Many of us have, at some time, fantasized about being ship-wrecked on a deserted island, knowing that our only hope of communicating with the outside world would be through messages sealed in bottles and tossed into the sea. As we toss the bottle into the water, we would likely pray that our message would travel by wind and ocean currents to some distant beach. There, a beachcomber would find the bottle, alert the world to our plight and send a ship to our rescue.

Scientists too dream of where the winds and currents will take an object floating in the ocean waters. Indeed, many theories of the colonization of the isolated Pacific islands such as Hawaii and Tahiti by humans and plant and animal life have been based upon the ability of winds, ocean waves and currents to transport them from one island to the next. Lizards such as the crested iguana of Fiji likely traveled across many kilometers of ocean from South America clinging to drifting trees before landing on a life-saving beach.

Oceanographers have long used floating objects to discover and study ocean currents. The technique generally employed is to release small bottles known as drift bottles into a specific area of the ocean. Each bottle contains a message asking the finder to return it indicating the date and location where the bottle was found. The path and time of travel can be estimated using the recovery information, the time and place of release and mathematical models of wind and ocean currents.

Curtis Ebbesmeyer, an oceanographer in Seattle, Washington has had a long interest in ocean currents and floating objects. His interest includes the possible historical and cultural significance of objects that may have floated across the Pacific Ocean from China and Japan to the Americas and influenced native cultures. He has even documented the trans-Pacific drift of the rubber wheels from the first aircraft to successfully cross the Pacific solo. They entered the ocean off Japan where the pilot had jettisoned them shortly after takeoff in order to reduce the weight of his aircraft and assure an adequate fuel supply for the flight. The wheels eventually reached shore in Washington State, not many miles from the final landing point of their aircraft.

Researchers have often used releases of drift bottles to provide data for studying ocean currents and testing mathematical models. Over the years, Ebbesmeyer has developed a rule of thumb for the recovery of objects released into the ocean currents. As the distance of the release site from the shore increases, the number of bottles recovered onshore decreases. For drift bottles or other mass released objects, 50% or more will be recovered.
when the release is within several miles of the shore. At release distances of hundreds of miles, recovery rates are generally below 10%. Only a few percent are recovered when objects are released 1000 miles or more from a shore. Therefore, it takes a large release to provide useful information on the movement of objects drifting in the open ocean. In drift-bottle studies, large releases have ranged from 21,600 to 148,400 bottles, but generally the releases have been smaller, under 1000 bottles.

In the past several years, Ebbesmeyer's latest research has used a single message-in-a-bottle, floating running shoes, bathtub toys and hockey equipment along with a computer simulation model known as OSCURS (Ocean Surface Currents Simulation) to study the effects of wind, wave and currents of the northern Pacific Ocean.

The Great Pacific Running Shoe Ultra-Marathon

In late May of 1990, the container vessel Hansa Carrier encountered a severe storm in the North Pacific Ocean (~48°N, 161°W) on its passage from Korea to the United States. During the storm, a large wave washed twenty-one shipping containers overboard. Five of these 20-meter containers held a shipment of approximately 80,000 Nike shoes ranging from children's shoes to large hiking boots. It has been estimated that four of the five containers opened into the stormy waters, releasing over 60,000 shoes into the North Pacific Ocean.

The following winter, hundreds of these shoes washed ashore on the beaches of the Queen Charlotte Islands, western Vancouver Island, Washington and Oregon. With the help of beachcombers from British Columbia, Washington and Oregon, Ebbesmeyer was able to determine that hundreds of shoes were recovered. When Oregon newspapers began running the story, the Associated Press picked it up, and the word spread. The publicity resulted in many additional reports of the finding of Nike shoes on Pacific beaches. Dubious about some of the reported finds, Ebbesmeyer decided to confine his study to only those shoes found in groups of 100 or more. Even with this restriction, he accounted for approximately 1300 shoes from the more than 60,000 released.

Despite a year in the ocean, much of the footwear was in fine shape and wearable after a washing. Unfortunately, the shoes were not tied to one another so that matching pairs did not always reach the beach together. Each shoe, however, had an identifying serial number, and with information obtained from the manufacturer, Ebbesmeyer was able to determine that the shoes were indeed from the Hansa Carrier.

