes, and built resinglass masts. As far as I know, all the production junk-rigged boats at present use tapered alloy tubular masts. I felt distinctly uneasy about using alloy tubes for unstayed masts. Tubes are strong in compression, yet the junk rig exerts almost no compression on the mast. Tubes do not like to be bent; if the wall buckles the whole tube crumples, and the junk rig does impose considerable bending strain. Production boats seem to manage alright with alloy masts, but for us the final clincher was the cost — astronomical!

We briefly considered building resinglass masts, but because so little information was available, we studied carefully the section on solid grown spars. Obviously, solid masts would be heavier than hollow masts, but certainly easier to make. And there were plenty of unstayed trees around to testify how solid poles can withstand bending.

Our fingers walked through the Yellow Pages, and we called every flagpole-maker listed (both of

Our first sail plan — obviously impractical, mainsail 465, foresail 230 square feet.

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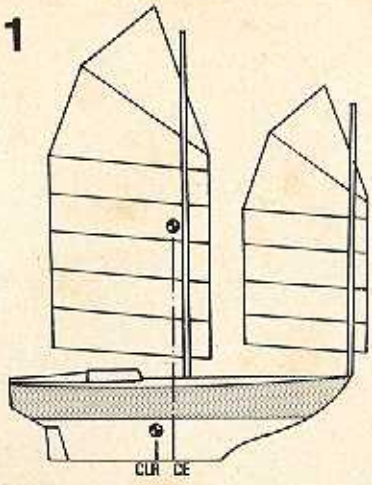

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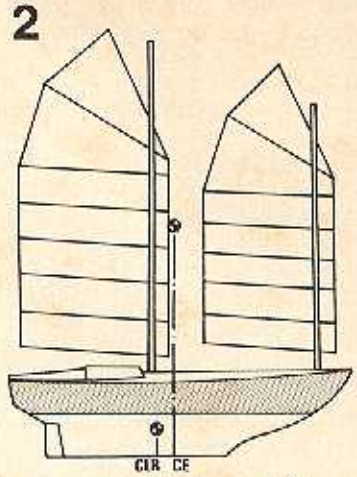

The second sail plan, which we eventually used, mainsail 400, foresail 300 square feet.

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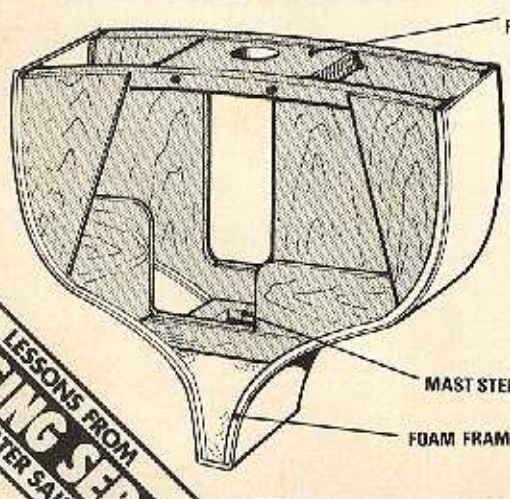

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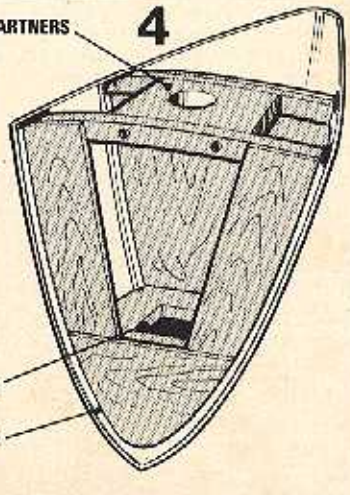

