Big Water

by Cynthia Mills

Few natural and dangerous realms remain in this mostly tamed world. The surf zone is one. If you've ever been knocked off your feet by a pounding wave, you understand the might of the sea.

Waves are a power born of wind, water and land that can break with a force equal to hundreds of tons per square yard. They form when energy from the air is transferred to the water. Many begin their journey in the latitudes with the most turbulent regions of atmosphere, the so-called Roaring 40s that stretch from 40° to 50° latitude in both the northern and southern hemispheres. Low pressure systems create storms with high winds that stir up large, irregular waves. As they move outward from the storm's center, they become more regular, changing into groups of long broad waves called swell.

If uninterrupted by land, a swell can travel hundreds of miles from its point of origin. This is possible because as the swell moves into undisturbed water, its front wave acts as an advancing force, allowing the waves behind it to conserve their energy. It's like bike racers who draft off one another, taking advantage of the reduced air pressure created by the cyclist in the lead. At the same time the front wave exhausts itself and fades away, a wave at the back of the swell replaces it. Because the energy of only one wave subsides at a time, the swell is able to maintain its speed — which turns out to be half the speed of one of its waves.

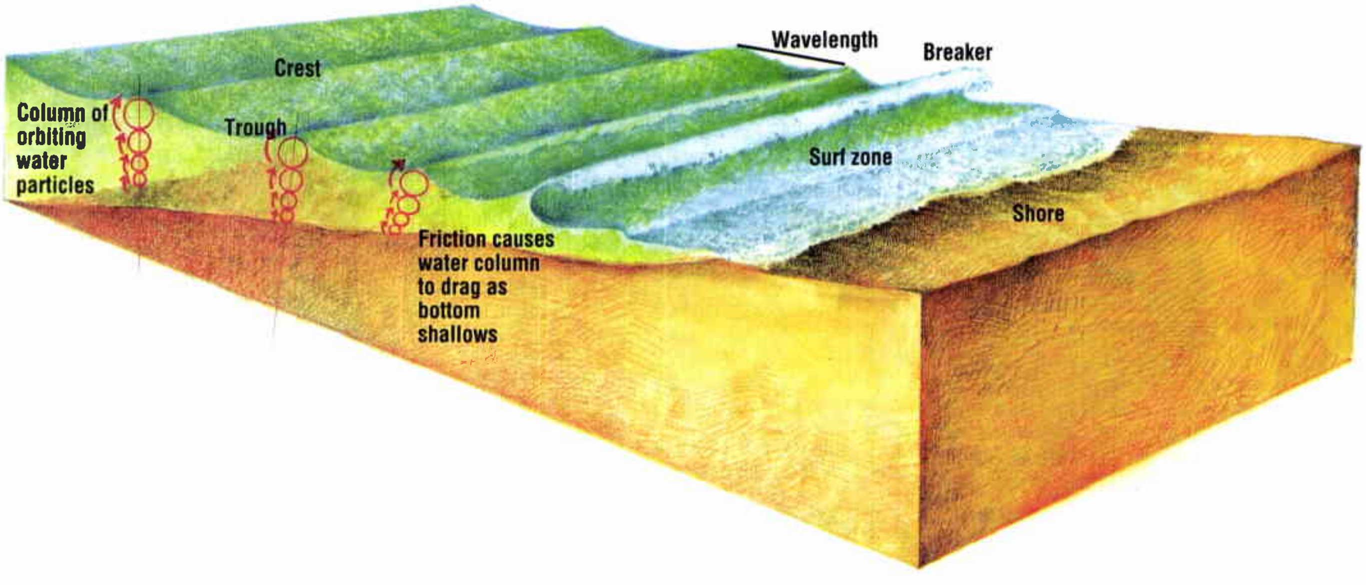
Although waves can travel hundreds of miles across the ocean, the water itself doesn't move forward at all. If you've ever gone fishing, you've probably noticed how your bobber moves up to the top of the wave, called the crest, and down to the bottom, called the trough. But the bobber doesn't move much toward shore with the wave. Water itself behaves in the much the same way. It stays in one place as the energy of the wave passes through it and travels beyond.

