The rise and fall of leaded gasoline

1853 — Tetraethyl lead (TEL) discovered by Carl Jacob Loewig (1803 – 1890), chemistry professor at the University of Zurich.

1916 — Dayton Electric Light Co. (DELCO) president Charles F. Kettering asks researcher Thomas A. Midgley to begin working on problem of engine knock in DELCO electric generators used in rural areas for electric lighting. Midgley discovers iodine as anti-knock but it's too expensive.

— Delco sold; Kettering starts Dayton Metal Products Co. (DMPC).

1917 — Kettering and Midgley test fuels for Army Air Corps at Wright airfield. Alcohols and benzenes are listed as best anti-knock substances available but unsuitable to aircraft engines except in blends with gasoline.

1918 — Kettering and Midgley manufacture cyclo-hexane "Hecter" from benzene; war ends before production can begin.

— Midgley patents benzene / gasoline blend as anti-knock.

1919 — General Motors buys DMPC and makes Kettering research vice president

— Midgley discovers analine anti-knock additive after being given two weeks to find something to make Detroit GM headquarters happy. But analine is expensive, dangerous and foul-smelling.

— Mounting concern about long term petroleum supplies and declining quality of gasoline. Some automotive engineers advocate lowering compression ratio to enable use of low-quality fuels. In a speech to the Society of Automotive Engineers, Kettering says that would be wasteful and advocated high compression engines and improving the quality of gasoline with additives.

— Alice Hamilton invited to join Harvard School of Public Health.

1920 — Anti-knock research proceeds but frustration sets in. Du Pont disagrees with idea of analine injectors.

— Midgley patents analine injectors; also patents anti-knock blend of ethyl alcohol and cracked (olefin) gasolines.

— Scientific American says that because of its antiknock effect in blends with gasoline, there is a "universal assumption that [ethyl] alcohol in some form will be a constituent of the motor fuel of the future." (Dec. 11, p. 593. Also see "Henry Ford, Charles Kettering and the Fuel of the Future.")

1921 — Anti-knock research almost abandoned; Midgley discovers potential of selenium and tellurium by accident.

— (July) Boyd explores ethyl alcohol production from cellulose at Yale.

— (August – December) Systematic tests of metallic elements for antiknock.

— (October) Midgley demonstrates 30 percent ethyl alcohol blend in gasoline as anti-knock to Indiana Society of Automotive Engineers meeting. According to unpublished notes from the meeting now among documents at Flint University archives, Midgley said:

"Alcohol (ethanol) has tremendous advantages and minor disadvantages… (such as) clean burning and freedom from any carbon deposit… [and] tremendously high compression under which alcohol will operate without knocking… Because of the possible high compression, the available horsepower is much greater with alcohol than with gasoline…"

— (December 9) First tests of tetraethyl lead in GM labs by Thomas Midgley. Substantial decrease in engine knock.

— (December) Kettering proposes product name "Ethyl" because solvent (ethyl alcohol) used to suspend lead in fuel, but the choice confuses (perhaps deliberately) the "high percentage" route to anti-knock additives with the "low percentage" route.

1922 — Continued tests of tetraethyl lead. Valve, spark and exhaust failures are problems. Scavenger such as ethylene di-bromide (EDB) needed.

— Strong letters of concern about safety of tetraethyl lead by fellow scientists and Public Health Service to General Motors.

— September — First demonstrations of effect of tetraethyl lead on engine knock\ at American Chemical Society (ACS) convention.

— Continued interest by Kettering, Midgley and Boyd in ethyl alcohol as the fuel of the future.

— League of Nations bans interior lead paints.

1923 — January — Midgley takes a few months off to recuperate from lead poisoning.

— February 1 — First commercial sale of Ethyl Gasoline in Dayton, Ohio. GM production line goes into full operation. No health tests conducted at this time.

— March — Midgley awarded American Chemical Society Nichols Medal for discovery of tetraethyl lead's anti-knock effect in gasoline.

— Two dead, 40 "under observation" from lead poisoning at GM pilot scale lead production plant in Dayton Ohio. Dates unknown.

— September — Du Pont begins production at Deepwater, N.J. (across bay from Wilmington, Del.) Frank W. Durr, 37, first worker known to die of lead poisoning Sept. 21 from TEL process.

— September — First safety tests begin at Bureau of Mines, Pittsburgh, Pa.

— October 20 — Sim Jones, 47, janitor, becomes the second Du Pont worker to die of lead poisoning from TEL process. Jones apparently absorbed the TEL fluid through holes in his boots.

1924 — January– Contracts for exclusive sales rights to Standard of New Jersey (Exxon), Standard of Indiana (Amoco) and Gulf Oil Co. specify that three grams tetraethyl lead produces anti-knock value of 40 percent benzene.

