liquefaction. The silvering from the vacuum jacket of cell C was removed and the reaction, $S_2 + L \rightarrow S_1 + L$, was actually seen. The crystals of S_2 appeared to be quite small and grey in color. When the transformation to S_1 began the crystals increased in number and size while the color changed from grey to a very pure white. Whether or not the transformation was S_2 to S_1 or L to S_1 could not be determined.

It is probable that a large percentage of organic compounds exhibit more than one crystalline form. In many cases the $S_1 \rightleftharpoons S_2 \rightleftharpoons S_n$ transformations occur at equilibrium temperatures which are very much lower than the temperature of the $L \rightleftharpoons S_1$ transformation. In such instances it is usually not difficult to establish the existence of the transformations. In other cases, however, the difference in temperature between the transformations $L \rightleftharpoons S_1$ and the $S_1 \rightleftharpoons S_2$ may be quite small, and the existence of the S_2 modification may not be conclusively established even though the compound has been extensively studied. This phenomenon has been observed with the isomers of dichloroethylbenzene. In this case it appears that nucleation of two or more forms may occur simultaneously during the initial supercooling. When this happens the calorimetric or thermometric experiments are extremely difficult to interpret. In the case of isopropyl alcohol we believe that the nucleation phenomenon of the S_2 form is a clear example of catalytic nucleation by a foreign body. However, whether this nucleation occurs through the liquid, vapor, or solid phase is not clearly established.

G. S. Ross, H. D. Dixon
L. J. Frolen, D. J. Termini
National Bureau of Standards,
U.S. Department of Commerce,
Washington 25

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20 August 1963

Emerged Holocene South American Shorelines

Abstract. *A pelecypod from the Salina beds of northern Peru at elevation 4.5 m (15 ft) shows a date of about 3000 years* B.P., *while a gastropod from elevation 22.5 m (75 ft) was older than 30,000 years* B.P. *A pelecypod from the island of Tierrabomba, near Cartagena, Colombia, at elevation 2.7 m (9 ft) gave a date of about 2850 years, while a pelecypod from Comodoro Rividavia, Argentina, at elevation 9 m (30 ft) gave a date of 5350 years* B.P.

It has been generally recognized that the western coast of South America is unstable, and has been so throughout much of the Cenozoic. Opinion differs regarding the eastern coast. Some workers believe that the eastern coast has been stable throughout much of the Pleistocene with the various shorelines having been caused by eustatic changes of sea level; others believe that the eastern coast is unstable tectonically, the movements being largely of an epeirogenic nature.

Recent field work in Peru, Colombia, and Argentina by Richards has afforded the opportunity for radiocarbon dating of mollusks by Broecker at the Lamont Geological Observatory. These studies suggest at least local Holocene uplift in the three areas studied.

Peru. The coast of northern Peru is marked by a series of elevated sea floors known as tablazos. These deposits extend inland as nearly level plains for many miles, particularly from the Sechura Desert northward into Ecuador. The tablazo deposits show evidence of regional uplift and warping of Pleistocene and post-Pleistocene age. The tablazos are especially well developed in the region of Talara, and have been studied by Bosworth (*1*), Lemon and Churcher (*2*), and Richards (*3*). The following three principal levels have been recognized (after Bosworth): (i) Lobitos tablazo, altitude 15 to 33 m (50 to 110 ft), thickness 1.5 to 4.5 m (5 to 15 ft); (ii) Talara tablazo, altitude 45 to 105 m (150 to 350 ft), thickness 2.4 to 7.5 m (8 to 25 ft); (iii) Mancora tablazo, altitude 60 to 370 m (200 to 1200 ft), thickness 23 to 75 m (75 to 250 ft).

Earlier workers such as Suter (*4*) and Daly (*5*) attempted to correlate the various tablazos with high interglacial stands of the sea, whereas more recent workers explain the elevation of the land on tectonic grounds.

In addition to the three easily recognized tablazos, there are conspicuous shell ridges left by a still more recent uplift. These, known as the Salina deposits, are especially conspicuous near Puerto Chuelo, 32 km south of Talara. These shell ridges parallel the present beach, extend some 8 km inland, and reach more than 9 m (30 ft) in elevation. Shells of *Donax peruviana* Deshayes, *Tivela hians* Philippi, and *Thais chocolata* Duclos are the most common.

A specimen of *Donax peruviana* from the Salina beds north of Puerto Chuelo at an elevation of about 4.5 m (15 ft) has given a radiocarbon date of 3000 ± 200 years B.P. (L-703-D), while a shell of *Turritella gonostoma* Val. from the Lobitos tablazo at approximate altitude of 23 m (75 ft), 16 km north of Talara, has given an age greater than 30,000 years (L-703-A).

Uplift and warping of the coast of Peru is obvious. That it is still going on is suggested by the very recent date of the shell from the Salina beds near Puerto Chuelo. The "dead" date of the shell from the Lobitos tablazo places the submergence at least as old as the Wisconsin. Unfortunately, present methods cannot be used to date the older, higher tablazos.

Colombia. Anderson (*6*) reported horizontal Pleistocene marine terraces with corals and mollusks along the Caribbean coast of Colombia to an elevation of 18 m (60 ft). More recently, dePorta and dePorta (*7*) described two Pleistocene terraces on the island of Tierrabomba (near Cartagena) at 20 and 3 m, respectively. They suggested a possible correlation of the higher terrace with the Penhalloway terrace of the Southern Atlantic Coastal Plain, and the lower one with the Silver Bluff of Florida. The age of the Silver Bluff is not known. Some, such as MacNeil (*8*) and Fairbridge (*9*), regard it as dating from a Holocene high stand of the sea, while others, such as Price (*10*) and Richards (*3*), suggest that it might represent a regression of the Pamlico (Sangamon) sea.

