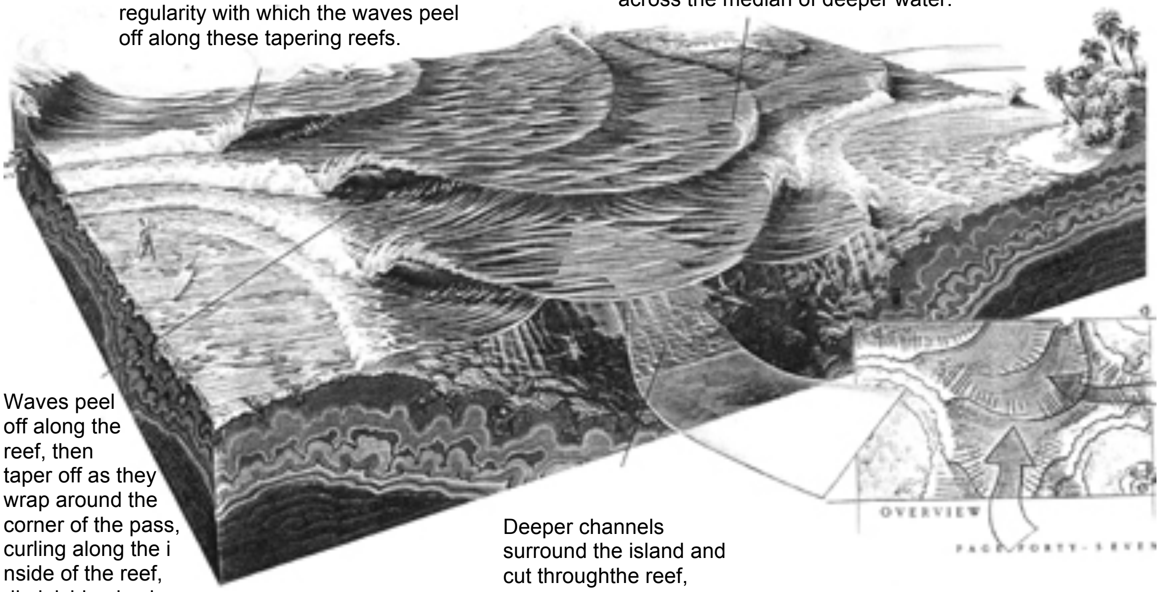
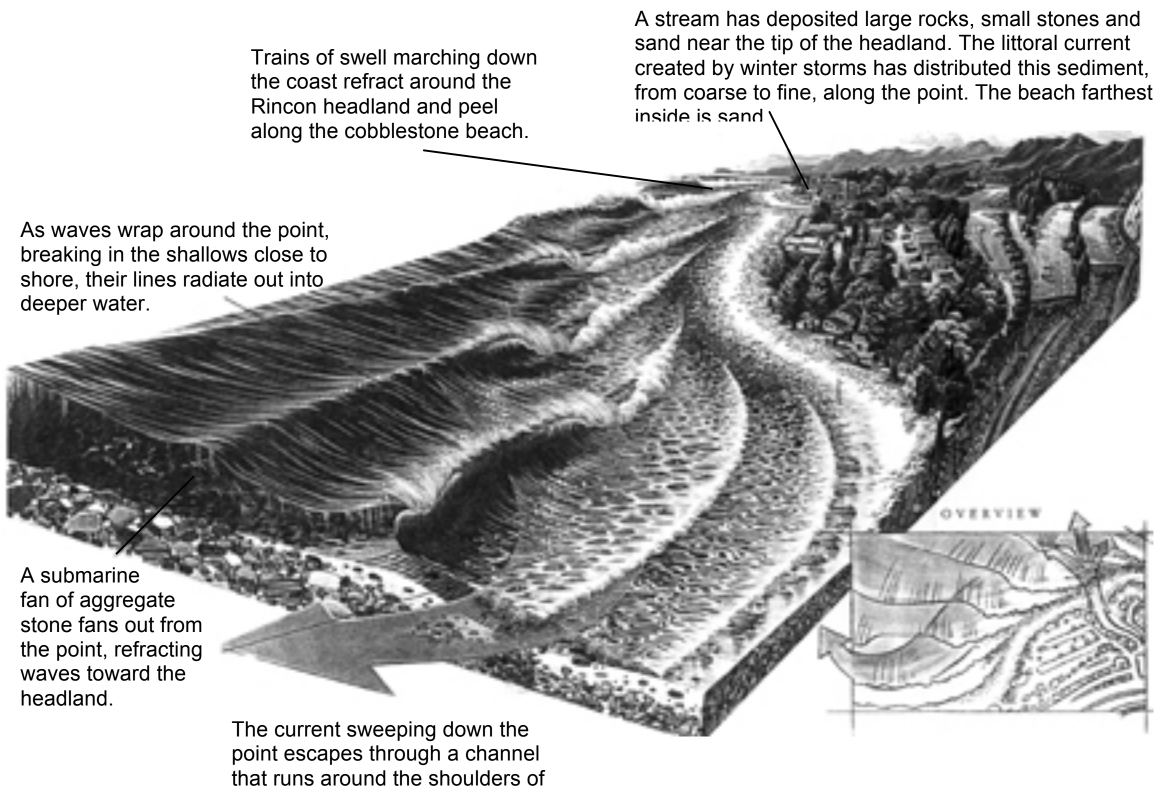
Interestingly, some human bodysurfers have also learned the art of surfing the underwater constant-pressure surfaces.