— February — New "ethyl chloride" process goes into operation at du Pont. Medical committee formed with du Pont, GM and Standard physicians, W. Gilman Thompson presiding.

— New ethyl chloride process planned by du Pont. Medical committee formed with du Pont, GM and Standard physicians.

— June –Standard Oil of New Jersey plans ethyl chloride mini-process (semi-works) at Bayway, N.J., across bay from New York City. Kettering and Midgley insist on stepped-up production, calling it "war orders" due to competition for octane additives which, they will later insist, does not exist.

— July 20 — Frank Hanley, 23, another du Pont worker, dies of lead poisoning as production is tripled over original capacity.

— August 12 — Joseph Clancy, 23, another du Pont worker, dies of lead poisoning as production is tripled over original capacity.

— August — Ethyl Gasoline Corp. formed as 50 / 50 partnership between General Motors and Standard Oil of N.J. Kettering made president and Midgley made vice president of operations.

— September — Du Pont engineers voice grave concerns about safety of Standard semi-works at Bayway. Concerns brushed aside.

— September 26 – October 30 — Six Standard Oil refinery workers die violently insane following daily exposure to tetraethyl lead fumes at
Bayway Ethyl plant. They are: Henry C. Becker, Ernest Oelgert, Walter Dymock, William McSweeney, William Kresge, and Herbert Fuson, all of Elizabeth N.J. An additional 33 workers are hospitalized. Some, like Joseph Leslie, will spend the rest of their lives at Graystone Psychiatric Hospital, and from 1932 on, at the Marlboro Psychiatric Hospital, both in New Jersey. (Note: Sometimes this is noted as five deaths. The first, Henry C. Becker, occurred Sept. 26, a few weeks earlier than the others, and is sometimes omitted).

— October 11 — Kettering sails for France on the White Star liner Homeric to attend secret negotiations between I.G. Farben and Standard Oil Co. at the Hotel Crillon in Paris. Kettering is particularly interested in Farben's iron carbonyl additive.

— October 27 — First headlines in New York city newspapers about leaded gasoline deaths at Bayway.

— December 23 — Ethyl board of directors meets at 26 Broadway in New York. The board authorizes $100,000 compensation to workers, considers variety of alternatives to tetraethyl lead, and worries about legal consequences from Bayway accident.

— December 24 — Kettering and du Pont technical director W.F. Harrington meet with Surgeon General Hugh Cumming in Washington D.C.

1925 — February — Criminal charges are dropped against Standard by a New Jersey grand jury investigating the deaths and injuries.

— February 13, 16, 28 — Three more workers die at the du Pont Ethyl plant in Deepwater, NJ: Federick DeFiebre, Robert F. Huntsinger, and Loring M. Boody.

— February — I.G. Farben licenses iron carbonyl anti-knock additive to a du Pont Corp. subsidiary, retains 35% rights.

— March 27 — James Connell is the last worker to die at the du Pont Deepwater plant before it is closed down.

— April 6 — Midlgey claims at an American Chemical Society meeting: "So far as science knows at the present time, tetraethyl lead is the only material available which can bring about these [anti-knock] results." The claim is a bald-faced lie that contradicts Midgley's own published research.

— April 21 — Kettering and Midgley are secretly fired as president and vice president of Ethyl Corp. at a meeting of the Ethyl board of directors at 26 Broadway. Both continue to work for General Motors. Kettering continues to pretend to be the president of Ethyl in official meetings that summer.

— April 30 — Yale university public health scientist claims Ethyl gasoline represents "the greatest single question in the field of public health which has ever faced the American public."

— May 4 — Joseph Leslie and an unknown number of other victims from the Bayway plant quietly transferred from Reconstruction Hospital in New York City to Greystone Psychiatric Hospital in New Jersey. Leslie will spend the next 40 years in psychiatric institutions due to nerve damage. His family is devastated.

— May 15 — Dept. of Commerce quietly publishes report on alternative anti-knock fuels used in 19 foreign countries; report is not discussed in interviews, in the press or at PHS in May 20 conference.

— May 20 — US Public Health Service holds conference to discuss viewpoints on Ethyl controversy and appoints blue-ribbon committee to conduct independent inquiry. Alice Hamilton and others insist that alternative anti-knock compounds are available, but consideration of alternatives is suspended as conference is cut back from two to three days to only one day. According to a 1950 memoir by T.A. Boyd, a confrontation between Hamilton and Kettering took place in a hallway during the conference recess, in which Hamilton privately said to Kettering: "You are nothing but a murderer" and "There are thousands of things better than lead to put in gasoline." Kettering laughs at Hamilton.

