It May Be a Small World, but Wait

If the Earth Expansion Theory Is Right, Does It Vindicate Chicken Little, Too?

By Eugene Mallove

AND NOW, the expanding Earth theory. Geology may chronicle events that proceed with mind-numbing slowness, but we can depend on it for some of the most piquant shocks of 20th century science. As recently as 30 years ago, for instance, the theory of continental drift was dismissed as the whimsy of cranks. But overwhelming evidence has made it conventional to believe, for instance, that Africa and South America were once part of one continent that split and drifted thousands of miles apart. Thus was explained what every schoolchild has noticed — that Africa and South America would fit together well if they drifted back together.

Now, research tremors are pointing toward another intellectual earthquake, which may well leave us believing that as little as 200 million years ago the Earth was only 80 percent as big in diameter as it is now, with only 50 per cent of the volume — and may still be growing, thus accounting for some of the slowing in the Earth's rotation, along with jokes that Chicken Little was right — the sky, relatively speaking, *is* falling.

Furthermore, the case can be made that unlike a lot of groundbreaking scientific ideas, this one does not contradict the previous wisdom, but strengthens it, continuing the revolution begun by the continental drift theory. This turn of events does not mean that geologists, even of the continental drift persuasion, are rushing to embrace the new idea. It remains beyond the pale, for a number of reasons that shed light on the working of scientific minds and communities.

Like all new theories, this one has a long history.

At the turn of this century, geologists believed the opposite — that the Earth had contracted as it cooled. The Earth's crust was imagined to be shriveling like the skin of a drying apple — hence, mountain ranges. To explain the periodic invasion and retreat of ocean water on land, geologists talked about the Earth's crust floating in a deep, viscous fluid mantle surrounding the earth's hot inner core. Up and down motions would cause oceans to flood and pull back. Land bridges between continents could rise and sink, explaining the appearance of similar fossilized creatures on continents now separated by oceans.

In 1912, Alfred Wegener, a 32-year-old German meteorologist with a penchant for arctic expeditions and no formal geology credentials, gave the perennial notion of continental drift a scientific foundation.

Wegener, like so many schoolchildren, was struck by the cozy fit of the west coast of Africa to the east coast of South America. There were also similarities in geological formations on the parts of continents that might have touched each other, and there were fossils of ancient creatures such as Mesosaurus that could be found only in Brazil and South Africa.

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The Earth May Be Expanding

EARTH, From B1

Wegener's intuitive mind found holes in the prevailing theory of continents that stayed put. He noticed that mountain chains occurred only on certain areas of the globe, instead of being uniformly distributed over the land as one might expect if his geological contemporaries were right.

Another peculiarity seen by Wegener: Instead of an even distribution of terrain highs and lows around the Earth, there were two main groups, one more elevated than the other —one being the land, the other being the ocean floor. Why was the Earth so different from the average shape one would have expected?

Wegener ended up proposing that 200 million years ago all the present continents were gathered in one supercontinent he named "Pangaea." Pangaea fragmented in a few tens of millions of years to form a southern continent, Gondwanaland and a northern one, Laurasia. These in turn fragmented to form what we have today.

Wegener published his ideas in 1915 in a book entitled "The Origins of Continents and Oceans." Some geologists were attracted to them, but many — particularly Americans — scorned the Earth-shattering idea that continents could glide across the surface of the Earth.

For one thing, why would continents behave like that?

Wegener had an answer, but it was wrong. He believed that tides in the solid earth raised by the moon and sun could move whole continents. More analytically skilled scientists showed that this could not be. If the land were not strong enough to resist tidal tugs, it would also not be strong enough to support mountains. Terrain would smooth out and the rotation of Earth would stop within a year due to tidal friction. So much for the contintental drift theory, given this reductio ad absurdum.

Wegener died in 1930 on an arctic expedition, and continental drift was in disrepute for decades before evidence from the ocean depths rescued it.

The evidence was presented roughly as follows: There was found to be a network of major cracks in the ocean floor. Through these cracks pours molten rock from the earth's interior. The pressure of the rock spreads apart so-called "tectonic plates" about 60 miles thick and new ocean crust is formed. These plates float on a fluid interior. The continents, composed of comparatively old and lightweight rock, ride on top.

Sometimes the one plate pushes under or over another, forming areas of intense mountain building, volcanism, and earthquakes — for example, the western edge of South America. Other evidence involves the existence of matching magnetic patterns on either side of ocean cracks. Also, continental rock may be several billion years old, while almost all of the ocean floor is less than 200 million years old.

