Rebecca Altman (2019) Time Bombing the Future. *Aeon Magazine.*

Protecting the Future
Domenico Mortellito, 1966-67
Copeland Sculpture Park, Delaware Art Museum, Wilmington, Delaware

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>
> 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.

2. **Penn State University Archives**

> Frank C. Whitmore papers. Call number PSUA 725
> Series 3, Box 7: "Correspondence: Simons, JH"
> Series 3, Box 7: "Simons, JH—notes on conversations with Whitmore."
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> Box 8: "Simons, J.H." – These include many of his personnel records re: hiring, promotion, resignation, 3M research agreements.
> Also From the Eberly College of Science Records
> Volume/Box: 23
> TN: 29115
> Item Title: Simons, J.h.
> Call Number: PSUA 1331
> Box: 23
>
> Kristen Yarmey. Nd. "Joseph H. Simons (1897-1986)." Research notes. Courtesy of Kristen Yarmey (Assoc. Professor of Digital Services Librarian, University of Scranton), and author of *Labors and Legacies*, a book about the history of chemistry at Penn State College/University. Interviewed by phone March 1, 2017. Kristen Yarmey. 2006. *Labors and Legacies: The Chemists of Penn State, 1855-1947*. Pennsylvania State University. Her book available here: https://scholarsphere.psu.edu/concern/generic_works/q811kj69p

3. **Minnesota Historical Society**, 3M historical corporate records, Box 129.E.19.7B, Folder 15: New products division: chronology of division projects, 1940-1953. Courtesy of Evan Hepler-Smith — Research and development updates from fluorocarbon carbon division mid-1940s through mid-1950s, notes early corporate interest, sampling program, scale-up of electrochemical fluorination/Simons process reactors, decisions about delaying/proceeding to pilot plant stage,

marketing, and early conversations with DuPont about a material needed by 1950 for its Teflon process.

Includes a selection of Annual Reports. See: http://www2.mnhs.org/library/findaids/00281.xml and here: http://libguides.mnhs.org/3m/primary

4. **University of Florida, Gainesville**, university archives has some papers, files, mostly research grants and administrative paperwork related to Joseph Simons. Worked with university historian Carl van Ness to pull these from the University Archives.

5. **George Westinghouse collection via Detre Library & Archives, Heinz History Center, Pittsburgh, PA —** The George Westinghouse Museum Collection MSS 920/ Box 19, folder 30, Also Subseries: World's Fair 1965 and also Folders 41 and 42: correspondence and photos (with captions) regarding the construction of the 1964 capsule.

6. **Hagley Digital Archives**, DuPont Co. https://digital.hagley.org/ Re: The New York Worlds' Fairs pavilion, Teflon history, and the art/work of Domenico Mortellito.

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> PCBs:
> http://chm.pops.int/TheConvention/ThePOPs/The12InitialPOPs/tabid/296/Defaul t.aspx
> PFOS:
> http://chm.pops.int/Implementation/IndustrialPOPs/PFOS/Overview/tabid/5221/Default.aspx
> PFOA:
> http://www.brsmeas.org/Implementation/MediaResources/PressReleases/POPRC14PressReleases/tabid/7685/language/en-US/Default.aspx

On **the term "forever chemicals**," see Joseph Allen (2018) in *The Washington Post*: These Toxic Chemicals are Everywhere — Even in Your Body, and They Won't Ever Go Away. *The Washington Post.* Available at: https://www.washingtonpost.com/opinions/these-toxic-chemicals-are-everywhere-and-

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On **the toxicology, ubiquity, environmental persistence of PFASs and resistance to environmental degradation**, see report compiled by the ATSDR/Department of Health and Human Services. 2018. Toxicological Profile for Perfluoroalkyls. (Draft for Public Comment, June 2018). Available at: https://www.atsdr.cdc.gov/toxprofiles/tp200.pdf (Last accessed 14 November 2018).

See also, the testimony delivered before the Senate Committee on Homeland Security and Dr. Linda Birnbaum (Director of the NIEHS and National Toxicology Program) 2018. Testimony delivered before the Governmental Affairs Subcommittee of Federal Spending Oversight and Emergency Management, September 26, 2018: https://www.hsgac.senate.gov/imo/media/doc/Birnbaum%20Testimony.pdf

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U.S. Environmental Protection Agency. 2017. Technical Fact Sheet on PFOA and PFOS. November 2017. Available at:

https://www.epa.gov/sites/production/files/2017-12/documents/ffrrofactsheet_contaminants_pfos_pfoa_11-20-17_508_0.pdf

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https://www.washingtonpost.com/politics/epa-flags-new-fears-about-nonstick-coatings/2018/11/14/0bd87096-e860-11e8-8449-1ff263609a31_story.html

Andrea Di Nisio et al., 2018. Endocrine disruption of androgenic activity by perfluoroalkyl substances: clinical and experimental evidence. *J of Clinical Endocrinology and Metabolism.* Published online 7 November 2018. Advanced article available via: https://www.documentcloud.org/documents/5316830-EDCs-Androgenic-Activity-Perfluoroakyl.html (Courtesy of Sharon Lerner and The Intercept.) High school boys (n= 383) with higher exposures to PFOS, PFOA via water contamination from industrial contamination had shorter penises, lower sperm count, lower sperm mobility, and reduced "anogential" distance, which is a proxy measure researchers use as an indicator of reproductive health than unexposed boys. In the lab, researchers also found that PFASs, which are structurally similar to testosterone, are able to bind testosterone receptors in cells, and in doing, disrupting the function of testosterone in the body.

Researchers concluded PFASs "directly interfere with hormonal pathways potentially leading to male infertility." Clinical and laboratory evidence support animal evidence in mice, rabbits and rats that PFASs are associated with reduced male fertility. Authors conclude: "the magnitude of the problem is alarming as it effects an entire generation of young adults, from 1978 onwards."

On **PFASs and lack of an environmental half-life**, see testimony delivered before the Senate Committee on Homeland Security and Governmental Affairs Subcommittee of Federal Spending Oversight and Emergency Management by Dr. Linda Birnbaum, Director, NIEHS and the National Toxicology Program at the National Institutes of Health, September 26, 2018: https://www.hsgac.senate.gov/imo/media/doc/Birnbaum%20Testimony.pdf (Last accessed 14 November 2018). Quote: "In fact, PFAS and complex PFAS degradation products remain in the environment for so long that scientists are unable to estimate an environmental half-life."