Frank Howard of Standard Oil says: “As a result of 10 years research … we have this apparent gift of God of three cubic centimeters of tetraethyl lead… It would be an unheard-of blunder if we should abandon a thing of this kind merely because of our fears.” Responding to Howard was Grace Burnham, director of the Workers Health Bureau, who pointed out that tetraethyl lead “was not a gift of God when those … men were killed or 149 men were poisoned.”

— *The Youth’s Companion* says of the leaded gasoline controversy: “No one disputes the facts of the case, which are that much of the lead in the gasoline comes out of the exhaust pipe as a fine impalpable dust, which, if breathed into the lungs in sufficient quantity, is capable of setting up lead poisoning in the body. And any physician will tell you that lead poisoning is a very serious matter… The question is whaether the lead dust would be produced in sufficient quantity and under such conditions as to become a danger to public health. Some chemists are sure that it would and that the use of ethyl gasoline ought to be forbidden by law. Others are equally sure that it would not.” (June 11, 1925, p.398)

— September 4 — USS Shenandoah, Navy dirigible, wrecks in heavy storm over Ohio following engine failure, killing 26 crew members. Contribution of Ethyl fuel to engine failure does not emerge in U. S. inquiry. When the British scientific publication *Engineering* blames the crash on the use of Ethyl gasoline in March, 1926, a flurry of G.M. memos confirms that the Shenandoah used Ethyl.

— Sept. 25 — Frank Howard writes a private memo to Kettering noting three “substitutes” for Ethyl then on the market: 1) vapor-phase cracked products; 2) benzol blends; 3) gasoline from napthenic-base crudes.

— October — Public Health Service study of 252 drivers and auto mechanics in Dayton and Cincinnati Ohio begins. Researchers find that drivers exposed to leaded gasoline showed somewhat higher “stippling” damage to red blood cells, while garage workers exposed to leaded gasoline showed much more damage to red blood cells, and one quarter of garage workers had over one milligram of lead in fecal samples. In the final published report in 1927, the Surgeon General’s Committee says blood cell stippling was found “to a relatively high degree” in garage mechanics whose exposure had been relatively short — as little as two and a half days.

— December 22 — Surgeon General’s Committee member David L. Edsall of Harvard objects that “we would be presenting a half-baked report” unless the committee studies “the effects this is going to have on others.”

1926 — January 26 — PHS committee releases a report that finds “no good grounds” for prohibiting Ethyl gasoline but insists on continued tests:

Owing to the incompleteness of the data, it is not possible to say definitely whether exposure to lead dust increases in garages when tetraethyl lead is used. It is very desirable that these investigations be continued… It remains possible that if the use of leaded gasolines becomes widespread, conditions may arise very different from those studied by us which would render its use more of a hazard than would appear to be the case from this investigation. Longer exposure may show that even such slight storage of lead as was observed in these studies may lead eventually in susceptible individuals to recognizable lead poisoning or chronic

degenerative disease of obvious character… The committee feels this investigation must not be allowed to lapse.

No independent tests are conducted until 1960s. Also, a list of alternatives to tetraethyl lead proposed by C.E.A. Winslow of Yale is kept from final report.

— Market strategy becomes rigid standardization, restricted selling and development of demand for "Ethyl" brand until April, 1933.

— Earl Webb, Ethyl's new president, visits American Research Co. in Denver, Colorado and observes a lack of precautions. "It's surprising someone hasn't died in your outfit," Webb says. Later that year, Irenee du Pont overrules Webb in an Ethyl board of directors meeting and insists that the contract be cancelled. "The risk of serious catastrophe is too great to be considered," du Pont says.

1927 — Du Pont and I.G. Farben sign agreement for anti-knock iron carbonyl marketing in the U.S.

— Final report on TEL health studies published by Bureau of Mines.

— Robert A. Kehoe of the University of Cincinatti begins experiments with TEL, finds "no effect" below a certain threshold. (Note: Kehoe's work was financed by Ethyl, and is seen by historians as an example of industry hegemony over science. See Rosner & Markowitz, 1989.)

1928 — Controversy over use of leaded gasoline breaks out in Britain; scientists concerned, London Daily Mail articles discuss lead; Ethyl gets approval from UK government.

— September — Julius Stieglitz of the University of Chicago, who had been a member of the 1925 Surgeon General's Committee on tetraethyl lead, along with N.P. Leach, a director of the American Medical Association, write to complain about an "infraction of the spirit if not the letter of the regulations" on tetraethyl lead from spillage and other workplace exposures to concentrated Ethyl fluid.

