New Arrangement of Southern Continents

Over 50 years ago, German meteorologist Alfred Wegener proposed that continents are like huge wandering rafts, which originally (some 300 million years ago) broke free and floated away from a single primordial land mass called Pangaea. Although reconstructing the mammoth jigsaw puzzle of the continents can be done roughly well by any child studying a world map, detailed accommodation of this or that piece of land still inspires scientific debate.

The latest contribution to this dialogue was reported last week by a group of scientists from the University of Miami's Rosenstiel School of Marine and Atmospheric Science at the American Geophysical Union meeting in Washington. They quote evidence that suggests Gondwanaland, massive primeval precursor of the southern continents, looked a bit different from what is currently believed.

The notable differences between theirs and the classical arrangement of continents are that the Antarctic peninsula curls around, instead of to the east of, the long finger of South America, and Madagascar is placed opposite Mozambique, instead of Kenya. Furthermore, the close fit between Australia and India eliminates the presence of a hypothesized waterway, Sinus Australis.

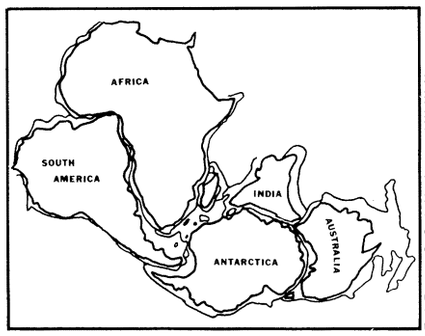
Of the several discrepancies, the one involving Madagascar is the most controversial. The battleline in this issue is unmistakenly drawn between two principal opinions that Madagascar was either in the northerly or southerly position.

The authors of the new grouping, Eric J. Barron, Christopher G. A. Harrison and William W. Hay, were compelled to place Madagascar in the southern paleoposition because of geophysical information obtained from the Mozambique channel and some history of the Kenyan coast.

They found Jurassic basalt deposits on either side of the Mozambique channel that match up Madagascar with the coast of southern Africa. According to Harrison, basalts of this kind are often found along the sutures of continental splitting, because they are produced by the volcanic activity that is associated with the fragmentation.

Furthermore, old deepsea sediments found off the coast of Kenya indicate that from a very early period, the coastal part of Africa was exposed to the ocean. This, they surmise, could not have been the case if Madagascar had been situated there.

Besides these researchers, a number of others have announced their endorsement of a similar nonclassical arrangement of the southern continents. Among them is Rhodes W. Fairbridge of Columbia University, who generally corroborates this new view in a forthcoming issue of GEOLOGY, but for somewhat different reasons. For one thing, he cites evidence for a Permian (about 260 million years old) marine basin that seems to have straddled what would be the boundary between Africa and Madagascar in the southerly position. The marine sediments found both in southern African rock and in the soil of Madagascar suggest that the two locations were once united.



The proposed new look of Gondwanaland.

He also emphasizes that the alignment of faults existing in the area goes contrary to any attempt to position proto-Madagascar opposite Kenya. If that were its original station, he says, then it would have needed to retrogress against the flow generally ascribed to movements in the area, for example that which carried India away to its present site.

Other evidence for Madagascar's southerly location comes from some measurements by Jan Kutina of American University. He mapped the distribution of land fractures along the southern African coast and on Madagascar itself. The two patterns he found match up remarkably well if one adopts the southerly arrangement of proto-Madagascar.

The Miami authors observe that the dispute will be settled quite swiftly when measurements of magnetic seafloor spreading anomalies are made in the area. The general pattern of magnetism frozen into the seabottom rock throughout these past millions of years is literally a history book, which when read can verify if Madagascar did indeed pull away from Mozambique. These measurements could be taken within the next several years, although no specific plans now exist. □

Prediction of ozone loss down, and up

The chemistry of the atmosphere is an intricate tangle of dynamic components with many interactions. Scientists have dealt with that complexity by designing computer models of the atmosphere and then plugging in their best observations and estimates. Because the elements of the model are all interrelated by numerous equations, an improved measurement of one value can have far-reaching ramifications.

