Historical Pesticide Purchases for a New Jersey Apple Orchard from 1931-1936 and 1943-1945, with Notes on Remnant “Legacy” Pesticide Concentrations in Soil

By David Moskowitz, Michael Levinson, and Evie McMenamin

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For more than a century (1905-1998) the Smith Farm in East Brunswick, New Jersey was well-known. At its peak it was the largest apple orchard in the state. The father and son proprietors, George and Lawrence Smith, were innovators, pioneering new and improved orchard management and apple growing techniques, and were dubbed “Apple Kings” and “Master Farmers” for their work. In 1998, the pesticide purchase records at the farm from 1931-1936 and 1943-1945 were serendipitously rescued from a dumpster. The receipts and other materials provide a historical glimpse of two time periods marked by rapid and significant changes in agricultural pesticides from largely naturally derived, to synthetic, a legacy of World War II chemical innovation. As cutting-edge orchardists, the Smith’s employed and experimented with the most up to date pest control methods of their time and their pesticide purchases reflect that. However, many of the chemicals used at the farm remain in soils for long periods after application. Soil sampling in 1998 identified extensive contamination from these “legacy” pesticides, an issue plaguing orchards across the United States. In 1999, with the oversight of the New Jersey Department of Environmental Protection, the contaminated orchard soils were remediated as part of a process to develop the property for housing. The orchard is long gone now, and in its place there is a housing development known as Apple Ridge Estates (with streets named after apple varieties). The history of the pesticide purchases at the farm may provide an important lesson about how one generation’s innovation may be seen as a subsequent generation’s curse.
“There’s small choice in rotten apples.” -William Shakespeare

Introduction

The Smith Farm in East Brunswick, New Jersey was started in 1879 when George Smith purchased 60 acres for $1,500.00. In 1905 he planted the first apple trees and the farm would continue as an apple orchard from about that time through 1998. In 2001, the site was converted into a housing development.

1940 (left) and 2018 (right) aerial photographs of the Smith Farm site showing the orchard on April 10, 1940 and the current Apple Ridge Estates housing development in 2018. 1940 photograph reprinted with permission of EcolSciences, Inc. 2018 photograph courtesy Google Earth.

At its height, the Smith Farm had 4,500 apple trees, producing 35,000 bushels of apples annually on approximately 60 acres, making it the largest apple orchard in New Jersey. The size and success of the orchard earned praise for George Smith and his son Lawrence J. Smith, who was given the title of East Brunswick “Apple King” in the early 20th century. The Smith’s

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1 A. Alvarez, The Smith Farm (East Brunswick, New Jersey: East Brunswick Historical Society, undated).
2 “East Brunswick’s ‘Apple King’ Is Cited as Top Farmer and Citizen at Dinner in His Honor,” Daily Home News (New Brunswick, New Jersey), November 9, 1951.
were well known in the New Jersey agricultural community as innovators and pioneers of new and improved apple-growing and orchard management techniques.\textsuperscript{4} They were repeatedly recognized for these efforts. In 1930 Lawrence Smith was awarded a gold medal by the \textit{Pennsylvania Farmer} magazine recognizing him as a master farmer in New Jersey\textsuperscript{5} and in 1934, New Jersey Governor Morgan Larson named George and Lawrence Smith “Master Farmers.”\textsuperscript{2} Because of their pioneering innovations in apple production, the pesticides purchased for their farm are expected to have been state of the art providing a window into the historical development of insect pest control at New Jersey orchards.

When the orchard ceased operations in 1998, approximately 43 acres remained. On a somewhat ironic note, after the farm was developed for housing, the residential project was named Apple Ridge Estates and the streets were named after apple varieties including, Cortland Drive, Winesap Drive and Braeburn Place. In 1999, as the orchard office was being demolished, an opportunity arose to salvage and preserve some of the farm records that had been disposed of in a dumpster. These records included the extensive pesticide purchases for the farm from 1931-1936 and 1943-1945. It is believed that these records are complete and cover all purchases during the two periods. Although the purchases for the intervening years are unfortunately now lost to history, the two periods covering nine years, prior to, and at the end of World War II, provide an interesting and important glimpse into the battle by the Smiths to combat insect pests and the shift from naturally-derived organic and inorganic pesticides to synthetic organic pesticides. This shift was a result of a number of factors including war time chemical development and use, agricultural pest resistance, and issues related to food safety and worker

\textsuperscript{4} Alvarez, \textit{The Smith Farm}.
\textsuperscript{5} “Lawrence J. Smith of South River, One of Leading Farmers in County, Has Made Science of Apple Growing. Pioneer Agriculturalist Led in Applying Modern Methods,” \textit{Sunday Times} (New Brunswick, New Jersey), April 7, 1940.
chemical exposure. Ultimately, the shift led toward the environmental impacts and awareness that would arise with Rachel Carson’s seminal book *Silent Spring* in 1962, detailing the ecological crisis of synthetic pesticides.⁶

