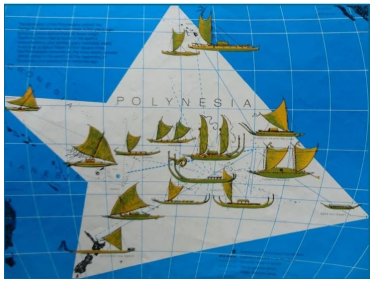
# SAILS-AND HOW THEY WORK

There are basically two categories of sails. “Square Rigger” sails are square like those seen on 1700 European Sailing ships and Viking ships of the 1100 where the sail sits perpendicular or across the hull of the vessel.

The second category of sails are called “Fore/Aft” sails because they tend to run parallel to the length of the hull from the forward or bow of the vessel to the stern or back of the vessel.

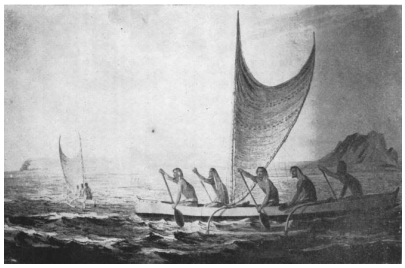
The Fore/Aft sails tend to be more efficient in sailing to the windward (the direction the wind is blowing form) than Square rigger sails.

Fore-and-aft rigged sails are further divided into categories which describe how the sail is attached to the mast. They include **staysails**, **Bermuda rigged sails**, **gaff rigged sails**, **gunter rig**, **lateen sails**, **lug sails**, **tanja sails**, and **crab claw** sails.




The sails used among the islands of the Pacific prior to European contact were Fore and Aft sail rigs. Each Island group had their own unique form of Fore and Aft sails which are further described as being **Crab Claw** sails.

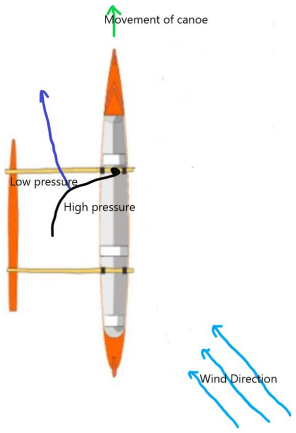
The **crab claw sail** or, as it is sometimes known, **Oceanic lateen** or **Oceanic sprit**, is a triangular sail with spars along upper and lower edges. The Hawaiian sail is a **Crab claw** Sail.



**HOW DOES A FORE-AFT SAIL WORK?**

When sailing with the wind the sail literally **“catches the wind”** causing the canoe to be blown before the wind. When sailing downwind the canoe can not sail any faster than the speed the wind

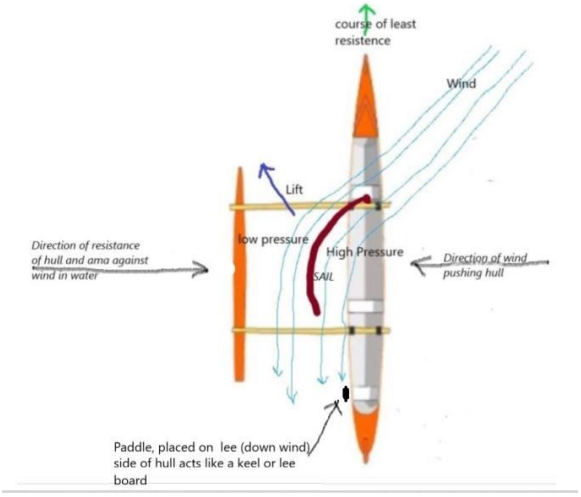
is blowing.  In fact the canoe, when sailing downwind,  will move slower than the speed of the wind because of a force called **Drag.**




**Drag,** is the resistance a solid object (canoe hull) experiences when it moves through a fluid ( the ocean)

Because the Hawaiian canoe hull is quite narrow ( one to two feet wide) there is less surface of the hull to create **drag** than if the hull was six feet wide. The narrow hull creates less **Drag** allowing the hull to move faster down wind.

The advantage of using a " **fore and aft"** sail rig is that a vessel using this kind of sail can not only sail in the direction the wind is blowing (down wind) but also across the wind or perpendicular to the direction the wind is blowing from.  It also allows the vessel to sail at an angle and in the general direction form where the wind is blowing (up wind).  No sail can sail directly into the wind.




When properly trimmed (adjusted or positioned), the sail's leading edge points into the wind, creating higher pressure on the windward side (the side facing the wind) and lower pressure on the leeward side (the side away from the wind)."

The sail "lifts," or moves, toward the lower-pressure side causing the boat to move. This happens because the sail isn't a flat sheet of cloth, it's curved, like a wing and the air traveling over the
topside of the curved portion travels faster than that traveling on the underside.  The curvature, or "draft," of the sail is caused by the wind being captured by the sail on the windward side and the flexibility of the spar or **Paepae** which causes the windward side of the sail to fill and bulge out toward the lee side.

Not all of the lift developed by a sail moves the canoe forward. Since the direction of lift is roughly at right angles to the sail, some of it tries to pull the canoe sideways, too—but the narrow shape of the canoe hull along with the narrow shape of the ama combined with the steering paddle being placed on the downwind side of the hull, creates higher resistance or **Drag** to the sideways force of the wind.

Because the hull of the canoe is longer than it is wide, there is more **Drag** along the side of the hull then there is toward the bow or **Mua** of the canoe.  This reduces the resistance or **Drag** at the narrow and pointed bow of the canoe allowing the canoe to move forward.

How much of the total lift acts to pull the canoe forward and how much sideways depends on the “point of sail,” the angle between the canoe and the wind: Closer to the wind = more sideways component, because the sail is trimmed in closer to the centerline of the canoe.

Because of this, when “beating” into the wind, most sailing vessels including canoes,  move a little sideways as well as ahead. Sailors call this “making leeway,” and always has to be  taken into account when navigating your course.