Direct laboratory measurements of a critical reaction have now led scientists to revise their predictions of potential depletion of the ozone layer by human activities. The newest data decrease the predicted damage by supersonic aircraft, but increase the potential threat by chlorofluorocarbon aerosol sprays.

Carleton J. Howard of the National Oceanic and Atmospheric Administration developed a technique that uses lasers to detect quantities of gases as small as one-part-per-trillion. He and Kenneth M. Evenson of the National Bureau of Standards discovered that one reaction, the combination of nitric oxide and hydroperoxyl radicals (HO_2), occurs 10 to 40 times more rapidly than previously estimated, Howard reported at the meeting of the American Geophysical Union last week in Washington.

The researchers took their new value to "the Boulder oracle," Paul Crutzen of the National Center for Atmospheric Research in Boulder, Colo. Crutzen and John McAfee of the Aeronomy Laboratory inserted the new value into their computer model to see whether it would significantly change their predictions of atmospheric trends. The revised reaction rate set off a chain of modifications. "The effects of these changes are most dramatic when the computer model is used with the new measurement to predict ozone depletion by high-flying aircraft such as the SST and by chlorofluoromethanes—the so-called fluorocarbons," Howard said.

The revised model indicates that chlorofluorocarbons are about 35 percent more destructive to the earth's ozone layer than was previously estimated. Crutzen's model predicts that in 1976 the amounts of fluorocarbons in the atmosphere would destroy 1.2 percent, instead of 0.9 percent, of the ozone layer.

Crutzen and McAfee also now predict that high-flying aircraft, such as the Concorde SST, would destroy only about half as much ozone as previously believed. When Howard's new reaction rate was inserted into the computer models of several other research groups, it caused them to predict that low-altitude subsonic planes may actually produce small amounts of ozone.

The new rate constant will also affect studies of reactions closer to the ground.

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The higher reaction rate between nitric oxide and hydroperoxyl radicals better fits observations in experimental smog chambers, Howard relates.

Laboratory experiments using the laser magnetic resonance technique may soon update other reaction rates. Howard predicts that his method will be applicable to "a tremendously long shopping list of hydroperoxyl reactions" that are now assumed to be slow.

"This high rate constant is a head-kicking effect, it completely changes predictions," Howard said in an interview. "But things can still change. We are learning at a rapid rate and expect major uncertainties. If we need to make long-term decisions, we need to use the best scientific evidence available." □

Academic science: Quality decaying

A two-year-long study concludes that while American academic science still enjoys a position of world preeminence, "sufficient warning signs of emerging problems have arisen to alert policy-makers to ensure these downward trends do not worsen." The 264-page report, based on interviews with scientists, deans and graduate students at 36 universities and numerous government officials, makes no specific recommendations for remedial action. It was sponsored by the National Science Foundation and published by Change Magazine Press.

Reacting to the report, Sen. Daniel P. Moynihan (D-N.Y.) said, "In the years since World War II, the United States developed the world's premier scientific research enterprise, primarily because of an extraordinary and mutually beneficial partnership between the national government and the great public and private universities. No public policy issue today is more compelling . . . than the future of that relationship."

Authors Bruce L. R. Smith of Columbia University and Joseph J. Karlesky of Franklin and Marshall College conclude that a decrease in federal and state funding of university research has provoked tension between all the parties involved: government officials, university faculty, graduate students and administration. The authors express concern that a greater share of an already dwindling R&D budget in the United States—decreasing from about 3 to 2.4 percent of the gross national product during the past decade—is being invested in the work of a smaller group of "elite" universities. This is causing a widening breach between the few well-financed and well-equipped research institutions and the great majority of others, which are not being as generously supported. Consequently, many universities may find it ultimately necessary to curtail certain educational and research programs due to lack of funds. □

Cytomegalovirus: The newborn's enemy

Cytomegalovirus infection, particularly of the genital tract, is common among American women. If present when a woman gives birth, the virus may not only infect her offspring but also damage its brain. Some 3,700 American newborns are mentally impaired each year from congenital cytomegalovirus infection. Thus, medical researchers would like to prevent this major public health problem by vaccinating women of childbearing age against the virus.

