

LAND CONNECTIONS BETWEEN CEYLON AND PENINSULAR INDIA.*

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Ceylon remained geographically a part of the Indian mainland until quite recent times. The island was first severed during the Miocene epoch when a wide arm of the Tertiary sea extended across the southern parts of the peninsula. This phase in the geological history of the island is indicated by the marine fossiliferous deposits laid down in the northern and north-western parts of Ceylon extending from Puttalam on the west coast to Mullaitivu on the east including the whole of the Jaffna peninsula in the north. The Puttalam Jaffna sediments, according to Davis (Wayland and Davis, 1923), may be as late as Pontian or Sahelian (Lower Pliocene) which, geochronologically stated, may probably be as old as fifteen million years. Similar, more or less contemporaneous, depression of land in the neighbouring parts of southern India is suggested by the very closely related Quilon beds of Travancore on the west coast.

This state of severance in the early history of Ceylon did not last long. Connection with the mainland was again established as the result of a slow uplift since the close of the Miocene-Lower Pliocene times which brought most of the sediments above the level of the sea. There were later minor oscillations of the level of the land and sea of sufficient magnitude to disturb the migratory land routes between the Indian mainland and Ceylon. Interchange of plants and animals took place whenever land connections were established and suitable climatic conditions prevailed. This is evidenced by the existence of closely related Himalayan fauna sustained on the mountains of Ceylon, and identical South Indian fauna thriving in the drier zones of the plain. It is surmised that the hill fauna entered during a 'cool, pluvial spell' and the other at a time when arid conditions prevailed (Deraniyagala, 1944). 'The failure of the former animals to withdraw to the Himalayas when arid conditions commenced, suggests that Ceylon had by then become isolated so that the entry of the latter group could only have occurred during a subsequent reconnection with the mainland' (Deraniyagala, 1944).

Further evidence of recent subsidence and emergence that might have effected land connections with the peninsula are not entirely wanting. The presence of the pearl oyster on the coastal 'pseudo-cliffs' would indicate former emergence while the sunken valleys of rivers, particularly of the Marichhukata which in earlier times probably extended beyond the present Vangalai pearl bank to the north-west of Ceylon, would point to earlier subsidence (Deraniyagala, 1946). It appears likely that this disruption of land area which probably lay in the route of migration occurred in post-Pleistocene times.

The recent discovery of vertebrate remains in the Ratnapura beds of Ceylon throws fresh light on the post-Pliocene phases in the migration of land animals into Ceylon. It would appear on the evidence of the Ratnapura fossils, that land connection between Ceylon and the mainland was in existence even as late as Upper Pleistocene, approximately, 25,000 years ago.

From a detailed study of several Siwalik forms Deraniyagala (1944) concludes that the Ratnapura fossiliferous horizon ranges in age from the Pinjor † to relatively

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<i>Recent.</i>	
U. Pleistocene	Kurnool
M. Pleistocene	Narbada
L. Pleistocene	{ Boulder Conglomerate
	{ Pinjor
	{ Tatrot
U. Pliocene	{ Dhok Pathan.

recent (post-Kurnool) times. The association of *Merycopotamus*, *Hexaprotodon* and *Elephas maximus* in the same beds is of particular interest. In the Siwaliks, *Merycopotamus* first appears in the Dhok Pathan stage or earlier, and extends to the Upper Pinjor, while *Hexaprotodon* manifests itself in the Tatrot and continues to persist into the Boulder Conglomerate of the Siwaliks and the later Narbada and Godavari deposits. In the Ratnapura beds the occurrence of the remains of an extinct race of the recent *Elephas maximus* along with the above two older forms may appear perplexing. Deraniyagala (1942), however, suggests that these beds contain both an older as well as a relatively recent fauna, re-assorted and re-deposited, and ranging in age from the Pinjor to post-Kurnool. Although *Merycopotamus* and *Hexaprotodon* might have migrated to Ceylon during the Upper Pliocene-Pleistocene times, *Elephas maximus* could have done so only at a much later date, very probably after the Upper Pleistocene when a land route was still operative. It would appear, therefore, that the final disruption of the island as a separate geographic entity did not take place until after the Upper Pleistocene.

