AN ABSTRACT OF THE DISSERTATION OF

Brenda Marcell Kellar for the degree of Doctor of Philosophy in History of Science presented on May 25, 2018.

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Anita Guerrini

Abstract

The use of honey bees to pollinate apple orchards seems natural, even inevitable. This dissertation examines the relationship of beekeeping and apple growing in Hood River, Oregon in the mid-nineteenth to the mid-twentieth centuries, as a case study in the development of commercial pollination service. Within this time period the values of the progressive era, changing technologies, and expanding infrastructure shaped the possibilities that were available to beekeepers and apple growers. Additionally, I explore the role of science in decision-making and policy creation by Oregon beekeepers and apple growers as they each focus on personal success. As this dissertation reveals, the relationship between honey bees and apple trees is not as simple as you might think.

Honey Bees and Apple Trees: Hood River, Oregon as a Case Study for the Creation of the Honey Bee Pollination Industry

by
Brenda Marcell Kellar

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I understand that my dissertation will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my dissertation to any reader upon request.

Brenda Marcell Kellar, Author

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TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

Page

TABLE OF CONTENTS (Continued)

LIST OF FIGURES

LIST OF FIGURES (Continued)

LIST OF TABLES

1 Introduction

Hood River Oregon, 1914

An unusually large number of women gathered in the courthouse. They clustered together, or with their families, seated on the hard benches provided for observers and those who wanted to present information to the Hood River City Council. Everything had started the month before, or really several years ago and last month was just the final straw. April was the time of year when the women began processing the remaining winter apples and pears into sauce or butter to make room for the new apples and pears to come in the fall. They had to get last year's fruit processed now as strawberries, then cherries, then all of the garden vegetables and other fruits would need processing. If something wasn't done it would be another canning season just like the last, with bees buzzing about them, making them afraid to reach for a piece of fruit for fear of getting stung, practically chasing them from the kitchen! The men had presented the council with the issue last month and the council had sent Councilman Taft to investigate Dakin's city apiary. Upon discovering that Dakin had ninety hives Councilman Taft quickly identified the apiary as a nuisance and the council supported that position. However, City Attorney Wilbur had been absent this past month and nothing had been done. Now, the women were present to describe what it was like living close to such a large apiary. It was not just themselves, the children were always getting stung.[1]

There were few commercial beekeepers in Hood River, Oregon, at the turn of the twentieth century. Many of the orchardists had a few colonies of bees, but W.W. Dakin was the only large

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[1] Dakin spoke of the financial hardship moving his bees at this time of year would cause him. "Members of the council stated that they were not desirous of forcing action that would cause him monetary loss." That appears to have been the end of the matter.
"Macadam Will be Repaired," *The Hood River Glacier* (Hood River, OR), May 7, 1914.

beekeeper with a city apiary and only one of two named beekeepers I could identify in the Hood River area. A second beekeeper, A.J. Brunquist, was a Hood River orchardist who took beekeeping seriously and entered the Oregon State Fair competition with his honey, wax, or both in 1913.[2] Because Hood River was an orchard region, the lack of bees might seem unusual. However, the relationship between honey bees and apple trees became complicated in the late nineteenth century and remains so today. This dissertation will use a historical perspective to explore many of the issues which make it complicated.

The time period I focus on, roughly the mid-nineteenth to the mid-twentieth centuries, includes the progressive era. This was a time when America believed in science. Not only that science could provide the answers to tangible problems facing Americans, but that it could also solve social problems through the production of rational, unbiased knowledge and the support of a centralized government. Those producing knowledge became known for their expertise. However, as the progressive era advanced, science became increasingly specialized, requiring not only very particular knowledge, but also the ability to use technologies specific to the newly established individual scientific disciplines. This created expertise in very specialized topics and discussions between experts that could include sound, but antagonistic expert opinions based in science. The progressive era belief in science as well as rapid creation of specialized knowledge arenas can be seen in the United States Department of Agriculture (USDA), in state experiment stations and extension agencies, and in quasi-governmental voluntary associations, like the Oregon State Board of Horticulture (OSBH). Through an examination of the development of honey bee pollination services in Hood River, Oregon, this dissertation builds on the

[2] "Bee Keepers Are Offered Premiums," *The Hood River Glacier* (Hood River, OR), July 17, 1913.

work of historians and social scientists who have previously examined questions of science, expertise, and agricultural development.