Before vaccination can become clinically available, however, scientists need to learn more about the infection in pregnant women and their progeny and particularly about the role of maternal and fetal immunity to it. A vital contribution toward this end is reported in the June 2 NEW ENGLAND JOURNAL OF MEDICINE by Sergio Stagno of the University of Alabama Medical Center in Birmingham and his pediatric and microbiology colleagues.

Stagno and co-workers examined levels of antibody against the virus in the blood of 239 pregnant women. They found that 208 out of 239 (82 percent) showed antibodies against the virus, indicating that they had been infected with it at some time or another. This result confirmed previous findings—that cytomegalovirus is indeed rampant among American women.

A more crucial finding came next. The women who had antibody immunity against the virus during pregnancy were still able to give birth to cytomegalovirus-infected infants. Seven of the 208 immune women's infants (3.4 percent) were infected, compared to 3 of 31 women (10 percent) without antibodies. In other words, maternal antibodies may provide only limited fetal protection against infection, if any, suggesting that vaccinating women against the virus might not shield their offspring.

None of the infected infants born to women with antibodies were mentally retarded, however. They eventually recovered from the virus infection. Thus, while vaccination (antibody immunity) may not protect newborns from cytomegalovirus infection, it might still safeguard them from viral damage.

Other valuable information has also come from the study by Stagno and his colleagues. Not only primary cytomegalovirus infections but also recurrent infections can infect women and harm their offspring. In fact, the results suggest that recurrent infections may pose even more of a danger than a primary one. Such viral behavior stands in stark contrast to other microbes that infect fetuses almost exclusively as a result of primary maternal infection. Stagno and his co-workers believe that these data demand that viruses to be used in the vaccines prevent primary maternal infection or reduce the chances for transmission to the fetus or subsequent infection. (Live cytomegalovirus vaccine trials are already underway in England and Switzerland and are being considered in the United States as well.)

In spite of the insights provided by this study, some crucial questions about cytomegalovirus infection and damage of offspring press for answers. This is emphasized by Donald N. Medearis Jr. of Cleveland Metropolitan General Hospital in an editorial in the same NEW ENGLAND JOURNAL OF MEDICINE issue. For one, what is the role of cellular immunity (immunity provided by white cells known as T cells) in cytomegalovirus infections? A 1975 study suggested that mothers who give birth to congenitally infected infants have a specific impairment of cellular immunity. However, cellular immunity has not yet been studied in mothers and infants to determine whether it might protect against either congenital infection or mental retardation.

Also to be studied is whether an offspring can only be infected during birth or whether it can also be infected in the womb. For the first three months of life, a fetus has few antibodies of its own, and because two other microorganisms—rubella (German measles) and toxoplasmosis—can damage a fetus during the first trimester in the womb, cytomegalovirus may be able to do so, too. □

Unprovable problem in arithmetic

One of the most profound achievements of 20th century mathematics was the proof given by Kurt Gödel in 1931 that the axioms of elementary arithmetic are incomplete: There will always be true statements of arithmetic that cannot be proved from the axioms. Gödel's discovery meant that, in principle, some of the famous unsolved problems of mathematics might be so not just because they are difficult, but because they are theoretically undecidable. Unfortunately, the only examples of undecidable propositions produced by Gödel's method—or in the 35 years since his proof—are exotic statements created solely for the purpose of exhibiting an example.

Last month Jeffery Paris at the University of Manchester proved for the first time that one of the important unsolved problems of arithmetic is really undecidable. He showed that a certain rather famous conjecture concerning the numbers of ways objects can be arranged in patterns cannot be proved from the axioms of elementary arithmetic. Perhaps more surprising, this conjecture is known to be true—by virtue of reasoning with infinite sets that lie outside the purview of elementary arithmetic.