Further direct geological data seem to be lacking. A study of the earth movements of the Ceylon-South Indian region accords indirect support to the views expressed above. It is not unlikely, as pointed out by Wadia (1941, 1943 and 1943a) that, of the two major uplifts in Ceylon, the last involving the highest, but topographically 'immature' terrain of the island, was more or less contemporaneous with the Nilgiri-Palni upwarp, the scarp faulting on the West Coast and the Narbada-Tapti system of faulting. How far these cataclysmic changes, believed to have taken place as late as Pliocene (? or even later), directly affected the relationship between Ceylon and the Indian peninsula since Miocene times, is not known with any degree of certainty. But it is likely that these movements might have influenced the regions profoundly re-establishing the land connection during the Pliocene (Wadia, 1943a) * and thus enabling the Siwalik animals to migrate to Ceylon. In this connection it is of some significance that the earliest record of the Siwalik fauna in Ceylon occurs in the Ratnapura beds which are not older than the Upper Pliocene. The 'evidence', though indirect, is worth further consideration.

Recent archaeological discoveries offer some fresh evidence on the separation of Ceylon (probably the final disruption of the land link with the Peninsula) in comparatively recent times. The old stone age Ratnapura man of Ceylon shows hardly any signs of progress in his industries as compared to those of the palaeolithic man of Madras, probably owing to his isolation on an island. It is quite possible, as Deraniyagala (1946) suggests that they were 'suddenly exterminated when a new land bridge enabled the neolithic Balangoda man to enter from India'. If this hypothesis is acceptable, connection with the mainland was in existence intermittently as late as, or even later than 10,000 years ago.

Arlt (1919) who made extensive palaeogeographical studies, also concludes that Ceylon finally became separated from the mainland during the Quaternary. His observations are mainly based on zoogeographical considerations. Arlt's map (1919) of the world during the Quaternary epoch (including Pleistocene) represents Ceylon as a continuous extension of the mainland. Seward (1933) is in agreement with Arlt in depicting Ceylon as a part of peninsular India in his palaeogeographic map of the early Quaternary.

A few points are, however, raised by Deraniyagala (1943) which tend to throw some doubt on the probable routes of migration of the Siwalik and recent fauna into Ceylon by way of southern India. 'The absence from Ceylon of many extinct animals common in other Siwalik areas, the presence of the hippopotamus which is unknown in South India, and the existence of a strong Malayan element in Ceylon's living faunas, suggest the not impossible view that its Siwalik fauna

* Wadia (1943a, p. 19) expresses the opinion, based on other evidence, that the connection with the mainland was restored for the most part by the middle of the Pliocene.

did not enter direct via South India.' But it is pointed out by Deraniyagala (1946) in a later paper, 'Since the bulk of Ceylon's extinct and existing species are barely separable from their Indian counterparts, their main route of entry was apparently longitudinally via India, but the fact that Ceylon also possesses African and Malayan faunistic elements unknown from India suggests supplementary temporary connections . . .' In the paper quoted above the author gives specific instances of related African and Malayan elements in the Ceylon fauna. It seems, however, doubtful if the Malayan element spread to Ceylon by way of temporary island connections as suggested by Deraniyagala. Possibly it reached Ceylon by way of the predominantly humid regions of the Indian mainland which afforded satisfactory conditions for migration during geologically recent times. Hora's (1949) hypothesis, based on his studies of the living fauna, that 'the route of migration lay from the Eastern Himalayas and Assam Hills over the Vindhya-Satpura trend of mountains down the Western Ghats to Ceylon', seems plausible (see also Hora, 1944, 1948). But we have no direct geological evidence in support of such a fascinating hypothesis, and one feels hesitant to reconstruct past geological scenes based solely on the distribution of the existing faunas and floras.

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