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Upcycling in History: Is the Past a Prologue to a Zero-Waste Future? The Case of Aluminum

Over the last two decades, upcycling—the creation of new goods from salvaged ones in a way that increases the value of the material—has become a trendy and environmentally conscious form of design. Contemporary upcycling efforts range greatly in scale and kind. Artisans tout their refashioning of old license plates into book covers as upcycling. Industrial designer Boris Bally's work includes chairs and plates fashioned from aluminum street signs. Bally does not remove the paint from the designs, so users can identify the metal's previous use easily before they sit in the chair. Aspiring to be "the ultimate urban alchemist," Bally stated in 2014: "Making something people value from something they have discarded is the *ultimate* challenge. It's getting them to pay big bucks for your design made of their own discards."[1]

This work represents a bridge between trained designers working in formal markets and informal reuse of scrap materials in activities that increase the cultural and economic value of the work. This work goes on throughout the world, adding complexity to our understandings of the uses of modern materials. For example, artisans in West Africa incorporate scrap aluminum into cast aluminum cooking pots and utensils.[2]

Of late, however, the term upcycling has become associated with activities on a larger industrial scale, for example, as detailed in architect William McDonough and chemist Michael Braungart's 2013 book *The Upcycle: Beyond Sustainability, Designing for Abundance*. In it, McDonough and Braungart describe how all industrial production should be reconceived to increase value from existing materials with the ultimate goal to never cast any material from manufacture into sinks and to never create toxic wastes. The allure of upcycling to attack environmental problems associated with waste has made its way from artisan producers like Bally to large corporations. The giant shoe company Adidas announced a collaboration with designer Cyrill Gutsch's firm Parley in 2015 to produce a sneaker with, as the press release declared, "a shoe upper made entirely of yarns and

1 Sarah Marchant, "Interview with Industrial Designer Boris Bally," *Goedecker's Home Life*, 29 January 2014, http://www.goedekers.com/blog/interview-with-industrial-designer-boris-bally/.

2 Emily Lynn Osborn, "Casting Aluminium Cooking Pots: Labour, Migration and Artisan Production in West Africa's Informal Sector, 1945–2005," *African Identities* 7, no. 3 (2009): 373–86.

filaments reclaimed and recycled from ocean waste and illegal deep-sea gillnets."[3] Parley seeks to find design solutions for the problem of plastic ocean pollution. In speaking of these efforts, Ocean Revolution founder Wallace J. Nichols argued: "Humans adapt. And one of the ways they're adapting is by turning this mess into other new products. They're doing science, they're doing research, they're communicating and they're being creative. That's what we do—that's what we humans do so well."[4]

Upcycling represents hope for responsible industrial production. The artisanal model of handmade goods differs in scale and process from Patagonia's mass-production of fleece or Adidas's attempts to turn plastics found in the oceans into shoes. The material Patagonia and Adidas use is unrecognizable from its previous incarnation, lacking the shape and branding of its old body or bodies.

Industrial approaches to upcycling include the clothing company Patagonia touting its conversion of PET bottles into polar fleece; the industry trade group Keep America Beautiful (KAB) uses similar rhetoric in its advertising, showing a plastic bottle declaring "I want to be recycled" into various goods ranging from a hairbrush to a park bench. Furniture designers such as Norman Foster advertise their use of secondary aluminum as chairs and tables as upcycling. And fashion designers such as Nathan Zhang identify their use of used denim jeans to create capes that sell for US$400 as upcycling.[5]

However, although this term for eliminating waste by repurposing still-usable materials is often seen as innovative, in fact the act of manufacturing goods of higher value than the post-consumer or post-industrial material that comprise them has a long history.

Much as the history of recycling delves further back into the past than the advent of curbside collection programs in the environmental era, the history of upcycling should encompass the methods and goals of manufacturers employing post-consumer and post-industrial materials throughout industrial history. This lens illuminates how and why industries have reused materials with greater considerations of value and intention.

3 Ann Binlot, "Adidas and Parley Team Up for Sneakers Made from Recycled Ocean Waste," *Forbes*, 30 June 2015, http://www.forbes.com/sites/abinlot/2015/06/30/adidas-and-parley-team-up-for-sneakers-made-from-recycled-ocean-waste/.