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"…Exposures driven by PFAS accumulation in the ocean and marine food chains and contamination of groundwater persist over long timescales. Serum concentrations of legacy PFASs in humans are declining globally but total exposures to newer PFASs and precursor compounds have not been well characterized. Human exposures to legacy PFASs from seafood and drinking water are stable or increasing in many regions, suggesting observed declines reflect phase-outs in legacy PFAS use in consumer products. Many regions globally are continuing to discover PFAS contaminated sites from aqueous film forming foam (AFFF) use, particularly next to airports and military bases. Exposures from food packaging and indoor environments are uncertain due to a rapidly changing chemical landscape where legacy PFASs have been replaced by diverse precursors and custom molecules that are difficult to detect. Multiple studies find significant associations between PFAS exposure and adverse immune outcomes in children. Dyslipidemia is the strongest metabolic outcome associated with PFAS exposure. Evidence for cancer is limited to manufacturing locations with extremely high exposures and insufficient data are available to characterize impacts of PFAS exposures on neurodevelopment. Preliminary evidence suggests significant health effects associated with exposures to emerging PFASs. Lessons learned from legacy PFASs indicate that limited data should not be used as a justification to delay risk mitigation actions for replacement PFASs."

On **PCBs as carcinogens**, see monograph from the International Agency for Research on Cancer/World Health Organization, Polychlorinated biphenyls and polybrominated biphenyls. Volume 107. IARC Monograph on the Evaluation of Carcinogenic Risks to Humans. Available at: https://monographs.iarc.fr/wp-content/uploads/2018/08/mono107.pdf

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Also see: Philippe Grandjean and Philip Landrigan. 2014. Neurobehavioral effects of developmental toxicity. *Lancet Neurology*. 13 (3): 330-8. https://www.thelancet.com/action/showPdf?pii=S1474-4422%2813%2970278-3

On **PCBs from birth to death**, see literature on PCBs in cord blood and also in cadaver tissues. Here's one example of a study that detected PCBs in cord blood: https://www.ncbi.nlm.nih.gov/pubmed/11138666 And another in cadavers: https://www.ncbi.nlm.nih.gov/pubmed/16114499

On **PCBs consumed during daily meals and holy feats**, See: Joy Paley. 2010. Researchers Find PCBs, Other Chemicals in Food. Food Safety News. September 15, 2010. Available at: https://www.foodsafetynews.com/2010/09/researchers-find-pcbs-and-other-chemicals-in-food Here's the original study, Arnold Schecter. 2010. Perfluorinated Compounds, PCBs, and Organochlorine Pesticide Contamination in Composite Food Samples from Dallas, TX, USA. 118(6). Available at: https://ehp.niehs.nih.gov/doi/10.1289/ehp.0901347 'Holy feasts' acknowledges **PCBs in subsistence and sacred, traditional foods** eaten by peoples of the circumpolar North, e.g., in walrus and bowhead, for example. See Marla Cone. 2005. *Silent Snow: The Slow Poisoning of the Arctic*. Grove Atlantic. And also: Welfinger-Smith et al. 2022. Organochlorine and metal contaminations in traditional foods from St. Lawrence Island, Alaska. *J. Toxicology Environ Health A* 74(18): 1195-214. https://www.ncbi.nlm.nih.gov/pubmed/21797772

On **history of endocrine disruption, and the significance of PCBs and the Great Lakes ecosystem in its development**: see Theo Colborn. 1990. *Great Lakes, Great Legacy?* Conservation Foundation. And: Theo Colborn, Dianne Dumanoski and J. Peterson Myers. *Our Stolen Future.* (Dutton, 1996). See also Theo Colborn. 1996. The Great Lakes: A Model for Global Concern. In *Interconnections Between Human and Ecosystem Health*. Edited by Richard T. Di Giulio and Emily Monosson. Chapman & Hall, London; Theo Colborn. 2004. Neurodevelopment and Endocrine Disruption. *Environmental Health Perspectives* 112(9). Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1247186/ Also: Sheldon Krimsky *Hormonal Chaos: The Scientific and Social Origins of the Environmental Endocrine Hypothesis.* (Johns Hopkins Press, 2000). As well as: Michael Gilbertson. 2001. The precautionary principle and early warnings of chemical contaminant of the Great Lakes. In: *Late Lessons from Early Warnings: The Precautionary Principle 1896-2000*. European Environment Agency. Pp. 126-134.

"The Great Lakes have provided a valuable if unwitting laboratory for studying the effects of organochlorine compounds, not only on the health of wildlife and humans, but also on the political responses to pollution of large ecosystems with persistent toxic substances. … The scientific aspects are characterized by a high degree of uncertainty. In essence, we are engaged in the trans-generational transmission not only of the legacy of contamination and the associated dilemmas, but also of chemically induced injury to the structural and functional development of exposed infants"

Kwiatowski et al., 2016. Twenty-Five Years of Endocrine Disruption Science: Remembering Theo Colborn. *Environmental Health Perspectives*. https://ehp.niehs.nih.gov/doi/full/10.1289/EHP746

On concept of "time bombing the future," see: Herman Muller. 1948. "Time Bombing Our Descendants," *The American Weekly*. 4 January 1948. P. 9. Courtesy of Kate Brown, author of *Plutopia* (Oxford: 2013). Courtesy Kate Brown.

For more **on elemental fluorine as reactive, lethal, and difficult to contain**, see the work of Eric Banks and colleagues. 1986. *Fluorine: The First One Hundred Years*. New York: Elsevier Sequoia Also: Milton Silverman. 1949. Taming Chemistry's Hellcat, *Collier's Weekly*, February 19th, 1949 edition. And the line **"that savage beast among the elements,"** appears in comments made by The Royal Swedish Academy of Sciences upon awarding of Henri Moissan for the having freed elemental fluorine with the Nobel Prize for Chemistry in 1906. See: https://www.nobelprize.org/prizes/chemistry/1906/ceremony-speech/

For **the history of Simons's work with carbon tetrafluoride, yielding liquid fluorocarbons** (via remnant mercury in a borrowed pipe), see Joseph H. Simons. 1972. A Pioneering Trip in Fluorine Chemistry. *The Chemist.* Feburary 1972. Simons published on his liquid fluorocarbons in a research brief in 1937, followed by the full publication in 1939. The citations are as follows: Joseph H. Simons and L.P. Block. 1937. *Journal of the American Chemical Society* 59: 1407; ibid. 61(1939) 2962. Importantly, date of publication for that edition of the journal noted online as October 1, 1939 See here: https://pubs.acs.org/doi/abs/10.1021/ja01265a111

More **on August 1939 letter from Einstein and colleagues to Roosevelt** featured here, via Letters of Note: http://www.lettersofnote.com/2009/10/einsteins-one-great-mistake.html

On **late 19th century Chicago, including Chicago Expo, and the rivalry between GE and Westinghouse to electrify it**: David M. Solzman. 1998/2006. The Chicago River, 2nd ed. University of Chicago Press; Scott Blackwood. 2017. "These Waters Run Deep." Chicago Magazine, August 2017: https://www.chicagomag.com/Chicago-Magazine/September-2017/Chicago-River/ (Last accessed 22 February 2018); William Cronon. 1991. *Nature's Metropolis: Chicago and the Great West.* W.W. Norton; Erik Larson. 2003. *The Devil and the White City: Murder, Magic, and Madness at the Fair that Changed America.* New York: Crown Publishing; Jill Jones. 2004. *Empires of Light: Edison, Tesla, Westinghouse and the Race to Electrify the World.* Random House.