In 1998, prior to the development of the site for single-family homes, the orchard soils were sampled as part of a process to ensure the land met acceptable New Jersey Department of Environmental Protection (NJDEP) standards for residual pesticides.⁷ Residual pesticides that remain in the soil from historic applications are an important issue throughout the United States, particularly as agricultural lands are developed for residential and other uses.⁸ Many states, including New Jersey, have issued guidelines or created regulations to address remnant historic pesticides in soils.⁹ Financial institutions and developers often conduct studies as part of environmental due diligence for real estate transactions involving current or historic farmlands and the Smith farm was no exception. This paper provides a review of the pesticide concentrations detected in the soils in 1998 and the efforts to remediate the contamination.

**George and Lawrence J. Smith – The Orchardists**

George Smith (1846-1940) and his son, Lawrence J. Smith (1898-1982) were well-known in the New Jersey agricultural community and were pioneers in apple growing and orchard management.

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In 1905, George Smith planted the first 45 acres of the Smith Farm with apples trees and with peach trees as fillers. The orchard would eventually grow to 60 acres by 1940. George Smith was apparently a master orchardist and as his orchard flourished, he produced more fruit that he could sell, losing a large portion of the crop to spoilage. In 1911, he decided to build a cold storage building that would use ice to keep the fruit cold until it could be sold. The building

10“Short Course Helped This Man to Farm, Lawrence J. Smith Makes Money With Apples,” New Jersey Agriculture V, no. 9 (1923): 5.
was completed in 1912 and was the first fruit cold storage building in New Jersey and one of only a few in the United States. The cold storage greatly extended the life of the fruit, allowing for sales at higher prices in the winter when fresh fruit was scarce. Soon after it was constructed, the cold storage building was used as an educational tool by the nearby State Agricultural College. The college had a 100-acre experimental farm in New Brunswick that ultimately would become the present-day George H. Cook campus and students attending the school would visit the Smith Farm cold storage building.\textsuperscript{11}

\textbf{The Smith Farm Cold Storage Building circa 1923, courtesy \textit{NJ Agriculture}.}\textsuperscript{12}

In 1919, Lawrence Smith was twenty-one and was encouraged by his father to enroll in the State Agricultural College fruit course.\textsuperscript{13} He attended the course between 1919 and 1920.\textsuperscript{14}

\begin{footnotes}
\item[11] Alvarez, \textit{The Smith Farm}.
\item[12] “Short Course Helped This Man to Farm, Lawrence J. Smith Makes Money With Apples.”
\item[13] Alvarez, \textit{The Smith Farm}.
\end{footnotes}
Among the farm records salvaged from the dumpster was his test notebook from the course dated January 19, 1920. The handwritten entries found on pages three and four of the notebook are the definitions of an insecticide, a list of ten insecticides, the way they work, and the target insects they killed. Lawrence Smith scored a 98 out of 100 on the test in what may have been the genesis of his innovative use of pesticides at the orchard. Lawrence Smith noted the importance of the short course for insect and disease control and pesticide spraying in 1923:

> The Short Courses have given me training of inestimable value in farm management, insect and disease control, and spraying and pruning. Furthermore, through the contacts I have maintained with my Instructors since leaving school I am keeping our methods right up-to-date.\(^{15}\)

Lawrence Smith would become a pillar of the New Jersey agricultural community, honored by the A.B. Agricultural Society at Rutgers in 1940, the Rutgers Agricultural College in 1950, and the New Jersey State Board of Agriculture in 1970. His influence on agriculture in New Jersey cannot be overstated. He served as President of the following organizations and Boards: Middlesex County Board of Agriculture, State Horticultural Societies, Hightstown National Farm Association, Farmers’ Cooperative Association of New Jersey, and the Rutgers College of Agriculture and Environmental Societies. Given this involvement in many aspects of the New Jersey agricultural community, and his recognition as an innovator in apple production and orchard management, it is not surprising that the Smith Farm was at the forefront of insect and other pest control practices utilizing the latest state of the art pesticides and methods available.

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\(^{14}\) “Lawrence J. Smith of South River, One of Leading Farmers in County, Has Made Science of Apple Growing, Pioneer Agriculturist Led in Applying Modern Methods,” *Sunday Times* (New Brunswick, New Jersey), April 7, 1940.

\(^{15}\) Lawrence Smith, *The Daily Home News* (New Brunswick, New Jersey), September 29, 1923.
Historic Pesticide Purchases

The history of pesticide use on apple orchards is well documented and reflects a continual battle against insects and diseases that damage the fruit or prevent the fruit from developing. The Smith Farm records illustrate this well. Purchases for the orchard reflect an initial use of large quantities of naturally derived pesticides and then a gradual shift to synthetic pesticides including DDT (see Table 1 below).

