

THE A B C OF FOSSILS.

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We shall start out with a definition which would do if we were writing a scientific treatise but we shall make every effort to break away from the technical method in what follows. As the definition will show, however, even the technical may be perfectly simple, and might often be more so than it is.

Fossils are direct evidences of life preserved by natural burial in the rocks of the earth's crust.

Fossils therefore represent life and occur in rock, but they need not be the actual remains of plants or animals, and the rock need not be the hard substance which we usually think of when we hear that term. In fact many beds of sand, mud, clay, and marl come within our definition, and all hard rock, with the exception of those that are igneous or volcanic, was once soft. It has been hardened by pressure, heat, and cementation (cementation) during the ages that have passed since it was first laid down.

Although a layer of lava (molten rock) flowing into water has been known to trap clams that were crawling over the chilled surface of a previous layer of the same kind of rock, and fossil clam-bakes of this kind have been found on Vancouver Island, for example, fossils are almost always confined to sedimentary rock. By this we mean rock which has been formed from wind-blown dust or sand; from the mud, sand, or gravel in river beds or valleys; from the sediment which falls to the bottom of ponds, lakes, or oceans; from the material piled up or carried by ice rivers, or glaciers; and from deposits for which animals and plants are responsible, for example coral reefs and coal beds. It will easily be seen that sand or mud settling in water would arrange itself in comparatively flat layers, but all sedimentary rocks, whether thrown together by the wind, by a river, by the waves, or by a glacier are piled up in similar layers; they are stratified to use the proper term, and this stratification is often surprisingly regular.

The amount of mud and sand which is being carried by rivers into the ocean, where it must of course all settle, has been computed for the Mississippi, but instead of giving you the number of billion cubic feet a year or the number of hundred million tons a year let us suppose that someone should put in the plant needed to strain this mud and fine sand out of the water before it reaches New Orleans and should send it past that city in canal barges. If these barges were 100 feet long the people in New Orleans would see a barge full of

sand pass every 10 seconds or less, and since it would take the river 30 seconds to float a 100 foot barge past a given point the barges would have to pass in bunches of three and there could be no space between the back of one set of three barges and the front of the next. If the man we have imagined were to take care of all of the sand and mud for a year he would have to work day and night, Sundays and holidays, winter and summer, and never allow an inch of space between each set of three barges. If these were to dump their loads in the Gulf of Mexico the sand would settle in piles but the river spreads it out very widely and sends enough material each and every year to spread a one inch carpet over more than 3000 square miles of the gulf's bottom.

This gradual piling-up process, one which takes place on land as well as in the water, affords a continual opportunity for the natural burial of the remains of the animals or plants that die and drop to the bottom. Those remains that do not decay and are preserved, however this may be done, are called fossils. So also are the casts or molds of animals that do decay, their footprints, etc. Whatever the form of the evidence that the animal or plant once lived, it simply must be direct, and whatever the manner in which the burial took place, it must have been by natural means. For example, hard coal, though we know it to be formed of plant remains, is not a fossil, the evidence is indirect; and a dog does not make a fossil, or even start one on the way, when he buries a bone. The latter may be a perfectly natural thing for the dog to do but it does not come within our definition of the term natural, a fact which will be perfectly clear before we are through.

An animal tries to cross a slough and gets mired, or sinks in quicksand, another breaks through the hardened surface of a tar pool and disappears, a jelly-fish is stranded on a tidal flat and the next tide covers it with a layer of sand or mud, an animal walks across some drying mud and the next rain washes sand into its footprints, an insect gets caught in a drop of resin, a mammoth is frozen in the ice in a polar climate, an animal dies on the desert and its whitened bones are covered by the next sand storm, a leaf sinks to the bottom of a pool and is covered with mud, a snail or a clam dies and the shell lies on the bottom of the ocean until it is covered, a coral or a sponge growing on the bottom is smothered by a shifting of the current which covers it with sand.