For a **general history, legacy of the Manhattan Project,** I consulted the following:

Joseph Masco. 2006. *The Nuclear Borderlands: The Manhattan Project in Post-Cold War New Mexico*. Princeton University Press. (re: Los Alamos) Also: 2015. "Nuclear Pasts, Nuclear Futures; or Disarming through Rebuilding." *Critical Studies on Security* 3(3): 308-312.

Pap Ndiaye. 2007*. Nylon and Bombs: DuPont and the March of Modern America.* John Hopkins Press. Especially see Chapter 4: The Forgotten Engineers of the Bomb.

> p. 141: "The traditional account of the history of the Manhattan Project gives top billing to the great names of nuclear physics…. [But] the Manhattan Project was not only a matter of cutting-edge research in nuclear physics. It also posed a set of technical problems. It was an industrial program, and the necessary know-how did not appear out of nothing; it had to be forged over a half-century of learning the techniques of mass production in the high-pressure chemical industry, particularly at DuPont."
>
> DuPont played a central role in the Manhattan Project (p. 143) as "the company in charge of plutonium… the main component of the Nagaski bomb." (p. 142) — and building and operating the plant at Hanford, WA.
>
> Official histories overlooked the role of the chemists, the engineers, in favor of what the physicists accomplished, argued Ndiaye (p. 153)… and some of the chemists involved… "historians have adopted the perspective of the physicists, as if the production had been secondary and left to bit players without any influence." (p. 176). Ndiaye's project is "the reintegrate the Manhattan Project into the history of industry, as one of its variants." (p. 177)

Also Dan Zak. 2016. *Almighty*. New York: Blue Rider Press; Stephane Groueff. 1967/2000. *Manhattan Project: The Untold Story of the Making of the Atomic Bomb;* Kate Brown. 2013. Plutopia: Nuclear Families, Atomic Cities, and the Great Soviety and American Plutonium Disasters. Oxford University Press; and Christopher Bryson. 2004. *The Fluoride Deception*. Seven Stories Press. On **gaseous diffusion** I recommend this video from the Atomic Heritage featuring Oak Ridge Historian D. Ray Smith.

On **working with Manhattan Project documents**: Excellent resource on Manhattan Project documents: Alex Wellertein's *Restricted Data: The Nuclear Secrecy Blog*: blog.nuclearsecrecy.com

For more on **the general history of fluorocarbons research**, see Joseph Simons, 1950 in *Fluorine Chemistry*. (NY: Academic Press); Special 1947 issue of *Industrial Engineering Chemistry* dedicated to fluorocarbon research during WWII (citation below); Neil McKay. 1991. *A Chemical History of 3M, 1933-1990* and also R.E. Banks,

D.W.A. Sharp and J.C. Tatlow, editors. 1986. *Fluorine: The First One Hundred Years*. New York: Elsevier Sequoia.

On **Simons's contributions to fluorocarbon chemistry,** see:

Joseph H. Simons, editor. 1950. *Fluorine Chemistry*, 1st edition. New York: Academic Press Inc., Publishers.

Joseph Simons. 1972. A Pioneering Trip in Fluorine Chemistry. *Chemist*. 49 (2): 52-4.

Joseph H. Simons. 1986. The Seven Ages of Fluorine Chemistry. Address presented 19 July 1973 Santa Cruz, CA on receipt of award for "creative work in fluorine chemistry." *Journal of Fluorine Chemistry* 32(1): 7-24.

Wm H. Waggaman. 1945. Fluorine, Devil Element. *Chemistry*. July 1945. P. 1-10.

Simons J. H. and Block L. P. (1937) Fluorocarbons. *J. Am.Chem. Soc.* 59, 1407; Simons J. H. and Block L. P. (1939) Fluorocarbons*. J. Am.Chem. Soc.* 61, 2962–2966 [Ref list]

Brice T. J. (1950) Fluorocarbons—their properties and wartime development. In *Fluorine Chemistry* (ed. Simmons J. H.). Academic Press Inc., New York, Vol. 1, pp. 423–462 [Ref list]

Simons developed the ECF process in 1941 -- but was not reported until 1949 for security reasons associated with the Manhattan project: Simons J. H.(1949) Electrochemical process for the production of fluorocarbons. *J. Electrochem. Soc*. 95, 47–67

Joseph H. Simons, State College, PA assignor to Minnesota Mining and Manufacturing Company. US Patent 2519983. Electrochemical process of making Fluorine-Containing Carbon Compounds. Application 29 November 1948. Patented 22 August 1950.

R.E. Banks, D.W.A. Sharp and J.C. Tatlow, editors. 1986. *Fluorine: The First One Hundred Years*. New York: Elsevier Sequoia. Especially: R.E. Banks and J.C. Tatlow. Synthesis of C-F Bonds: The Pioneering Years, 1835-1940. In: *Fluorine: The First One Hundred Years.* R.E. Banks, D.W.A. Sharp and J.C. Tatlow, editors. New York: Elsevier Sequoia. P.71-108.

R.E. Banks, B.E. Smart and J.C. Tatlow, eds. 1994. *Organofluorine Chemistry: Principles and Commercial Applications.* New York: Plenum Press.

Kristen Yarmey. 2006. *Labors and Legacies: The Chemists of Penn State* 1855-1947. Pennsylvania State University.

Richard Toon. 2011. Fluorine, An Obsession With a Tragic Past. *Education in Chemistry*. P. 148-151.

See also: Memorandum in Support of Plaintiff State of Minnesota's Motion to Ammend Complaint. State of Minnesota vs. 3M Company, filed 17 November 2017. State of Minnesota. District Court, 4th Judicial District, County of Hennepin.

On **Joseph Simons and his fluorocarbons:**

Primary sources included interviews conducted with three descendants of Joseph H. Simons, conducted on 4/7/2016; 2/15/2017; and 4/12/2017. Personnel files available at the archives maintained by Pennsylvania State University, College Station, PA and University of Florida, Gainesville, Florida

See Kristen Yarmey. Nd. "Joseph H. Simons (1897-1986)." Research notes. Courtesy of Kristen Yarmey (Assoc. Professor of Digital Services Librarian, University of Scranton), and author of *Labors and Legacies*, a book about the history of chemistry at PSC/U. Interviewed by phone March 1, 2017. Kristen Yarmey. 2006. *Labors and Legacies: The Chemists of Penn State, 1855-1947*. Pennsylvania State University. Her book available here: https://scholarsphere.psu.edu/concern/generic_works/q811kj69p

Discoveries Made Here Cited as Significant by 'Science' Magazine. *Penn State Collegian*. 26 January 1940. P.2.

