

This race has been already burnt up by the curse, and is going to perish by mutual strife. Seven days from now this city will be submerged by the ocean" (*Srimad Bhagavatam*, Book 11, Chapter 7 Shloka 3 & 4).

This leads us to two possible inferences : (i) there was an understanding that sea level was not stable and that their knowledge at the time was advanced enough to provide prediction. One may ask if he knew pretty well that the city is going to be submerged then why did he build it? May be based on the concept of "Cost and effect"? (ii) the technology was available to reclaim the land from the sea for urgent use.

Reasons for the drowning of land as reported in religious books can be classified as flood due to sea level changes or rainfall. Emiliani (1976 a, 1976 b) based on a study of marine sediment from the Gulf of Mexico indicated that there was indeed a universal flood and this flood came from the sea rather than from the sky.

In view of the foregoing the key question is - whether the above indications of sea level fluctuations and related phenomena available in different religions and archaeology can be substantiated with scientific records, or on the other hand, can scientific explanations be provided for mythological references to sea level change? If so, where are such records? Records of sea level fluctuations and related climatic changes are preserved in seabed in the form of layered sediments and can be studied through proxy data like faunal contents and sedimentological characteristics of the sediments. Longer geological records show that once upon a time, about 280 million years ago there was a major marine transgression when an arm of sea reached deep into Madhya Pradesh. There are several evidences which show that over 200 million years ago in place of Himalayas there was a large sea known as the "Tethys". However, our immediate interest is with the relatively shorter time span of the last 11,000 years B.P. (known as Holocene in geological literature) as it

covers recent human history and culture.

Our earlier geological studies from the west coast of India indicate that about 10,000 years B.P., sea level was 60-90 m below the present and climate changed from warm and to warm and humid (Nair and Hashimi, 1980; Hashimi and Nair, 1986). A subsequent intensification of monsoon was also inferred. Historical records also indicate that total rainfall during the Indus valley civilization was double than the present (Singh et al., 1986) and the sea level was about 2-6 m higher than the present.

History of global sea level changes for the past 8,000 years was presented by Fairbridge and Hillaire (1977). To resolve the possible cycles from these records Negi and Tiwari (1988) have performed maximum entropy spectral analysis. They have demonstrated stable periodicities of 1083 and 634 years in sea level fluctuations and correlated well with planetary cycle of 1133 and 567 years respectively within error limits. Astronomical variations of 550-1100-1650 years are known and are related periods to earth/moon orbital motion. According to Fairbridge (1982) peak years in ice melting in Scandinavia as counted in the varved lake sediments are at 10,500; 9,950; 9,400 and 8,900 years B.P. Analyses of biological records in the form of tree rings from Japan also revealed the cycle of 523 years which reflect 567 years cycle within the error of dating. The above converging evidences indicate conclusively a cycle of about 550 years in sea level and climatic changes.

The catastrophic astronomical events not only changed sea levels but left their signatures in archaeological events. A correlation has been established between the Little Ice Age in Europe which had its origin in year 1443 - a year of "all planetary conjunction" witnessed perigee spring tide, catastrophic tide, flooding etc. Formation of East India Company in 1600 AD and subsequent colonisation of Asia, South America, Africa by Europeans, were in fact associated with deterioration of

climate.

Dhavalikar (1988) has reported some of the ports like Sopara which also went out of use during this period. Negi and Tiwari (1988) have stated that confirmation of the characteristic time units allows us to predict that human race must have gone through 20 such phases ("anthropological waves") during the last 11,000 years. If we consider the cycle of about 550 years then there should be 6 phases of transgression of sea and submergence of Dwarka during the time span from 1500 B.C. to present day (Negi and Tiwari, 1988) assuming no tectonic movement. This inference is very close to Rao's marine archaeological findings (1987).

The rise and fall of sea level and related climatic phenomenon have not only forced ancient man to migrate in the course of a rise but also helped them to flourish along the coast during low level. Even now, man is worried about consequences of rise in sea level in the next century due to global warming associated with the greenhouse effect. As a consequence, it is feared that many world wide coastal establishments will be affected adversely (Nigam, 1989). It is hoped that the data generated for sea level and other paleoclimatic changes on the basis of records from the seabeds will be useful to substantiate the veiled references in religious and archaeological records on the one hand and also to generate predictive models for the welfare of future generation of mankind on the other hand.

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References :

Dhavalikar, M.K., 1988. The decline of Sopara IN *Marine Archaeology of Indian Ocean Countries* (S.R. Rao, ed.) National Institute of Oceanography, Goa, 104-106.

Emiliani, C., 1976 b. The Great flood. *Sea Frontier*, 259-270.

Emiliani, C., 1976 a. Glacial surges and flood legends. *Science*, 193, 1268-1271.

Fairbridge, R.W., 1982. *Cambridge Encyclopedia of Earth Science*.

Fairbridge, R.W. and Hillaire, M.C., 1977. An 8000 years palaeo-climatic record of the "Double Hale", 45 year solar cycle, *Nature*, 268.

Hashimi, N.H. and Nair, R.R., 1986. Climatic aridity over India 11,000 years ago : Evidence from feldspar distribution in shelf sediments. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 53, 309-319.

Nair, R.R. and Hashimi, N.H., 1980. Holocene climatic inferences from the sediments of the western Indian continental shelf. *Proc. Indian Acad. Sci. (Earth. Planet. Sci.)*, 89, 299-315.

Negi, J.G. and Tiwari, R.K., 1988. Climate and sea level variation cycles during last 8000 years and their relationship with global human history: *Marine Archaeology of Indian Ocean Countries* (S.R.Rao, ed.), National Institute of Oceanography, 79-82.

Nigam, R. 1989. Sea level rise and expected impact on coastal zone. *Coastal Zone management in India*. (S.N.Dewidi, V.S.Bhatt & P.Chaturvedi, eds.) Ind. Assoc. Advan. Sci., New Delhi, 145-147.

Rao, S.R. 1987. *Progress and prospects of Marine Archaeology in India*. National Institute of Oceanography, Goa, 76 pp.

Singh, G., Joshi, R.D. and Singh, A.B., 1972. Stratigraphic and radio-carbon evidence for the age and development of three salt lake deposits in Rajasthan, India. *Quaternary Research*, 2, 496 - 505.