<table>
<thead>
<tr>
<th>Pesticide</th>
<th>1931</th>
<th>1932</th>
<th>1933</th>
<th>1934</th>
<th>1935</th>
<th>1936</th>
<th>1943</th>
<th>1944</th>
<th>1945</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead arsenate</td>
<td>9,024 lb</td>
<td>8,064 lb</td>
<td>3,034 lb</td>
<td>8,016 lb</td>
<td>3,150 lb</td>
<td>2,016 lb</td>
<td>3,840 lb</td>
<td>2,016 lb</td>
<td></td>
</tr>
<tr>
<td>Flotation sulphur</td>
<td>2,000 lb</td>
<td>4,020 lb</td>
<td>1,020 lb</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>C.P.O. solid</td>
<td>1,346 lb</td>
<td>1,504 lb</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Scale Oil</td>
<td>654 gal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Black leaf 50</td>
<td>9,024 lb</td>
<td>8,064 lb</td>
<td>3,034 lb</td>
<td>8,016 lb</td>
<td>3,150 lb</td>
<td>2,016 lb</td>
<td>3,840 lb</td>
<td>2,016 lb</td>
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<tr>
<td>Ortho K Medium Oil</td>
<td>162 gal</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Magnesium arsenate</td>
<td>80 lb</td>
<td>48 lb</td>
<td></td>
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<td></td>
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<tr>
<td>Liquid lime sulphur</td>
<td>1,500 gal</td>
<td></td>
<td>750 gal</td>
<td></td>
<td>600 gal</td>
<td></td>
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<td></td>
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<tr>
<td>Sulfrox wettable sulphur</td>
<td>100 lb</td>
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<tr>
<td>Koppers Flotation Sulphur</td>
<td>3,000 lb</td>
<td></td>
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<tr>
<td>Fluorid</td>
<td>100 lb</td>
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<td></td>
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<tr>
<td>Dormoil</td>
<td>324 gal</td>
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<tr>
<td>Nicotine sulphate 40</td>
<td>120 lb</td>
<td></td>
<td>200 lb</td>
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<tr>
<td>Anhydrous Ammonia</td>
<td>106 lb</td>
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<td>105 lb</td>
<td></td>
<td>210 lb</td>
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<tr>
<td>Kleen-O-Cil</td>
<td>304 gal</td>
<td></td>
<td>972 gal</td>
<td></td>
<td></td>
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<tr>
<td>Bowkers Flowable Oil Emulsion</td>
<td>108 gal</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>High-Calcium Chemical Spraying Lime</td>
<td>9,000 lb</td>
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<tr>
<td>Koppers Flotation Sulphur</td>
<td>3,000 lb</td>
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<tr>
<td>C.P.O. solid</td>
<td>1,346 lb</td>
<td>1,504 lb</td>
<td></td>
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<td></td>
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<tr>
<td>Calox</td>
<td>480 lb</td>
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<tr>
<td>DDT</td>
<td>2 pt</td>
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<tr>
<td>Koppers Emulsion</td>
<td>648 gal</td>
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<tr>
<td>Ortho D Soluble</td>
<td>108 gal</td>
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<tr>
<td>Ammonia Oil</td>
<td>30 gal</td>
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<td></td>
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<tr>
<td>Liquid Orthex</td>
<td>378 gal</td>
<td></td>
<td></td>
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<tr>
<td>SW Lead</td>
<td>2,016 lb</td>
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<td></td>
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<td></td>
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<tr>
<td>Cyanamid</td>
<td>2,000 lb</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Flotation sulphur paste</td>
<td>1,000 lb</td>
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<td>DDT</td>
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<tr>
<td>Kolodust</td>
<td>1,000 lb</td>
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<tr>
<td>Kemite</td>
<td>30 gal</td>
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<tr>
<td>Femate</td>
<td>150 lb</td>
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</tbody>
</table>

Table 1. Smith Farm Pesticide Purchases from Receipts 1931-1936 and 1943-1945.
Illustrating the early recognition of this issue is a 1915 quote in *Insect Pests of Farm, Garden and Orchard*:

> Ever since the locust plagues in the time of the Pharaohs history is replete with accounts of insect scourges and the enormous losses they have caused agriculturalists of all ages. However, instead of diminishing with the advancement of agricultural methods, injurious insects have undoubtedbly become both more numerous and more destructive in modern times.\(^\text{16}\)

The extent of the problem and the vast costs of insect damage just after the turn of the 20\(^{th}\) century was described by C. L. Marlatt, Assistant Chief of the Bureau of Entomology, US Department of Agriculture in the *1904 Yearbook US Department of Agriculture*.

