

Plastics Book Talk

by Elizabeth Barker

In 1992 a storm swept a shipping container overboard leaving 28,796 Floatee bath toys adrift in the Pacific Ocean near the Aleutian Islands. Eric Carle created a children's picture book in which 10 Little Rubber Ducks come off the production line chuckedy - chuck-chuck and then sail away into the ocean.

Donovan Hohm wrote Moby-Duck (2010). Once again our intrepid journalist travels around the world to see sites, interview participants, and possibly find his own plastic duck souvenir. Sharing the trips with him is delightfully entertaining and informative. He travels up the Alaskan coast beachcombing and studying currents. He goes to toy factories and trade shows in China. He voyages to the Pacific garbage patch and through the Northwest Passage and on a freighter. He has "read about the science of hydrography and the chemistry of plastics and the history of childhood...learned the Beaufort Scale of Winds and the chemical structure of polyethylene and the medieval ages of man".

He takes six different trips over several years. His accounts of those trips fill almost 400 pages and are strewn with literary (Moby Dick by Melville!) and scientific references, personal anecdotes, and widely flung ruminations. The iconic yellow bath toy duckling is based on a single species, popularized by Sesame Street's Ernie. The duck's possible trip goes through the Northwest Passage to the eastern American coast. That's plastics and ocean currents and a lot of terrain and childhood and our view of animals, ad infinitum almost. Random facts are as invasive in the book as plastics in our environment. But they are much more interesting.

Animals today are for kids, raw materials, commodities, and pets. Childhood is defined by dependence, which education lengthens. China makes 80% of our toys. There was a 2007 campaign to stop that. The United States spends \$31 billion on toys and video games, half the world total. Excess Civil War production was diverted to making cheap knock-offs of European goods. Excess WWII production of chemicals led to consumer plastics - and pesticides and synthetic fertilizers. The submarine warfare did as much for ocean science as the space race did for astronomy. There is a Beachcomber society with a regularly published newsletter. You just have to read this book yourself.

Plastic Ocean by Charles Moore with Cassandra Philips (2011).

Here is the actual researcher's tale of plastics in the ocean. Moore (one of the interviewees in Hohm's book) is given credit for discovering the Great Pacific Garbage Path in 1997. This led him on his own sojourn of organizing research teams and collecting bonafides through his active participation. He is the co-author of a much cited paper and the star of the Synthetic Ocean video. A color photograph spread includes two helpful maps of northern Pacific Ocean

currents. Details of plastic collecting voyages are interspersed with discussions of the production and use of plastics, the logistics of research publication and activism, and the effects of plastic contamination on the marine ecosystem.

He starts with a 10 page synopsis of plastics development and its connection with the oil industry. Descriptions of the Pacific currents reveal two gyres and a convergence zone. Looking for other research and trying to activate concern about ocean pollution reveals that both scientists and activists are focused in a way that hinders communication. Marine pollution people are concerned with fishing gear. Scientists are in an elitist bubble which doesn't involve solutions. And the priorities of industries and economic interests (plastics, oil, fishing, Mylar balloon makers...) exert enormous pressure.

A look at the broader problem of waste and its disposal morphs into a similar view of the expansion of single use disposable convenience products. Economic pressure is exerted not just through lobbying, but by the basic needs of a growing population and industrial development for more jobs, and production, and consumption. Plastics are not only the epitome of better living through chemistry but seemingly an escape from the limitations of natural resources - and seemingly inert.

The problem of plastic pollution is consistently assigned, not to the producer, but to the consumer. Solutions are oriented toward littering and recycling. His research voyages collected micro plastic debris and investigated its ingestion by marine organisms. Those tiny particles harbor micro plankton which provides a food source for other marine organisms. They also leach a variety of chemicals and adsorb others. They are distributed throughout the ocean and they work their way up the food chain. An economic system that brought wealth and growth hasn't given us a healthy planet.

I wish the above could do justice to this book. It exudes the actual sea-faring research experience and an activist's passionate examination of our lack of concern about the negative effects on the environment in the service of our economic system. It deserves better.

Plastic Purge by Michael SanClemens (2014).

This wasn't the only book about using less plastic. It's a good overall choice. The author is an ecologist with "an engaging casual style". He starts with an interesting history of plastics. A 1860s "save the elephant" prize was offered for a synthetic polymer that could replace the use of ivory for billiard balls. Unsuccessful Parkesine led to Bakelite, nylon, Tupperware and ever so much more.