In any case, that battle is won, and scientists merely are in a mopping-up operation. They have determined that the continents drifted. Now they're working on exactly how. Most believe that thermal currents in the earth's mantle caused the tectonic plates to move around.

Having lived through the shock of the continental drift theory, many are not eager to rush into the tumult of an idea that has the Earth expanding like a pumpkin in August. Besides, many are specialists in the geology of particular areas, and aren't occupied with the big picture.

But like schoolchildren studying a globe, some are.

Geologists such as Hugh Owen in the Department of Paleontology of the British Museum and Warren Carey of the University of Tasmania have looked at the globe and come to maintain that what explains the fit of South America and Africa, along with the other continents is an earth with a diameter only 80 percent of today's size. They claim that if we reconstruct the world of the supercontinents on an Earth the size of today's, we are left with gaps or "gores" radiating from the center of the map that can't be accounted for by any known oceanic or continental crust. When the same reconstruction is done on the 80 percent diameter globe, the fit is much more precise.

Hungarian geophysicist L. Egyed noted in 1955 that the pattern of ocean flooding and retreats from the land was consistent with an expanding Earth, not a static one. Starting in the Cambrian period, 570 million years ago, the area of continents covered by sea has gradually declined. But where has all the water gone? There are reasons to believe the volume of surface water has remained nearly constant over those times. This leads to support for the theory of an expanding Earth.

John Wells of Cornell University developed a technique to measure the number of days in a year by examining pieces of ancient ocean coral now on dry land. This gives a measure of how fast the Earth was rotating millions of years ago. Scientists have long known that the friction of ocean tides has slowed the rotation of Earth over time. But expansion of the Earth could also contribute to slowing the rotation, in the same way a rapidly spinning figure skater slows her rotation by extending her arms.

Ancient corals built up minute ridges in their structure because they more actively secreted carbonate material during daylight and less actively secreted at night. Using the gauge of one ridge per day and grouping the ridges into larger apparent seasonal variations in them, Wells showed that there were about 400 days (rotations of Earth) in each year almost 400 million years ago.

If expansion exclusively is invoked to explain the decrease of the rotation rate, then the earth has expanded significantly since those ancient times. Since tidal friction must have contributed substantially to the rate decrease, the expansion of Earth thus derived would be smaller. It is fascinating that Wells' coral measurements leading to a 400-day year are at least consistent with astronomical measurements that show the day increasing by about 2 seconds every 100,000 years. Whether expansion explains part of this is another matter yet unresolved.

British geologist Arthur Holmes has supported the Earth expansion theory, but disagreed with some earlier advocates of Earth expansion that the theory could account completely for continental drift over the last 200 million years. He wrote that, "circulation processes operating in the mantle, such as convection currents, have been of greater importance than global expansion in 'engineering' the latest separation of the continents."

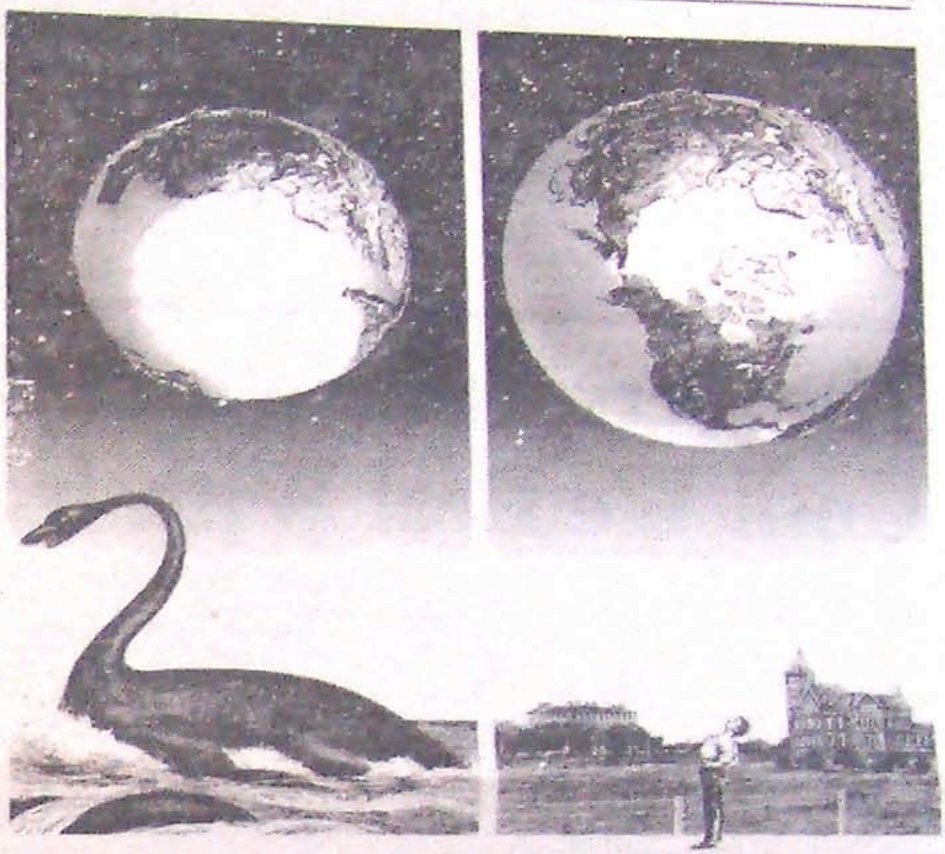
In his 1965 textbook, "Physical Geology," Holmes devoted a major section to the theory of the expanding Earth, but was careful to argue that a combination of Earth expansion and convection in the mantle might best explain continental drift. He wrote of the two hypotheses, "The combination is stronger than either separately."

