No One Asked for Plastic
Plastic production just keeps expanding, and now is becoming a leading cause of climate change.

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*Edited by Sarah Laskow
**Fact checked by Sam Fentress

The published text is hyperlinked, where possible. But here are additional specifics on those sources in addition to others consulted during the writing of this essay and the larger book project from which this essay draws (tentatively titled *The Song of Styrene: An Intimate History of Plastics*, forthcoming from Scriber Books (US) and Oneworld (UK).

**Acknowledgments**

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Also, to the dedicated archivists at: the Library of Congress, the Smithsonian Museum of American History, the Hagley Museum and Library, the Science History Institute, the West Virginia State Archives, the South Charleston Interpretive Center, Carnegie Mellon Institute Archives at Carnegie Mellon, The University of Iowa, The FDR Presidential Library (Collection on the Rubber Survey Committee), Bergen Grant (Boston University), and for the personal collections shared by Kim Johnson.

**On plastics additives:**


*From abstract:* “In total, we identify more than 10,000 relevant substances and categorize them based on substance types, use patterns, and hazard classifications wherever possible. Over 2,400 substances are identified as substances of potential concern as they meet one or more of the...
persistence, bioaccumulation, and toxicity criteria in the European Union.”

On scale of US contribution to plastic pollution:


On the history of ethylene-derivatives, petrochemicals and plastics (including vinyls/Vinylite) at Union Carbide (previously Carbide and Carbon Chemicals):

*A note of clarification: ethylene dichloride (EDC) was technically a byproduct from Carbide’s production of ethylene chlorohydrin, the precursor chemical used in making ethylene glycol (marketed as Prestone). So when I wrote EDC was a byproduct of antifreeze/ethylene glycol production, I was referring to the whole cascading series of processes that yielded Prestone (not specifically the step in the process that produced ethylene glycol).


On lackluster early Vinylite sales, marketing struggles and the existence of a credit department, see A Marketing Revolution: Early Sales Efforts of Union Carbide Chemicals Company. C. W. McConnell to R. D. Stief, October 31, 1995.

Other sources consulted on early Carbide history in ethylene-derivatives and vinyls:


On the carcinogenicity of styrene, vinyl chloride, butadiene – all monomers used in commodity plastics production—

After forty years of research, a working group of 23 scientists (from 12 countries) International Agency on Research and Cancer (IARC), based on the weight of the evidence, in March 2018, upgraded the status of styrene from “possibly” to “probably carcinogenic,” a determination which, to the casual reader, can be confusing. Note: The designation of “possibly” or “probably” carcinogenic has strict meaning, and is a characterization of the strength of the scientific evidence NOT of the cancer-causing potential of the chemical itself.

A breakdown of the IARC carcinogen classification system is available here: https://ec.europa.eu/health/scientific_committees/opinions_layman/en/electromagneticfields/glossary/ghi/iarc-classification.htm

IARC grouped styrene as a Group 2A “probably carcinogenic” based on the weight of the scientific evidence, meaning there is evidence to support that it is carcinogenic. The National Toxicology Program, in their review of the evidence, determined styrene was “a reasonably anticipated human carcinogen.” IARC. 2019. Styrene, Styrene-7,8-oxide, and Quinoline. IARC Monographs on the Evaluation of Carcinogenic Risks to Humans. Volume 121. Available at: https://www.ncbi.nlm.nih.gov/books/NBK551039/


Mette Skovgaard Christensen, Jesper Medom Vestergaard, Francesco d’Amore, Jette Sønderskov Gørløv, Gunnar Toft, Cecilia Høst Ramlau-Hansen, Zara Ann Stokholm, Inge Brosbøl Iversen,

For vinyl chloride, IARC classifies vinyl chloride as a group 1 human carcinogen – which officially means conclusive evidence of carcinogenicity. Available at: https://monographs.iarc.who.int/wp-content/uploads/2018/06/mono100F-31.pdf


On 1,3- butadiene, is classified by IARC as a group I human carcinogen, meaning there is conclusive evidence underpinning that designation. See: https://monographs.iarc.who.int/wp-content/uploads/2018/06/mono100F-26.pdf

For general history of industrial petrochemistry, petrochemical and integrated or networked production:


Center for International Environmental Law. 2017. Fueling Plastics, 4 part series, including: *Fossils, Plastics, and Petrochemical Feedstocks*  
*How Fracked Gas, Cheap Oil, and Unburnable Coal are Driving the Plastics Boom*


**Re: reticent early markets for Celluloid, Bakelite and general 19th-early 20th cntury plastics history:**


**On history of polystyrene development and uncertainties about its commercial prospects in the US:**


On pre- and post-war polystyrene production statistics, see:


On ICI polyethylene/polythene license to DuPont and Union Carbide via US Navy, and on technological, legal and commercial difficulties during, and following WWII:


> between the two companies. Something special, like the agreements covering nylon, might be more suitable.

