# setting sail

From earliest times man has found relaxation and pleasure in a combination of the sea, the sun, and fresh, salty air. It is not surprising, therefore, that sailing is one of the most popular of all outdoor sports.

Yet sailing is something more than a sport. A man sailing a boat, in making the elements drive his boat where he wants to go, is employing a skill almost as old as time. Wind and weather are constantly changing, and sailing experience can range from the wonderful peace of a calm, with only the occasional ripple of the tide to break the silence, to the fury of a gale when the sailor finds himself fighting for his very existence.

A sport that can provide such extremes is a sport indeed, and the man who is once bitten by the 'sailing bug' will never be cured of sea (or river) fever. Yachts, boats, call them what you like, need not cost much today. They certainly do not cost much to hire. There are sailing clubs, yacht clubs and so forth in abundance all round our coasts and on many of our rivers. The newcomer to sailing will never lack for advice – for paradoxically, sailing, once an occupation reserved for kings and courtiers, is now one of the most democratic of sports. A little knowledge may be dangerous in some cases, but it can also whet the appetite for more. The more one learns about ships and the sea the more there seems to be to learn. Let us consider the basic mechanics of this sailing business.

One of the reasons for the popularity of sailing is the pleasure which comes from the ability to harness the wind to drive a boat in the direction that the helmsman wants to go. A sailing boat cannot be made to sail directly into the wind, of course, but with the ever-increasing efficiency of hull design and sail plans, she can be made to sail very near to the wind's direction (can be made to sail 'close to the wind'). By proceeding in a series of zig-zags, called tacks, a yacht makes remarkable progress against the wind. This method of sailing is called tacking, or beating to windward. The three points of sailing, (1) against the wind (as described above), (2) with the wind on the beam, and (3) before the wind, are known respectively as close-hauled, reaching, and running.

The earliest craft that history records had a square sail and sailed *before* the wind. It will be clear from Figure I that the