Speaking of the progressive era, historian Glen Gendzel has said, “The maddening variety of reform and reformers in the early twentieth century has perpetually confounded historians' efforts to identify what, if anything, the progressives had in common” and that “historians run the risk of magnifying the fragmentary fringes of the movement while obscuring its common core.”[3] Progressives’ desire to use the power inherent in government for those who were the least powerful was a core tenet identified by Gendzel. In the marketplace “industrial capitalism” had created new inequities that, according to progressive philosophy, only government could help bridge. At the same time there was a fond nostalgia for the ideals of the by-gone small town, where the community rallied around anyone in need, what Gendzel calls “mutual custodianship.” In addition to government custodial activities Gendzel saw benevolent societies as an effort to provide the missing support for individuals who were falling behind, but he found that most benevolent societies were ineffective.[4]

Historian Laurie Carlson sees the progressive era coming out of the earlier populist movement in the late nineteenth century. Where the populist movement was a grassroots call for greater equity in labor practices, recognition of regional needs, and a schism along class-lines, the progressive era was an educated middle-class call for centralization of power. Carlson identifies the United States Department of Agriculture (USDA) as a creation of this progressive ethos.[5] Another historian, David E. Hamilton, examined the concept of an associative sector, sponsored by the USDA and meant to align regional

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[3] Glen Gendzel, "What the Progressives Had in Common," *The Journal of the Gilded Age and Progressive Era,* no. 3 (2011): 331-332.
[4] Gendzel.
[5] Laurie Carlson, "Forging His Own Path: William Jasper Spillman and Progressive Era Breeding and Genetics," *Agricultural History,* no.1 (2005).

interests with the USDA's interests, an idea that, although published before Carlson's, adds to her discussion.[6] This associative sector would include state agricultural associations, such as farm bureaus and experiment stations, marketing associations usually labeled as cooperatives, and private professional associations such as the Oregon Horticultural Society. Charles Rosenberg, in 1997, discussed the idea of a transition from populist to science-based progressive ideals.

> The similarity between scientific and religious values made it natural for most Americans to move fluidly from one intellectual and emotional realm to another. Science, like religion, offered an ideal of selflessness, of truth, of the possibility of spiritual dedication...Moral and scientific progress did not seem contradictory but, to the ordinary American, inevitably parallel and complementary.[7]

Progressive era confidence in the ability of science to create an even playing field because it was unbiased, based only on facts, supported the progressive belief that only science could alleviate social inequalities. Modern historians, like Micah Rueber and Deborah Fitzgerald, have talked about the role of data collection in rational turn of the twentieth century agriculture. This adds to a conversation begun in 1985 by Alan I. Marcus and which I hope to add to with this dissertation.[8] However, Rueber's examination of turn of the twentieth century dairy cattle judging reveals that despite progressive-era dedication to quantification and rational, scientific methods, scientists and experts were recommending

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[6] David E. Hamilton, "Building the Associative State: The Department of Agriculture and American State-Building," *Agricultural History,* no.2 (1990).

[7] Charles Rosenberg, *No Other Gods On Science and American Social Thought* (Baltimore: The Johns Hopkins University Press, 1997), 3.

[8] Deborah Fitzgerald, *Every Farm a Factory* (New Haven: Yale University Press, 2003); Alan I. Marcus, *Agricultural Science and the Quest for Legitimacy Farmers, Agricultural Colleges, and Experiment Stations, 1870-1890* (Ames: Iowa State University Press, 1985); Micah Rueber, "Is Milk the Measure of All Things? Babcock Tests, Breed Associations, and Land-Grant Scientists, 1890-1920," in *Science As Service Establishing and Reformulating American Land-Grant Universities, 1865-1930*, ed. Alan I. Marcus (Tuscaloosa, Alabama: The University of Alabama Press, 2015).

both confirmation, a subjective system of evaluation, and milk production records, a hard data system.[9] My investigation of beekeeping and apple growing will examine instances of consensus and conflict between traditional, often subjective, methods and practices and new, quantitative, scientific methods and recommendations.