> McGowan’s letter struck a responsive chord. Within a few days three du Pont engineers were flying to London. Shortly before Pearl Harbor they were back in the U.S. with enough operating information to design an American-built plant. In March, 1942, du Pont signed a Navy contract calling for the construction, by the Bureau of Ships, of a two-million-pound plant at the du Pont works in Belle, West Virginia. The unit was completed by the middle of 1948, but
And re: difficulties, p.135:

On Teflon/PTFE production spurred by Manhattan Project:


Malcolm M. Renfrew, interview by James J. Bohning at New Orleans, LA, 31 August 1987. (Philadelphia: Chemical Heritage Foundation/Now: Science History Institute.) Oral history transcript #0076. -- *Renfrew was a DuPont employee charged with scaling the industrial process for making PTFE. His oral history is a key source on how PTFE/TEFLON was produced pre-war*
in gram measure, and the role of the Manhattan Project in spurring on development. Here is page 24 from that oral history:

It turned out, of course, that they were counting on PTFE to be the gasket material for the gaseous diffusion process, that was to be used at Oak Ridge in the gaseous separation of uranium isotopes. But it didn’t turn out to be a really satisfactory gasket material; it would flow under pressure. Also, there were enough impurities in the polymer the way we were making it then that there were reactions with uranium hexafluoride. There were a number of things that mitigated against Dunning’s proposed use, but a lot of PTFE went into the war effort. A lot of it was used later at Hanford in the plutonium process and that’s where Willard Crane soon went. He was transferred there by DuPont and was there during the rest of the war years. I then moved into his position. I was head of an engineering group that was doing the scale-up of polymerization. I had taken a night-school course in Badger and McCabe [15], and thus became an engineer! It may have been a source of embarrassment to my chemical engineering friends that I got into the American Institute of Chemical Engineers as a ‘senior member’. They had such a classification then and I made that on the strength of my short course and my associates.

BONNING: You said that Dunning wanted to be making a million pounds a month. You then were making the polymer in hundred gram lots?

RENFREW: Fifty or a hundred grams. We had a small rocker tube and we did early manufacture in that equipment.

BONNING: Were you principally looking at catalysts, trying to find better catalysts?

RENFREW: Well, this was one of the needs actually. I meant

Key:
PTFE = Teflon (branded)
Dunning w/ Manhattan Project (at Columbia)
Renfrew, worked for DuPont.


Interview with Irénée du Pont, Jr. by the Voices of the Manhattan Project. Atomic Heritage Foundation. Dated: August 11, 2014. Available here:


www.atomicheritage.org Also, interview with Joe Dykstra via www.manhattanprojectvoices.org.


**On general history of WWII and plastics**


**Re: the Post-War production boom of polystyrene because of excess styrene capacity (from synthetic rubber production), see:**

On polystyrene’s comparatively smaller role in packaging today, compared with polyethylene and polypropylene: (For 2% statistic, see page 20).


On the history of synthetic rubber, including production of styrene and butadiene:


The Rubber Industry in Germany during the period 1939-1945, British Intelligence Objectives Sub-Committee Overall Report No. 7. 1948. London: His Majesty’s Stationery Office.


**On plastics, petrochemical industry as a major advertising client, see:**


**On plastics and disposability:**


On polystyrene as an important 20th century “packaging plastic:”


On polystyrene in Napalm:


On disposable plastics and plastic packaging beyond public demand or awareness, see:


For further instructions on how to soak a paper takeaway cup to reveal inner plastic lining, consult the website of the University of Toronto Trash Team: https://uofttrashteam.ca/


On how little plastic has been effectively recycled and why recycling is so complex:

Geyer R, Jambeck JR, Law KL. 2017. Production, use, and fate of all plastics ever made. Sci Adv. 2017 Jul 19; 3(7):e1700782. Note: this is the source for statistic on less than 10% of
plastics made since 1950 have been recycled. And for statistic “more plastics had been made in the last two decades than in the 20th century.”


