Although differentiation of clay suites of sandstone according to environment is not so pronounced, the pattern generally conforms with that found in shale and mudstone. However, significant differences exist in the relative amounts and in the degree of crystallinity of the minerals. The chlorite:kaolinite:illite ratio is about 2:1:3 for nonmarine sandstone and 1:1:4 for nearshore marine sandstone. All species of clay minerals in the sandstone are more crystalline than are those in the shale and mudstone.

Chlorite probably enters the depositional basin in a cation-depleted condition and accepts Mg^{++} in the oxidizing environment of evaporitic mudflats and lagoons and Fe^{++} in the reducing environment that occurs after burial in the normal marine environment. The absence of chlorite in the nonmarine shale and of kaolinite in the offshore marine environment is the likely result of differential flocculation during sedimentation. The greater degree of crystallinity of the illite from mudstone in evaporitic rocks probably results from the increase in the availability of cations, particularly K^{+}, in the evaporite brine. The complete lack of expandable-lattice clays may result from deep burial and accompanying incipient metamorphism. All processes, except differential flocculation, probably did not occur until temperature and pressure rose to a significant level in response to increased depth of burial.

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Fish Otolith Assemblage of Gastrolithic Beach Gravel

The richest recorded sample of fish otoliths, most of which are pelican gastroliths, was collected at the shoreline of a "mudlump" island in the lower Mississippi delta. It is dominated by gravel-size ear stones of sea catfish, common croakers, and sea trout, with abundant sand-size ear stones of a tropical gadoid. The remainder of the approximately 6,400 otoliths make up a rich, polyenvironmental assemblage ranging from fresh-water catfishes and killifishes to conger eels and deep-sea brotulids of anomalous origin.

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Pebble Shape Development on Tahiti-Nui

Abrasional shaping of basalt pebbles was studied in nine rivers and on 14 high- and low-energy beaches of Tahiti-Nui. Measurements were made on four size classes, ranging from 16 to 256 mm. Surf ranged from 10-ft combers at Punaauia to few-inch ripples at Point Venus.

Roundness was measured by sharpest-corner/inscribed circle, adapted from Wentworth (1922); fluvial pebbles had mean roundness of .38 whereas beach pebbles averaged .45–.50 in low-energy areas, and .60 in high-energy areas.

Maximum-projection sphericity (Sneed and Folk, 1958) averaged .68 for river pebbles, and .60 for beach pebbles. A new measure of oblateness-prolateness, $OP = L/S(L\text{-}I/L\text{-}S - .50)$, is introduced; river pebbles averaged $OP = +0.2$ (neutral), and beaches $OP = -1.7$ (oblate), with greatest difference between the two environments shown by the smallest pebbles (16–32 mm). Using isotropic rock of uniform basaltic composition, there is no doubt that, on Tahiti, accumulations of beach pebbles distinctively have lower sphericity and more discoidal form compared with river pebbles.

The above generalities are modified by some complicating factors. On some high-energy beaches consisting almost entirely of coarse gravel (*e.g.*, Papenoo and Punaauia), large pebbles (128–256 mm) have lowest sphericity (.55) whereas small pebbles average .68; apparently the waves are so large that they can slide the large pebbles, but toss the small ones randomly. On some low-energy beaches (*e.g.*, Maraa, Arue, Venus), the smallest pebbles (16–32 mm) are nearly coin-shaped (sph. = .54, $OP = -5$, strongly oblate) because they are able to be slid by the gentlest waves, whereas large pebbles relatively are immobile and do not achieve typical beach shapes (sph. = .67, $OP = +1$, weakly prolate). Thus the particular pebble size at which most extreme oblateness and lowest sphericity occur is a measure of wave energy.

Where pebbles are scattered on a dominantly sandy beach (Mahaiatea, Papeiha), abnormally great concentrations of low-sphericity discs occur. On sand beaches with gravel cusps (Taaone), discs are scarce in the gravel cusps but abundant in the sandy intervening zones. In a few areas discs tend to be thrown far back on the beach, and rods and equants accumulate at the beach foot. Despite the definite evidence of shape-sorting in some localities, the great increase of discs in the beach pebbles as a whole, compared with the river pebbles as a whole, must be the result of surf abrasion. The change in shape is accomplished within distances of a few feet to a few hundred feet of the river mouth.

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Morphologic Studies of Fusulinids from Lower Permian of West Pakistan

The "Lower Productus Limestone" of West Pakistan yields an abundant and well-preserved fauna of fusulinid Foraminifera. The fusulinids are found in the lower part of the Amb Formation of the Zaluch Group of Early Permian age described by Teichert in 1966. About 50 samples of the fusulinids, collected by C. Teichert in 1961–62 and R. E. Grant in 1964–65, contain the genus *Monodiexodina*. Each sample of fusulinids is relatively homogeneous in morphologic characters, having a fairly normal distribution of values through a limited range for most characters. There are large differences between many of the samples with little or no overlap in the dimensions of some characters at specified volutions. Distinct species could be described by conventional methods based on a few specimens or even on reasonably large samples, and statistically meaningful differences could be demonstrated. Cutbill and Forbes' 1967 discussion on the significance of the prolocular diameter and its effect on comparisons by volution has led to a re-evaluation of the data on these samples. Comparison of measurements at equal radii instead of by volution brings out many similarities between samples. For example, two samples that are quite distinct when compared by volution cannot be distinguished at equal radii. The biologic significance of the prolocular diameter needs reconsideration. Microspheric and megalospheric forms are accepted as representing the same species, and Le Calvez and others have shown that several megalospheric generations can develop between microspheric generations. The megalospheric generation groups may not all develop the same size of proloculus. One species could be represented by microspheric forms as well as a wide range of megalospheric forms. Apparent differences which are related directly to prolocular diameter are not considered sufficient evidence for specific discrimination.

