PLASTICS AND THE OCEAN

ORIGIN, CHARACTERIZATION, FATE, AND IMPACTS

EDITED BY **ANTHONY L. ANDRADY**

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Preface

Interestingly, the invention of the first plastic was closely linked to the conservation of the African elephant. The material was invented as a low-cost replacement for ivory used to make Billiard balls back in the 1800s. With a single elephant tusk yielding just three balls, the expense, difficulty, and perhaps even the brutality of securing ivory, drove Michael Phelan, a star player of the game and an entrepreneur of his day, to announce a prize for anyone with an apt substitute for the unique ivory. That led the US inventor Wesley Hyatt, in 1869, to come up with hardened nitrocellulose (which he called celluloid) as a good substitute. Though he did not receive the prize, his efforts ushered in an era of plastics, a defining feature of the anthropocene epoch. It was soon followed by Bakelite in 1907 and then by a series of other plastics that continue to serve us even today. In fact, all the common plastics in use today were discovered by the early 1950s. An early success was nylon (invented by Carothers at Du Pont) introduced to the consumer at the 1939 World Fair, causing a sensation with 64 million pairs of stockings sold in a year. As nylon was a replacement the natural silk used in hosiery, the discovery of this first synthetic textile fiber saved millions of silkworms from an early demise as the demand for fine natural silk leggings dropped.

Plastics captured the imagination of the public and much was expected of this miraculous material which lived up to public expectations, quickly finding applications in fabric, packaging as well as in numerous other consumer products. The August 1955 issue of the *Life* magazine proudly announced the dawn of a plastic era with “throwaway living,” where housewives would finally be relieved of having to clean utensils after each meal. Not only did this ominous claim come true with every single item in the Life magazine illustration becoming a common household product, but also introducing a host of innovative single-use plastics products widely used today. With nearly half the commodity plastics produced today devoted to disposable products, the unmanaged or carelessly disposed post-use plastics have now ended up in our environment, ironically harming wildlife, especially marine organisms. Today every aquatic system including the Marianna trench, the Arctic ice masses, and rivers on even uninhabited islands around the world are contaminated with post-use plastics. Marine convergence zones, like those in the Northern Pacific, concentrate small fragments of plastics, the microplastics, counted in the trillions in the upper ocean. As some plastics in the ocean sink to the sediment, what is sampled in surface water is only the tip of the proverbial iceberg. Their abundance in the water column, especially the bottom sediment, is reported to be much larger than in either surface water or the dry beach sediment. How much plastic enters the oceans is not precisely known. An estimate places the influx in 2010 at 4.8–12.7 MMT but it keeps growing each year.

An Already Stressed Ocean

The ocean that ends up receiving an annual increment of plastic waste from both land-generated debris *via* riverine transport and also directly from coastal areas, is already under stress. The burning of fossil fuels over the past several hundred years has already increased the acidity of surface waters by 30% threatening the survival of hard-shelled species; it’s impact on the global fishery is not reliably known. Rampant unsustainable overfishing depleting the fishery, also leaves behind enormous amounts