The problem is that Earth expansion is like continental drift — no one seems to be able to explain completely satisfactorily just how it happens.

In 1957, Princeton physicist Robert Dicke and former student Carl Brans proposed a modification in Einstein's theory of general relativity that would have gravity slowly weakening as the universe aged. They calculated that the expansion of Earth over the past 3 billion years from this effect would be a 15 percent increase in volume and that about 50 cracks in the Earth, each 20 miles wide, could be expected. The cracks were later confirmed in the form of the mid-ocean ridges, but the predicted expansion due to gravity weakening could still not have accounted for the expanse of ocean between the continents.

The weakening of gravity as the universe ages and expands is a venerable curiosity that was proposed in 1937 by physicist P.A.M. Dirac, one of the founders of modern quantum mechanics. There have been many attempts since then to demonstrate experimentally gravity's decline. By careful measurements of the moon's orbit, some observers have claimed to find a small decrease.

But more recent measurements on the radio transmissions from the Viking landing spacecraft on Mars show that the weakening, if it exists at all, is far too small to account for Earth expansion. The definitely ex-



BY JOHN PACK FOR THE WASHINGTON POST

panding universe and the hypothetically expanding Earth are probably not connected in the intimate way once imagined.

Other theorists are looking to the Earth's core for answers.

The core is thought to consist of two parts: a solid inner core extending upward from the center 700 miles sheathed by a liquid part exteding up to 2,100 miles from the center. The entire core has a temperature estimated from 7,000 to 9,000 degrees Fahrenheit. Pressures are extreme: 1.3 to 3.5 million times sea-level atmospheric pressure.

Matter is crushed to such an extent in the core that elements not normally behaving as metals take on metallic properties. Electrical currents in the core generate the earth's magnetic field — a force field which has has often inexplicably reversed itself in periods as short as a few thousand years. Radioactive elements continue to heat the core, adding to the primordial energy deposited when Earth was formed. And gravity continues to squash all this matter to an extent we can just barely simulate in minute laboratory samples.

Scientists don't know enough about the core to rule out the possibility that it could act as a gigantic spring — storing up energy and slowly releasing it to expand the mantle and the tectonic plates above that. Holmes did some calculations on the energy available in the core and concluded, "Not only is the energy available for release amply sufficient to carry out the work of expansion but a considerable surplus is left over for earthquakes, mountain building, and a great variety of other tectonic, thermal, and magnetic activities."

Given the complications of the problem, we should not be surprised that there are major disagreements on even fundamental questions such as whether the Earth is expanding.

Besides, most geophysicists today don't spend much time wondering about an expanding Earth. The question is just not on their agenda as they work on big and important sub-problems of explaining the drift of continents.

But the motion of continents seems hardly less incredible than an expanding Earth, so why aren't more people paying attention to it?

Geologist A. Hallam, writing in Scientific American on the history of the continental drift theory, proposed that "geologists and geophysicists had to be overwhelmed by evidence, as they were in the 1960s, before they could abandon the established doctrine of stationary continents."

Continents drifting? Only a cosmic eyeblink ago the answer was, "Absurd!" Yet science is unique among human pursuits in its rather prompt acceptance of what was once [illegible] — once thought of the [illegible]