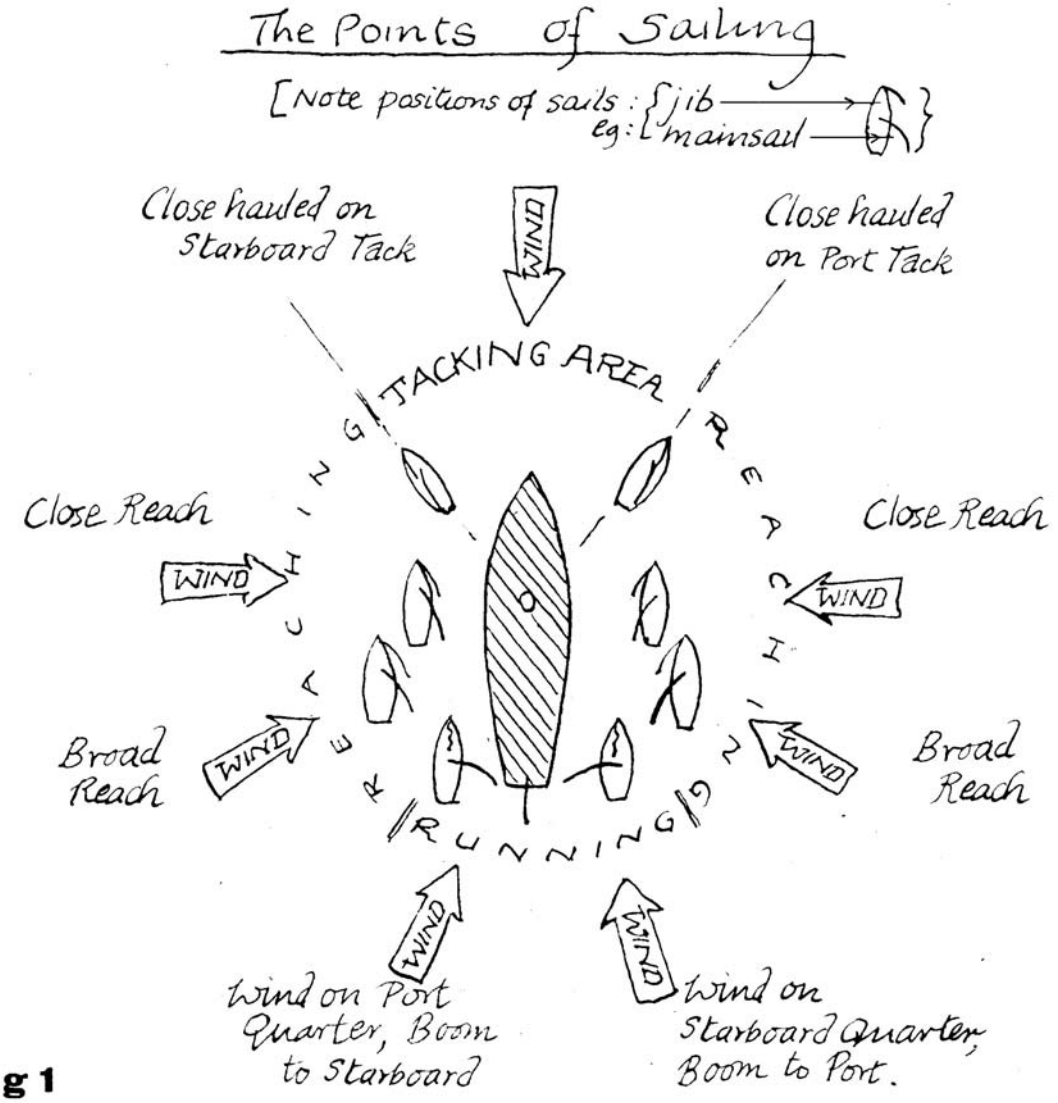



**Fig 1**

mechanics of running and reaching are relatively simple, but it is at first sight not so easy to see how a boat can be made to sail so close to the wind that it can tack *against* it. To understand this, take a look at Figure 2. In this figure, the plane of the mainsail is represented by the line AB, the line CD represents the wind. We can now make use of a geometrical device called the 'parallelogram of forces' to show how the force of the wind, CD, can be turned into a forward-acting force to drive the boat through the water. Let the line CD represent the force of the wind, and let AB represent the plane of the sail. From A draw AF at right angles to AB to cut CD at F. Draw FE parallel to AD and DE parallel to FA. Now we have our parallelogram of forces – ADEF. The force of the wind CD has been resolved into two forces acting at right angles to one another, AD and DE. AD may be said to represent the force running to waste along the sail. DE is a force acting at right angles to the sail. Now we take DE and resolve it by the same method into another pair of forces, GD and HD. GD is again a force acting, so to speak, sideways and is what causes a yacht to heel over and to make what is known as leeway, which means sideways movement through the water. HD, *however, is our actual forward-driving force.*

Now the hull of a yacht is designed to offer the minimum forward resistance and the maximum sideways resistance, so that while the larger force GD merely heels our vessel and produces a little leeway, the small forward force HD is able to drive the boat easily through the water.

