shaped masses (swamp). Although hardness tends to increase with increasing burial depth and age, some nodules in relatively young deposits are very hard. Preliminary chemical analyses and X-ray diffraction studies indicate that they are composed of various carbonates, mainly calcium, manganese, magnesium, calcium-magnesium, and iron. Iron carbonates are abundant and appear to be more common in the older deposits. The change in proportion of the various carbonates presently is being investigated but this change must be abrupt. Other inclusions, such as iron oxides. iron hydroxides, *etc.*, also are abundant.

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SEDIMENTATION IN MALAYSIAN HIGH-TIDE TROPICAL DELTA

The Klang-Langat delta empties into the Straits of Malacca at 3° N. lat. along the west coast of the Malay Peninsula. Both the delta and its catchment basin are located in the wet tropics with mean annual rainfall ranging from 80 to 140 inches. The subaerial delta occupies about 160 square miles. Wave energy levels along this coast are low to moderate; the range of mean spring tides is 15 feet. Tidal processes dominate sediment dispersal patterns and control delta form. An extensive tongue-shaped sand bank or shoal (Angsa Bank) is down-drift from the delta. The subaerial delta displays a maze of criss-crossing tidal channels separating mangrove islands. Although the system has the configuration of an estuary, it is in reality a complex delta of the Klang and Langat Rivers.

Six major environments and facies are recognized in the active delta. The most seaward of these consists of well-sorted medium-grained sand deposited on extensive shoals or banks. Sorting reflects intensity of tidal currents. Local concentrations of shell and transported organic debris also are characteristic. This marine sand forms the bulk of the subaqueous delta deposits. Fringing the subaerial delta are broad low tidal flats composed of irregular-bedded, fine-grained sand, silt, and clay. Networks of small tidal creeks dissect the flats; shellfish and other burrowing organisms abound. Bottom sediment in major tidal channels is predominantly clayey sand with local concentrations of shell and transported organic debris. Mangrove-covered islands constitute most of the active subaerial delta. Although organic production is high, it is overshadowed by fine-grained detritus resulting in accumulation of organic clay, rather than peat. On the margins of the islands small sandy accretion beaches border channel mouths. Central parts of large islands and backswamp areas between major channels in the older parts of the delta are occupied by large fresh-water jungle-covered swamps. These are the sites of woody peat accumulations which attain thicknesses of 20 feet or more.

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ATLANTIC COASTAL PLAIN TERRACES AND TERRACE FORMATIONS

The relation between coastal-plain terraces and their underlying formations has long been obscure. Atlantic coastal-plain terraces are underlain by "cyclic formations" in the sense proposed by Stephenson (1928). They consist of continental and marine contemporaneous cyclic sequences. The continental sequence consists of stream, fresh-water, marsh, lacustrine, estuarine, and deltaic sedimentary facies. The marine cycle consists of littoral, sublittoral, bar, barrier island-lagoon, and barrier-island tidal-marsh sedimentary facies. The two sequences are gradational within estuarine facies and disconformable along former strandlines.

The cyclic formations overlie an unconformity that has been cut into older stratigraphic units. Landward the unconformity surface consists of stream valleys and divides over which the continental sequence was deposited during a rise in sea-level. Seaward the unconformity has been modified by marine scour. The marine sedimentary sequence occurs on this scoured surface. Initial marine erosion proceeds landward during a rise in sea-level until estuaries are filled and sediments supplied to the ocean balance sediments being eroded. From this stage onward, during slow transgression through subsequent regression, coastal-plain accretion takes place seaward with construction of one or more barrier-island and tidal-marsh stages and seaward growth of deltas.

The terminal surface of the cyclic formation is the terrace which contains both continental and marine land forms representing the last processes operative in the area during regression. Thus geomorphology and pedology reflect the terminal nature of the underlying litho-, bio-, and environmental facies. The underlying stratigraphic facies illustrate the cyclic sequence of environmental stages necessary to develop the terminal land form.

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RECONSTRUCTION OF AN ANCIENT SHALLOW-WATER MARINE ENVIRONMENT*

It is commonly possible to decide that an ancient body of rock was laid down in a shallow-water marine environment but in many cases it is impossible to determine precisely which shallow-water marine environment.

The Ordovician Stairway Sandstone, a shallow-water marine formation of the Amadeus basin, central Australia, contains appreciable, though so far non-commercial, quantities of oil, gas, and phosphate. It is therefore desirable to have a detailed knowledge of the depositional environment of this formation. For this reason, extensive field and laboratory studies were undertaken.

These studies have revealed that the sedimentary rocks, mainly orthoquartzite and phosphatic shale, were deposited during a regressive-transgressive cycle which resulted in the migration of a single shallow-marine depositional environment across at least 40,000 square miles of the basin. This has profoundly influenced facies distribution. Using a detailed graphic-log approach, the numerous sedimentation units in the Stairway Sandstone can be grouped into six composite units. These, in turn, comprise a single compound sedimentation unit whose characteristics are the result of a particular depositional environment.

The characteristics of this compound unit, compared with those of modern sediments, show that the modern lagoon-barrier and intertidal-flat sediments

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