The wave is made of water particles rotating in a circular direction under the water's surface. The rotating particles are stacked one on top of the other in a vertical column. At the surface of the water, the diameter of their orbit is equal to the height of the wave. But the diameter of each orbit below that gradually becomes smaller. At a depth of one-half the wavelength, the distance between the crest and trough, the orbital motion dies out. This is why scuba divers in deep water are unaffected by wave action.

As the wave form approaches shore, the vertical column of rotating water particles makes contact with the seafloor. Friction causes the bottom of the wave to slow, even though water at the surface continues to move at the same rate. The wavelength, which may have been quite broad and gently sloped at sea, becomes shorter and much steeper closer to shore. Water piles up at the wave's crest, which continues to move forward until the wave can no longer support itself. Inevitably it breaks into the surf zone, sometimes crashing with force enough to kill.

Surfers aren't intimidated by this

This illustration shows wave motion as it nears shore. When the column of water touches land, the bottom of the wave slows. The top continues to move forward, steepening to a point where it can no longer support itself. Finally the wave collapses into a breaker and crashes into the surf zone.



Matthew Groshek

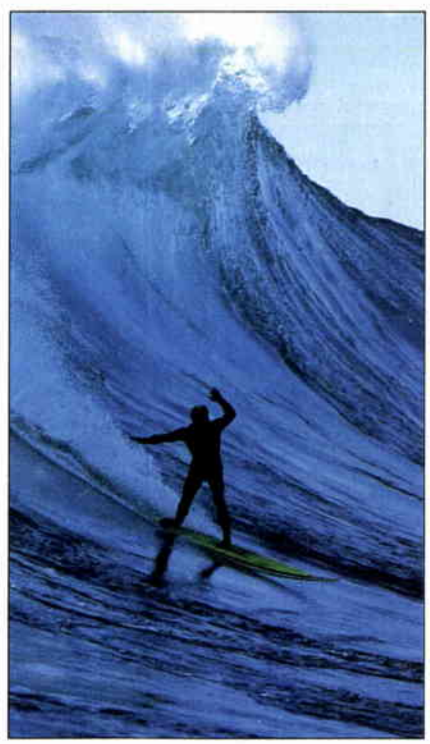
Steve Lissau

It's likely that this powerful wave originated from a storm near the Aleutian Islands and travelled for days before breaking in Waimea Bay, on the northeast shore of Oahu, Hawaii.

fact. They brave the biggest water in places like Southern California and Hawaii, knowing full well that monster waves occur mostly in the Pacific Ocean. This huge ocean generates more storms than the Atlantic and, therefore, more swells. Wide and powerful swells are born from huge fetches, large areas of ocean where strong winds blow without interference. A narrow fetch could create big waves, but they would tend to spread and dissipate, the way a flashlight beam fades at its edges.

The contour of land under the ocean also plays a key role in the size of the wave. The broad continental shelf off the United States' Atlantic Coast extends far out into the ocean. When large waves encounter it, they are slowed down further out at sea than they are on the Pacific Coast. The continental shelf off the coast of California, however, rises abruptly near shore. As a result, waves are stopped suddenly and tend to break with more power closer to the beach.

The classic big wave spot is Waimea Bay on the northeast shore of Oahu, Hawaii. Here surfers in the late 1960s first successfully rode 30- and 40-foot waves. The volcanic island juts out from deep ocean with no continental shelf at all. But Waimea Bay waters conceal a reef that rises at a 30 degree angle. When an incoming wave hits a submarine point at the north end of the reef, one side of it slows down. The other side bends, or refracts, into the bay like a cracking whip, taking with it increased speed and energy. The bottom of the wave drags and the water column steepens. Sometimes the friction is so great that the top of the wave flies forward and down, creating the watery cylinder called a tube that surfers all over the world dream about — and only on occasion experience. ⊕



Robert Brown

Surfers know that the biggest water occurs in the Pacific, the ocean that generates the most storm systems.