Today plastics are ubiquitous in our daily life - and in the ocean. Many economic benefits and technological advances depend on plastics. Plastic's strength and light weight has numerous energy saving aspects, especially in relation to transportation. Quite a few negative effects related to personal health, the environment, and energy use need to be recognized. Plastics are made from petroleum products, leach chemicals that disrupt hormones and pollute the air. They are difficult to recycle.

Much of the plastic purging relates to packaging and health. Losing weight and feeling healthier

were side effects of the author's efforts. The emphasis is on using fresh foods and glass jars. He says essentially all cardboard and metal containers are lined with plastics which leach chemicals. He says BPA metabolites are found in 90% of U.S. adults' urine. Consuming the recommended 8 glasses a day of tap water would cost \$0.50. Bottled water would cost \$1,400. One child uses 8000 disposable diapers. The United States has 4% of the world's children and buys 40% of its toys, mostly made of plastics. Single use, cheap, and disposable are three adjectives that deserve a lot of questioning.

Life without Plastic by Chantal Plamondon and Jay Sinha (2017).

The authors are founders of the title organization which sells plastic replacement products. The book is promotional in that respect, but quite practical in outlining an awareness of plastic prevalence in daily life. The complexity of recycling plastics and the environmental consequences are explained. Alternatives in specific areas, such as personal care and cleaning products, are detailed. Substitutes can be difficult to find. Some suggestions, such as carrying non-plastic containers to the grocery for items from the butcher and feminine hygiene solutions, sound extreme. It's hard to recognize how quickly we have become dependent upon a convenience, and how easy it is to ignore the effects on a living earth on which we are dependent for our lives.

Plastic: a Toxic Love Story by Susan Freinkel (2011).

This book, too, gets high marks. Freinkel starts by listing all the plastic things she touches during a single day. The presumed organization of the book is an examination of several everyday plastic objects: comb, chair, Frisbee, IV bag, disposable lighter, grocery bag, soda bottle, and credit card. The objects are primarily vehicles for exploring more general areas (the medical field, etc.) and attitudes (our throw away culture, etc.).

The history of plastics and the wide spread polluting effects of its durability covers familiar territory. Then Freinkel goes on to expand in a way that illuminates both the multiple advantages of living in Plasticville and of how ingrained those advantages are in our lives. There are tidbits of facts and anecdotes. There are whole paragraphs that cry out for verbatim transcription. It's a sprawling, nuanced, well researched, intelligently evaluated look at humankind's relationship with plastics. This is illustrated by our ability to define ourselves and better our lives with an endless supply of things that have so little value they can be thrown away. Amazing medical advances (neonatal care, artificial hips) are counter balanced by chemical additives that leach and are in the blood and tissue of humans around the world.

Combs have been around since prehistoric times and were one of celluloid's wonders. So was the Kewpie Doll. Frisbees started out as pie pans and Hula Hoops were an enterprising use of low grade scrap plastic. Chairs, made from a single block - stable and cheap, are a design wonder exemplifying the malleable versatility of plastics. The plastic American Express card

appeared in the 1960s and its success could be marked by the meaning of "she has a purse full of plastic". That card also affects our values. It's easy to buy something new and dispose of the old. We define ourselves to a certain extent by the things we have and what value do those things have if they are so easily replaced?

Excess plastic production, savings in production and transportation, and the lure of constant demand spread from the oil and chemical industries throughout manufacturing. Consumers had to be persuaded to accept disposable plastic replacements. Original Dixie cups were carefully saved for reuse. Collectible Zippos (guaranteed for life), returnable bottles, repairable appliances, and heirloom furniture had value. They were durable goods. Disposables were not, but they represented convenience and the luxury of constant change.

