the 110 exhibited by the model and in addition much of the detail is obviously French. The scale is 1/120, or 1/10 in. to the foot, so that the little sailor is only about half an inch in height. It will be noted that a pair of binnacles replaces the single cupboard type with its compass at each end. This arrangement seems to have been adopted rather earlier by the French Navy than by our own. It is shown in the model of a French vessel captured in 1803 and twin binnacles were on board the *Tonnant* and *Vengeur* in 1818. The former of these two vessels was built at Toulon in 1791 and was taken at the Nile in 1798. Her original binnacles may well have remained. The *Vengeur*, despite her name, was built in England in 1810.

The photograph also shows the binnacle at the conn, about twelve feet forward of the steering binnacles. All three are identical in design. The compass is fitted below half height and can be seen from all sides. Perhaps removable shutters were supplied for fitting when required. In the top of each binnacle is a shelf; no doubt the stowage for watch glasses &c. described in the various books. There does not seem to be any arrangement for lighting the compass. The cupboard type binnacle had a lamp or candle in a central compartment between the two compasses.

A very interesting point about the conn binnacle is that an azimuth compass is standing upon it. All the evidence available is to the effect that the azimuth compass was portable and was brought up for use when required, being then placed in a convenient spot, usually the top of the binnacle. It was Captain Matthew Flinders who recommended that the azimuth compass should *always* be used on the binnacle to avoid differences of deviation which would be encountered if varying positions were used.

Navigating in the Offshore Powerboat Race

from Captain J. O. Coote, R.N. (Ret.)

WHEN the Offshore Powerboat Race was first held in 1961, navigators made the painful discovery that conventional methods of coastal pilotage were useless in a comparatively light, high-performance powerboat being driven to its limit.

Taking part in the race is like driving a Mini-Cooper over a frozen ploughed field in intermittent fog from London to York, the same distance as the course from Cowes to Torquay. Chart-work is out of the question. It is physically impossible to lay off a bearing or read a course. Furthermore, the figures and symbols are too small to be read, and, as often as not, the chart gets blown overboard. Radio bearings are unobtainable over the engine interference. A hand-bearing compass cannot be held steadily enough. Parallel rulers, dividers, pencils and the navigator's notebook end up in the bilges.

But the problem of accurate navigation remains of paramount importance, considering the penalty for mistakes with a boat travelling at 75 ft. per second. An error of 10° in course on the offshore leg between Portland Bill and the Skerries Buoy off Dartmouth puts the boat 7½ miles out in its landfall—disastrous in a boat with a maximum theoretical sighting range of the turning buoy of 4½ miles, though in practice nearer 3 miles.

The first thing to do is to consider the factors affecting the problem. It sounds straightforward enough to say that all one needs is an accurate compass, a log and good local knowledge. Of these three, only the latter is readily available.

In an ideal world, all the boats would have specially strengthened and mounted gyro-compasses, but a suitable one would cost upwards of £1200. So we are left with magnetic compasses. Here the problems are twofold. First, a boat slamming heavily into the sea pulls as much as 7 *g* forward on each bump (that is a recent measurement taken in *Tramontana*), or almost what an astronaut has to cope with on re-entry. The compass card tends to swing violently after each bump, and, if the slamming is frequent enough, the card will hardly ever settle down. There are several possible answers to this problem. One is to damp the compass card down sufficiently to prevent it swinging; but, in doing so, the compass may become insufficiently sensitive. Another approach is to put in a stronger magnetic element in the compass. Or again, one might be able to mount the compass resiliently in some way. Manufacturers are busily pursuing these lines.

Secondly, the compass may very well be sited so close to the magnetic interference range of the large mass of the engine that satisfactory compensation is difficult. Aircraft get round this by having remotely situated compasses with electrical repeaters in the cockpit. Indeed, many boats in the race use surplus aircraft Bendix compasses which cost only £15 each. The sensitive element is situated well away from the engine, with their repeaters in front of the helmsman and navigator, but hitherto there have been significant errors inherent in the repeater circuits. Furthermore, they were never designed for this type of work. A similar type of compass has been developed by the Lamas Research Laboratory, whose prototype was tried in this year's race. It uses a Brookes & Gatehouse Heron compass, but differs from the Bendix by taking its supply to the repeaters off slip rings sited underneath the compass card. The practical accuracy of this compass in calm waters is greatly superior and probably around half a degree. However, in heavy slamming conditions, the compass card tends to jump around just like any other magnetic compass.

Another requirement for the steering repeater or compass is that it should be marked off in large, bold figures, as it is often impossible to read the figures on a standard boat's compass. The grid type of course-setter on the helmsman's compass is also desirable.

That all these problems will be beaten by compass manufacturers there is little doubt. Now that the race has emphasized the need, renewed efforts are being made.

So much for aiming the boat in the right direction. Now for knowing the distance run and where you are. No existing log is entirely satisfactory under these conditions. A hull-fitted log cannot cope with the amount of time spent airborne, or the aerated water under the hull. A towed log would be extremely difficult to read, and would probably be ripped off. So the best method is to measure speed by the propeller revolutions, after making an accurate rev-knot table from runs over a measured mile at different speeds before the race. Engine tachometers are, by and large, very accurate. Knowing the revolutions at which the engines are running can certainly give you your speed to within 5 per cent, when there is no cavitation. With this information and a good stop-watch—again with bold figures—the navigator can readily obtain the distance run from the last known fix. It would of course be possible to get the answer directly by feeding time and revolutions into the same black box. In short, it is not unlike navigating an unsophisticated light aircraft without radio aids.