> Very careful estimates, based on crop reports and actual insect damage over a series of years, show the loss due to insect pests of farm products, including fruits and livestock, now reaches an almost inconceivable total of $1,000,000,000, annually.\(^\text{17}\)

In *Insect Pests of Farm, Garden and Orchard*, published a decade later, E. D. Sanderson, commenting on Marlatt’s assessment, continued:

> The above quotations by Mr. C. L. Marlatt, Assistant Chief of the Bureau of Entomology, US Department of Agriculture, may appear to the reader either ludicrous or startling, according to whether he be more or less informed concerning the important role which insects play in our agricultural community, which in turn forms the warp of American prosperity.\(^\text{18}\)

In 1906, E. G. Packard’s poem “Spray, O, Spray” was published in *Entomological News*, a leading entomological journal, and perhaps lightly demonstrates the importance of insecticide spraying and the way it was viewed by the entomological community of the time.

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\(^\text{18}\) Sanderson, *Insect Pests of Farm, Garden and Orchard*. 
The insect problem, addressed with ever increasing spray rates, was compounded by resistance to pesticides complicating their use and resulting in the need to find ever more powerful and effective compounds and application methods. Insect resistance to the naturally derived compounds resulted in continuously higher application rates and a concomitant concern for pesticide residues on the fruit, human consumption safety, damage to the trees and fruit, and the need to find more effective pest controls.

From the late 1800s until the mid-1920s, the pesticide of choice, used for a wide variety of insect pests were largely arsenical based compounds mixed with lead.20 As

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insects became resistant to these pesticides, more frequent and heavier spraying was employed. By 1925 lead residues on apples in New Jersey and elsewhere resulting from heavier lead arsenate applications were beginning to come into focus. The problem became critical to New Jersey orchardists in 1925 when:

Several New Jersey fruit growers experienced their first serious difficulty with spray residue in the harvest of their 1925 crop of apples as a result of the enforcement of a temporary embargo by the US Department of Agriculture following the announcement by Government health officials of the failure of the fruit in storage to comply with pure food requirements. Distribution of the harvested crop was prohibited pending the reduction of spray residues.21

In 1933, due to growing concerns about human lead exposure from residues on apples, the Federal Food and Drug Administration set a desirable zero tolerance limit on pesticides containing lead and allowable lead residues on fruit. Among the records salvaged from the Smith Farm was a letter dated April 6, 1933 from Harry McLean, Chief Spray Residue Investigations, containing a memo stating:

This Department and cooperating State agencies are earnestly studying the possibilities of developing effective lead-free spraying, materials. Pending the development of such substitutes, protection of the public health demands that lead residues be held to the lowest possible point. Beginning with the 1933 shipping season, fruits shipped within the jurisdiction of the Federal food and drugs act containing lead in excess of 0.014 grain lead (Pb) per pound will be subject to seizure and the shippers to prosecution.

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COPY

UNITED STATES DEPARTMENT OF AGRICULTURE
OFFICE OF THE SECRETARY
Washington, D.C.

April 2, 1933

NOTICE TO GROWERS AND SHIPPERS OF FRUITS:

The world tolerance of 0.01 grain arsenic trioxide per pound of food will continue in effect during the season of 1933. Experience has shown that with careful adherence to recommended spray programs and the application of appropriate spray residue removal methods this tolerance can be readily met.

Lead is more poisonous than arsenic. Its use under conditions which will leave any residue at time of marketing should be abandoned at the earliest possible moment. This Department and cooperating State agencies are earnestly studying the possibilities of developing effective lead-free spraying materials. Pending the development of such substitutes, protection of the public health demands that lead residues be held to the lowest possible point. Beginning with the 1933 shipping season, fruits shipped within the jurisdiction of the Federal food and drugs act containing lead in excess of 0.014 grain lead (Pb) per pound will be subject to seizure and the shippers to prosecution.

Those who contemplate using lead arsenate on fruit in 1933 should choose cleaning methods which are efficacious in the removal of lead as well as arsenic. The lead problem should be avoided entirely wherever possible by the choice of spray materials which do not contain lead.

In turning to other insecticides the question of their possible effect on health should not be overlooked. The substitution of fluorine compounds for arsenicals has been urged as a solution of the spray residue problem. There is adequate evidence to establish the deleterious character of certain fluorine compounds and reason to look with suspicion upon all such compounds. The presence of fluorine spray residues on fruits shipped within the jurisdiction of the Federal food and drugs act will be regarded as a basis for action under that law.

Sincerely yours,

R. G. Tugwell
Assistant Secretary
In 1937, in order to give farmers guidance on preventing residues on fruit, the New Jersey Agricultural Experiment Station “Spraying Recommendations for Apples” began including a table for the “Latest Dates on Which A Lead Arsenate Spray May Be Used Without Danger of Leaving an Excessive Lead or Arsenic Residue on the Fruit at Harvest.”22 Pesticide residues on the apples and regulatory efforts to control them resulted in the need to find alternative pesticides and methods to clean the fruit. This in turn, drove agricultural chemical innovation and research. The pesticide purchases at the Smith Farm reflect this during the two periods when receipts are available.