4 "Ocean Plastic: Seeing Opportunity in Waste," Parley website, 23 April 2015, http://www.parley.tv/updates/2015/4/20/ocean-plastic-seeing-opportunity-in-waste/.

5 David Gianatasio, "Bottles and Cans Plead to Be Recycled in New Ads for Keep America Beautiful," *Adweek*, 19 July 2013, http://www.adweek.com/adfreak/bottles-and-cans-plead-be-recycled-new-ads-keep-america-beautiful-151303/.

Such an approach may lead to reappraisals of the automobile made from disused railways, the skyscraper made from demolished buildings, and even the mass-produced book made from rags. It may lead to philosophical debates on the values inherent in transforming plowshares into swords and vice versa. One way this history might be told uses a material largely employed since the mid-twentieth century: aluminum.

The Case of Aluminum

Aluminum is a useful case study as it became a part of the waste stream in the middle of the twentieth century, and recycling aluminum has both environmental and economic benefits when compared to smelting virgin aluminum. Furthermore, aluminum has been, in different applications, derided as ersatz and celebrated as modern.

Nineteenth-century designers valued aluminum for its durability and lightness, yet the energy requirements of smelting aluminum from bauxite prevented widespread use of the metal. The mass production of virgin aluminum during World War II created an abundance of the metal in the United States and Europe. Between 1940 and 1960, aluminum use spread from aviation to beverage containers and siding for housing. The metal gained a reputation as ersatz, cheap, and disposable, despite the environmental toll inherent in its creation.

To mitigate criticism of aluminum as potential litter, the Aloca Corporation and beverage distributors touted the metal's potential for reuse and recycling. Salvage campaigns during and after World War II evolved into eco-friendly recycling campaigns, culminating in the Keep America Beautiful campaign of the 1970s. The industry's efforts raised awareness among designers that salvaged aluminum was both durable and economically more affordable than virgin aluminum.[6] By 1950, scrap comprised about one-third of all aluminum used in production in the United States; ten years later, scrap comprised more than half of domestic production, and in recent years the proportion of scrap in aluminum production has ranged between 55 and 60 percent. Recycling is the primary source of aluminum in the US.[7] Much of this is used to fashion new soda and beer cans,

6 Bartow J. Elmore, "The American Beverage Industry and the Development of Curbside Recycling Programs, 1950–2000," *Business History Review* 86 (2012): 477–501.

7 T. D. Kelly and G. R. Matos, comps., Historical Statistics for Mineral and Material Commodities in the United States: US Geological Survey Data Series 140, accessed 10 March 2013, http://pubs.usgs.gov/ds/2005/140/.

an activity that at best can be described as static in value and (as McDonough and Braungart noted) risks downcycling the metal and creating pollutants.

But recycling cans is only one of the many uses of secondary aluminum. Between 1950 and the present, designers have also salvaged the material in new designs of vehicles, furniture, and musical instruments. A few brief comments on each follow.

Transportation inspired the mass production of aluminum in World War II, as the material allowed for faster fighters and larger bombers, such as Boeing's B-52.[8] After the war, commercial and military aircraft manufacturers refined aluminum alloys, with prompt post-industrial scrap used in the manufacture of new aircraft such as the DC-9 and 707 (and later, larger jets, including the 747). In addition, European automobile manufacturers, including Porsche, Aston Martin, BMW, Mercedes, and Ferrari, used aluminum for the bodies of racing cars during the 1950s and 1960s, enhancing the reputation of the metal in sleek, aerodynamic designs.[9]

Before aluminum became more accessible after World War II, designers in Europe and the United States coveted the material for its malleability but designs were limited by cost and scarcity of the metal. After the war, Alcoa worked with manufacturers such as the furniture producer Herman Miller to incorporate the suddenly abundant material into modernist designs. Herman Miller contracted several designers to work with aluminum, most famously Charles and Ray Eames.