Collier's Article Cites Findings of Dr. Simons. *The Daily Collegian*. Pennsylvania State College/University. 25 February 1940.

George H. Waltz. 1949. New Materials that Won't Wear Out. *Popular Science*. January 1949. Pp. 132-136.

Milton Silverman. 1949. Taming Chemistry's Hellcat. *Collier's Weekly*. 19 February 1949: 27, 32.

John M. McCullough. 1949. New 'Magic' Compound Aided A-Bomb Output. *Philadelphia Inquirer*. 2 November 1949. Front Page.

Clifford Hicks. 1952. Wanted: A Job for a Trillion New Chemicals. *Popular Mechanics.* March 1952. 97(3): 81- 85; 252, 254, 276.

A.E. Hetchner. 1953. Dr. Simons' Incredible Formula. *The Des Moines Register*. 14 June 1953. P. 7, 24-5.

James Barron. 1984. Joseph H. Simons Dies at 86; Pioneer in Fluorocarbon Use. *The New York Times* 3 January 1984.

Special issue of the *Journal of Fluorine Chemistry*, memorial to Joseph H. Simons. 1986. 32 (1). Especially: R.D. Dresdner. 1986. Joseph H. Simons and His Work in Fluorine Chemistry. *Journal of Fluorine Chemistry* 32 (1): 25-28.

Wilbur H. Pearlson. 1986. The Simons electrochemical fluorination process (commercial development at 3M). *Journal of Fluorine Chemistry* 32 (1): 29-49.

See relevant sections in Neil MacKay. 1991. *A Chemical History of 3M: 1933-1990*. Published by the 3M. Including: Chapter 1: "Joe Simons's Stuff."

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Joseph H. Simons. 1986. The Seven Ages of Fluorine Chemistry. Address presented 19 July 1973 Santa Cruz, CA on receipt of award for "creative work in fluorine chemistry." *Journal of Fluorine Chemistry* 32(1): 7-24.

Joseph H. Simons, editor. 1950. *Fluorine Chemistry*, 1st edition. New York: Academic Press Inc., Publishers.

Paul P. Plexus (pen name). 1957. *Realism*. New York: Vantage Press.

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On **import of fluorine chemistry to Manhattan Project, war effort:** See "Fluorine Chemistry," edited by Dr. Joseph H. Simons in 1950. And: Harold Goldwhite. 1986. The Manhattan Project. In: *Fluorine: The First One Hundred Years.* R.E. Banks, D.W.A. Sharp and J.C. Tatlow, editors. New York: Elsevier Sequoia. P.109-132. Also see: special issue March 1947 (vol 39 no 3) of *Industrial Engineering Chemistry* – first published disclosure of much fluorine chemistry developed just before and during WWII. The March 1947 issue solely looks at developments in fluorine chemistry during World War II:

> Walter J. Murphy, editor. The Fruits of Cooperation. Introduction to special issue of *Industrial Engineering Chemistry* special issue on fluorocarbons during the war. March 1947 39(3): 235-136A "…the breathtaking pace at which they were brought about…" "Exploratory tests of the fluorocarbons began in mid-1941. And a serious coordinated laboratory effort… was not started until early 1942. Yet when the first diffusion separation units went into test operation at Oak Ridge, the necessary amounts of fluorocarbons were available"

Ralph C. Downing. DuPont. 1946. The Electrolytic Preparation of Fluorine. United States Atomic Energy Commission, Oak Ridge, TN. Notes history of fluorine, industrial fluorine, fluorocarbon history at outset of Manhattan Project.

A.V. Grosse and G.H Cady. 1947. Industrial Engineering Chemistry p. 368. – how the Manhattan Project analyzed and determined Simons' fluorocarbons could withstand uranium hexafluoride.

Park J. D., Benning A. F., Downing F. B., Laucius J. F. and McHarness R. C. (1947) Synthesis of tetrafluoroethylene. *Ind. Eng. Chem*.39, 354–358.

Roy J. Plunkett, interview by James J. Bohning at New York, New York and Philadelphia, PA, 14 April and 27 May 1986. (Philadelphia: Chemical Heritage Foundation/Now: Science History Institute). Oral history transcript # 0037.

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.

Interview with Irénée du Pont, Jr. by the Voices of the Manhattan Project. Atomic Heritage Foundation. Dated: August 11, 2014. Available here: http://www.manhattanprojectvoices.org/oral-histories/irénée-du-pont-jrs-interview-2014

Interview w/ Raymond P. Genereaux. Hanford, "we made the first real use of Teflon" Design: The Met Lab and DuPont. In *Working on The Bomb: An Oral History of the WWII Hanford*. S.L. Sanger. Continuing Education Press: Portland State University.

Bill Wilcox. 2007. In Memorium: Joe Dykstra (re: fluorine production at Hooker and K-25 fluorocarbons at Oak Ridge). Published 3 May 2007. *The Atomic Heritage*. www.atomicheritage.org Also, interview with Joe Dykstra via www.manhattanprojectvoices.org.

Carleton A. Sperati. 1986. Polytetrafluoroethylene: History of Its Development and Some Recent Advances. In: *High Performances Polymers: Their Origins and Development*. Ed. R.B. Seymour and G.S. Kirschenbaum. P.267-278.

Volume I of Book VII of the Manhattan District History. Feed Materials and Special Procurement. Appendix G: Special Chemicals for K-25. Lists fluorocarbons, fluorochemicals used, and code names.

Milton Silverman. 1949. Taming Chemistry's Hellcat. *Collier's Weekly*. 19 February 1949: 27, 32.

John M. McCullough. 1949. New 'Magic' Compound Aided A-Bomb Output. Philadelphia Inquirer. 2 November 1949. Front Page.

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Wm. H. Waggaman. 1945. Fluorine, Devil Element. *Chemistry*. July 1945. P. 1-10.

On **dangers of fluorine, fluorocarbon work during Manhattan Project**

Christopher Bryson. 2004. *The Fluoride Deception*. New York: Seven Stories Press. Manhattan Project documents and others Bryson curated are archived at the University of Massachusetts at Amherst, Special Collections and University Archives as the "Christopher Bryson and Joel Griffiths Papers, 1997-2010." Details here: http://scua.library.umass.edu/umarmot/bryson-christopher-1960/

Milton Silverman. 1949. Taming Chemistry's Hellcat. *Collier's Weekly*. 19 February 1949: 27, 32.

