A PROBLEM OF SUBMARINE MORPHOLOGY : THE GREAT CONTINENTAL TALUS CANYONS.

A review of an article by Monsieur A. PERPILLOU,

in the *Annales de Géographie*, n° 292 of October-December 1943, pp. 241-263.

The author reviews the various hypotheses put forward to explain the formation of what are called " submarine canyons " and which he prefers to call " submarine crevasses ", in order not to prejudge their origin.

I) He examines their distribution. It seems fairly irregular, since none are known to exist between Cape Hatteras and the south end of Florida, whilst there are a great many between Delaware Bay and Nova Scotia. Some are also to be encountered off a few large river mouths, also off the west coast of North America, off Corea, Japan, Formosa, Luzon and Ceylan.

A great variety is also to be found in the morphology of these crevasses. On the Californian coast (1), the slope of their thalwegs is much greater than that which would be presented by river valleys of the same order ; it is always more than 5 % and reaches even 30 %. In the upper portion of some of these thalwegs, large deposits of coarse sediments have been found, whilst none are encountered downstream.

On the Atlantic coast of the U.S.A., this type of crevasses is different. They are longer than the previous ones and do not offer like them any ramifications. Their slope is still more than 12 %, below 1400 meters.

On the Asiatic coasts of the Pacific and Indian Oceans, the slopes reach from 25 to 60 % in the upper parts. Such is the case in the Mediterranean and in North Africa. It looks as though along steep coasts these crevasses were more like tectonic trenches than former river valleys.

As regards crevasses which appear to prolong the mouths of some large rivers such as the Congo, Ganges, Indus, Adour, they are very long but little steep. Those of the Mississipi and of the Bahamas are a very special feature.

It has been possible to dredge samples of the rocks making up the American canyon walls (2,3). They are generally calcareous sand stones, consolidated clays of the mesozoic and cenozoic ages ; but the crevasses are cut sometimes right into granite. On the Atlantic coasts of the North American Continent they are cut into the mantle of secondary and tertiary rocks; those of the Asiatic coast into granitic or eruptive rocks.

It seems unlikely that such dissimilar elements of relief should have a common origin.

II) The hypothesis of the hollowing out of these crevasses by subaerial erosion put forward by some authors (3,4,5), assumes that during the post-pliocene period, the sea level was nearly 3000 meters below its present position, a disruption whose causes seem difficult to admit.

III) The hypothesis of the excavation by submarine erosion (2,3,6,7,8) assumes the action of depth hydraulic currents. But those whose existence can be ascertained at the present time do not seem to be strong enough to cause such indents, whilst in some places, they do not even prevent the sedimentation of blue clay. Is it possible that during quartenary glaciations there have been some strong density currents or powerful waves carrying mud rivers and gullying the ground on account of their enormous solid load ? This latter explanation may have been given in connection with the formation of sublacustrine gullies, but does not seem valid in connection with the sea in which sediments are deposited at a fairly quick rate and could not have acted at distances of about 100 kilometers from the origin of the talus, so as to cut into hard beds and even granites. Moreover, no traces of cones of dejecta are to be found at the mouths of these canyons.

IV) The sub-terranean erosion hypothesis has been supported by D. W. Johnson [7] ; it was resorted to, on the assumption of landslides being caused by salt or gypsum stratum disintegrations or resurgences of thermal springs (Dubelen) to explain the formation of the Cape Breton abyss. Conditions for the formation and strength of these artesian springs were much more favourable to the Creceous and Tertiary ; these springs are supposed to have moved from downstrean to upstream, as was the case in the formation of some Colorado canyons. But these did not develop so extensively as submarine canyons ; besides, one would have to assume that the action of the springs is a very lasting one and has not been affected by ground movements which occured during geological periods. If it may be considered that this hypothesis can explain the formation of some submarine crevasses, it cannot apply to all, and, in particular to those which are cut right into granite.

V) The hypothesis of tectonic faults [3, 9, 10, 11, 12, 13, 14] in the continental shelf ascribes generally a very remote origin to submarine crevasses and explains the absence of sediments by more recent shaking actions which are supposed to have cleared them out. Bucher [14] also refers to the effects of the erosion caused by tsunamis swells as a result of earth tremors. Still, we must observe that the submarine crevasses of the east coasts of North America and of the Indian Ocean are very far away from the epicentres (*) and do not seem to have any connection with them. This latter explanation could therefore not apply to all submarine crevasses.

Aimé Perpillou ends by stating that crevasses are scarce in front of coasts with a long stability whilst they are grouped in the vicinity of great earth's scars. Those which are a prolongation of river estuaries may be accounted for by the previous existence of the crust dislocation which is supposed to have directed the river system [15, 16]. But it would be premature to give a general interpretation. One may refer to tectonic checks and various phenomena of hydraulic erosion by different motions, which would explain their diversity of aspect by their diversity of origin and evolution.

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