On the design of plastics for branding and performance (vs reclamation)


**On long standing human rights violations of the plastics industry:**


And see supplemental bibliography (for further references, by plastic type) here: [https://rebecca-altman.com/s/Science-2021-Altman-supplement-bibilography-FINAL-t8fy.pdf](https://rebecca-altman.com/s/Science-2021-Altman-supplement-bibilography-FINAL-t8fy.pdf)

**On plastics as “boundary threat” and “toxicity debt” plastics cast into the future:**


On historic scale of capital costs to build and operate petrochemical facilities:

Conrad Berenson. 1963. *The Chemical Industry: Viewpoints and Perspectives*. John Wiley & Sons. See Ch 1 -2 The Background of the Chemical Industry and “What is So Different about the Chemical. P. 6 “The capital investment of the chemical industry (per employee) is among the highest in the nation… The high investment is due to both high equipment costs and the high minimum plant capacity necessary before break-even points can be reached.”


Regarding the energy use drawn by plastics industry, see sources in section on plastics and climate. For historic look at how much power Carbide drew in the 1940s to run its integrated petrochemical operations in West Virginia, see:

*See 3-part series published in Fortune, “The Corporation” (June 1941); “Alloys, Gases and Carbons” (July 1941) “Carbide and Carbon Chemicals,” (September 1941). Although, note there is no by-line and specific claims require historical vetting with other sources.*


On fossil fuel industry growth opportunity in plastics:


**On plastics and climate change:**


Re: contributions of plastics industry relative to other manufacturing industries: see IEA 2020:  
https://www.iea.org/reports/tracking-industry-2020


[https://www.theguardian.com/environment/2021/nov/22/chemicals-industry-pollution-emissions-climate](https://www.theguardian.com/environment/2021/nov/22/chemicals-industry-pollution-emissions-climate)

[https://doi.org/10.1371/journal.pone.0200574](https://doi.org/10.1371/journal.pone.0200574)


Tim DeVries et al., 2017. Recent Increase in Oceanic Carbon Uptake Driven by Weaker Upper-Ocean Overturning, 542 *Nature* 215. [https://www.nature.com/articles/nature21068](https://www.nature.com/articles/nature21068)


**On subsidies to the oil and gas sector, and plastics:**


[https://www.nature.com/articles/s41560-017-0009-8.epdf?author_access_token=aH0zbeyBMKe-ztgdommdNdRgN0iAjWel9jnR3ZoTv0OyLLEcIVrbwv-XjMBX8LWW5XTAymRsrwwntLZpd13c0rFV4PDemwy7NO5c87YQWrt8y8K-iySi15WFLB4KmtPeX440qesPTsBvYo0898Wca4O%3D%3D](https://www.nature.com/articles/s41560-017-0009-8.epdf?author_access_token=aH0zbeyBMKe-ztgdommdNdRgN0iAjWel9jnR3ZoTv0OyLLEcIVrbwv-XjMBX8LWW5XTAymRsrwwntLZpd13c0rFV4PDemwy7NO5c87YQWrt8y8K-iySi15WFLB4KmtPeX440qesPTsBvYo0898Wca4O%3D%3D)


John M DeBell, William C. Goggin and Walter E. Gloor. 1946. *German Plastics Practice: A Record, Rewritten and Amplified*. Report initially commissioned by the Quartermaster Corps. Reprinted with permission by the Department of Commerce. Murray Printing Company, Cambridge, MA. *“This is an account of the German plastics industry as we found just after VE day.”*

**On public perception of plastics over time, and industry push-back on policy:**


Re: 15 state legislatures, p. 266-7; push back against NYC proposed 2 cent tax on bottles/containers, p. 267; effectiveness of industry pushing back against legislation, p. 28


during the 1980s and 1990s to employ the third strategy. Many of the laws and regulations drafted during the late eighties attempted to address the issue of solid waste. Frequently, they were based on common perception, rather than fact. FPA was instrumental in challenging and changing these laws and regulations.

One such case involved a regulation passed in Suffolk County on New York’s Long Island. The regulation, which was passed on March 29, 1988, prohibited non-degradable plastic food packaging at the retail point of purchase. It also prohibited most Polyvinyl Chloride (PVC) and all polystyrene packaging. In August 1988, FPA joined The Society of the Plastics Industry, Inc., the Polystyrene

Images

Dow, via Science History Institute, “Styrene, A chemical Charged w/tremendous public promise.”... Quotes: “indispensable to industry and victory” "waiting only for an honorable discharge from the war--materials ready to serve a world at peace." [URL]

“Pure porcelain smooth polystyrene!” Life, May 14, 1965 p. 135
"Uncle Sam owns it -- five oil companies run it -- free!" *Life*, Jan 17, 1944 p41

GR-S rubber/BUNA-s shipping from Union Carbide, WV 1943
The Story of Polystyrene (from BP)
Available via: archive.org
https://archive.org/details/polystyrenestory0000bped

McCall’s pamphlet co-published with Society of the Plastics Industry
From the Hagley Museum and Library (DuPont’s archives)