![Image of a table showing the latest dates on which a lead arsenate spray may be used without danger of leaving an excessive lead or arsenic residue on the fruit at harvest.](image)

The first late date spraying table from 1937 for lead arsenate in New Jersey orchards.23

**Pesticide and Agricultural Chemical Purchases: 1931-1936**

The pesticides utilized at the Smith Farm during this period were naturally derived and primarily a continuation of those used at orchards since the late nineteenth

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23 Ibid.
These pesticides were mineral or plant based and mined or harvested. Despite being natural, many issues were emerging from the use of these pesticides including insect resistance, fruit and tree damage, worker health and food safety. Pesticide purchases during this period included large quantities of arsenical-based compounds including Lead, Magnesium and Calcium arsenic, Sulphur and lime-based compounds, copper compounds, insecticidal soaps made from plant and animal oils (C.P.O.), petroleum oils and nicotine-based formulations.

1931 C.P.O. insecticidal soap spreader advertising materials found in the Smith Farm records. Private collection of D. Moskowitz.
Insect resistance to these formulations led to the need to continually increase the amount and rate of applications and the mixing of various chemicals to increase efficiency. Lead arsenate provides perhaps the clearest example of this. Lead arsenate was first introduced in 1892 to control the non-agricultural gypsy moth and then in 1898 it was tested on apple orchards to control the codling moth, a serious pest of apples.

The codling moth was so damaging to apples and so widespread that without treatment between 20 and 95 percent of the crop in every orchard was estimated to be impacted. Lead arsenate was initially highly effective against the codling moth and as early as 1904, the United States Department of Agriculture was reporting that nearly

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every commercial apple orchard was being treated with it. However, codling moth resistance developed quickly, and recommended spraying increased from one application in the first decade of the twentieth century, to two by the middle of the second decade and to four by the third decade.\textsuperscript{26} Despite continued increases in the strength and frequency of lead arsenate applications, apple losses due to the codling moth also increased, and by 1944, apple growers across the United States were concerned it would lead to the collapse of the industry.

In New Jersey, lead arsenate was recommended continuously by the New Jersey Agricultural Experiment Station (NJAES) for the routine spraying of apples throughout the growing season from 1917 through 1964 and in every year covered by the Smith Farm receipts.\textsuperscript{27} Application recommendations ranged from 2 to 4 pounds of lead arsenate mixed in 100 gallons of water and sprayed three or more times in the growing season. For a large orchard like the Smith’s this required large quantities of lead arsenate, which is reflected in their purchases. During this six-year period, the farm receipts show 27,352 pounds of lead arsenate was purchased. Other arsenical compounds were also purchased during this period, including 128 pounds of magnesium arsenate and 480 pounds of calcium arsenate. The use of non-lead arsenicals including magnesium and calcium directly resulted from concerns with lead residues on harvested fruit and human health.\textsuperscript{28} Based on estimates by Murphy and Aucott,\textsuperscript{29} recommended spray rates for New

\textsuperscript{28} \textit{Codling Moth Biology and Control Investigations} (Wooster, Ohio: Ohio Agricultural Experiment Station Bulletin 583, 1937).
\textsuperscript{29} Murphy, “An Assessment of the Amounts of Arsenical Pesticides Used Historically in a Geographic Area.”
Jersey apple orchards translate to approximately 24 to 100 pounds of lead arsenate applied to each acre during the growing season.
# FOWLER CHEMICAL COMPANY

## CALCIDE (CALCIUM ARSENATE) PRICE SCHEDULE

**EFFECTIVE APRIL 17, 1934**

**APPLICABLE THROUGHOUT THE UNITED STATES**

<table>
<thead>
<tr>
<th>Description</th>
<th>Carload</th>
<th>Over 500 Pounds</th>
<th>Less Than 500 Pounds</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 lb. drum</td>
<td>6 lb.</td>
<td>6 lb.</td>
<td>7 lb.</td>
</tr>
<tr>
<td>25 lb. bags (in single cartons)</td>
<td>6 lb.</td>
<td>6 lb.</td>
<td>7 lb.</td>
</tr>
<tr>
<td>4 lb. bags (12 to case)</td>
<td>6 lb.</td>
<td>6 lb.</td>
<td>7 lb.</td>
</tr>
<tr>
<td>1 lb. bags (50 to case)</td>
<td>7 lb.</td>
<td>9 lb.</td>
<td>10 lb.</td>
</tr>
<tr>
<td>1 lb. cartons (50 to case)</td>
<td>9 lb.</td>
<td>11 lb.</td>
<td>12 lb.</td>
</tr>
</tbody>
</table>

NOTE: Mixed carloads of dry and paste insecticides and fungicides will take the carload price.