1933 — Farmers advocate mandatory or tax-encouraged use of ethyl alcohol as fuel anti-knock instead of Ethyl leaded gasoline. Iowa State University and several Midwestern companies begin experimenting with and selling 10 percent ethyl alcohol in gasoline as anti-knock fuel. American Petroleum Institute urges oil industry to fight back vigorously.

— April — Ethyl marketing strategy switches to broad unbranded use in any gasoline; wholesalers begin to be licensed by Ethyl. Sales shoot up.

— Ethyl Corp. denies license to sell Ethyl to wholesalers using ethyl alcohol blended gasolines, selling cheaper than majors or violating "business ethics" as defined by Ethyl and Standard, according to F.B.I. report.

— U.S. Navy researchers at Annapolis find that Ethyl leaded gasoline and 20 percent ethyl alcohol blends in gasoline were almost exactly equivalent in terms of brake horsepower and useful compression ratios. The 1933 report was never published.

1934 — January — Standard Oil public relations expert Ivy Ledbetter Lee meets with Adoph Hitler to offer advice on how to reconcile Americans to the Nazi government. In July, Lee is brought before an outraged House Un-American Activities Committee for questioning about contacts with the Nazis. He died Nov. 9 of that year from a brain tumor.

1935 — Ethyl and Standard agree to provide I.G. Farben technology and know-how to manufacture tetraethyl lead in Germany. A similar agreement is reacheed with Montecatini for TEL manufacture in Italy.

1936 — Chemical Foundation finances factory to turn grain into ethyl alcohol for blending into anti-knock gasoline. "Agrol" fuel (10 to 20 percent ethyl alcohol with gasoline) sold in 2,000 stations across Midwest. The plant goes bankrupt by 1939.

— June 13 — Cushing Gasoline and Refining Company is ordered to cease disparaging remarks about Ethyl. Cushing advertised its gasoline was not "doped" and said: "It stands on its own merits and needs no dangerous chemicals — hence you can offer it to your customers without doubt or fear." The Federal Trade Commission said this was an unfair trade practice. Ethyl gasoline "is entirely safe to the health of [motorists] and to the public in general when used as a motor fuel, and is not a narcotic in its effect, a poisonous dope, or dangerous to the life or health of a customer, purchaser, user or the general public." Ethyl was "said to be the only chemical used commercially for mixture with gasoline for the purpose of eliminating the 'knocking'…" the FTC said in a press release about the decision.

1937 — Ethyl Gasoline Corp. indicted for violations of Sherman Anti-Trust Act related to enforcing business "ethics" on the market by denying wholesalers licenses to sell Ethyl. Some 10,000 out of 12,000 wholesalers in the US are licensed. Ethyl appeals and loses suit in Supreme Court 1940.

— January 8 — Midgley awarded ACS Perkins medal.

1938 — Standard transfers technical know-how for tetraethyl lead production to I.G. Farben of Germany; Farben promises but never delivers synthetic rubber production technology in return.

1939 — Ethyl Corp.'s tetraethyl lead is marketed in virtually all American gasolines except Sunoco, which uses select crudes, more expensive refinery processing and tertiary-butyl alcohol to reach regular and premium octane levels.

1942 — Sen. Harry S. Truman's war investigating committee exposes a treasonous pre-war relationship between American companies Ethyl, Standard Oil (Exxon), General Motors and DuPont on the one hand and the German chemical company I.G. Farben on the other. By the mid 1930s, Farben had been taken over by the Nazis. Standard company memos described the relationship as a "full marriage" which was "designed to outlast the war" no matter which side won.

GM, Ethyl and Standard Oil gave the Nazis leaded gasoline production technology in return for a patents on synthetic rubber, a critical strategic material. Although the U.S. companies did very little research of their own, they vigorously protected the German synthetic rubber patents. When the war opened, supplies of natural rubber from southeast Asia were cut off by the Japanese, and meanwhile, the Standard – Nazi connection was blocking the development

of synthetic rubber. The episode is considered to be a classic case of economic warfare , and was recognized as such at the time; British intelligence, for example, called Standard Oil a "hostile and dangerous element of the enemy." (Stephenson, 1976; Borkin, 1978).

1943 — Three quarters of US synthetic rubber production comes from alcohol based butadiene process rather than petroleum processes.

1944 — November 2 — Thomas Midgley found strangled by a harness he was using to get out of bed at his home in Columbus, Oho. It was probably a suicide. Midgley had been unable to walk for the previous four years, although he had given an address at the ACS meeting Sept. 11, 1944.

1945 — US Army says it wants "a method of removing tetra-ethyl lead from leaded gasoline so that the gasoline can be burned in stoves, lanterns and small engines." (April 29, 1945, NYT, p. E9).