Accordingly, the navigator draws up a flight plan beforehand in simple tabulated form, giving the courses and distances between each mark with the elapsed times between marks at different engine revolutions. Alongside, one makes a brief description of the leading marks to be looked for on the shore. There is the tall block of flats west of Boscombe Pier, for example, and the radio masts north of Start Point. For the long crossing of Lyme Bay, it pays to have a table giving the Sun's bearing at half-hourly intervals. This will at least give warning of a major error developing in one's compass. A sun compass, of the type used in the Western Desert during the war, might usefully be tried.

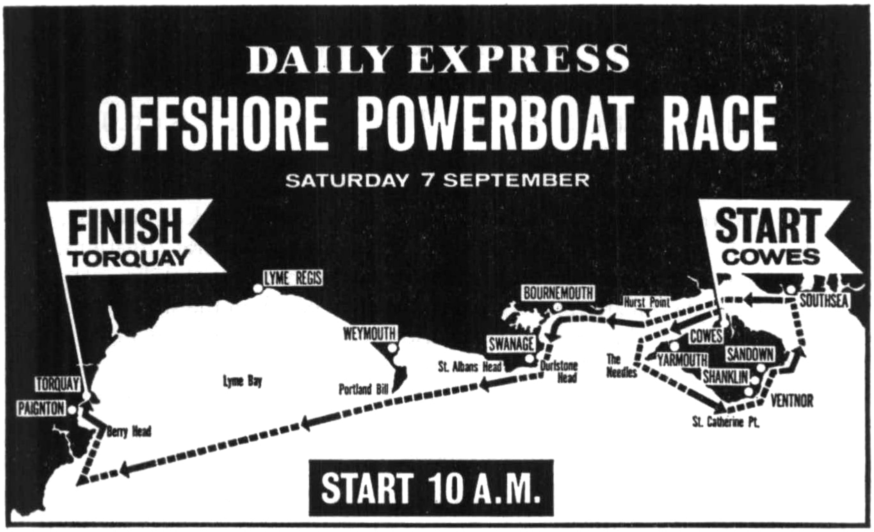

FIG. 1.

Where it ceases to be like navigating an aircraft is in competing with the sea itself. There are not only the well-known hazards of a rough sea to be negotiated, but there are nasty overfalls off some of the headlands on the course. These are greatly aggravated by the tidal condition at any given time.

On last year's race, high water at Dover was 20.2 ft. above datum, the highest of the whole summer. Therefore the tides were running above normal spring rates, and when they turned against the westerly wind, the sea everywhere was shorter and steeper than would be expected, but it was out of all proportion off the Needles, St. Catherine's, St. Alban's Head and Portland Bill.

The navigator's job is to know the areas in which these overfalls occur and to direct the driver round them. The extra distance is well worthwhile. On this race the tide was flooding up the Solent at the start, and some used the yachtsman's ploy of hugging the Hampshire shore to avoid the worst of the tide, but it may be that a planing boat with very little of its hull in the water is little affected by the surface tidal current. The tide was flooding up Channel until about 13.30, so it was very much in competitors' interest to get round Portland Bill before then. Few made it.

Across Lyme Bay one has to decide not on the shortest course, but the quickest. In 1961 it paid handsomely to go 18 miles further by taking a detour in towards the Dorset coast and thus get in sheltered water sooner. In 1962 it was somewhat calmer and paid not to deviate too far off rhumb line. But, unless it is flat calm, there will always be a case for striking the optimum course to give the quickest crossing.

The important thing is to get there in one piece.

Collision Avoidance by Discussion

from Captain F. J. Wylie, R.N. (Ret.)

'Collision Avoidance by Discussion' (see this *Journal*, p. 159) has been part of the radar controversy since it began. If it is assumed, as I think it must be, that no solution is acceptable which does not apply to multilateral situations, the complications inherent in such a proposal become apparent. A bilateral agreement, for example, on alterations of course will be based on the situation as seen at a given moment; this may change drastically within minutes as other ships' bilateral or monolateral decisions are put into effect. These may necessitate changes in intention and further confabulation, possibly now with others than the ship originally contacted, and so on.

The ability to communicate pre-supposes:

(*a*) that *everyone* has v.h.f. R/T using a common calling channel,
(*b*) that *everyone* can be positively identified on everyone else's radar, and
(*c*) that *instant* communication is possible in the event of intentions being changed or other matters of urgency arising.

The original premise concerning multilateral situations is fundamental because the master cannot be expected to adopt different processes depending on the number of ships around him. The requirement for 100 per cent participation has the same basis; if only a proportion of ships can be identified or are able to communicate the situation becomes impossible. The same basis applies to the insistence on immediate communication.

It is clearly impossible to guarantee either (*a*), (*b*) or (*c*). Even if it could be assumed that every ship giving an echo on the radar screen had the correct equipment, switched on and in working order, the simple fact of the availability of the communications circuit without delay to any ship out of perhaps 20 or 30 within range of one another could certainly not be taken for granted.