**TERMS:** 1% 10 days, 20 days net. May 1st, 1934 dating on shipments prior to that date.

**DELIVERY:** Freight allowed on shipments of 96 lbs. or over.

No orders accepted for less than case lots.

Prices subject to change without notice and all offers are without engagement.

Supersedes all previous schedules and price quotations.
### DOWKER CHEMICAL COMPANY

**DRY POWDERED ARSENATE OF LEAD PRICE SCHEDULE**

**EFFECTIVE APRIL 17, 1934**

**APPLICABLE THROUGHOUT THE UNITED STATES**

<table>
<thead>
<tr>
<th></th>
<th>LOAD ON 500 POUNDS</th>
<th>OVER 500 POUNDS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>POUNDS</strong></td>
<td><strong>POUNDS</strong></td>
</tr>
<tr>
<td>100 lb. drum</td>
<td>9 lb.</td>
<td>9 lb.</td>
</tr>
<tr>
<td>25 lb. bags (in single cartons)</td>
<td>9 lb.</td>
<td>9 lb.</td>
</tr>
<tr>
<td>5 lb. bags (10 to case)</td>
<td>9 lb.</td>
<td>9 lb.</td>
</tr>
<tr>
<td>4 lb. bags (12 to case)</td>
<td>9 lb.</td>
<td>9 lb.</td>
</tr>
<tr>
<td>1 lb. bags (50 to case)</td>
<td>1 lb.</td>
<td>1 lb.</td>
</tr>
<tr>
<td>1 lb. cartons (50 to case)</td>
<td>1 lb.</td>
<td>1 lb.</td>
</tr>
</tbody>
</table>

**NOTE:** Mixed carloads of dry and paste insecticides and fungicides will take the carload price.

**TERMS:** 1% 10 days, 30 days net. May 1st, 1934 dating on shipments prior to that date.

**DELIVERY:** Freight allowed on shipments of 90 lbs. or over. No orders accepted for less than case lots.

Prices subject to change without notice and all offers are without engagement.

Supersedes all previous schedules and price quotations.

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1934 price schedules for lead and calcium arsenate. Private collection of D. Moskowitz.
Also found within the salvaged Smith Farm records were chemical analyses performed by the New Jersey Agricultural Experiment Station of three different lead arsenate (1933-1934) and one lime sulphur (1932) purchases providing data on the arsenic, lead, and sulphur concentrations in the samples. The lead arsenate samples revealed arsenic oxide concentrations between 32.09 and 33.32 percent, water soluble arsenic between 0.20 and 0.32 percent and lead oxide between 64.02 and 64.48 percent. The lime sulphur sample showed sulphur comprised 25.01 percent.

July 7, 1933 Report from the New Jersey Agricultural Experiment Station of Bowkers Dry Powdered Arsenate of Lead submitted by George Smith for analysis. Private collection of D. Moskowitz.
While the codling moth was perhaps the most destructive pest in New Jersey apple orchards during the 1930s, scale insects, mites, and diseases also took a heavy toll and various naturally derived pesticides were used to combat them as well.

San Jose Scale and Mite life histories.  

Sulphur and lime and petroleum-based-oil sprays were the most widely used. Various mixtures of these, like the arsenical compounds, were purchased in great quantities for the Smith Farm. Between 1931 and 1936, 101,260 pounds and 2,850 gallons of sulphur and lime were purchased.

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Shipping invoices for Scale Oil and Lime Sulphur. Private collection of D. Moskowitz.
Other naturally derived pesticides were also purchased for the orchard during this time period: nicotine-based compounds and soaps including 268 pounds of nicotine sulphate, 2,950 pounds of solid Crystal Potassium Oleate (C.P.O.) soap and other powdered soap, copper compounds, and even milk-based preparations. These pesticides were used to combat a wide range of pests with varying degrees of effectiveness.
Shipping invoices for large quantities of Lead Arsenate and Nicotine Sulphate. Private collection of D. Moskowitz.

**Pesticide and Agricultural Chemical Purchases: 1943-1945**

World War II was a turning point in agricultural pesticides as compounds developed during the war, or at least that had their value identified during the war, found wide application for agricultural purposes. Troop health was linked to effective warfare and extensive pesticide research was conducted to prevent insect and arachnid-borne
epidemics from lice, mites, ticks, chiggers, mosquitoes, fleas, flies and bedbugs. As A.W.A. Brown would write in 1951, 

The search for insecticidal compounds, greatly accelerated during World War II, continues to advance into the fertile fields pioneered by the organic chemist. As a result, insecticides of ever greater power are being discovered, and the arsenal of weapons for insect control is steadily increasing.

The pesticide purchases for the Smith Farm illustrate this well with the first purchases of Parmone and Elegtol in 1943 and then Krenite, Fermate and perhaps most significantly, two pints of DDT in 1945.