Just as not all beaches and bottom configurations help to develop plunging waves, not all beaches—relatively few, in fact—are conducive to the creation of waves for surfing. A perfect wave for surfing is one that is refracted in such a way as to concentrate its power in a given area of the wave band, then "peels" off laterally over a relatively abrupt, shallow bottom so that the wave is a plunging breaker with an extremely concave or "hollow" face. When the crest of such a wave pitches out toward the trough, it can then complete a tunnel-like formation, creating the ideal "barrels" that the best surfers travel the world to find.

Reef Pass Wave Tavarua Island, Fiji



Point Break Wave Rincon Point, California



In the dramatic last seconds before lines of swell become breakers, waves respond to the sudden shallowing of the water depth by gaining considerably in height (sometimes double or more the swell height), developing a critical concave face, and assuming a beach-facing profile that reflects the immediate characteristics of the bottom shape directly under the wave. These local bottom configurations determine the final form of the breaking waves. In general, there are several types of wave "breaks."

Relatively straight sandy or gravelly beaches with a gentle slope create "beach break" waves—a pattern of peaking waves with periodic channels to carry the advancing water back out through the surf zone. Such waves break on sandbars or "gravelbars," deposits of material mobile enough to be arranged and rearranged at the whim of swell, tide and wind. Often the beach face is scalloped in a regular pattern of "cusps" reflecting the regularity of the coastline, the subsequent regularity of the refraction that concentrates and disperses the wave energy, and the mathematical relationship between the advancing force of waves and the receding flow of water.

Outgoing currents of water between areas of breaking waves are called "rips" or riptides; in large surf they are capable of becoming overwhelmingly powerful channels, in moving rivers of water heading back out to sea—frightening locations for swimmers, but ideal on-ramps for surfers wishing to make it through the near-shore "beach break" waves to catch rides in deeper water.

Very steep sand or gravel beaches are likely to produce surging breakers, where the depth immediately offshore is insufficient to greatly diminish the potential energy in the breaking waves. Thus, most of the wave energy is released directly up onto the beach face or reflects back at the incoming waves; the outgoing sheet of water creates a "backwash" effect that can double or triple the size of an approaching wave, often with spectacular effect.

Submarine formations like coral reefs, rock reefs, sunken ships and other relatively abrupt submerged or partially-submerged formations create "reef" surf — waves that break more or less abruptly and in a variety of shapes, depending on the configuration, depth and size of the obstacle.

The famous Banzai Pipeline off Oahu's North Shore is a reef break; swells radiating in from great Pacific storms to the northwest come out of very deep water to touch coral reefs more than a mile off shore. This outside reef bends the waves, focusing them in on the near-shore Banzai reef with little loss of energy. The waves rise steeply over the "outside" reef, then appear to almost disappear in the intermediate deep-water zone, then abruptly "jack up" as they rush in at the abrupt "inside" reef. There, these giants that have come so far are forced up out of themselves by the sudden wall of battered coral. Immediately there is insufficient water the trough of the wave for the circulation of water. The face goes as concave as a storm pipe (hence the pipeline name), the crest becomes a "lip" of plunging water that leaps beachward to complete the cylindrical shape of the wave, creating the spectacular hollow within, followed by the familiar blast of mist as the wave collapses around the pocket of trapped air. Add to these fundamental dynamics the angled seaward face of the reef, which causes the wave to peel off to the left and (sometimes) to the right, and it would be hard to imagine a more perfect wave. And, if all this weren't enough, the prevailing wind is off the land and straight up the left-breaking faces of the waves. This has the effect of smoothing the faces, holding them up longer, and allowing them to grow even hollower before breaking.

