In the water, a surfboard has two different states, or personalities. It can be a *displacement* hull or a *planing* hull, or it can be a combination of the two. Most of the time it is a displacement hull, so let's discuss that first.

THE SURFBOARD AS A DISPLACEMENT HULL

Let me now remind you of the first and third functions of a surfboard, which I spoke of earlier, and relate them specifically to surfboards. Let me also draw your attention to three definitions:

displace—to take the place of

displacement—the weight or volume of liquid (for example, water) displaced by a floating or submerged body (such as a surfboard and a surfer)

Archimedes principle (Ar-ka-mee-dees—he was the man who jumped out of his bathtub and yelled "Eureka!" when he thought of how to measure the amount of gold in the king's crown)—any object placed in a liquid is buoyed up by a force equal to the weight of the liquid displaced

When a surfboard is a displacement hull it is like a tugboat or an ocean liner. As the board floats, or moves at paddling speed in the water, it supports itself and the surfer with its buoyancy. A surfboard weighs about five pounds per cubic foot, and seawater weighs about 64 pounds per cubic foot. The human body weighs slightly less than the equivalent volume of water, so that when a naked person is in the water (with a little air in his lungs), he will float with just the top of his head out of water. Neglecting the weight of the board, a surfboard with a volume of two cubic feet can support a surfer weighing 120 pounds, and a board with a volume of three cubic feet can support a surfer weighing 180 pounds. If the 180-pound surfer lies on the two-cubic-foot board, the board will sink until 60 pounds of the surfer is underwater, while the remaining 120 pounds stays above the surface.

When you lie on your modern surfboard and paddle, the board and some part of you will be in the water. As you push along, the water will flow easily around the smooth curves of the board, but will get tangled up in eddies and turbulence around the part of your nonstreamlined human shape that is in the water. The more of your

human shape that is in the water, the slower you will go! Ask yourself who goes faster—the swimmer with no board or the person paddling the surfboard? This is the reason why getting a conventional, short knee board out to the break is such hard work. You really don't paddle it out; you *swim* it out.

What does this mean? It means that the shorter, narrower, and thinner your board is, the harder you will work to paddle it and the slower you will travel (see Chapter 13).

Well, you say, I'm young, strong, and I've got great shoulder muscles, so I'm going to buy that thin, gun-shaped speedy beauty and really carve up the waves, even if it does disappear underwater when I lie on it. My answer is: go to it, *but* you may be able to last only two hours in good surf before you're exhausted, while your friends with the floaty boards stay out for four hours. In addition, you will have to take off on the wave much later than the others. With so much of your body in the water, you may not be able to paddle fast enough to catch anything but a steep-faced wave.

If you are an expert, or professional surfer, don't worry about flotation or buoyancy. You surf enough so you have plenty of paddling endurance. You don't mind late takeoffs in the soup, and you enjoy the initial vertical drop. However, you beginning, novice, or intermediate surfers who surf only on weekends and two weeks in the summer, buy a board that floats you! Don't pay any money for a board until you know that it will support you enough so that when you lie on it in the water, almost all of your body is out of the water, and that means all but your feet and shins. Many self-styled experts on the beach and in the surf shop will say that a board "floats" them, when actually they can sit on it and the board disappears and their body submerges to the waist (see Fig. 4-1). So don't take any of their buoyancy judgments seriously. Try out the board yourself, in the water, before you pay.

BUOYANCY

Measuring the buoyancy of a surfboard is not difficult. In my opinion, every surfboard manufacturer should permanently mark on every board the weight the board will support before it submerges. Most surfers would be amazed at how little the short surfboards and knee boards will actually support. (In Chapter 13 I

Fig. 4-1. This surfer would probably tell you that his board "floats" him, when it actually supports less than 60 percent of his weight and is unsuitable for small waves

discuss some work I have done in this area.) If the manufacturers won't do this, then I feel it is the responsibility of the surfboard dealer to discover this vital quantity by testing the boards he has in stock. I wonder how many novice or intermediate surfers have become discouraged over the past two years because they were sold boards with insufficient buoyancy. A "submarine" will work you to death paddling out and will be difficult or impossible on small waves.