1950 — Dr. Arie Haagen-Smit identifies causes of smog in LA as interaction of hydrocarbons (cars largest source) and oxides of nitrogen. Additional concerns about leaded gasoline begin emerging.

— Eugene Houdry, a petroleum engineer, announces development of a catalytic converter for auto exhaust to cut down carbon monoxide. (WSJ, Dec. 4, 1950) The combination of the catalytic converter and unleaded fuel would not be implemented for another 30 years.

1952 — General Motors and du Pont face a federal anti-trust suit for restraint of trade in gasoline additives, automotive paints and other chemical industries. US Supreme Court rules that research collaboration is not a violation of the Anti-Trust Act.

1953 — First serious post-war concerns about lead as an air pollutant surface in Los Angeles. Kettering follows issues closely through memos from industry observers as well as clips from newspaper articles.

1954 — Octel begins TEL production in England.

1958, 1959 — US Sen. Richard Neuberger and Rep. Paul Schenck introduce legislation requiring the US Surgeon General to hold public hearings on exhaust fumes and control standards. Schenck said the auto industry opposed the legislation "with everything it could throw into it." (WP Feb. 26, 1960).

1959 — US Public Health Service approves Ethyl Corp. request to increase lead in gasoline.

1959 — California becomes first to impose automotive emissions standards, requiring "blow-by" valve to recycle crankcase emissions back through the carburetor. Automakers combine to fight mandatory use of the $7 device, a fight which leads to an anti-trust suit by the U.S. Justice Dept. that is not settled until 1969.

1960 — Health, Education and Welfare Secretary Arthur S. Fleming urges adoption of "smog killer" devices on cars. (WP Feb. 26, 1960).

— Sept. 9 — Eight workers die handling TEL, according to an article in American Industrial Hygiene Journal, Dec. 1960, p. 515-17.

1962 — General Motors and Standard Oil of New Jersey (Exxon) abandon Ethyl Corp., selling it to Albemarle Paper Co. for $200 million in a leveraged buyout which the corporations themselves finance.

1965 — Clair Patterson publishes "Contaminated and Natural Lead Environments of Man," the first to show that high lead levels in industrial nations are man-made and endemic. (Arch Environ Health. 1965 Sept 11:344-60.)

— Sept. 9 — American Petroleum Institute responds to Patterson, saying that while the findings "may be of academic interest … they have no real bearing on the public health aspects of lead. Contrary to Mr. Patterson's conclusion, the mass of evidence proves unquestionably that lead isn't a significant factor in air pollution and represents no public health problem in any way." (WSJ Sept. 9, 1965)

— December 13 – 15 — Public Health Service holds a symposium on leaded gasoline, hearing from Robert Kehoe and Clair Patterson. Kehoe tells the scientists: "There is not enough lead in our environment to be a health hazard to anybody. Those who say there is are ignoring the substance of the scientific work that has been done." (WP Dec. 19, p. A14). Harriet Hardy of MIT argues that small doses of lead could be a contributing factor to disease, and cites studies that suggest links between lead and mental retardation. (NYT Dec. 16, p. 22).

1966 — June 8 — Hearings on leaded gasoline begin in U.S. Senate and include testimony from Robert Kehoe, a scientist working for industry, and Clair Patterson, a UCLA scientist who exposed Kehoe1s fraudulent industry research.

In one of the most sterling moments in public health and environmental history, Patterson tells the committee:

"It is not just a mistake for public health agencies to cooperate and collaborate with industries in investigating and deciding whether public health is endangered – it is a direct abrogation and violation of the duties and responsibilities of those public health organizations."

The hearings, chaired by Sen. Edmund Muskie, lead to extended debate about the need for new regulatory agencies and new approaches to regulations.

— US Public Health Service publishes report "Protecting the Health of Eighty Million Americans" stating that old problems of worker safety and health were not solved and new technological challenges were complex. The report leads to a reorganization of the PHS and the establishment of OSHA in 1970.

1969 — Auto makers settle suit by Justice Department for conspiracy to delay the development of pollution-control devices.

1970 — Jan. 22 — General Motors president Edward Cole promises "pollution free" cars by 1980 and urges the elimination of lead additives from gasoline in order to allow the use of platinum-based catalytic converters. The irony of GM abandoning leaded gasoline is not lost on the public — or Ethyl Corp. — since GM scientists discovered the anti-knock (octane boosting) effect of lead in 1921.

1971 — Ethyl Corp. officials claim to be victims of a "witch hunt," and say environmentalists are using "scare tactics" by blaming lead for the fall of the Roman Empire.

