Creating the Nation's first BioPark

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Letter From the Desk of David Challinor
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Humans have the machinery and energy to change the very structure of the earth's surface with dams, roads, canals, open pit mines and quarries, many of which are so durable that they may even remain long after Homo sapiens becomes extinct. Humans' activities have thus affected our planet's geomorphic characteristics. Geomorphology is the study of the configuration and evolution of a planet or its satellite(s) from a geological perspective. Thus the movement of tectonic plates, which results in continental drift and the excavation of an open pit mine, are both examples of geomorphic activity.

We tend to take for granted man's ability to restructure the earth to suit his needs, often at the expense of other organisms with which we live. People sometimes must be reminded that alterations to the earth's surface are also being made by many non-human organisms, often on a scale that dwarfs the most grandiose human effort. Scientists who study such activity are zoogeomorphologists and this letter will briefly consider two levels of non-human induced change: macro- or mega-zoogeomorphic (alterations that are readily visible to human observers), and micro-zoogeomorphic (not so obvious and therefore requiring careful observation).

The largest and most evident earth form built by animals is a coral reef, whose construction time is on a geologic scale. Coral rock is made from the skeletons of tiny marine organisms that have and still do live in the warm oceans of the world. These invertebrates synthesize their calcerous skeletons from sea water and over time colonize the dead remains of their predecessors. Coral reefs change continuously and expand or contract according to the depth and temperature of the ocean in which they live. A drop in sea level that leaves the reef surface permanently exposed or a drop in sea water temperature would kill growing coral. Such reefs have existed since the Permian era (275 million years ago) so that today relics of ancient coral reefs are found deep below such places as Texas and Alberta and far from current oceans.

The landward side of Permian reefs is an important site for crude oil deposits and geologists can use them to determine possible sites for drilling. By identifying microfossil remains of foraminifera, a tiny marine, single-celled animal, from the characteristic shell of each species, petroleum geologists can

determine from deep earth cores containing these microfossils whether the exploratory oil well being drilled is penetrating the seaward or landward side of the ancient Permian reef. Foraminifera still live in the world's oceans and many have changed little over millions of years. Geologists can determine the boundaries and characteristics of the ancient sea floors through identification of these and other microfossils.

Although coral reefs today are the largest and most visible of earth's animal-made or zoogeomorphological features, other plants and animals have wrought their imprint on earth. In pre-Cambrian times (600 million years ago), blue-green algae grew in the shallow seas and under the right conditions for them formed alternating layered deposits of algal growth and trapped sediments. The combination of algal growth and sediment deposits produced massive dome-shaped stromatolites along the shores of ancient seas. These hummocks, consisting largely of limestone, built up to diameters of a meter or greater, but the characteristics of the world's oceans have changed and actively growing stromatolites are rare today. The best place to see them now is Shark Bay in Western Australia, about 400 miles north of Perth. However, a small living colony was recently found in the Bahamas. Ancient stromatolites are still frequently snapped off the bottom by fish trawls in the relatively shallow waters of the North Sea.

There is a wide gap between the evolution of algae and that of arthropods (from the Greek, meaning joint-footed) such as ants, beetles, crabs, spiders, etc. Yet arthropods also can change the landscape. Termites (in the order Isoptera) generally live in warm, humid areas throughout the world and certain species build towering nests, some as high as 8 meters (25 feet). They dwell in colonies and African and Australian species in particular construct complicated towers with vertical passageways for air to circulate, thus maintaining a relatively even temperature and adequate oxygen for the colony. Furthermore, mounds can endure for long periods, on the order of centuries, as recolonization of the same sites occurs.

Almost as vast but not as obvious to humans are the branching tunnels and subterranean fungus gardens of leaf-cutting ant colonies. Tunnel dimensions are difficult to measure so we can only estimate the length and volume of the colony. Burrowing animals and the roots of plants and trees have a large cumulative effect on the geomorphological character of the earth's surface. Tree roots, for example, can split rocks and wind-thrown trees create gaping holes where their roots were.

We do not generally consider birds to have much effect on changing the earth's geomorphological character. Flamingo mud nests, for example, although of considerable volume in a large nesting colony, are transitory, vulnerable to destruction by high water and very localized. However, colonial nesting, fish-eating birds that have nested for millennia on islands in fish-rich tropical waters have raised the elevation of their nesting areas hundreds of meters by their excretions. Islands off the Peruvian coast in the Humbolt current have been mined for phosphate fertilizer (ancient guano) since the days of the Incas. Many such islands have been mined so intensely that commercial exploitation of this resource has declined. Nauru, for example, is a small (10 square miles) island lying on the equator in the SW Pacific. It is now independent and has one of the highest per capita incomes of any nation, a prosperity resulting from the mining of guano. Realizing how finite fossil guano is as a resource, this country is wisely investing its income from phosphate mining in real estate; Nauru House in London, for example, is a major new office building and an important source of revenue for the government.

Compared with such dominant landscape alteration by coral growth, blue-green algae and bird droppings, the effects of change by mammals is relatively local. For example, ponds are created behind beaver dams. A few beavers still live in Europe, but the conditions for their survival there are no longer favorable. Although once common from England to eastern Siberia and across North America, they are only now recolonizing their former habitat in eastern United States; trapped out by centuries of exploitation they are now returning. Beavers are common today within Washington's city limits. They live along the C&O canal just west of Georgetown and travel up Rock Creek at least as far as the Zoo, where a few years ago they felled three newly planted hickories.

Finally, there are those zoogeomorphological changes which are much less obvious because they are so hard to see. For example, on the bottoms of shallow bays of Puget Sound and British Columbia divers discovered grooves and pits five or more meters long and ten or more centimeters deep in the mud substrate. They eventually saw in the murky water grey whales ploughing furrows in the rich mud with their snouts. By swimming on their right side they suck mud into their mouths with their powerful tongues. The rich store of invertebrates living in the top layer of the muddy bottom is trapped inside by the baleen bristles in their jaws through which the whale expels the muddy water. Scientists have calculated that the 15,000 grey whales that summer in the Bering Sea re-suspend a minimum of 120 million cubic meters of sediment there. By comparison, this amount is nearly three times the annual sediment load discharged into the Bering Sea by the Yukon, which in turn is the fourth largest sediment source in

North America. If you ever go whale-watching in the lagoons of Baja California you will notice that barnacles grow only on the whale's left jaws.

From the examples given we realize that the earth's surface is being continually modified by creatures ranging from tiny reef-building corals to feeding grey whales. There are endless additional examples of animals changing the shape of our globe, including by geophagy, where birds and animals actually eat mineral-rich soil in areas deficient in micro nutrients. Their action, along with that of humans, illustrates the one facet of the future of which we can be certain: nothing is static on our planet, and even without the impact of a single human being, it will change in shape (morphology) and character continuously just as does every creature throughout its life, whether measured in minutes or centuries.

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