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.

Arnold Kramish, "They were Heroes Too," *Washington Post*, December 15, 1991.

Carleton A. Sperati. 1986. Polytetrafluoroethylene: History of Its Development and Some Recent Advances. In: *High Performances Polymers: Their Origins and Development*. Ed. R.B. Seymour and G.S. Kirschenbaum. P.267-278.

David Hounshell and John Kenly Smith. 1988. *Science and Corporate Strategy: DuPont R&D, 1902-1980*. Cambridge University Press

On **explosion risk of early Teflon process**:

Roy Plunkett. 1986. The History of Polytetrafluoroethylene: Discovery and Development. In *High Performance Polymers: Their Origin and Development.* Pp. 261-266. "Looking back," Plunkett later reflected, "what is more significant to me is that storing a cylinder with a kilogram of TFE in it could have been the end of both Jack and me."

Roy J. Plunkett, interview by James J. Bohning at New York, New York and Philadelphia, PA, 14 April and 27 May 1986. (Philadelphia: Chemical Heritage Foundation/Now: Science History Institute). Oral history transcript # 0037.

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.

Sperati mentions **carbon tetrafluoride formation and explosion risk** here: Carleton A. Sperati. 1986. Polytetrafluoroethylene: History of Its Development and Some Recent Advances. In: *High Performances Polymers: Their Origins and Development.* Ed. R.B. Seymour and G.S. Kirschenbaum. P.267-278. Note: Sperati worked at Arlington Works/DuPont with Malcolm Renfrew.

> "Not only does TFE have an extremely wide explosive range when mixed with air," explained Carl Sperati, who had worked on Teflon at Arlington, but "under a wide range of conditions [it can] form carbon and carbon tetrafluoride with the explosive force about equal to black powder."

Oral history/interview given be Irénée du Pont, Jr. by the *Voices of the Manhattan Project*. Atomic Heritage Foundation. August 11, 2014. Available here: http://www.manhattanprojectvoices.org/oral-histories/irénée-du-pont-jrs-interview-2014

Personal correspondence with Mildred Hayner (3/31/2017) former employee at DuPont's Arlington Works (Kearny, NJ during WWII and remembers the blast site, and explained its location using Google maps).

On **other explosions, disasters at Manhattan Project- affiliated fluorine, fluorocarbon, uranium hexafluoride sites**: see Christopher Bryson. 2004. *The Fluoride Deception*. Seven Stories Press – who pulled from Manhattan Project archives.

> The company's Chambers Works facilities, where DuPont manufactured uranium hexafluoride, hydrogen fluoride, and other organic fluorine-based materials, "frequently caught on fire, and the activators often burned out so that employees were frequently exposed to rather large amounts of fluorine compounds." Pollution emitted from this plant resulted in a lawsuit filed against DuPont and two other chemical companies during the war. In the mid-1940s, a group of southern New Jersey farmers sued after their peach crop was decimated. "Peaches Blitzed by Atomic Bomb, Growers Contend," read one Canadian headline in October 1945 (see *Ottawa Citizen*. October 17, 1945). Communities downwind of DuPont's Chamber Works facility described not only orchard blight, but also poultry flocks that had instantaneously died, fields of limp or dead cattle, and orchard workers ill after eating fruits harvested from the fields. (See Bryson 2004.)
>
> There'd been another explosion in a different DuPont unit, which made the material later made into Teflon. Two died gruesome deaths—their lungs, upon autopsy, looked like victims of war gas. In one Manhattan Project memo

dated 1944, three DuPont workers were hospitalized after exposure to "waste gases" from the TFE process. Two eventually died. Their autopsies revealed lungs like the "victim of a World War I poison gas." Recounted in Bryson p. 70, see footnote #24, p. 290: William C. Bernstein, Captain Medical Corps. Memorandum to Colonel Stafford L. Warren, Chief Medical Section. 11/3/1944. Subject: Report on Medical Section in Wilmington, DE. Wilmington Area, Box 14, Accession #72C2386 Atlanta FRC, RG 326. See footnotes 23-26 on p. 271 of relevant Manhattan Project documents discussing this early history of PTFE production hazards. Renfrew, in his oral history, also describes this incident.

Other fluorine-related causalities had taken place at the Philadelphia Navy Yard, where a cylinder of uranium hexafluoride exploded, killing two. Their families hadn't been notified about the details of their deaths until the 1990s, wrote Arnold Kramish in the Washington Post (1991), who had worked on the Manhattan Project. Some of the Bomb's earliest causalities, wrote Kramish, had been causalities such as these. (Kramish wrote another piece in 1995 called Hiroshima's First Victims, which appeared in the *Rocky Mtn News*).

On **other large companies with Manhattan Project contracts to manufacture fluorocarbons**, included, among others, Hooker Chemical and Linde Air Products (a division of Union Carbide) See: Christopher Bryson. 2004. *The Fluoride Deception*. Seven Stories Press, also Neil MacKay. 1991. *A Chemical History of 3M, 1933-1990*. 3M.

On **general Teflon history**

"Where Washington Walked." DuPont Magazine. March 19946. Available digitally through the Hagley Digital Archives. 40(1): P. 14.

Roy J. Plunkett, interview by James Bohning at New York, New York and Philadelphia, PA, 14 April and 27 May 1986. (Philadelphia: Chemical Heritage Foundation/Now: Science History Institute). Oral history transcript # 0037.

Also see Plunkett: "The History of Polytetrafluoroethylene: Discovery and Development." Speech delivered at the American Chemical Society, April 1986.

Anne Cooper Funderburg. 2000. Making Teflon Stick. *Invention & Technology Magazine.* Summer 2000.

See Sharon Lerner multipart (and growing) series, "The Teflon Toxic" via The *Intercept* here: https://theintercept.com/series/the-teflon-toxin/

Jeffrey Meikle. 1997. *American Plastic: A Cultural History*. Rutgers University Press.

David Hounshell and John Kenly Smith. 1988. *Science and Corporate Strategy: DuPont R&D, 1902-1980*. Cambridge University Press.

Interview with Irénée du Pont, Jr. by the Voices of the Manhattan Project. Atomic Heritage Foundation. August 11, 2014. Available here: http://www.manhattanprojectvoices.org/oral-histories/irénée-du-pont-jrs-interview-2014

Interview w/ Raymond P. Genereaux. Hanford, "we made the first really use of Teflon" Design: The Met Lab and DuPont. In *Working on The Bomb: An Oral History of the WWII Hanford*. S.L. Sanger. Continuing Education Press: Portland State University.

Carleton A. Sperati. 1986. Polytetrafluoroethylene: History of Its Development and Some Recent Advances. In: *High Performances Polymers: Their Origins and Development.* Ed. R.B. Seymour and G.S. Kirschenbaum. P.267-278. Note: Sperati worked at Arlington Works/DuPont with Malcolm Renfrew.