"The clincher by all prophets of doom is that someone started the rumor that lead was the cause of the fall of the Roman Empire… The legend always gets fuzzy — sometimes it is caused by lead-lined aqueducts, other times it is from their wine being drunk from lead-lined flasks." — Ethyl vice president Lawrence E. Blanchard, Jr. "Washington Press Briefing," National Press Club, Jan 18, 1971.

1972 — Feb 22 — EPA announces that all gasoline stations will be required to carry "non-leaded" gasoline in the future to protect catalytic converters (which reduce other auto exhausts such as carbon monoxide). EPA asked the Dept. of Health Education and Welfare "to provide a health basis for the planned reduction…" But HEW "informed EPA that they could not support the reduciton of lead in gasoline for reasons of adverse health effects since no medical or scientific data were available to indicate that it was a hazard to health." EPA delays setting standards until 1973, then is sued by Ethyl Corp.

— July 1 — Lancet reports death of four workers cleaning a tank that held TEL. Blood lead levels were between 64.2 and 92.5 ug/dL.

1974 — May 7 – 8 — Hearings before the Panel on Environmental Science and Technology of the Subcommittee on Environmental Pollution of the Committee on Public Works. Sen. Joe Biden (D-Del) calls for "a panel of medical scientists having expertise in the field" to perform a literature review, but concludes: "In my opinion, lead from auto emissions does not constitute a public health hazard."

J. Julian Chisolm also testifies about a "normal population without undue exposure to lead" having blood lead in the range of 10 to 30 ug/dL. "No adverse health effects have been demonstrated in such groups," Chisolm says, though he cautions that some may show blood metabolism effects. He also blames lead paint for most of the country's problems: "The extent to which the removal of lead from gasoline would ameliorate this problem is uncertain, but probably quite small." Others, notably Herbert Needleman, disagree.

1975 — New car models made with catalytic converters which require unleaded gasoline. Ethyl Corp. unsuccessfully proposes "lead tolerant" catalytic converters.

1976 — March 19 — Preliminary decision in Lead Industries Association v EPA; court says EPA has authority to regulate leaded gasoline. Even if there is no certainty that lead in gasoline is a danger, "awaiting certainty will often allow only for reactive not preventive regulation," says judge J. Skelly Wright. The lead phasout begins, and by June 1979, nearly half of all US gasoline is unleaded.

1978 — Energy Tax Act creates ethanol tax incentive, expanding use of ethanol anti-knock fuel additives in US.

1977 — Testing by public health scientists shows correlations between high levels of lead in children's blood and brain damage, hypertention and learning disorders.

1979 — Herbert Needleman begins first large study of behavior and intelligence as influenced by lead exposure.

1980 — June 27 — Final decision in Lead Industries Association v. EPA, affirms EPA regulations for leaded gasoline, allowing the phase-out to go forward. Judge J. Skelly Wright says:

The national ambient air quality standards for lead were the culmination of a process of rigorous scientific and public review which permitted a thorough ventilation of the complex scientific and technical issues presented by this rulemaking proceeding… To be sure, even the experts did not always agree about the answers to the questions that were raised. Indeed, they did not always agree on what the relevant questions were. These disagreements underscore the novelty and complexity of the issues that had to be resolved,

— National Academy of Sciences says that leaded gasoline is the greatest source of atmospheric lead pollution, and estimated daily intake of 0.3mg per person.

— National Security Act of 1980 requires that all gasoline be blended with a minimum of 10 percent ethanol. Mandate is dropped during Reagan administration.

— Gasohol Competition Act requires oil companies to stop their discrimination against sales of ethanol – gasoline blends.

— Ethyl reports it has expanded overseas business tenfold between 1964 and 1981.

1981 — Vice President George Bush's Task Force on Regulatory Relief proposes to relax or eliminate US leaded gas phaseout, despite mounting evidence of serious health problems.

1982 — Reagan Administration reverses opposition to lead phaseout.

1983 — EPA reports that between 1976 and 1980, amount of lead consumed in gasoline dropped 50 percent and corresponding blood-lead levels dropped 37 percent. The benefits of the lead phaseout exceed its costs by $700 million.

— Howard Mielke first reports that leaded gasoline in city soils are a factor in childhood lead poisoning, beginning a long record of research on the topic.

1983 — University of Virginia press publishes UVA historian Joseph C. Robert's corporate history: "Ethyl: A History of the Corporation and the People Who Made It." He acknowledges Ethyl's role in underwriting the costs of the book in the preface. Many factual details are grossly inaccurate and interpretive perspective is entirely hagiographic.

1984 — City of Chicago first to order end of all leaded gasoline sales since New York City ended ban on leaded gasoline in 1928. Newspapers conclude the Chicago order is first in the nation, indicating extent of historical amnesia concerning the Ethyl controversy.

