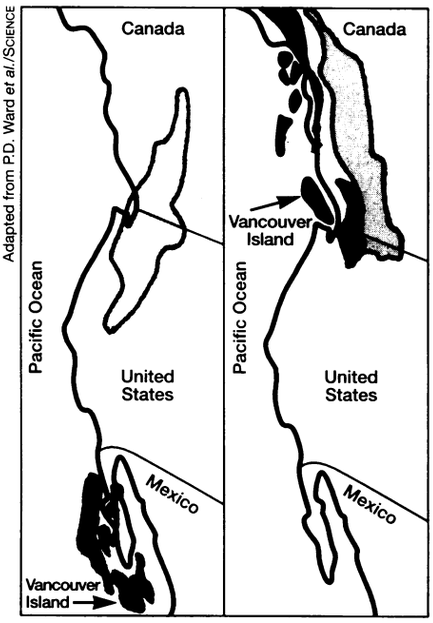
The West Coast's Roving Real Estate

The restless spirit lives deep in the American West, which was built by waves of pioneers seeking something new. First came the ice-age hunters from Siberia, followed by Spanish missionaries, then sodbusters in wagon trains from the east. Even the land itself suffers from wanderlust, according to geoscientists who have discovered evidence that some of the western coastline has migrated great distances, bringing what was once part of Mexico north to form parts of Canada and Alaska.

"Our analysis suggests something like 3,600 kilometers' worth of movement. That's a lot. It tickles me pink to think that Vancouver Island was probably once down where Baja California is now," says Joseph L. Kirschvink of the California Institute of Technology in Pasadena. Kirschvink and his colleagues report their findings in the Sept. 12 SCIENCE.

The new discoveries come from two small islands situated east of Vancouver Island. The scientists collected samples of ancient sedimentary rocks, which contain specks of magnetic minerals. These grains are like frozen compasses: They aligned themselves with Earth's magnetic field when the rocks were forming, 90 million years ago.

Kirschvink and his coworkers deduced the original position of the coastal rocks by analyzing how much these frozen compasses tilt relative to the horizontal. If the rocks formed at the equator, they would have recorded a flat magnetic field. Near the magnetic poles, the field dips steeply.



Adapted from P.D. Ward *et al.*/SCIENCE

Rocks originally attached to Mexico (left) may now reside in the Pacific Northwest (right). Inland rocks (stippled area) may also have moved north.

Kirschvink and his coworkers found that their samples had a much shallower magnetic orientation than that recorded by inland rocks 90 million years ago. According to their analysis, Vancouver Island was at 25°N, the present position of Baja California.

These results square with other puzzling paleomagnetic data collected over the past 25 years in the Cascade Mountains, British Columbia, and southeast Alaska. "I was just absolutely thrilled when I heard about these new results. I felt vindicated," comments P. Jane Wynne of the Geological Survey of Canada in Sidney, British Columbia. Wynne has obtained similar findings from her analysis of Canadian rocks.

Geophysicists who study the paleomagnetic evidence have almost unanimously agreed that the coastal rocks of British Columbia and southeast Alaska took a grand journey, trekking 3,000 to 4,000 km north sometime between 83 million and 45 million years ago. A belt of rocks near the coast apparently traveled between 1,000 and 2,000 km.

The paleomagnetic evidence has not swayed geologists, who fail to see signs of such wanderings. "When you look for the geological and paleontological evidence, I just don't think it's there," says James W.H. Monger of the Geological Survey of Canada in Vancouver. "I'm sitting on the fence."

In particular, geologists want to find the massive ancient faults—similar to the San Andreas fault—that would have separated the peripatetic rocks from the rest of North America. Lacking these or other signs of long-distance movement, geologists contend that the Pacific Northwest coast has not ventured far from its position during the days of the dinosaurs.

Darrel S. Cowan, a geologist at the University of Washington in Seattle, urges his colleagues to test the migration theory. "If it were such a loony idea, we ought to be able to go out and find geological evidence that rules it out. But the geological evidence is weak. Nothing rules out this idea." —*R. Monastersky*

Lucky choice turns up world-record prime

As one of about 1,700 participants in the Great Internet Mersenne Prime Search (GIMPS), Gordon Spence had a choice of numbers to test. One of the numbers that he happened to pick turned out to be a record-breaking prime—the largest number yet identified that is evenly divisible only by itself and 1.

An information technology manager at Thorn Microwave Devices in Hayes, England, Spence used software written by computer programmer George Woltman of Orlando, Fla., to determine that $2^{2,976,221} - 1$ is a prime number. If printed out, this 895,932-digit behemoth would fill 450 pages of a paperback book. It is more than twice as long as the previous record holder, found last November.

Remarkably, Spence used a modest Pentium-based desktop computer to find the record prime. It took 15 days of calculation to obtain the result, which was later verified independently on a supercomputer. Woltman, who organized GIMPS more than a year ago, announced the discovery last week.

The new champion is also the 36th Mersenne prime to be found. Expressed in the form $2^p - 1$, where the exponent p is itself a prime, Mersenne numbers have characteristics that make it relatively easy to determine whether a candidate is a prime. All the Mersenne numbers having exponents smaller than 2,976,221 have not been checked, so another Mersenne prime may yet lurk between the present record holder and the previous largest prime.

Aside from offering the thrill of holding a world record, however briefly, searches for huge primes have led to improved methods of multiplying large numbers, an operation crucial in many scientific and engineering applications. The Intel Corp. in Santa Clara, Calif., uses a modified version of Woltman's program to help detect manufacturing defects in its Pentium chips.

Because a program for testing primes constantly uses key parts of a microprocessor and stores and retrieves huge amounts of data, the chips can generate a greater than normal amount of heat, which sometimes causes failures. Roughly 2 to 4 percent of all machines used in the GIMPS project run into problems, Woltman says.

There are more Mersenne primes to be found, Woltman notes. Anyone with a reasonably powerful computer can join the hunt (http://www.mersenne.org/).

"If we could use all the computing power that was wasted on screen savers, we could move a lot further forward," adds mathematician Chris K. Caldwell of the University of Tennessee at Martin. —*I. Peterson*