US Patent 2612484 Polymeric Tetafluoroethylene Dispersions. Assigned to E I du Pont de Nemours and Company, Wilmington, DE. Filed July 27, 1949. Serial No. 107,135. Issued September 30, 1952.

Malcolm Renfrew and E.E. Lewis. 1946. Polytetrafluoroethylene: Heat-resistant, chemically inert plastic. *Industrial and Engineering Chemistry* 38(9). 870-877. First article on Teflon, published September 1946.

Anatomy of a Rumor. 1962. *DuPont Magazine*. Booklet adapted from a paper delivered by Dr. Zapp before the Industrial Hygiene Foundation refuting early concerns about polymer fumes or dangers assocated with Teflon. Teflon "is widely recognized as a tough guy among plastics because it surives exposures virtual every known chemical as well as to soldering irons, electric arcs and prolonged sunlight."

E.I. Du Pont de Nemours and Co. in *AdAge*. 2003. Available at: https://adage.com/article/adage-encyclopedia/e-i-du-pont-de-nemours/98450/

On the long, sometimes difficult**, decade long research and development process required to make Teflon**. Note: For all the money and time DuPont sunk into developing Teflon for the Manhattan Project, like Simon's Process, Teflon, too, had turned out to be less critical than initially hoped. The Manhattan Project, despite initial projects, instead had "obtained [Teflon] on normal purchase orders." After the bomb had been dropped, Teflon was listed among "miscellaneous" feed materials—important, but not critical to Oak Ridge. This is from Volume I of Book VII of the Manhattan District History. Feed Materials and Special Procurement. Appendix G: Special Chemicals for K-25. Teflon found uses elsewhere in the war effort, including the nose cones of guided artillery, and also, as Renfew explained, in the construction of Hanford, the plutonium processing plant the Manhattan Project built along the

Columbia River in Richmond, Washington. [Volume I of Book VII of the Manhattan District History. Feed Materials and Special Procurement. Appendix G: Special Chemicals for K-25.]

After the war, in 1946, DuPont announced their new "chemically inert" plastic –at a gathering of the American Chemical Society in Atlantic City. Teflon was to be sold in "simple shapes" and "in small quantities for development purposes." At the time, said Malcolm Renfew, one of the head engineers in charge of its development, "price was considered ridiculous"(p. 29). "It was fifty-five dollars a pound at the time." Worse, as was the case during the war, it remained a difficult product to fabricate, he had said. But, it demonstrated an unprecedented durability and inertness, suitable for industrial environments of an "unusually severe" nature.

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.

David Hounshell and John Kenly Smith. 1988. *Science and Corporate Strategy: DuPont R&D, 1902-1980*. Cambridge University Press. There were a number of lingering R & D troubles still left for DuPont engineers to work through, wrote David Hounshell and John Smith in a book recounting the history of R & D within the company. Notable among these problems, was continued difficulty with the polymerization process itself. In their words, the material also needed to be "tamed" (p. 486). In total, it would take more than a decade and a half, noted Hounshell and Smith, "to turn [Roy] Plunkett's fortuitous discovery into a successful commercial product" (486).

Anne Cooper Funderburg. 2000. Making Teflon Stick. *Invention & Technology Magazine.* Summer 2000.

On **Malcolm Renfrew**, see: 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.

Elaine Woo. 2013. Malcolm Renfrew dies at 103; chemist helped develop Teflon. The LA Times October 15, 2013. Available at: http://www.latimes.com/local/obituaries/la-me-malcolm-renfrew-20131016-story.html

On **history of fluorocarbon compounds detected in human blood:** see

Taves, Donald R. 1968. Evidence that there are Two Forms of Fluoride in Human Serum. *Nature*. 217: 1050. https://www.nature.com/articles/2171050b0 "These findings are consistent with the presence of a fluorocarbon molecule."

W.S. Guy. 1972. *Fluorocompounds of Human Plasma: Analysis, Prevalence, Purification and Characterization.* Doctoral thesis. University of Rochester, Rochester, NY.

W.S. Guy, Donald R. Taves and W.S. Brey. 1976. Organic Fluorocompounds in Human Plasma: Prevalence and Characterization. In: *Biochemistry Involving Carbon-Fluorine Bonds: A symposium sponsored by the Divisions of Fluorine and Biological Chemistry at the 170the meeting of the American Chemical Society,* Chicago, Ill, 26 August 1975. Washington, DC: American Chemical Society. Pp.117-134. https://pubs.acs.org/doi/pdf/10.1021/bk-1976-0028.ch007

See also relevant section, references in: Memorandum in Support of Plaintiff State of Minnesota's Motion to Amend Complaint. State of Minnesota vs. 3M Company, filed 17 November 2017. State of Minnesota. District Court, 4th Judicial District, County of Hennepin.

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Sharon Lerner. 2018. 3M Knew About the Dangers of PFOA and PFOS Decades Ago, Internal Documents Show. *The Intercept.* 31 July 2018. Available at: https://theintercept.com/2018/07/31/3m-pfas-minnesota-pfoa-pfos/ "Taves had detected a form of fluoride in his own blood that hadn't been found in blood before."

Guy's concern of their "universal" presence suggested here: 3M interoffice correspondence. From G.H. Crawford To Krough, Lazerte, Newmark and Pendergrass. Title: Record of a telephone conversation August 14, 1975. Subject: Fluorocabrons in Human Blood Plasma. Available at: https://www.documentcloud.org/documents/4558283-Dr-Guy-Phone-Call-to-3M.html (Last accessed 15 November 2018). But also see Warren S. Guy. 1972. Fluorocarbon(s) of Human Plasma: Analysis, Prevalence, Purification and Characterization. Dissertation. Department of Biochemistry, University of Rochester School of Medicine and Dentistry. Rochester, NY. "All results of this work are consistent with the original hypothesis that human plasma contains an organic fluorocompound. Evidence presented here suggests that this substance is widespread in human plasma" (from the abstract).