Ebbesmeyer and Ingraham used the OSCURS model to determine where and how the shoes may have drifted after the containers were swept overboard. The model suggested that the main landfall would have been around the northern tip of Vancouver Island and the central coast of British Columbia approximately 249 days after the spill. The first reports of shoe landfall came from Vancouver Island and Washington approximately 220 days after the spill. A large number of shoes were recovered in the Queen Charlotte Islands and northern Oregon suggesting that when the shoes neared the North American coast, some were diverted north and others south by coastal currents.
In the summer of 1992, shoes were reported arriving at the northern end of the Island of Hawaii. After reaching North America, these shoes may have continued southward along the California coast and then been pushed off the coast by currents moving westward to Hawaii.

**Have You Seen My Rubber Ducky?**

Ebbesmeyer's next serendipitous study of the ocean currents in the North Pacific came in late 1992 when a large number of brightly colored bathtub toys were reported on the beaches near Sitka, Alaska. These toys had been part of a shipment of containers headed from Hong Kong to Tacoma, Washington. In January, 1992, the container ship carrying the toys among its cargo encountered severe storm conditions near the International Date Line (44.7°N, 178.1°E). Twelve containers went overboard as the ship rolled about 40 degrees in the heavy seas. One of these 20-meter containers held a shipment of 29,000 bathtub toys.

"They're toys for two-year olds, and they're called Floatees, and they're meant to go into the bathtub with the kids," recounts Ebbesmeyer. "Each package has a green frog and a blue turtle and a yellow duck and a red beaver."

When the container emptied the toys into the ocean, they were packed in a plastic housing glued to a cardboard backing. After about a day in the water, the glue deteriorated releasing the four toys into the sea. And, being floating toys, they began to float pushed by wind, wave and currents across the Pacific.

The first landfall of these toys was reported on November 16, 1992. There on the beach of Baranof Island just south of Sitka, Alaska, six toys were found. A few days later, another 20 were found north of the initial site. A further 400 toys were discovered by beachcombers between November 1992 and August 1993 along an 850-kilometer stretch of shore between the city of Cordova, Alaska and Coronation Island in the southeastern Gulf of Alaska.

Ebbesmeyer expanded the search for the toys in newsletter articles and notices to lighthouse keepers and beachcombers on the Queen Charlotte Islands, Vancouver Island and in Washington State. No landfall of toys was reported south of Coronation Island, so Ebbesmeyer assumes most drifted north after reaching the Sitka region.

Ebbesmeyer and Ingraham calculated a number of possible drift trajectories of the toys for the next two years. Some took the flotilla of toys southward to the vicinity of Hawaii. The most likely trajectories, however, took them into the Gulf of Alaska gyre moving westward along the Alaskan coast toward the Bering Sea.

And what of the future for this colorful plastic navy? Ebbesmeyer's calculations suggest that by January of 1994, they should have arrived in the southeastern Bering Sea. Some of the toys would likely be transported into the Bering Sea and then northward through
the Bering Strait into the Arctic Ocean. Others may turn south toward eastern Asia and be caught in the Kuroshio Current perhaps eventually heading to Hawaii.

After five years or so in the Arctic Ocean and ice, the northern flotilla is predicted to emerge into the North Atlantic Ocean destined for the beaches of Greenland, Iceland, Norway, Ireland and Great Britain. While Ebbesmeyer and colleagues look for other information to improve their ocean models, they eagerly await the reports in the year 2000, an invasion of yellow ducks and red beavers and green frogs and blue turtles hitting the beaches of Europe.

Ebbesmeyer sees such accidents as fortunate events for the study and modeling of ocean currents and surface drifting. More information is needed to study the flow of surface waters in the world's oceans. In addition, seasonal current variations or variations during El Niño episodes are poorly understood. By improving the mathematical models which predict the motion of objects in ocean currents and waves, the movement of oil spills and missing vessels or people can be better predicted. This would greatly facilitate clean-up or rescue by determining the path to be followed by a floating object.

Ebbesmeyer and other oceanographers eagerly await the next oceanic escape of rubber ducks or shoes or.... If you live on the coast of one of the oceans or other large water bodies, have a beachcomber's eye for any large deposits of commercial items. They may become part of the next great ocean experiment.