If the support weight is not marked on the board by the manufacturer or the dealer, take the board out to the water and lie on it. If you find that a lot of you is in the water, take it back and get a larger board. Surfing is strenuous and challenging enough without using a submarine for a surfboard.

The buoyancy of the board should be well distributed. Here *buoyancy* means the same thing as *thickness*. The thickness of a surfboard is the distance from the deck to the bottom, and is usually between 3½ and 4 inches at the midsection, 1½ to 2½ inches at the nose, and 2½ to 3½ inches at the tail.

The board should be buoyant, or thick, from the center almost all the way to the rails. The rails themselves should not be too thick, but the thickness should be carried to within 2 to 3 inches of the rail and then sloped into the rail itself. This will make for a stable surfboard. If the rails are thin and the thickness is concentrated in a ridge down the center, the board will be tippy or unstable.

The tail of the board should be of generous thickness because it has to support your legs as well as the lower part of your body. The tail must be buoyant enough to rise as the wave comes under you, because the board must slope downhill or it will not slide well on the face of the wave.

Be sure to buy a board with a buoyant nose. A surfboard with a thin or nonbuoyant nose will give you trouble every time you lie on your board an inch too far forward (this can happen often); the nose will immediately sink. I had a board like this once. The nose and tail were thin, and there was a buoyant hump in the middle. If I didn't lie within a half inch of the right place, either the tail would sink too much (which was annoying) or the nose would go under, which was a disaster. Make sure your board has a thick, rounded nose for stability and safety; those long, pointed noses are useless for anything but waves over 10 feet high.

Buy a surfboard that floats you well, and you can: stay out longer because paddling is easier, catch waves earlier and farther outside and ride them farther in, stay warmer in the winter because less of your body is in cold water, and have fun on small waves.

THE SURFBOARD AS A PLANING HULL

The other state, or personality, of a surfboard is that of a *planing* hull. Planing is something we see outboard motorboats, fast yachts, and Navy P.T. boats do when they are going fast. The hull of the boat rises out of the water, the bow sticks up more than the stern, and the boat seems to skim on top of the water. A water ski is a good example of a planing hull. A water skier is entirely supported by planing action.

Some sailboats will plane if there is enough wind and the conditions are right. This type of sailboat has a shallow draft (doesn't draw much water), is wide, and has a fairly flat bottom. Sailboats that plane the most readily are a type called Inland Scows, which are shaped somewhat like a surfboard with a wide, squared-off nose and not much curve in the outline.

A surfboard is probably closer to a planing sailboat than to a motorboat. Their speed ranges are similar, as are their hull shapes.

Sooner or later one of you is going to say, Why all this talk

about boats? They have *motors*, or they have *sails*; but surfboards are different, nothing *drives* a surfboard!

Wrong. A surfboard is very similar to a boat and it is driven by *gravity*. The same force that caused the apple to fall on Sir Isaac Newton's head pulls the surfboard and its rider down the face of the wave. The face of a wave is a steep slope made of *water* instead of grass, asphalt, or snow. It differs from the other slopes because it doesn't last long and it moves at 5 to 15 miles per hour. But at any given moment, it is a steep slope made of water, and a surfer and board will slide down it just as a skier slides down a snow slope. All surfers know that when the wave face is not steep (a spilling wave), you must paddle hard to catch the wave, and then you take off slowly. When the wave face is steep (a plunging or hollow wave), you need to paddle very little, and then you take off fast. You don't take off fast because the wave is fast, you take off fast because the wave is *steep*. (Look back at Chapter 2.) The only kind of wave that will actually *push* you is a broken, or translation, wave, which is already carrying a load of water and foam in to shore.

PLANING

A displacement hull is a very limited thing. It can support only as much as it displaces, and it cannot go fast because the water around it resists being pushed aside quickly. On the other hand, a planing hull is a much freer thing, in that it can go as fast as you dare push it, and it will carry a wide range of weights, which depend on speed, planing area, planing width, planing angle, and drag.