Smith Farm receipt for Ortho pesticide products. Private collection of D. Moskowitz.

32 A.W.A. Brown, Insect Control by Chemicals (New York: John Wiley and Sons, Inc. 1951).
September 13, 1945 shipping receipt for the first purchase of DDT by Lawrence Smith. Private collection of D. Moskowitz.
DDT was first synthesized in 1874 but its effectiveness as an insecticide was only discovered in 1939.\textsuperscript{33} During World War II, the United States began producing large quantities of DDT to control vector-borne diseases such as typhus and malaria among the troops.\textsuperscript{34} DDT rapidly changed the use of pesticides in apple orchards, reducing and then eliminating lead arsenate and other naturally-derived compounds. It would, in time, become one of the most vilified pesticides in the United States and elsewhere, starting with the publication of Rachel Carson’s seminal book *Silent Spring* in 1962.\textsuperscript{35} The book illustrated the environmental impact of DDT and was the impetus for its ban a decade later in 1972 by the United States Environmental Protection Agency.\textsuperscript{36} The other synthesized compounds purchased in 1943 and 1945 were at the forefront of the large shift from naturally-derived to synthetic organic pesticides. Du Pont Pest Control Products was an early leader in the production of agricultural pesticides and in 1945 *The Du Pont Magazine* featured a full-page overview with the following:

> At Du Pont, research scientists are continually seeking new and better insecticidal compounds to aid the farmer in his age-old battle against insect enemies. More than 30 such compounds, listed at right, testify to the continual effort of Du Pont scientists in helping the farmer with his task of destroying the destroyers.\textsuperscript{37}

\textsuperscript{35} Whorton, *Before Silent Spring. Pesticides and Public Health in Pre-DDT America*.
THERE are thousands of different kinds of destructive insects—billions upon billions of them—on the farms of this country. Uncontrolled, this predatory population would destroy valuable food crops of first importance to the farmer and to you.

But the scientists and the farmers have banded together to fight these insect pests, and the result of their joint work is to make the American farmer the most productive farmer, and the American family the best fed, in the world.

At Du Pont, research scientists are continually seeking for new and better insecticidal compounds to aid the farmer in his age-old battle against insect enemies. More than 30 such compounds, listed at right, testify to the continual effort of Du Pont scientists in helping the farmer with his task of destroying the destroyers.

E. I. du Pont de Nemours & Company (Inc.), Grasselli Chemicals Department, Wilmington 98, Delaware.

1945 Du Pont advertisement for pest control products.27

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27 Ibid.
The Du Pont slogan of the time, “Better Things for Better Living...Through Chemistry” fit well with the rapid growth of synthetic pesticides available to the farmer in the mid to latter part of the 1940s. The Smith Farm receipts illustrate this well with four of the new Du Pont chemicals purchased in 1943 and 1945.

A comparison of the Smith Farm receipts with the NJAES yearly Spraying Recommendations for Apples indicates, not unexpectedly, that the Smith’s were on the cutting edge of the most current pesticide advances. For example, the fungicide Elgetol, used to control Apple Scab, was first noted in the 1946 NJAES Spray Recommendations but was purchased by the Smith’s three years earlier in 1943. Similarly, DDT was first recommended in the 1947 NJAES Spray Recommendations but was purchased in late 1945 for the orchard. Fermate was also purchased in 1945, the same year it was recommended in the NJAES Spray Recommendations. Krenite was also purchased by the Smith’s in 1945, and although not noted by name, it is the same class of fungicide as Fermate recommended for use by NJAES in 1945. In 1943, the receipts also show the first purchases of Parmone, a Dupont synthetic hormone used to reduce fruit drop. The Smith’s were pioneers in modern orchard practices, clearly utilizing the most advanced methods for fruit production and insect and disease control. But those efforts would have a long and unanticipated legacy.

**Pesticide Residues in Smith Farm Orchard Soils and Their Remediation - 1998**

In 1998, as part of the development of the Smith Farm for housing, the orchard soils were sampled for pesticides that can remain long after their application. High concentrations of many of these “legacy” chemicals were found. Soil screening,

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particularly in orchards which were known to have had high pesticide application rates, is routinely conducted by the New Jersey development community. In 1999, in order to provide sampling guidance and consistency to evaluations, the NJDEP Historic Pesticide Contamination Task Force that was tasked with creating a guidance document to address this issue published “Findings and Recommendations for the Remediation of Historic Pesticide Contamination.” As noted in the report introduction:

Farmers, orchardists, homeowners, turf growers, local governments and others have used a wide variety of pesticides over the last 100 years in an effort to control pests and increase crop yield. Many pesticides were used in limited circumstances, others became widely used, and some became the "pesticide of choice" for entire crops or industries. Some of these pesticides are persistent in the environment, and thus may be present in the soil long after they have been applied. As a result, residues of a number of pesticides (including arsenical pesticides, DDT and dieldrin) can be found in soils at levels that may pose a human health risk. The New Jersey Department of Environmental Protection ("the Department") estimates that up to 5 percent of the state’s acreage may be impacted by the historical use of arsenical pesticides alone. The primary concern with historical pesticide residues is human health risk from inadvertent ingestion of contaminated soil, particularly by children.