The progressive belief within early twentieth century experiment stations in "the connection between social stability and an economically viable agriculture" was unshakable, according to Charles Rosenberg.[10] Similarly, the Country Life Movement, "a group of businessmen, scientists, and social reformers who wanted to investigate the drift of farmers to the cities and figure out how to keep good farmers in the country" saw agriculture and the health of the rural sector as paramount to success of the nation. This movement became the Country Life Commission in 1908 at the behest of President Theodore Roosevelt.[11] The President asked the commission to identify the deficiencies present in rural populations and find solutions. The commission created a report summarizing their research. Modern critics of this report have claimed it was "a rural example of the Progressive Era's manipulative technocratic social engineering, aimed at benefiting urban elites by remodeling and urbanizing country life and industrializing agriculture in order to make it more scientific, productive, and efficient," according to Scott J. Peters and Paul A. Morgan, Professors of Education.[12] One concern identified by the Commission was that cooperative organizations, with local leadership, were essential, especially for

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[9] Micah Rueber, "Is Milk the Measure of All Things? Babcock Tests, Breed Associations, and Land-Grant Scientists, 1890-1920," in *Science As Service Establishing and Reformulating American Land-Grant Universities, 1865-1930*, ed. Alan I. Marcus (Tuscaloosa, Alabama: The University of Alabama Press, 2015).
[10] Charles Rosenberg, *No Other Gods On Science and American Social Thought* (Baltimore: The Johns Hopkins University Press, 1997).
[11] Deborah Fitzgerald, *Every Farm a Factory* (New Haven: Yale University Press, 2003), 29.
[12] Scott J. Peters and Paul A. Morgan, "The Country Life Commission: Reconsidering a Milestone in American Agricultural History," *Agricultural History*, no.3 (2004): 291.

“single-crop, undiversified farming” like wheat farmers, or in this dissertation, like many honey producers or Hood River apple growers. These single-crop (specialist) agriculturists were more vulnerable to any issue impacting that product, because they had no other products to fall back on when things went wrong.[13] Laurie Carlson discusses hybridization, increased production, increased size of farms, and an increased need for mechanization because of the increases in production and farm size, which decreased the need for labor, pushing people off farms and making small farming unprofitable.[14] My discussion will touch on all of these issues and will add the effect of World War I and World War II, which pulled men away from orchards thereby increasing the need for mechanization to take their place.

Historian Benjamin R. Cohen has said that in the nineteenth century “improving the land was consonant with improving the moral stature of the individual,” while at the same time the “concept of improvement was…growing to be synonymous with, scientific knowledge and technical practice.”[15] Rosenberg, in 1997, took a similar stance, claiming that agriculture gained early government support not only because of the need to reinforce American agriculture within a global market, but because the farmer was cast as an idealized social type. Farmers were virtuous and support given to agriculture was support for the United States as a whole, “his interests were indistinguishable from those of the nation."[16] At the same time, we cannot ignore the other side of this idealized image, the side revealed

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[13] Scott J. Peters and Paul A. Morgan, "The Country Life Commission: Reconsidering a Milestone in American Agricultural History," *Agricultural History*, no.3 (2004): 309.
[14] Laurie Carlson, "Forging His Own Path: William Jasper Spillman and Progressive Era Breeding and Genetics," *Agricultural History,* no.1 (2005): 70.
[15] Benjamin R. Cohen, *Notes from the Ground Science, Soil & Society in the American Countryside* (New Haven: Yale University Press, 2009), 6 and 11.
[16] Charles Rosenberg, *No Other Gods On Science and American Social Thought* (Baltimore: The Johns Hopkins University Press, 1997), 18.

