EARTH SCIENCES

Paleoclimate: Keeping step with the sun

In attempts to explain the parade of past climatological anomalies, scientists have often looked outside the earth for causes. Two geologists have found that an 8,327-year-old terraced coastline on the eastern side of Hudson Bay in Canada may be evidence that the sun and planets had a hand in triggering climatic phenomena like glacial advances. Since there are 187 regularly spaced ledges in the coastal terracing, Rhodes W. Fairbridge of Columbia University and Claude Hillaire-Marcel of the Universite de Quebec at Montreal surmise that the related terrestrial mechanism waxes and wanes every 45 years.

Each ledge was, at some time, a beach that could have been sculpted by unusually stormy weather that came and went according to this cycle. "Such a regular succession of climatically related geomorphic phenomena ... invite[s] a search for an exogenetic (cosmic) cause. The solar cycle seems to be the most obvious candidate," the authors report in the Aug. 4 NATURE. Peaks in the well-known, 11-year sunspot cycle themselves seem to grow and shrink every 45 years.

Although the coastal ledges are largely similar to one another—archaeological testimony to the cyclic precision of their cause—there are slight variations that suggest the effects of other, more sluggish periodicities. One of these may be 1,134 years long—the time between conjunctions of the major planets. "The great mid-Holocene glacial readvance .... coincides precisely with the fourth [1,134 year] cycle back from A.D. 1433. Other dates are less than compelling. At present, we can only say the results look interesting," the authors conclude.

Volcanic calm before the seismic storm

It is a well-known consequence of plate tectonics that sites of great geologic upheaval occur along plate margins. Here, plates collide and are diverted, one beneath the other. There is also evidence for some relationship, albeit vague and unreliable, between seismic and volcanic activity—something like the terrestrial equivalent of an unsettled stomach.

Now, a geologist has identified between volcanic eruptions and major (shallow-thrust) earthquakes, some intriguing and specific correlations. The most persuasive of these is an apparent volcanic quiescent period—a few years to a few decades long—that often precedes a major earthquake.

The data examined by Michael J. Carr of Rutgers University pertains to convergent plate margins along the circum-Pacific region (alias the notorious "ring of fire") —including the coasts of Central America, southern Chile and Kamchatka—and the northern Antilles island-arc.

Carr found that major earthquakes—typically of magnitudes greater than 7—were accompanied by a three-part "signature." It begins with a portentous surge in volcanic activity, followed by a dormant period, and culminates in another resurgence of volcanism. The associated earthquakes variably occurred during or immediately (up to several years) before or after the second episode of volcanic agitation.

The quantitative aspects of the correlation are highly erratic, which makes speaking about average behavior a bit misleading. Nonetheless, the average time between an earthquake of magnitude less than 8 and the initiation of its precursive signature is less than 15 years; it is longer for stronger quakes.

Carr's results, in the Aug. 12 SCIENCE, suggest that central and western El Salvador in Central America and the Guadaloupe arc of the northern Antilles (site of La Soufriere volcano) are prime candidates for a large shallow-thrust quake. The volcanoes in the first region have been ominously (and anomalously) dormant since 1955; the pattern in the second region is very reminiscent, according to Carr, of what preceded the large earthquake of 1897.

PHYSICAL SCIENCES

Fractional charge follow-up

At the April meeting of the American Physical Society William Fairbank, A. S. Hebard and G. S. LaRue reported an experiment in which they had found fractional electric charges on tiny balls of niobium (SN: 4/30/77 p. 276). This was the first time (at least in decades) that anyone had made a positive report of a finding of fractional charge. The amounts measured (in thirds and two-thirds of an electron charge) suggest that the fractional charges could come from free quarks attached to the balls.

The fundamental importance of the matter for particle physics and classical electrodynamics is leading a number of physicists to investigate various aspects of the matter. Four of them, Roger Bland, Dean Bocobo, Masatoshi Eubank and Jeffrey Royer of San Francisco State University report in the Aug. 15 PHYSICAL REVIEW LETTERS on a search for fractional charges attached to tungsten particles.

They picked tungsten because Fairbank, Hebard and LaRue had suggested in their report that the fractional charges found on the niobium may have become attached to it while it was in contact with tungsten during a heat treatment. But Bland et al. report finding no fractional charges on their tungsten. That does not mean that someday someone else may not find fractional charges on other tungsten, but, Bland and his colleagues conclude, "we have tested 3.07×10^{-10} grams, or [1,100,000,000,000] atoms, of tungsten. While other workers have tested samples as large as 10^{-4} grams of iron, niobium, and other materials for the presence of quarks, our result is the first published for any element heavier than niobium."

Tide marks suggested on Phobos

One of the things that show up prominently in the close-up photos of the Martian satellite Phobos that were made by the Viking orbiters is a series of striations on the surface of the satellite. In the Aug. 4 NATURE Steven Soter of Cornell University and Alan Harris of the Jet Propulsion Laboratory suggest that the striations are grooves caused by tidal stress.

Phobos orbits rather close to Mars at 2.76-times the planet's radius. The satellite's orbit is decaying at a rate that will bring the satellite to the planet's surface in about 100 million years, provided Phobos doesn't break into pieces first. As the satellite gets nearer the planet, tidal stresses on it get stronger, and its shape must readjust to the stresses. Soter and Harris suggest that the striations are grooves that appear in response to such adjustment. In support of their contention, they point out that the striations appear to be younger than the large craters made at the time of the satellite's formation yet older than some of the newer small craters, and that "one very prominent series of grooves is arranged nearly concentrically around the tidal equator (normal to the satellite's long axis), which orientation is to be expected from tidal stress theory."

Maybe they are faster than light

One of the astrophysical conundrums that will not go away concerns the objects that appear to be expanding or splitting faster than the speed of light. Physicists are unhappy with anything going faster than light, and a number of hypotheses have been put forward to explain away the velocities, but some of them seem too contrived for their own good. According to a review article in the Aug. 4 NATURE (M. H. Cohen of Owens Valley Radio Observatory et al.) there are now four such objects, three quasars and a galaxy. They include nearly half of the strong, compact, very distant radio sources. That one of these sources is a galaxy precludes explaining away the apparent superluminal velocities as due to misinterpretation of the object's distances. For the moment these authors let the subject rest there without putting forward a hypothesis.