On **PFAS-related corporate cover-up** of PFOA, PFAS science and history see: Sharon Lerner's reporting for The Intercept: https://theintercept.com/series/the-teflon-toxin/ As well as: Mariah Blake 2015. Welcome to Beautiful Parkersburg. *Huffington Post.* https://highline.huffingtonpost.com/articles/en/welcome-to-beautiful-parkersburg/ August 27, 2015; Nathaniel Rick. 2016. The Lawyer Who Became DuPont's Worst Nightmare. *New York Times Magazine.* 6 January 2016. https://www.nytimes.com/2016/01/10/magazine/the-lawyer-who-became-duponts-worst-nightmare.html As well as: Lauren Richter, Alissa Cordner and Phil Brown. 2018. Non-Stick Science: Sixty Years of Research and (In)Action on

Fluorinated Compounds. Social Studies of Science 48(5): 691-714. Available: https://journals.sagepub.com/doi/10.1177/0306312718799960 And: Philippe Grandjean. 2018. Delayed discovered, dissemination, and decisions of intervention in environmental health: a case study of immunotoxicity of perfluorianted alkylate substances. *Environmental Health*. 17: 6 pages. Available at: https://doi.org/10.1186/s12940-018-0405-y

On the **corporate versus public discovery of PFOA in public drinking water near its Washington Works plant**, see Callie Lyons. 2007. Stain-Resistant, NonStick, Waterproof, and Lethal: The Hidden Dangers of C8. Praeger. Also: Mariah Blake. Welcome to Beautiful Parkersburg. Huffington Post. https://highline.huffingtonpost.com/articles/en/welcome-to-beautiful-parkersburg/ Rebecca Altman. 2008. Chemical Body Burden and Place-Based Struggles for Environmental Health and Justice, A Multi-Site Ethnography of Biomonitoring. Dissertation. Brown University, Department of Sociology. May 2008. Available at: https://repository.library.brown.edu/studio/item/bdr:277/And: Lauren Richter, Alissa Cordner and Phil Brown. 2018. Non-Stick Science: Sixty Years of Research and (In)Action on Fluorinated Compounds. *Social Studies of Science* 48(5): 691-714. Available: https://journals.sagepub.com/doi/10.1177/0306312718799960

On **Nylon history**, see: Pap Ndiaye. 2007. *Nylon and Bombs: DuPont and the March of Modern American*. John Hopkins Press.

On **3M/Minnesota Mining and Manufacturing history,** see: "Minnesota to Manufacture Fluorochemicals." 1951. *Chemical and Engineering News* 22 October 1951. P. 4487-89.

Wilbur H. Pearlson. 1986. The Simons electrochemical fluorination process (commercial development at 3M). *Journal of Fluorine Chemistry* 32 (1): 29-49.

The 3M Company. 2002. *Century of Innovation: The 3M Story*.

Minnesota Historical Society, 3M historical corporate records, Box 129.E.19.7B, Folder 15: New products division: chronology of division projects, 1940-1953. Courtesy of Evan Hepler-Smith. Particularly research and development updates from fluorocarbon carbon division mid-1940s through mid-1950s, notes early coroproate interest, sampling program, scale up of ECF reactors, decisions about delaying/proceeding to pilot plant stage, marketing, and early conversations with DuPont about a material needed by 1950 for its Teflon process.

University of Minnesota, 3M Company Corporate Records. Includes a selection of Annual Reports. See: http://www2.mnhs.org/library/findaids/00281.xml and here: http://libguides.mnhs.org/3m/primary

“Agreement.” 15 October. 1945. Between The Pennsylvania State College and Minnesota Mining and Manufacturing Company. In the archives maintained Penn State Special Collections Library. Title: Eberly College of Science records Volume/Box: 23 TN: 29115

Memorandum in Support of Plaintiff State of Minnesota’s Motion to Ammend Complaint. State of Minnesota vs. 3M Company, filed 17 November 2017. State of Minnesota. District Court, 4th Judicial District, County of Hennepin.

That **3M began to sponsor Simon’s research in 1943** is described in a 1945 “Agreement” between 3M and Pennsylvania State University, Eberly College of Science records, “Simons, JH HR files” PSUA 1331 Box 8 “JH Simons.” Dated October 15, 1945.

On **3M’s licensing of Joseph Simons’s process and early fluorocarbon history**, See Neil MacKay’s book; W.H. Pearlson’s 1986 article in the *Journal of Fluorine Chemistry* special tribute to Joseph Simons; the Minnesota Archives 3M archives, and and most especially: *3M’s A Century of Innovation: The 3M Story*, published in 2002, Pp. 53-4. "Gambling on the unknown. In 1944, William McKnight approved the acquisition of the rights to a process for creating fluorocarbon compounds from Professor Joseph Simons of Penn State University. No one knew how to use the compound. Finding uses for the technology was not easy. About a decade earlier, 3M had begun exploring silicone, thinking that the new material would help make 3M's tape products even better. However, three major companies, including GE, had a head start on silicone experimentation and, by the time World War II broke out, these competitors had already filed patents for silicone applications. The patens were frozen during the war, but as the fighting wound down, they were approved. Believing that the competition had beaten them, 3M asked the scientists at Penn State University what else they had in their inventory of new ideas. Fluorochemicals help promise, although marketable products were elusive. At first, 3M's lab people could only make low-boiling point and inert fluorocarbon liquids. Even so, the concept was so new -- and the materials produced so unusual -- that they technology aroused great excitement. But, this was a costly venture. Only a few good ideas surfaced and none lead to practical applications. Equally disturbing, these 'products' were called by insiders 'the most expensive organic compounds known to man,' costing about $40 a pound. By 1952, as many as 100 people were focused on the promise of fluorochemicals--the largest research project ever undertaken, up to that time, by 3M. McKnight wondered if the gamble would ever pay off, so he asked his VP of research and engineering, Dick Carlton, to talk with 50 people on the project--one at a time. The question was simple: should 3M continue to pursue fluorochemicals? Imbedded in that question was another. Will fluorochemicals make us money? When 48 said 'yes' the project had new life."

On **number of people who donated blood for the C8 Science Project** in the Mid-Ohio Valley of Ohio and West Virginia, see http://www.c8sciencepanel.org/

This news article puts number at 70, 000:
http://www.newsandsentinel.com/news/local-news/2017/02/c8-in-the-mid-ohio-valley-to-be-featured-on-tv-series

On **male infertility and possible association with PFAS exposure**:

Andrea Di Nisio et al., 2018. Endocrine disruption of androgenic activity by perfluoroalkyl substances: clinical and experimental evidence. *J of Clinical Endocrinology and Metablosm.* Published online 7 November 2018. Advanced article available via: https://www.documentcloud.org/documents/5316830-EDCs-Androgenic-Activity-Perfluoroakyl.html (Courtesy of Sharon Lerner and The Intercept.) High school boys (n= 383) with higher exposures to PFOS, PFOA via water contamination from industrial contamination had shorter penises, lower sperm count, lower sperm mobility, and reduced "anogential" distance, which is a proxy measure researchers use as an indicator of reproductive health than unexposed boys. In the lab, researchers also found that PFASs, which are structurally similar to testosterone, are able to bind testosterone receptors in cells, and in doing, disrupting the function of testosterone in the body. Researchers concluded PFASs "directly interfere with hormonal pathways potentially leading to male infertility." Clinical and laboratory evidence support animal evidence in mice, rabbits and rats that PFASs are associated with reduced male fertility. Authors conclude: "the magnitude of the problem is alarming as it effects an entire generation of young adults, from 1978 onwards."