One of us (H.G.R.) visited the island in June 1962 with Jaime dePorta, and an extensive molluscan fauna was ob-

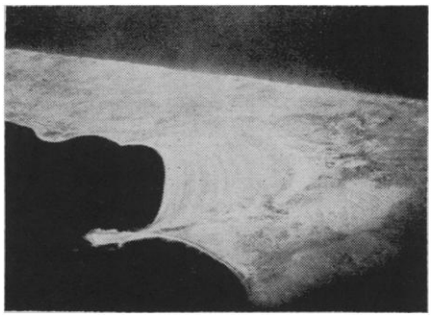

Fig. 1. Elevated beaches along Bahia San Matias in the Valdez Peninsula, Argentina.

tained from the lower terrace deposit. No fossils have been found on the higher terrace.

A shell of *Codakia orbicularis* Linné from the lower terrace deposit on Tierrabomba gave a radiocarbon date of 2850 ± 150 years B.P. (L-719-F). This date indicates Holocene emergence of the region. Uplift is favored as the cause, although a Holocene high stand of only 2.7 m (9 ft) above the present cannot be entirely ruled out. A correlation with the Silver Bluff of Florida cannot be established until the latter deposits are more definitely dated.

Argentina. Darwin (*11*), on his famous voyage of the *Beagle*, first recognized emerged beaches along the coast of Patagonia. While he attributed these to uplift of the land, Zeuner (*12*) and other workers have tried to explain these beaches by eustatic fluctuation of sea level. Feruglio (*13*) described a series of marine terraces up to 140 m (464 ft). He dated the higher terraces from the interglacial stages, while those below 30 m (100 ft) were correlated with the fourth glaciation and postglacial time. Auer (*14*) also found evidence for postglacial high stands of the sea in Patagonia and Tierra del Fuego.

Recent studies conducted by the Lamont Geological Observatory have revealed the presence of a submerged shoreline on the Argentine Shelf at a depth of about 105 m (350 ft). Many of the fossils obtained from cores from this beach indicate a cold, shallow sea, and a correlation with the low stand of the Wisconsin sea is suggested (*15*).

Several shells taken in water less than 65 fathoms (119 m, 390 ft) show ages between 11,100 and 17,250 years B.P. and thus suggest a Late Wisconsin age. One sample (L-628) from 82 fathoms (150 m, 492 ft) off Puerto Deseado gave a carbon-14 age of greater than 25,000 years B.P. This may represent a lowering of sea level in Illinoian time (*15*).

In January 1963, shells were collected from various elevated beaches in the vicinity of Comodoro Rivadavia, especially from Feruglio's terrace of that name. A carbon-14 date of *Chione antiqua* King from an outcrop near the electric plant of Y.P.F. (oil company) 5 km north of Comodoro Rivadavia at an elevation of 9 m (30 ft) gave a date of 5350 ± 200 years B.P. (L-740-A).

The finding of an elevated beach only some 5000 years old at an elevation of 9 m at Comodoro Rivadavia casts some doubt on the absolute stability of at least that local region. Recent Argentine workers, notably Bordas (*16*) and Parodiz (*17*) recognize only two Pleistocene marine ingressions along the Argentine coast, and believe that these were primarily due to movements of the land, and that the entire area has been rising and falling epeirogenically since the Pliocene.

While flying over Bahia San Matias en route between Buenos Aires and Comodoro Rivadavia, we noted a series of emerged beaches at Punta Buenos Aires on the Valdez Peninsula. These strongly suggest recent uplift (Fig. 1). Furthermore, the irregular elevation of terraces along Rio Gallegos, 80 km (50 miles) north of the Straits of Magellan, suggests differential uplift caused by epeirogenic movement. Unfortunately, time was not available for detailed field work in that area (see Fig. 2).

Whether the higher terraces along the coast of Patagonia reflect uplift of the land or eustatic changes in sea level is not clear from the available data. Further field work and radiocarbon dating will be necessary to clarify this point (*18*).

HORACE G. RICHARDS
Academy of Natural Sciences, Philadelphia, Pennsylvania
WALLACE BROECKER
Lamont Geological Observatory, Palisades, New York

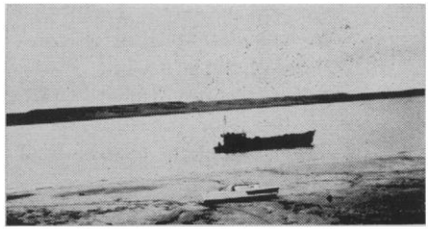

Fig. 2. Pleistocene terraces on Rio Gallegos, Argentina.

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3 June 1963

Atmospheric Jet Streams

The earth's high latitude atmospheric jet streams occupy a mean latitude at which the diurnal heat pulse from the sun's radiation moves through the main body of the atmosphere at approximately Mach 1 (speed of sound). At the equator this velocity is approximately Mach 1.4. At latitudes higher than the mean position of the jet stream the heat pulse moves at subsonic velocities.

It is proposed that this is associated with the development of the jet streams by the following mechanism. At the zone of the jet streams (40° to 50°) the cyclic heating must take a form roughly equivalent to a repeating deflagration wave in a gas, with particle flow exhausting mainly in a direction opposite to the direction of motion of the heat pulse (that is, retrograde in respect to the pulse and prograde in respect to the earth's rotation). For a *single* passage the velocity of this flow will be approximately equal to the increased particle velocity of the gas over the temperature rise. Repetitive diurnal