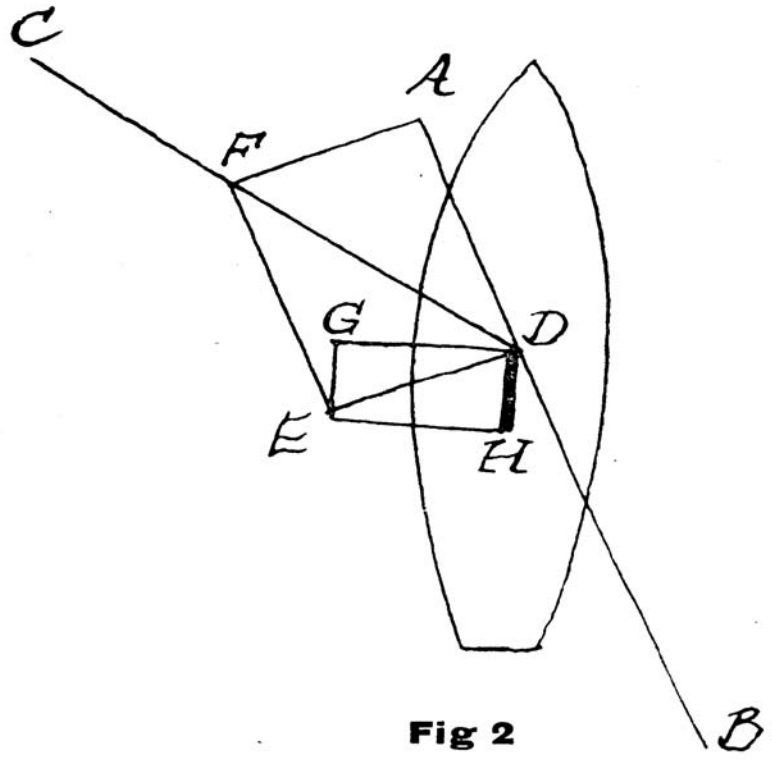



**Fig 2**

Look now at Figure 3. Fairly early in the history of the development of the aeroplane, it was discovered that it is not the wind's *pressure underneath* an aeroplane's wings which lifts the aircraft, but a *vacuum on the upper surface* of the wings. As the aircraft moves through the air, the wind flowing over the curved upper surface of the wings causes a vacuum, or negative pressure, which imparts an upward lift. In Figure 3 we see that the wind blowing on the leeward (away from the wind) side of the sail, imparts a similar forward lift. Let us call this forward lift AB. Draw BC parallel to the boat's keel, the length of BC being proportional to the degree of forward drive in AB, and draw AC at right angles to BC, AC being proportional to the degree of leeward drive in AB. Now draw AD equal to and parallel to BC and join BD. We now have again a leeward-acting force AC and a forward-acting force AD. Once again, because of the design of the boat's hull, AC will produce a little leeway and a heeling movement, while AD will drive the boat relatively easily through the water.

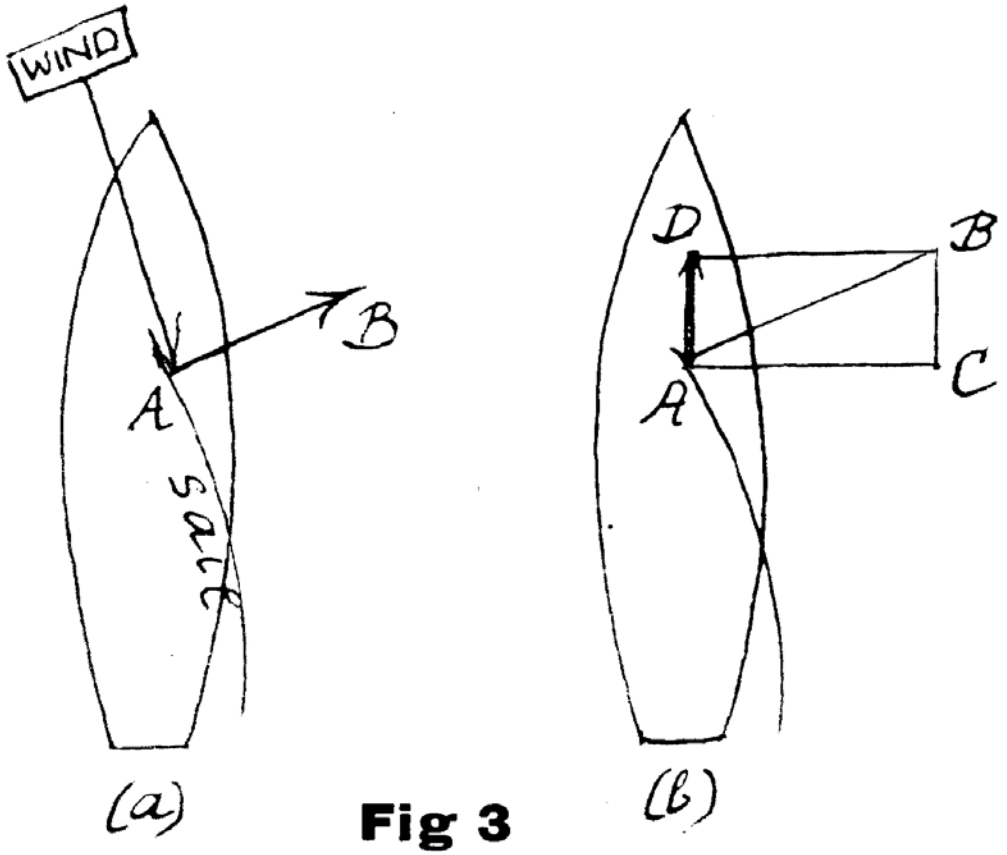
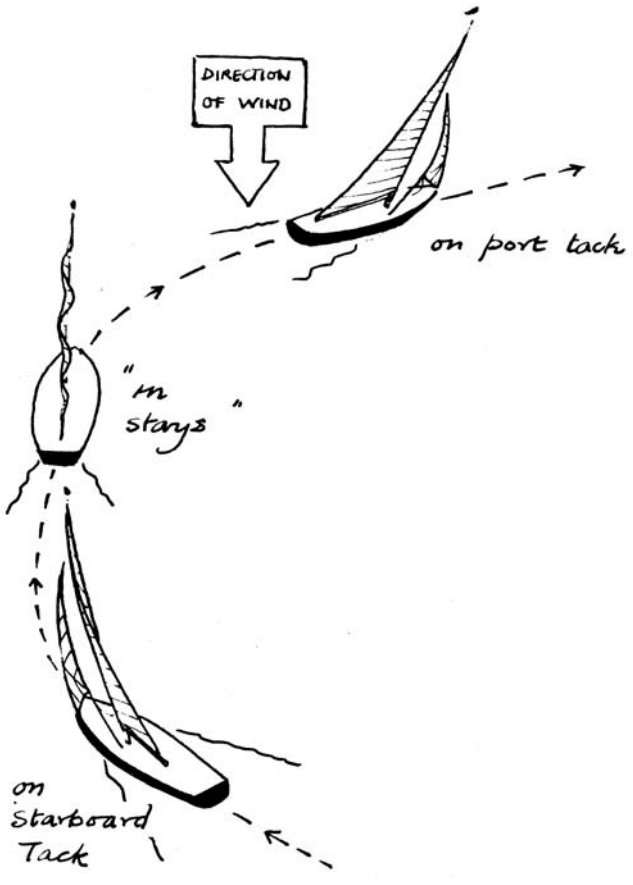