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Coprolites *versus* Fecal Pellets

Since the earliest descriptions by Lister (1678), animal fecal excrements have aroused the interest of scientists. Fossilized specimens, thought at one time to be fossil fir cones, gained special recognition following the first suggestion of their animal origin by Mantell (1822) and the coining of the term "coprolites" by Buckland (1829). Special recognition came about because coprolites provide data pertaining to the diet, the physiological nature of certain internal organs, and the ecological environment of the animals that deliver them.

A literature review of more than 400 publications on the subject has been prepared (Häntzschel, El-Baz, and Amstutz, in press). A study of the terminology applied in these reports indicates a lack of consistency. In matters of nomenclature, there are strong criteria which support the following:

1. The term "coprolites" is used correctly when reference is made to petrified fecal excrements. It is used incorrectly when it refers to dessicated, dried, or fresh fecal remains.
2. Coprolites should be restricted to fossilized fecal remains of vertebrates (between 1 mm and 20 cm). Invertebrate fecal remains (usually smaller than 1 mm) may be called fecal pellets, and where petrified, fossil fecal pellets.
3. Accumulation of petrified fecal excrements of birds may be referred to as guano deposit or fossil guano.
4. Coprolites and fossil fecal pellets should be used to describe specimens which are *known* to have originated as animal fecal excrements. Those concretionary fossil forms showing partial geometric or chemical similarity to them should be termed "pseudo-coprolites" and "pseudo-fossil fecal pellets," respectively.

Statistical studies of published information concerning coprolites, fossil fecal pellets, and related objects (enterolites, urolites, vomit balls, gastric concretions, vesinal and urinary calculii, *etc.*) proved to be rewarding. It was feasible to classify coprolites and fossil fecal pellets according to shape, size, color, and composition. Statistical counts of the distribution, animal of origin, enclosing sediments, and geologic age of known occurrences also were carried out.

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Recent Carbonate Sedimentation and Diagenesis in Walker Cay-Grand Cays Area, Little Bahama Bank

The Walker Cay-Grand Cays area is on the northwestern part of the Little Bahama Bank, 130 nautical mi northeast of Miami, Florida. This study was made to provide detailed data on the sediment changes that occur within a small, complex, shelf-edge carbonate area.

On a typical traverse seaward across the area, the environments observed are: (1) shallow bank with muddy calcarenite; (2) oölite bars; (3) islands of lithified Pleistocene calcarenite, (4) patch reefs with a *Gorgonacea, Montastrea, Agaricia, Diplora* assemblage; (5) the fringing reef, largely "dead" and algal encrusted, except for scattered growth of *Acropora* and *Millepora;* (6) a deeper, forereef zone of live *Montastrea* with patches of coarse coralgal calcarenite; and (7) a rock platform with little sediment cover, lying at a depth of about 65 ft and sloping gradually seaward until it reaches a depth of 85–125 ft where it intersects the very steep continental slope.

On traverses across these environments, 135 bottom samples were collected. The sand-size fractions of the samples were impregnated with polyester resin and thin-sectioned. The data resulting from point counts of these thin sections were analyzed by *R* and *Q* mode factor analysis. In the *Q*-mode analysis, 5 factors accounted for 96 percent of the variation in the data. Mapping of these factors led to a relatively simple pattern of sedimentation: a broad area of skeletal sand composed of variable percentages of *Halimeda,* mollusks, foraminifers, and pellets, separated in protected areas by carbonate mud, around the reefs by coralgal sand, and in areas of strong tidal flow, by sand bars of superficial oölite.

Lithification of Recent carbonates occurs as: (1) beachrock; (2) subaerial crusts about 3 in. thick on beach ridges; (3) thin, well-indurated algal mats near the edge of a mangrove swamp; and (4) semilithified blocky submarine crusts on some oölite bars. Another diagenetic change in the sediment is "micritization" of the grains, particularly on some of the "older" stabilized oölite bars, where the oölitic coatings are being destroyed. This process, if continued, might lead to the misinterpretation of these deposits as pellet sands.

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Phylogeny and Ontogeny of Charophyta

The oldest known occurrence of the Charophyta is from the Devonian of eastern Europe. Devonian and Lower Mississippian rocks also contain the most diverse types of charophytes but their pre-Devonian ancestors are still unknown.

During the Devonian the dextrally spiralled forms of the Trochiliscaceae increased in size, the number of spiral units decreased, and calcium carbonate was first secreted in coronula cells. Some workers believe that the reticulate forms of the Sycidiaceae and vertically ribbed forms of the Chovanellaceae are related closely and represent utricula.

In the Middle Pennsylvanian through middle Permian are found the sinistrally spiralled forms with apical pores and hollow spirals of *Stomochara* Grambast.

Palaeochara Bell has six spirals and is the only post-Devonian form of that type with the exception of some modern types.

The upper Permian and Triassic contain forms not