

## HOW PLANES FLY AND BOATS SAIL INTO THE WIND

By Richard Sorokin

To create lift on an airplane wing you have to unbalance the air pressure surrounding it. This is done by having one surface longer than its opposite surface. This is accomplished by making one side of the wing curved and the opposite side flat. The amount of air moving over the longer curved surface has to spread out and speed up. Space between the molecules widens and less pressure is put on this surface. Now, the situation is such that the pressure on the flat surface is greater than the curved surface and this pushes up, giving "lift" to the wing. The force of the lift is determined by the curve of the wing and the speed of the air. The Wright brothers made a wind tunnel and experimented with these phenomena. The original device is in the Franklin Institute Science Museum in Philadelphia. They measured the lift and drag of many wings before they got the best curve.

In your home during the summer when the windows are open a wind will cause a door to suddenly close. The moving air, wind, has less pressure than the fixed; still air thus the still air pushes the door close.

Modern sail boats use the same principal. Move air over a curved surface and you get lift. The more air the more lift. The main sail is the basic wing. It is made in such a way that it has a curved surface. You set the sail at such an angle that the wind blows over both surfaces as in the airplane wing. This gives you lift or a force on the flat side of the sail. The fore sail, the jib, is set to enhance the amount of wind going over the main sail. In this manner a modern sailing vessel can sail less than 35 degrees into the wind.

The resulting force is not usually in the direction of the bow but more perpendicular to the main sheet. To convert this force to move the vessel in the direction of the bow, centerboards or keels are used on all sail boats except a catamaran. Catamarans use the shape of their hulls to redirect the forces. The fore and aft rig replaced the square rig sail. It can travel in most directions and has a big advantage.

The square sail era was around for a few thousand years. Today almost all small sailing boats are fore and aft rigs. Some larger vessels use a combination rig. The days of these huge square riggers like the *Flying Cloud* and the *Thermopole* are gone forever. What a sight these clouds of sail must have been coming over the horizon.

If you have a chance to notice a modern airplane wing you'll see at take off, low speed devices extend from the wing to enhance the curve effect. On some planes the forward part of the wing extends and drops down increasing the curve. Flaps on the rear of the wings extend and drop down increasing the curve. All this increases the lift and extends the payload of the aircraft. As the plane increases in speed these devices are retracted because they cause drag and are not needed for the increase in speed gives the normal wing all the lift it needs. The modern airplane wing is a marvelous advancement.