For Charles and Ray Eames, the ecological benefits of recycling aluminum were less significant than its materiality. A durable, malleable, yet light metal allowed the construction of minimal frames that could be easily mass-produced. Recycled aluminum made the designs more affordable, allowing Eames furniture to find homes on patios, in living rooms, in offices, and even in airport lounges, where the chairs were valued as being lightweight, stylish, comfortable, and incredibly robust.

8 Marc Reisner, *Cadillac Desert: The American West and Its Disappearing Water* (New York: Viking, 1986); Eric Schatzberg, "Symbolic Culture and Technological Change: The Cultural History of Aluminum as an Industrial Material," *Enterprise and Society* 4, no. 2 (2003): 226–71.

9 Hermann E. Burst and Erich W. Strehler, *The Use of Aluminum in the Porsche 928* (Warrendale, PA: Society of Automotive Engineers, 1978); K. M. Loasby, *The Use and Manipulation of Aluminum in Aston Martin and Lagonda Cars* (Warrendale, PA: Society of Automotive Engineers, 1978).

The Aluminum Group furniture was part of a larger context of acclaimed design for mass production, and the furniture they designed for Herman Miller after 1958 influenced a wave of furniture and appliance design with the metal. Herman Miller continues to sell Eames furniture more than half a century later, with prices for new Aluminum Group chairs ranging from several hundred to several thousand dollars.

In the half century since, aluminum has become a structuring material for furniture from designers from all over the world, including Philippe Starck of Paris, Norman Foster of London (whose 20-06 chair for Emeco, he emphasizes, is made of 80 percent recycled aluminum), Joris Laarman of Amsterdam, and the late Charles Pollock of Brooklyn. If the language Norman Foster uses now explicitly references upcycling, his material use echoes what the Eamses did 50 years earlier.[10]

Guitar luthiers recognized the durability and resonance of aluminum as early as 1928. Luthiers known specifically for working with aluminum became more prominent between 1950 and 1975, bolstered both by lower prices and the abundance of aviation-grade alloys. Three pioneers of the aluminum-necked guitar, Wandre Pioli of Italy and Travis Bean and John Veleno of the United States, fashioned high-performance instruments at the request of musicians such as Jerry Garcia, Keith Richards, and Todd Rundgren.

Musicians appreciated the extended sustain of notes on an aluminum neck and the guitars' relative indestructability compared to wooden instruments. The instruments have appreciated in value; a Travis Bean guitar once cost about US$400; today, the guitars sell on eBay for between US$3,000 and US$10,000 apiece. While scarcity and antique pricing may account for some of the appreciation of these now-discontinued instruments, other designers continue to manufacture aluminum instruments.

Sustainable Design in a Historical Perspective

In each of these applications, the specific material properties and economic context of aluminum shaped particular design decisions and applications. While much of the use discussed predates the term upcycling and even the ecological ethos to use the materi-

10 Marcus Fairs, *Green Design: Creative Sustainable Designs for the Twenty-First Century* (Berkeley, CA: North Atlantic Books, 2009), 71–75.

als, the applications of secondary aluminum by Charles and Ray Eames in the 1950s and John Veleno and Travis Bean in the 1970s is effectively the same as the consciously green design uses of aluminum by Norman Foster in the early twenty-first century. The Eames chairs may not have undergone a comprehensive life-cycle assessment to assess savings of water and energy in the construction and use of Aluminum Group chairs, although these factors were implicit in the affordability of secondary aluminum that Herman Miller used to mass-produce the designs.

The environmental consequences of recycling aluminum are also instructive. Fashioning aluminum from secondary sources represents a 95 percent energy saving compared to smelting aluminum from bauxite. This energy saving, along with reducing landfill volume, represents much of the case for recycling as an environmentally responsible activity. Yet concerns about pollution from this industrial process exist. Although recycling aluminum presents significant energy savings over producing virgin aluminum, energy is still required, and the process creates both solid and gaseous toxins, including dross (or salt cake), dioxins, and furans. Although recycling this highly malleable material has many benefits, the process is not a completely closed loop. This is true of the aluminum employed in Eames furniture a half century ago and remains true of the aluminum used in Norman Foster's designs in the twenty-first century.