by the 1925 Eugenics Survey of Vermont and other studies and commentaries about rural denigration and eugenics, which portrayed rural populations as not only isolated, poor and illiterate, but because of these deficiencies they were seen as a burden on society.[17]

Within the progressive era, I explore the creation of commercial pollination services. Many individual, group, and governmental instances of decision-making went into creation of the commercial pollination service we are familiar with today. As someone who is not a beekeeper or commercial apple grower, but who has enjoyed the idea of a blooming orchard filled with busy bees, commercial pollination service seemed pretty uncontroversial to me when I began this study. An orchardist would contact a beekeeper and ask for a certain number of bees to be present in the orchard for a specific time period. The orchardist would tell the beekeeper where to place the bees and would avoid doing anything that would hinder the pollination process until the beekeeper came and reclaimed the bees. The beekeeper would collect their fee and move on to the next crop that needed to be pollinated. Everyone was happy – the apple grower had larger and more apples, the beekeeper had the pollination fee, and the bees were busy and their hives were full of pollen and honey. Unfortunately, like most of life, it isn't that simple. Within each chapter I examine some of the factors influencing the creation of commercial pollination service, concentrating on five main themes – globalization, expertise and decision-making, the mixing of vocation and avocation by scientists and government officials, the role of legislation, and the role of personal economics.

Environmental historian David H. Diamond, reminds us that the early horticulturists were craftspeople. Grafting of a scion onto rootstock, even the ability to identify rootstock, was a specialized

[17] M. Farland, "Modernist Versions of Pastoral: Poetic Inspiration, Scientific Expertise, and the 'Degenerate' Farmer," *American Literary History,* no.4 (2007). doi: 10.1093/alh/ajm037.

skill, usually handed down from craftsperson to craftsperson, and Diamond describes these grafted fruit and nut trees as a "modified, hand-crafted living product requiring care for several years."[18] The early Oregon orchards were built by these vigorous, full-sized apple trees, which could reach heights over twenty feet and could live for a hundred years. These were not the precisely sculpted, practically bonsaied, orchards we are familiar with today. Just as early horticultural craftspeople created a unique product, the trees then created unique spaces. "The assertive trees created emotive cultural sites, contributing structure, texture, and a comforting majesty to beguiling hybrid landscapes."[19] Historian Johanna Christensen and her history and environmental sociology colleagues Don Garden and Ruth Beilin acknowledge the influence of the environment on what can be grown in an area, "but the relationship is reciprocal – the choice of crop also creates places."[20] This is particularly true for the orchard spaces I discuss. Over time, changing markets, technologies, and scientific recommendations created a series of orchard spaces. As time went on, the apple orchards became more like the honey bees – intensively managed rather than crafted. Unfortunately, the management practices present in the orchards often conflicted with the management of bees.

By the 1920s, agriculture and manufacturing shared five components that "characterized nearly every successful factory: large-scale production, specialized machines, standardization of processes and products, reliance on managerial (rather than artisanal) expertise, and a continual evocation of 'efficiency' as a production mandate," according to historian Deborah Fitzgerald.[21] I have found all five

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[18] David H. Diamond, "Origins of Pioneer Apple Orchards in the American West: Random Seeding versus Artisan Horticulture," *Agricultural History,* no.4 (2010): 428.
[19] Diamond, 425.
[20] Johanna Christensen, Don Garden and Ruth Beilin, "An Antipodean Apple Narrative: How Place and Time Evolved for the Market," *Agricultural History,* no.3 (2016): 293.
[21] Deborah Fitzgerald, *Every Farm a Factory* (New Haven: Yale University Press, 2003), 23.

components present in commercial Oregon beekeeping and apple growing by the next decade. Admittedly, the commercial beekeepers were less focused on efficiency then the apple growers, but they were still concerned about creating a pollination schedule that was efficient in terms of being timely and productive. Additionally, one of the characteristics that beekeepers found most attractive in their honey bees was their efficiency. Fitzgerald goes on to state that in California, "the fruit growers were way ahead of other producers in sensing the importance of an industrial model for agriculture."[22]