U.S. plastic production has exceeded that of steel since 1979. In little more than half a century we have been cajoled into a consumer based disposable economy. Standard Oil was the first to isolate plastic raw material from petroleum. Plastic uses 4% of U.S. petroleum as a raw material and another 4% in plastic production. There are five families of commodity plastics (listed in an appendix). PET equals 75% and is the most recyclable. Production (cracking) involves high temperatures and pressures. Dow's 500 acre Texas complex runs continuously. The end resin product is molded into long strands and chopped into small pieces called nurdles. Production is beginning to shift to developing countries. Guandong Province in China hosts 5000 factories turning those nurdles into products. Medical uses account for 10% of plastics, packaging =33%, consumer products =20% and construction = 17%. Various chemicals are added along the way, mostly "trade secrets" and unidentified. Regulation is divided between the EPA and FDA. It is generally assumed that additives are safe unless proven otherwise. Plastic is thought to be inert. However, certain chemicals do leach and have been shown to be endocrine disrupters. Possible effects in humans include ADHD, diabetes, obesity, and infertility. The timing of exposure may be more critical than the dosage. Particles in the ocean attract microorganisms and various chemicals. The effect of their ingestion and food chain consequences is difficult to determine. The ocean itself embodies the tragedy of the commons both in the continuing harvest and its use as a dumping ground. Trash is matter out of place. Plastic bags are a good example. Their visible presence is striking as is their sheer volume worldwide. Various attempts to curtail their use from bans to fees have some effect. Requiring stores to collect them at least consolidates them. And reduces the guilt we feel about using them. Plastics overall have a 7% recycle rate compared to glass at 23%, metal 34%, and paper 55%. The U.S. Henry Ford actually produced soy based plastic which he used in his cars. Plant based plastic doesn't mean its biodegradable. The consumer is held responsible; she litters, he doesn't recycle. Extended Producer Responsibility shifts to the manufacturer- encouraging less packaging, and the ability to repair and recycle. There are 52 pages of notes citing and expanding specifics in the 223 pages of text. They are easy to skip but worth looking at.

—

American Plastic: a Cultural History by Jeffrey Meikle (1995).

A lot has changed in the past 15 years. There's not much here about all the plastic components in the ocean and in ourselves, but there's a lot about the early development of plastics and how they have influenced our culture. A long chapter on Bakelite details its multiple uses and the many scientific and commercial problems encountered in its development. Edison isn't the only interesting inventor, nor was Baekeland.

Henry Ford produced a single plastic bodied car in 1941. The first Corvette had a fiberglass body. Pre-introduction security for nylon rivaled that for the Manhattan Project. Nylon was a WWII essential for parachutes and gears. A polymerized resin for plywood turned it into a valuable construction staple. Teflon was used to prevent corrosion in Oak Ridge facilities - and workers who manufactured the product experienced toxic effects then. A plastics society sponsored an MIT research lab for structural uses in the late 19040s. The 1967 Nobel physics prize went to linear polymerization researchers.

Plastic production was from the beginning dominated by oil and chemistry industries. Once polymerization was achieved the variety of specific products and effects of additives burgeoned. That multiplicity and many uses (gears, wiring insulation, adhesives, magnetic tape, etc.) were relatively invisible to the general public. People's awareness and acceptance of "plastic" was and continues to be ambivalent. Were Bakelite combs and Melamine a cheap substitute or did they bring luxury to the masses? There was not much standardization of quality or differentiation between types. A few trade journals and societies actively promoted positive information. They advertised in women's magazines and held expositions. One was sponsored by Hooker Chemical - later indicted for the Love Canal pollution. Their approach might be exemplified by one chemical engineer who was related to Freud and had been Pavlov's student.

Modular homes, blow-up and damp clean furniture, the geodesic dome, the Eames chair, and water beds were the future. Designers created affordable products that meticulously reproduced expensive materials and intricate workmanship or achieved previously impossible forms and qualities. Materials were easy to maintain and didn't corrode. Disney Land is an ultimate expression.

Artists and sculptors utilized the new materials. Writers and film producers subsumed the ambiguity of living in a world which seemed to be devoid of limitations and thus, disturbingly, of real value. Andy Warhol, Jack Kerouac, Thomas Pynchon, and Buckminster Fuller are a few of those discussed. The coming complexities of virtual reality are alluded to as is an expansion of our increasing involvement in a synthesized world and detachment from the natural environment.

Two juvenile books, Coping with Plastic Trash by Jamie Daniel and Veronica Bonat (1991) and You Are Eating Plastic Every Day by Danielle Smith-Llera (2020) are examples of good basic information. Plastics and Polymers Science Fair Projects by Madeline Goodstein (2004) has ideas that could also be done at home. Models of molecules, making "slime", and experiments to demonstrate qualities of different kinds of plastic (including ways they can be sorted for recycling) are the main emphasis. Simple hands-on activities promote better understanding of chemistry and scientific evaluation methods.

The PVC Project Book by Charles Sanders (2004) has a couple of greenhouse projects but is otherwise pretty rudimentary, mostly about utilizing plastic pipe as a material. My impression is that structural use of plastics optimizes the value of their strength, durability and light weight. I wish I had found material on that area. It's such a contrast to our proliferate use and acceptance of single use, disposable plastic, especially for packaging.