The case of aluminum shows that historians can deepen our analysis of one of the environmental claims for recycling. Does upcycling secondary material promote circular material flows or turning salvaged materials into durables? Toxic byproducts reveal important limitations on circular material flows, but the claim of diverting materials from solid waste disposal invites scrutiny of producing high-value goods as a means of reducing waste. The examples in this paper indicate success at creating durable goods, as the designs are kept or sold decades after their manufacture. (One contrast is Apple's use of aluminum in the bodies of its laptop computers. Though expensive and highly-valued, these machines are subject to technological obsolescence and Apple's use of aluminum is in part intended to allow for recycling of the machines when they are deemed too slow for use.) Creating goods of durable value removes them from the waste stream, but also removes them from a circular flow of materials. This may affect the intentions of designers to design for immortality rather than disassembly, and if we define upcycling as creating goods of greater worth from salvaged materials, such intent is consistent with that definition.

Aluminum, then, represents an important historical example of upcycling. It also invites us to see the limits of applying the term to the wide variety of materials championed as possibilities for upcycling, including paperstock, glass, and especially polymers. This is important, as claims for upcycling of such materials conflict with historical utility of these materials. Unlike aluminum, plastics have a low recycling rate in industrial society. The current debate over upcycling polyvinyl chloride (PVC), polyethylene terephthalate (PET), and other plastics is a contentious one, with concerns including limitations due to contamination, tendency of recycling materials to downgrade, and emissions of toxins (including endocrine disruptors and carcinogens) from manipulating the materials.[11]

The word *upcycling* today has power to affect design strategies and waste management policies. In addition to McDonough and Braungart's expansive use of the word, the Product Policy Institute, founded in 2003 to advocate public policies to encourage waste prevention, clean production, and reduce use of toxics in products, renamed itself UPSTREAM to place the concept at the center of its advocacy efforts. The organization is engaged in a contentious debate with critics of zero waste about how extended producer responsibility factors into design with plastics and their eventual disposal or reuse. Life cycle assessments are crucial to evaluating this material reuse, but so is the demonstrated history of transforming—or failing to transform—secondary materials into goods of enduring value. This modest look at aluminum's history is one way to historicize our understanding of upcycling, and I offer it to encourage zero-waste advocates to inform their work with awareness of the historical applications of recovered materials. Such an assessment will better allow designers and policymakers to devise effective zero-waste strategies in the future.

11 Samantha MacBride, *Recycling Reconsidered: The Present Failure and Future Promise of Environmental Action in the United States* (Cambridge, MA: MIT Press, 2011); Max Liboiron, "Redefining Pollution: Plastics in the Wild" (PhD diss., New York University, 2012).

Further Reading:

Recent studies of sustainable design strategies include Hartmut Esslinger, *Design Forward: Creative Strategies for Sustainable Change* (Stuttgart: Arnoldsche Art Publishers, 2012); and Philip White, Louise St. Pierre, and Steve Belletire, *Okala Practitioner: Integrating Ecological Design* (Phoenix, AZ: Okala Team, 2013).

Studies on the history of salvage, recycling, and material reuse include Susan Strasser, *Waste and Want: A Social History of Trash* (New York: Henry Holt, 1999); Carl A. Zimring, *Cash for Your Trash: Scrap Recycling in America* (New Brunswick, NJ: Rutgers University Press, 2005); and Finn Arne Jørgensen, *Making a Green Machine: The Infrastructure of Beverage Container Recycling* (New Brunswick, NJ: Rutgers University Press, 2011).

On the history of aluminum production and use, see George David Smith, *From Monopoly to Competition: The Transformations of Alcoa, 1888–1986* (New York: Cambridge University Press, 1988); and Mimi Sheller, *Aluminum Dreams: The Making of Light Modernity* (Cambridge, MA: MIT Press, 2014).

On mid-century modern designers use of aluminum, see Sarah C. Nichols, Elizabeth R. Argo, Elizabeth Teller, and Paola Antonelli, *Aluminum by Design* (Pittsburgh, PA: Carnegie Museum of Art, 2000); and Marilyn Neuhart and John Neuhart, *The Story of Eames Furniture* (Berlin: Gestalten, 2010).