This dissertation contributes to ongoing historiography about the international exchange of knowledge by scientists and other experts. The chapter on the bee disease foul brood is the most obvious example within this dissertation, although the reader will find examples of these interactions in all the chapters. Mark R. Finlay, an agricultural historian, looked at the period between the Morrill Act (1862) and the Hatch Act (1887), focusing mainly on the international exchange of knowledge about agricultural chemistry. Finlay claimed that American agricultural scientists "often turned to European nations, especially the German states for justifications for their work, for reliable scientific methodologies and for answers to their questions."[23] This is similar to the relationship between American and German beekeepers, which I discuss in the chapter on bees in Oregon. Finlay goes on to identify globalization of the progressive ideal that improved agriculture would help all societies, citing this as the reason for European willingness to help American agricultural experts. Aijaz Ahmad, Marxist philosopher and literary theorist, agrees with the idea of a globalized progressive ideal, but focuses on the cultural and literary attempt to create a globally shared set of cultural values evident within a global

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[22] Deborah Fitzgerald, *Every Farm a Factory* (New Haven: Yale University Press, 2003), 113.
[23] Mark R. Finlay, "Transnational Exchanges of Agricultural Scientific Thought from the Morrill Act through the Hatch Act," in *Science As Service Establishing and Reformulating American Land-Grant Universities, 1865-1930*, ed. Alan I. Marcus (Tuscaloosa: The University of Alabama Press, 2015), 34.

literature. “Nor is it true that the international progressive movement reached its zenith in the 1930s, 40s and 50s. The past half-century has seen immense growth of it.”[24]

Globalized science led to a need for standardized scientific practices and terms. Nomenclature is present to some degree in the chapters on bees in Oregon and the codling moth. I found this subject interesting because it highlights a large number of turn of the twentieth century issues, such as colonizing of knowledge, Darwinian ideas about species characteristics, commodification of nature, and the creation of international scientific policies. As you will read in the chapter on the codling moth and my discussion of the International Commission on Zoological Nomenclature (ICZN), some of these issues remain unresolved.

Commodities and species were also moved around the world and my chapters on the apple in Oregon, the codling moth, and bees in Oregon are three where this discussion is notable. Hood River apple growers chose to pursue an international, niche market, supplying only the finest quality eating apples to the burgeoning middle class in Britain and Europe. They were competing not only with other, sometimes local, apples, but with newly available and prestigious tropical fruits. Conversely, Oregon beekeepers were serving local markets, but were looking to the old world for breeding stock. The USDA endorsed the U.S. beekeepers’ effort, sending their top bee expert on extended trips to Europe and the Middle East to look for breeding stock that could be used to create a “coming” bee.

Beekeepers and apple growers were bombarded with information, from other beekeepers and apple growers, from local professional organizations, from state and national professional organizations, from experiment station scientists, and from other government scientists. At times the information

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[24] Aijaz Ahmad, "The Progressive Movement in Its International Setting," *Social Scientist,* no.11/12 (2011): 30.

came as a recommendation for a specific action, such as the spray recommendations given by experiment stations to apple growers. If the recommendation called for a change in the apple grower's or beekeeper's current practice then the apple grower or beekeeper had to make a decision – to follow the recommendation or not. Many factors went into these decision-making moments, including evaluating the expertise of the person giving the recommendation. Was the information sound? Would it work for that apple grower's or beekeeper's particular needs? What were the costs involved? Was it possible for the apple grower or beekeeper to implement this recommendation? Were other experts recommending a different action?