**Fig 3**

We have seen what happens when the wind blows on both sides of the mainsail. Let us assume that our boat is rigged with two sails, a mainsail and a jib. In sailing close-hauled ('close to the wind') the wind acting on the leeward side of the jib will also produce a forward lift, but the jib has an additional function which is to guide the wind round the leeward side of the mainsail. This important function of the jib greatly reduces the eddies, known as turbulence, along the after edge of the mainsail. The jib is, in fact, performing much the same function as the slots on the wing of certain types of aircraft. A third and equally important function of the jib is that since its forward edge, being very narrow, makes a good 'entry' into the wind, it improves the efficiency of the sail plan; the thin forward edge causing little or no turbulence. It has been estimated from experiments in wind tunnels that about three-quarters of the force that drives a yacht forwards comes from the negative pressure on the leeward side of the sails. A modern well-rigged vessel will sail about four points off the wind, that is to say about 45 degrees from the direction from which the wind is blowing. If, therefore, you wish to sail directly into the wind you will have to proceed, as we discussed earlier, in a series of tacks, sailing first at 45 degrees to one side of the wind and then 45 degrees to the other (see Figure 4).




"TACKING"

To sail a boat really well to windward is the hardest lesson for the budding helmsman to learn. There is one golden rule that should be learnt: 'Never starve the ship'. By this I mean never haul the sails in so hard that the boat becomes sluggish and, by the same token, never sail so close to the wind's direction that the wind ceases to drive the boat. The whole object of sailing to windward is to find a compromise between sailing so close to the wind that the wind ceases to have effect, and sailing so far away from the wind as to waste the forward driving force.

Sailing to windward is an art, and like all arts can only be mastered with experience. Again like all arts, real mastery will come more easily to those with a feel for sailing a boat. There is much in common between the tiller in the hand of a sensitive helmsman and the reins in the hands of an experienced horseman. The method of sailing to windward briefly is as follows: trim the sails as flat as will cause the boat to give her best performance. Only experience will show the degree of flatness your particular boat can stand. You meet the changing shifts of wind by slight alterations of course, you so to speak 'fence' with the wind with the tiller, trying to anticipate as much as possible. If the wind draws ahead, the sails will shake and you must put the tiller up to windward to turn the boat's bow away from the wind and so bring the wind on the beam until the sails cease to shake. Watch carefully both the sail and the burgee (the flag at the masthead). When the burgee is making a broader angle with the fore and aft line of the boat than the sail, you can take this as a warning that you are sailing too far off the wind. Now you must put the helm away from the wind ('down'), so bringing the bows into the wind until the sail starts to lift, which is your sign to bear away just sufficiently to stop it shaking.