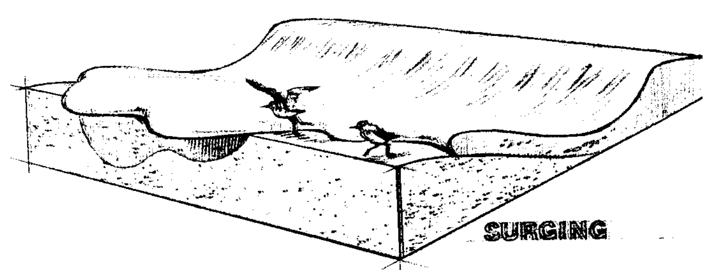
It is this "shoulder" effect, where the wave can peel along the angled edge of a shallow reef, that makes a wave of interest to surfers. A triangular-shaped reef, with its apex pointing to sea, will tend to create an initial peak wave, then waves will peel off in either direction as the lines of swell refract and converge alongside the reef. The result can be symmetrical, twisting cylinders of great beauty and finesse.

Assuming a perfect equilateral triangle with its base parallel to shore, such a reef would create the most perfectly balanced peeling waves when the lines of swell approached it squarely. Should the swell direction be from one side or the other, the wave on the near side of the triangle will tend to peel off too fast (to "close out" or "section" ahead of the rider) while the wave on the far side will be "mushier" and less hollow—more of a spilling breaker—as it wraps around the apex of the triangle and disperses its energy into the deeper water beyond.

Peeling waves can also be created by "passes" in coral reefs — channels created in the living formations by the runoff of fresh water from the tropical island land masses which these living reefs tend to surround. Here, the typical surfable wave will wind off the end of one shallow shoulder of reef, peeling toward a deep channel. Such waves can be a mile or more out from shore, and because the reef itself is usually submerged, these walls of water have an isolated and unpredictable beauty.

The one-directional peeling of the reef-pass wave is similar to the peeling of a typical "point" wave, created when lines of swell wrap around a coastal promontory or protrusion and break—often with remarkable regularity and evenness—as they refract around the bend at a relatively constant distance from the curved shoreline.

One fine example is the wave at California's Rincon Point near Santa Barbara—a beautiful triangle of cobblestoned shoreline extending roughly a half-mile from the inside cove to the apex of the point where a creek spills out into the Pacific. The machine-like regularity with which the swells fan around the point and trace the even shape of the shallow bottom with a surging carpet of white water is a moving impression to the surfer and wave watcher alike.



Whereas the exposed tip of such a point or promontory will generally have a rocky, gravelly or boulder-strewn beach, the bay into which point waves peel is typically a repository of fine sand. This is because, once a wave has broken into a tumbling chaos of foam, it has lost its internal oscillatory motion. Instead, the particles of water are actually driven forward by the momentum of the wave action. This movement of water toward the beach translates into a strong beachward current along points and promontories. It is this current that is able to move large amounts of sand and other fine particles along the point and into the bay. As energy, momentum and wave speed dissipate, the sand drops to the bottom or washes ashore. For this reason, peeling point waves will often end in an abrupt beachbreak "close-out," as a long section of wave suddenly shoals over a sandbar or surges up onto a straight beach.

Whatever their form, whatever their size, whatever their cause, waves are relentless proof of the power of great outside forces over our lives—the same forces that suspend our world in space, in an intricate web of physical laws—the same forces that sustain the very fabric of our reality.

Waves are carriers of a very important message: that we are not alone, that we are part of a larger whole, and that we are an important enough part of the whole to deserve this lavishly beautiful and magnificent planet. Waves are living proof that something in nature and the universe has quite a high opinion of our intelligence and our capacity for appreciation.

Poetically, waves may be the lips of the sea, eternally communicating —simultaneously—to an infinite number of landfalls. Scientifically and physically, waves are great translators or transformers of energy. If we owe all life to the sun, then ocean waves are, literally, messengers of the gods.

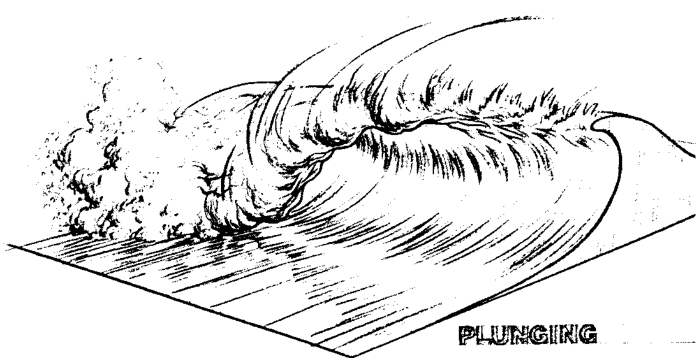


Figure 10 - Types of waves: Depending on the local bottom conditions and the steepness of the beach, waves break in three distinct fashions - surging, spilling, and plunging.

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