1985 — Jack Lewis of EPA writes "Lead Poisoning: An Historical Perspective," in which the 1921 development of leaded gasoline is depicted as technologically inevitable. "… Other substances had all fallen by the wayside in the frantic search for a fuel additive that would improve engine performance and reduce engine knock." This is far frolm true. Lewis' depiction of recommendations for more research were shunted aside, he says, "… during the gin-soaked, jazz-crazed Roaring Twenties."

1986 — Citing conclusive evidence of brain damage from leaded gasoline, phase-out of 92 percent of all lead in gasoline ordered by EPA. Practical effect is banning of tetraethyl lead from U.S. market.

1986 — Primary phaseout of leaded gas in US completed. Study shows health benefit to technology cost ratio at 10:1.

— Safe Drinking Water Act amended to set standards for 83 contaminants and ban use of lead pipes and solder in new drinking water systems.

1990 – Leaded gasoline is "The Mistake of the 20th Century" according to C.M. Shy of the UNC School of Public Health in a paper published by the World Health Statistics Quarterly.

The environmental health calamity caused by lead in petrol could have been avoided if the initial warnings had been heeded and better preliminary research of the health issues had been carried out. Nevertheless, incontrovertible proof of causality should not be required before regulations are made to protect public health. (Shy, C.M. "Lead in petrol: the mistake of the XXth century." World Health Stat Q. 1990;43(3):168-76.)

1991 – OECD says that phasing out leaded gasoline was the most important lead poisoning prevention action possible for any national government.

1992 — Rio environmental summit calls for worldwide lead phaseout.

1994 – US researchers declared "lead poisoning remains the single most significant preventable disease associated with an environmental and occupational toxin"; and "Although lead in gasoline represents only 2.2 percent of total global lead use, leaded gasoline is by far the single most significant source of lead exposure in urban areas"

— UN Commission on Sustainable Development called on all governments to eliminate lead from gasoline.

— Blood lead levels show 78 % declines from 1978 to 1991 during leaded gasoline phase-out.

— American Academy of Pediatrics study shows direct relationship between lead exposure and IQ deficits in children.

1995 — December – Final US phase out leaded gasoline for road-use vehicles. US EPA press release says: "The elimination of lead from gas is one of the great environmental achievements of all time," [EPA Administrator Carol M] Browner said. "Thousands of tons of lead have been removed from the air, and blood levels of lead in our children are down 70 percent. This means that millions of children will be spared the painful consequences of lead

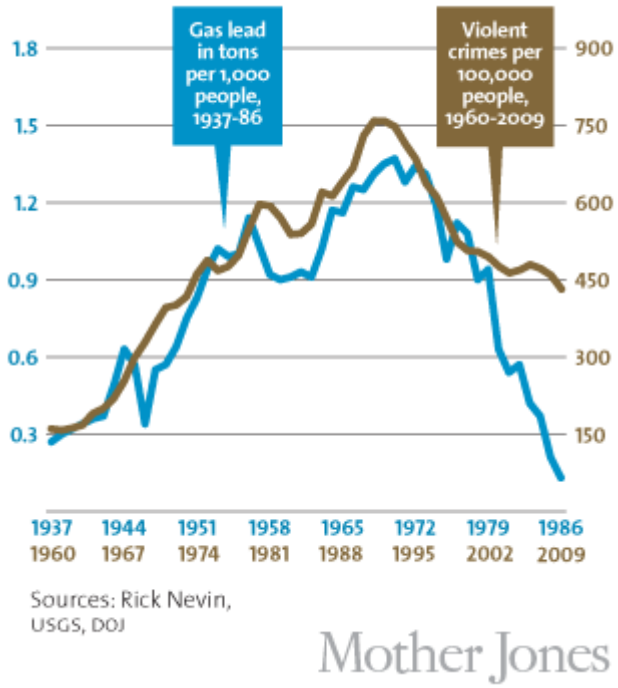
poisoning, such as permanent nerve damage, anemia or mental retardation." The actions taken today, although procedural, mark the end of a quarter-of-a-century of work to keep Americans safe from exposure to lead from gas."

— April 14 — Ethyl v. EPA — The only reason to ban a gasoline additive is to prevent the failure of emissions control systems, the US Court of Apeals for the District of Columbia says. Public health concerns were not a sufficient reason for the denial of Ethyl's application to sell MMT (methylcyclopentadienyl manganese tricarbonyl) as a gasoline additive.

1996 — Feb 20 – OECD member nations, World Bank, signed a Lead Declaration placing lead petrol phase-out as the number one action for each OECD country. The report links public health with economics and notes that the health costs of leaded gasoline are far higher than the benefits to a few refiners and gasoline distributors.