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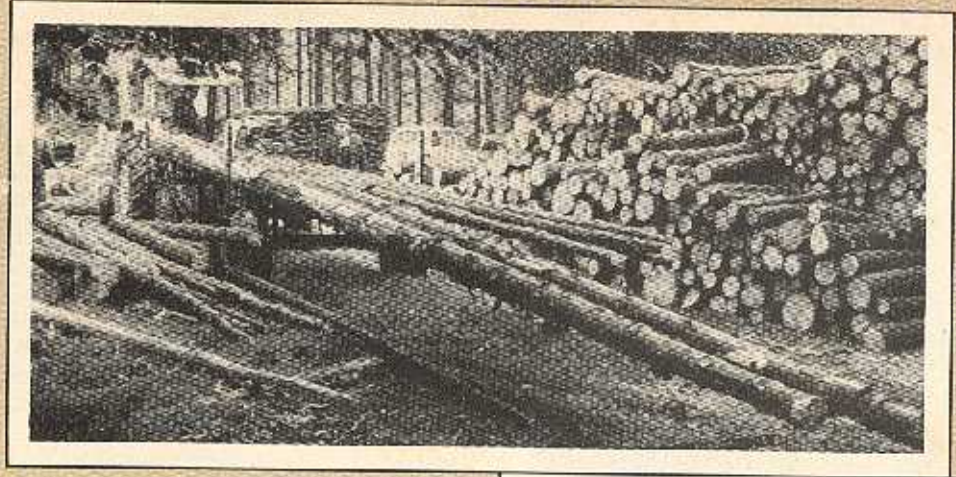


them!). Then we tried timber importers and telephone-pole-makers; nobody had anything of even nearly the right dimensions. Finally, armed with McLeod's Appendix on solid grown masts, we drove up to the local forest.

We took the model of our boat along, found the man in charge, and sought his advice. He took us for a lovely walk alongside a little stream, into the heart of the forest. It was a beautiful autumn afternoon. He showed us some trees which looked long and straight, and assured us that they were Norway spruce.

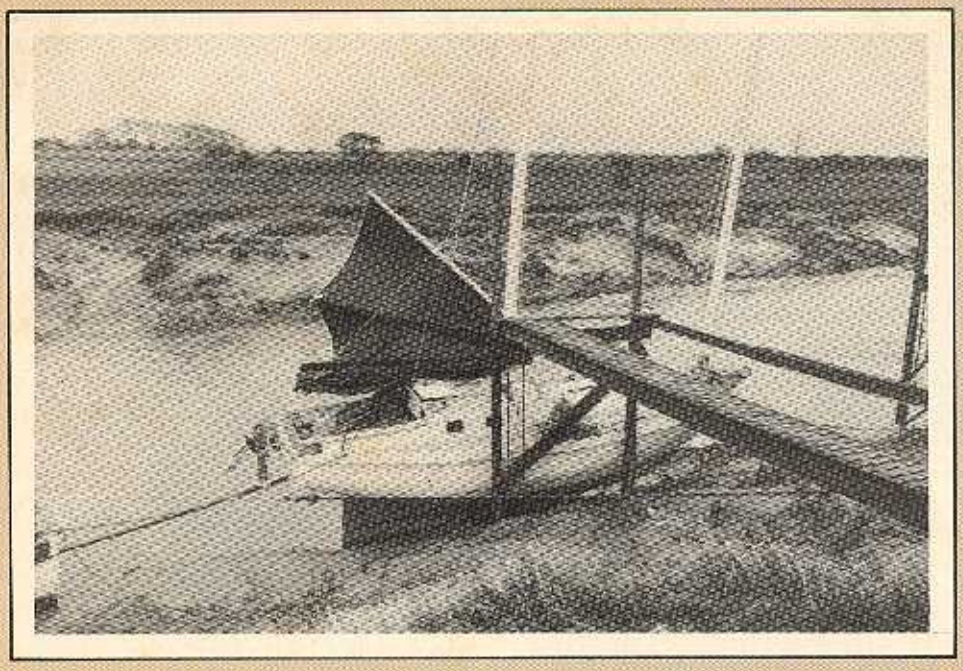
The Appendix listed Norway spruce, not at the top of the list, but it was there, as a possibility. We

looked for two trees of the right size. The mainmast had to be 41 feet long, 10½ inches in diameter at the partners and 4⅜ inches at the top. The foremast had to be 34 feet long, with a similar taper, but about ½ inch smaller diameters. The list of points under 'Selection' was daunting: straight grain, few knots, eight to twelve growth rings to the inch, and the tree should follow the taper of the masts with few irregularities. It seems that the masts are stronger if a ring of sapwood is retained.