Instead of gliding *through* the water and pushing it to one side, a planing hull rides *on top of the water* and at a slight (2- to 5-degree) angle to the surface of the water. There is a wedging action that takes place, whereby the hull is trying to push the water down, and the water is pushing up (see Fig. 4-2). If there is no angle, there is no wedging; the water does not push up, and the hull isn't planing anymore. The faster the hull goes, the harder the water pushes up and the smaller the hull needs to be to carry a certain weight.

An important characteristic of the planing state is that the water does not close in around the stern of the hull or the tail of the

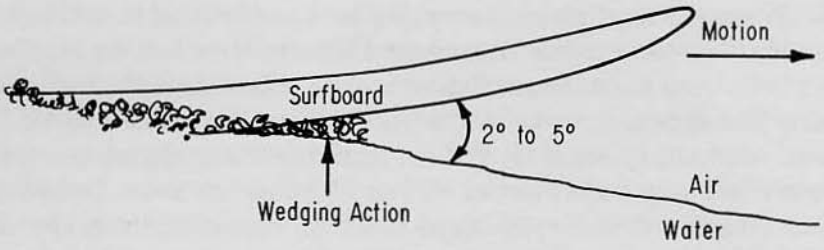

Fig. 4-2.

surfboard. The water leaves as soon as it can disengage itself from the trailing edges (see Fig. 4-3), and closes in *after* it leaves the trailing edges; then resumes its former level. The faster the water flows past the trailing edges, the farther from the tail of the board will be the water that closes in. The sharper the trailing edges the more easily the water disengages and the lesser the drag. The water will not want to wrap around a sharp corner, but it will want to wrap around a blunt, or large-radius trailing edge. For this reason you will find that most surfboards have hard, down rails in the tail. (Please understand that I am talking about the *rail shape* and not whether the board has a round tail, pintail, or square tail.)

Surfboard planing depends on the area of the bottom, the width of the board, the speed the board is traveling in the water, and the

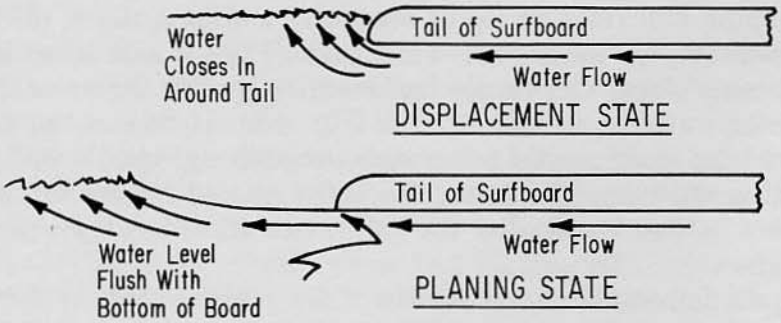

Fig. 4-3.

weight of the surfer. The greater the area the better, the wider the better, and the faster the better (this last is the most important). If the board does not plane easily at low speeds, you will have difficulty catching spilling or flat waves. You will be confined to faster-breaking, steep-faced, hollow waves, and your enjoyable surfing will be limited to those times and places that such waves are available.

You want your surfboard to plane quickly while you are *catching* the wave, because if you can't catch the wave, the other aspects of surfing don't mean a thing. When you are on the face of a wave, paddling hard, you want the board to speed up quickly and develop enough *planing lift* so that you can jump to your feet without having the board sink (see Fig. 4-4). As I have said before, if the wave has

Fig. 4-4. A surfer whose board is "mushing out." His surfboard has sunk below the surface; he did not have enough buoyancy, planing area, or width for these small, spilling waves

a steep face, almost anything will work, but if the wave has a flat face, like most of the waves we surf on, you will need a surfer-surfboard combination that has low drag and gets going quickly. This low-drag, easy-starting combination is a surfer with a board that floats most of him and keeps most of his high drag—legs, knees, and feet—out of the water. *Surfboard buoyancy is the single most important factor for the average surfer.*