— Lead poisoning is linked to anti-social behavior in a study by Dr. Herbert Needleman, a psychiatrist at the University of Pittsburgh Medical Center. The study is published in the Journal of the American Medical Association and caps a long line of studies about physical and behavioral problems caused by leaded gasoline and lead paint. "I'm not saying that lead exposure is the cause of delinquency. It is a cause and one with the biggest handle to prevention." He explained: "Lead is a brain poison that interferes with the ability to restrain impulses. It's a life experience which gets into biology and increases a child's risk for doing bad things." (Aggressiveness and Delinquency In Boys Is Linked to Lead in Bones by Jane Brody, Feb. 7, 1996, New York Times.)

1999 — Rick Nevin submits How Lead Exposure Relates to Temporal Changes in IQ, Violent Crime, and Unwed Pregnancy Environmental Research, Volume 83, Issue 1, May



2000, Pages 1-22.

"Long term trends in population exposure to gasoline lead were found to be remarkably consistent with subsequent changes in violent crime and unwed pregnancy," Nevin says.

2000 — Jan 1 — European Union bans leaded gasoline as a public health hazard.

— US Senate resolution declares last week of October as national childhood lead poisoning prevention week. Information at the Centers for Disease Control lead pages. International lead poisoning awarness day is towards the end of October.

2001 — June — Declaration of Dakar sets timetable for removal of leaded gasoline from Sub-Saharan Africa through United Nations Partnership for Clean Fuels and Vehicles.

— May 25 — Gilbert Grosvenor, chairman of the National Geographic Society and former editor of National Geographic magazine, is elected to another term on the Board of Directors of the Ethyl Corp.

2002 – the World Summit on Sustainable Development (WSSD) took two decisions to protect children's health from exposure to lead. Firstly, the WSSD Plan of Implementation (POI) called for: "Supporting the phasing out of lead in gasoline." One result of WSSD 2002 was that the United Nations Environment Programme (UNEP) set up the Partnership for Cleaner Fuels and Vehicles (PCVF) with a core goal of global elimination of leaded petrol.

1999 – 2001 — Reginald Smith Jr., et al, v. Lead Industries Association et al, Case No. 24-C-99-004490, Circuit Court of the City of Baltimore, plaintiffs alleged damage through leaded paint and leaded gasoline to six Baltimore children. Case dismissed on preliminary motion, all documents sealed at request of Ethyl Corp.

2004 — Ethyl Corp. changes its name to New Market. Gilbert Grosvenor leaves board.

— Nov. 19 — Ethyl chair Bruce Gottwald funds Virginia Military Institute center for *"ethics*." Gottwald says he "believes the Institute's mission of transforming young men and women into tomorrow's leaders is more important today than ever."

2005 – The LEAD Group of Australia publishes a tally of 67 countries that were still selling leaded petrol.

2006 — January – Octel changes its name to Innospec.

— Jun 6 – SAICM (Strategic Approach to International Chemicals Management) releases Global Plan of Action, including a primary goal of eliminating lead in gasoline within the 2006-2010 timeframe. (SAICM Global Plan of Action page 33 of 84, 6 June 2006).

–Sept 9 – LEAD Group web-publishes Lead Mining Stewardship – Grey Lead and the Role of The LEAD Group fact sheet, which proposes "preventing lead from mining companies from being sold to the one manufacturer who uses lead to make the leaded petrol additive, that is, Innospec in the UK. If Innospec could not buy lead, hundreds of millions of children in the … countries still selling leaded petrol would not have to wait until 2010 for the SAICM … goal of a global lead petrol ban to be achieved."

2007 — International crime trends linked to pediatric lead exposure by Rick Nevis. The study found "a very strong association between preschool blood lead and subsequent crime

rate trends over several decades in the USA, Britain, Canada, France, Australia, Finland, Italy, West Germany, and New Zealand."

2008 – Beijing PCFV meeting acknowledges it will fail to meet its original target of a 2008 global leaded gasoline phaseout.

— LEAD Group calls for a ban on Australian lead exports for TEL for road-use and asks Xstrata to stop supplying lead to Innospec via Britannia.

2010 — March 18 – Leaded gasoline producer Innospec pays Securities & Exchange Commission $40 million in fines for corrupt practices in marketing leaded gasoline, including bribes to public officials in Indonesia and Iraq before and after the 2003 US invasion. See SEC v. Innospec, Inc., Civil Action.

The US SEC Complaint against Innospec also names Swiss-based Alcor, "a wholly owned subsidiary of Innospec" and states Alcor's "financial results were consolidated with those of Innospec throughout the relevant period.

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