As more and more agricultural land is developed, developers, municipal officials, homebuyers and others are becoming increasingly aware of the possible presence of pesticide residues in soils. Some municipalities now require environmental assessments of land as part of their site approval process. Banking institutions take environmental risk factors into consideration in their lending decisions. Developers and builders sample soil more frequently to determine whether or not to purchase land or how to develop land they already own. Homebuyers are also considering pesticide residues along with a myriad of other environmental factors such as indoor air radon levels, the presence of lead paint in the home, and the quality of potable water. The presence of pesticide residues is also a consideration in non-residential property uses including day care centers, schools, parks and general commercial and municipal usage.39

It comes as no surprise given the large quantities of pesticides purchased for the Smith Farm that “legacy” pesticides were found in the orchard soils in 1998. These included arsenic, lead, DDT and DDE (among other chemicals not available in the time periods covered by the Smith Farm receipts). DDE is a metabolite of DDT reflecting the breakdown of the chemical bonds over time.\textsuperscript{40} Although a direct comparison cannot be made between the large pesticide purchases made in the 1930s and 1940s and the residual concentrations found in 1998, they must certainly be a part of the legacy of those.

The presence of “legacy” pesticide contamination was noted in a comprehensive Remedial Action Workplan (RAW) approved by the New Jersey Department of Environmental Protection. The purpose of the RAW was to develop a plan to remediate the site contamination to levels within acceptable NJDEP cleanup criteria, allowing development for housing. Extensive soil sampling conducted as part of this study confirmed the presence of dieldrin, lead, 4,4’ DDE and 4,4’-DDT at depths ranging from six to thirty inches below the ground surface. It was concluded that the presence of these compounds was a result of routine historic pesticide applications.

Based on the recommendations provided in the RAW, the soils that contained pesticides, arsenic and lead at levels that exceeded the NJDEP cleanup criteria were delineated by further soil sampling to understand their spatial extent and depth. They were then excavated and relocated to a designated portion of the site where it would not be at risk of human contact. Following these remedial activities, the impacted areas were “capped” with a twelve-inch layer of clean fill soil plus an additional six inches of imported certified clean topsoil. These areas were then fenced to limit access, deed

\textsuperscript{40} W.D. Guenzi and W. E. Beard. \textit{The Effects of Temperature and Soil Water on Conversion of DDT to DDE in Soil} (New York: Van Nostrand Reinhold Company, 1986).
restricted from future development, and are now maintained as large lawns within the housing development. Once all of the remedial activities were completed, and the New Jersey Department of Environmental Protection determined they were acceptable to protect human health, a No Further Action Letter was issued by the agency confirming the site was able to be developed into the single-family homes that currently occupy the property.

The old Smith farmhouse remains adjacent to the property and now serves as the headquarters of the East Brunswick Historical Society. The apple trees are all gone now. But a historical marker on the front lawn of the Society serves as a silent reminder of the vast apple orchard that once occupied the property and the pioneering and innovative farming methods of George and Lawrence Smith, the “Apple Kings” of times now past.

David Moskowitz holds a B.A. in Environmental Studies from The George Washington University, an M.S. in Environmental Policy Studies from the New Jersey Institute of Technology and a Ph.D. in Entomology from Rutgers University. He is Senior Vice President with EcolSciences, Inc. in Rockaway, New Jersey and has been with the company for thirty-three years.

Michael Levinson received his B.S. in Environmental Science from Rutgers University and an M.S. in Biology from Montclair State University. He is Senior Project Manager with EcolSciences, Inc. in Rockaway, New Jersey and has over 11 years of environmental experience.

Evie McMenamin received her Bachelor of Technology in Wildlife Management from the State University of New York in Cobleskill. She is Environmental Scientist with EcolSciences, Inc. in Rockaway, New Jersey, and has been with the company for six years.

Authors note: The Smith Farm documents have been donated to the East Brunswick Historical Society (https://ebhistoricalsociety.webs.com/) so they can be available for future research.

The authors would like to thank the East Brunswick Historical Society for permission to use photographs of the Smiths, and Richard Walling for assistance with early newspaper archives. We are also indebted to two anonymous reviewers for their suggestions that improved the manuscript. Thank you is also due EcolSciences, Inc. for the time and resources to prepare this historical account. Finally, a special thank you is due Melissa Ziobro for her encouragement to write this history.