The traditional way to make a mast is to cut the tree square in section first. Then the corners are cut off to make it octagonal. The corners are again cut off to make it 'threepenny bit' shaped before it is finally rounded. This would ensure that the finished mast would be straight, but it would undoubtedly remove all the sapwood.

We chose two trees about the right size and put the kiss of death on them. Two days later we returned to fetch them and, appalled at their weight, transported them with some difficulty to the home of my long-suffering parents. We immediately stripped the bark off. Apparently, if the bark is left on until it is dry, the job is twice as hard. The trees were blocked up straight and clear of the ground, and left for almost a year, while we went off on a delivery trip.

After about six months, small shakes began to appear, and we began to get all kinds of conflicting advice about what to do. What we did, right or wrong, much to the neighbours' annoyance, was to plane the knobs off the trees with a very noisy electric plane. The trees had stayed very straight, and after three days of planing, they began to look like masts. We then gave them three liberal coats of a very



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expensive mixture of pure turpentine and raw linseed oil. We especially worked the mixture into all the shakes, and they began to close up. We then went on to a cheaper mixture of linseed oil and paraffin, and oiled the masts once or twice a week until the shakes no longer opened. That covered perhaps three months. Then we left them alone for a month or so, to let the oil dry, and finally painted them white.

All I can say is that so far they look fine. They have been in the boat now for over a year and have suffered some quite strenuous sailing. The masts cost us fifteen pounds each, and we spent about the same again on oil, and on transport. The weight does not seem to affect the performance of the boat adversely; she stands up to her canvas well.

The sails were easy to make. They are cut flat, and our only problem was to find a space big enough to lay them out. Seams are vertical so, if one should split, it will split between battens rather than right across the sail. Each seam we sewed with three rows of zig-zag stitches, and a two-inch wide Terylene tape was sewed round all the edges of the sail. Following Jock McLoed's instructions in the second folio, we put grommets in each seam above each batten. If a sail is damaged or blown out, these grommets will allow us to lash two battens together and so reef out the damaged panel.

For the battens we ended up using clear Columbian pine. It is a little heavy, but quite strong, and it is what we were able to get in suitable lengths. There is ample scope for experimenting with different materials.

We found the rigging easy to make up, again following the instructions in the second folio. The rope used was three-strand Terylene in 6mm and 8mm diameters. That sounds pretty thin, but the sheets and halyards all have multipart purchases, so the loads are not very high. Although we used nearly five hundred metres of rope the cost was not all that great because of the small size. By the same token, we had to buy a lot of blocks, 52 of them in fact. But the expense was not great, again because the relatively light loads allowed us to use small ones. We also fitted a small winch for each halyard, but we find that we need to use them only on those occasions when we are unreefing a sail and for some reason don't want to spill the wind. If a sail is not drawing, the winch is not needed.

The only real snag we have found with the rig is chafe. We have tried to reduce it on the mast, as much as possible, by fastening polythene strips to the forward ends of the battens, and to the yards and booms where they bear on the masts. The battens are held close to the masts by parrels, or loops of rope passing round the mast. We find that the 8mm three-strand rope tends to saw into the mast. We have since substituted 12mm plaited rope for these parrels and that has substantially reduced the problem. A judicial application of tallow or even beef dripping can reduce the problem still more.

When the sails are up, there is a lot of halyard tail to stow. Our halyards are set up as a four-to-one purchase. Care must be taken to stow these tails neatly if tangles are to be avoided. Perhaps in time we will follow Jock McLeod's suggestions and make reels or lockers for the tails.

There will perhaps be times when we will miss light weather canvas. So far we have not felt the need. With our more than adequate sail area, if we can feel the breeze, *Papilio* moves quite well enough. It is possible to rig a light weight ghoster, set flying off the mainmast. If we really feel the need for such a sail, we will make one, but this sort of sail would mean going on deck and things like that . . .

We really are getting lazy. ●

Next Month . . .

Raising the wind

Whenever we meet people, who are not themselves cruising full time, sooner or later they all ask: *"What do you do for money."*