It will be obvious that constant attention is necessary to sail a boat well when close-hauled. This is particularly true of that most popular type of craft, the sailing dinghy. The reactions of the sailing dinghy are tremendously quick, and it has been said that the man who can sail a dinghy to windward well, can sail anything. A yacht will always heel over more when sailing to windward than on the other points of sailing. This may look dangerous to the onlooker but, in fact, when sailing to windward the helmsman has complete control of his boat as long as he keeps her moving through the water.

To sail on the points of sailing known as reaching and running, although not so difficult as windward sailing, nevertheless requires experience to get the most out of the boat. Figure 5 shows how the sails should be trimmed for these various points of sailing.

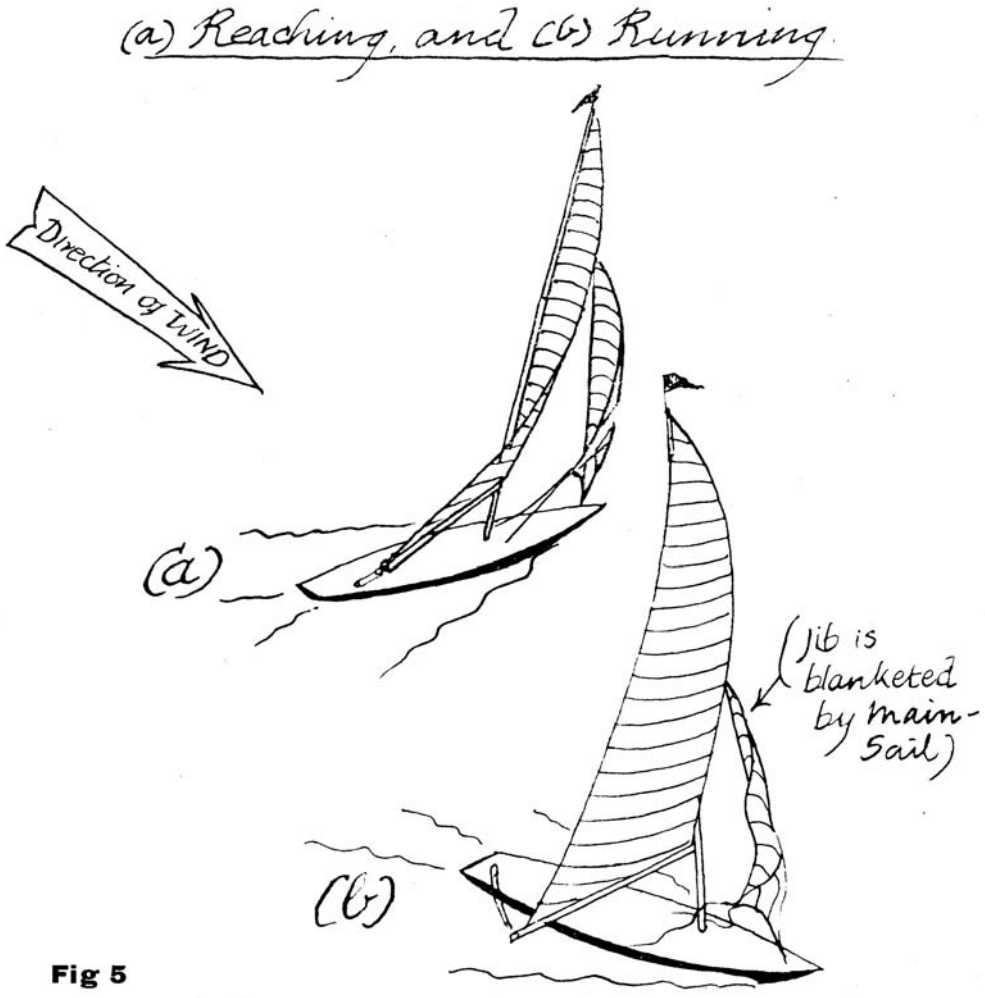



**Fig 5**