Hagai Levine et al. 2017. Temporal trends in sperm count: a systematic review and meta-regression analysis. *Human Reproduction Update* 23(6): 646-659. https://academic.oup.com/humupd/article/23/6/646/4035689

Sharon Lerner. 2018. PFOA and PFOS cause lower sperm counts and smaller penises, study finds. *The Intercept*. November 30, 2018. Available at: https://theintercept.com/2018/11/30/pfoa-and-pfos-cause-lower-sperm-counts-and-smaller-penises-study-finds/

Ashley Fetters. 2018. Sperm Counts Continue to Fall. *The Atlantic*. October 12, 2018. Available at: https://www.theatlantic.com/family/archive/2018/10/sperm-counts-continue-to-fall/572794/

Robin McKie. 2017. The infertility crisis is beyond doubt. Now scientists must find the cause. *The Guardian.* July 29, 2017. Available at: https://www.theguardian.com/science/2017/jul/29/infertility-crisis-sperm-counts-halved

For history, context see Ted Schettler, Gina Solomon, Maria Valenti and Gina Solomon. 1999. Generations at Risk: Reproductive Health and the Environment. MIT Press, as well as Theo Colborn, Pete Myers, Diane Dumonski. 1996. Our Stolen Future: Are We Threatening our Fertility, Intelligence and Survival? NY: Dutton.

On **cellulose acetate in cigarettes filters** see: Branford Harris. 2011. The intractable cigarette filter problem. *Tobacco Control* 20: 10-16. And also Alexander H. Tullo. 2016. The decline of the cigarette filter: with fewer smothers, the makers of cellulose acetate for cigarette filters are adjusting. Chemical and Engineering News. 94(26): 26. https://cen.acs.org/articles/94/i26/decline-cigarette-filter.html

On **the restoration of Florida longleaf pine**, see Cindy Swirko. 2014. Restoring the native longleaf. *The Gainesville Sun*. Published 24 April 2014. Accessed March 3, 2017. Also see documentary: Secrets of the Lonleaf Pine. (http://longleafpine.org)

On **Domineco Mortellito**, see resources available via the Hagley Digital Archives (DuPont), and also Susannah Handley. 1999. *Nylon: The Story of a Fashion Revolution*. Johns Hopkins U Press. Describes the 1939 World's Fair exhibit, and Mortellito's contribution, p. 40. And also: *DuPont Magazine* Nov-Dec 1964 58(6). A Delaware sculptor finds urethane foam is a new medium for art.

Seth Kugel. 2004. A Mural of Strength, but for its invisibility. *New York Times* September 19, 2004. https://www.nytimes.com/2004/09/19/nyregion/thecity/a-mural-of-strength-but-for-its-invisibility.html
Notes: First to create art out of Teflon; Went to Pratt

John Ward. 1994. Domeico Mortellito, 87, artist, DuPont art director The News Journal, Wilmington, DE August 4, 1994. Re: creation of Mr. Teflon, Mr. Neoprene, and role at 1964 World's Fai; known for his work in synthetics, Teflon; history with company, including role in 1939, 1964 World's Fair Pavilions.

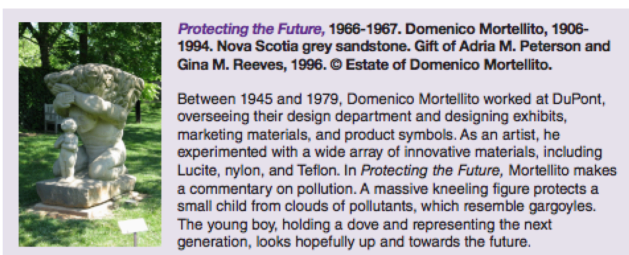
Bette McNear. 1966. Art and industry meet. *The Morning News*, Wilmington, DE 7 April 1966.

William S. Dutton. 1939. New York Presents: A Drama Opportunity. *DuPont Magazine* 33(6). Notes chemical products, the offspring of "coal-air-water"
Also… "As one enters the DuPont Exhibit Building, the eye is caught by a large mural of delicate shades of coloring. Carved and cut out figures symbolize the story of chemistry: The figures were fashioned from Lucite and from Plastacele cellulose acetate plastic. It is the only such work of art in the Fair… Its creator, the eminent artist, Domenico Mortellito, believes that it also symbolizes a new day in art when new materials of chemical origin will displace the traditional media of expressed used by artists for centuries."

DuPont Magazine 33(3): 11 1939 Fair Doings: Highlights from the DuPont exhibits at New York and San Francisco. Re: two DuPont plastics carved for 1939 murals. "Mortellito has chosen two DuPont plastics for his mural which depicts, through theme figures carved in intaglio relief, the part of the research chemist in creating from raw materials of forest, farm and mine, the products that bring 'better living' within reach of all. When installed in the circular foyer, facing the entrance, it will

extend sixty feet along the wall, into the taller, adjoining exhibit hall, where it reaches a height of nineteen feet. Against the irregularly shaped background of Lucite methyl methacrylate resin, are superimposed huge figures carved with a fine feeling for dynamic movement and built up with small carvings of the same material. Plastacele cellulose acetate plastic adds interesting contrast to the sweeping unified design. Mortellito finds the transparency and light-reflect property of Lucite particularly effective for murals. Oddly enough, this massive panel is carved on both sides—front and back. The back carvings show through in soft outlines—an altogether lovely, mute obligato to the central theme. Varied textures are carved by using different knives. Colors are sprayed on the back and along the edges. Clusters of hidden lights will illuminate the mural with a soft glow and bright highlights." P. 11

On **Protecting the Future**, see Copeland Sculpture Garden, Delaware Art Museum. Notes: donated by his daughters, made between 1966-67, and was made of Nova Scotia grey sandstone. Notes the piece "makes a commentary on pollution."
http://www.delart.org/uploads/pdf/visit/SculptureParkGuide.pdf



***Protecting the Future,* 1966-1967. Domenico Mortellito, 1906-1994. Nova Scotia grey sandstone. Gift of Adria M. Peterson and Gina M. Reeves, 1996. © Estate of Domenico Mortellito.**

Between 1945 and 1979, Domenico Mortellito worked at DuPont, overseeing their design department and designing exhibits, marketing materials, and product symbols. As an artist, he experimented with a wide array of innovative materials, including Lucite, nylon, and Teflon. In *Protecting the Future*, Mortellito makes a commentary on pollution. A massive kneeling figure protects a small child from clouds of pollutants, which resemble gargoyles. The young boy, holding a dove and representing the next generation, looks hopefully up and towards the future.