Philosopher Alvin I. Goldman has said that there are at least two types of conditions central to determining expertise – the person's knowledge or information and the person's skill or performance ability.[25] The first condition would be filtered by the amount of information known about the topic, who else was within the same network who could provide information on the topic, and then a comparison of who is the most reliable at providing the most truths on the topic. In the chapter on foul brood this necessitates a shifting designation of expert as the amount of information known about the disease changed over time, and as the network of people with information about the disease also changed over time. The second condition includes both skill (the ability to teach) and performance (the ability to provide information the questioner could not have gathered on their own). Again, looking at the foul brood chapter, it was the inspectors who were the teachers, showing beekeepers how to recognize and manage the disease. However, it was the scientists with access to specialized knowledge and specialized equipment who were the performers. Roland Bal, Professor in Health Policy & Management, and his colleagues have identified three types of legitimized expertise – contributory, experiential, and

[25] Alvin I. Goldman, "Expertise," *Topoi,* March, 2018, doi: 10.1007/s11245-016-9410-3.

consequential expertise. Contributory expertise adds to the existing "substantive, scientific expertise about the issue being considered." Experiential is expertise based in personal experience with the issue. The last type, consequential, is expertise achieved by someone with oral and/or written communication with groups who will be affected by recommendations.[26] Again, using the foul brood chapter as an example, all three types of expertise are present, but within different groups. Using either Goldman's or Bal's definitions, and looking at the majority of issues discussed in this dissertation, it is easy to see that it is rare for one group to be in possession of all types of expertise, which forces lay people -- the beekeepers and apple growers -- to evaluate the level of expertise and then to prioritize information sources as well as information.

Historians have argued that the boundary between scientist and non-scientist is used as a professionalizing, exclusionary barrier by scientists, locking in their right to a scientific high ground in any discussion.[27] But does it? Sociologists H.M. Collins and Robert Evans looked at the exchange of specialized knowledge between scientists and sheep farmers and found that contrary to many discussions of expertise, scientific knowledge was not found within the public, but rather that "the sheep farmers were a small group in possession of a body of knowledge as esoteric as that of any group of qualified scientists. The sheep farmers were not 'lay' anything, they were not people who were not experts - they were experts who were not certified as such."[28] An interesting aspect of Collins' and

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[26] Roland Bal, Wiebe E. Bijker and Ruud Hendricks, "Democratization of Scientific Advice," *BMJ: British Medical Journal,* no.7478 (2004): 1340.

[27] For more information on the scientific boundary see: Rebecca Ellis and Claire Waterton, "Caught between the cartographic and the ethnographic imagination: the whereabouts of amateurs, professionals, and nature in knowing biodiversity," *Environment and Planning D: Society and Space, no.*23 (2005); and, Jeremy Vetter, "Introduction: Lay Participation in the History of Scientific Observation," *Science in Context,* no.2 (2011).

[28] H.M. Collins and Robert Evans, "The Third Wave of Science Studies: Studies of Expertise and Experience," *Social Studies of Science,* no.2 (2002): 261.

Evans’ discussion is that they identify the scientists as the ones unwilling to bridge the scientific boundary.

> The scientists' expertise was not at risk of being displaced by that of the farmers; it was, or should have been, added to by that of the farmers. Should the situation have been symmetrical, it might have been an arbitrary matter whether the farmers' expertise was absorbed by the scientists or the scientists' expertise was absorbed by the farmers, but it was not symmetrical. To produce the optimum outcome, the scientists needed to have the interactional expertise to absorb the expertise of the farmers. Unfortunately, they seemed reluctant either to develop or to use such expertise.[29]

Historian Paolo Palladino emphasizes the similarity of method between early entomologists who worked in the field, using observation and recordkeeping as markers of research advancement, and farmers whose experience and authority had also been created in the field through observation and recordkeeping.[30] Another historian, James E. McWilliams, focuses on the need for scientists to distance themselves from farmers and that their change from field to lab, and especially scientists’ focus on chemistry, was really the only thing that made them different than the farmer.[31] This would be particularly pertinent for those agricultural scientists who were also beekeepers or orchardists, and I will show that agricultural scientists in this situation used other methods to buttress their status as scientists. Kathy J. Cooke, historian, points out that not all agricultural scientists felt this need to distance themselves from scientific farmers.[32]

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[29] H.M. Collins and Robert Evans, "The Third Wave of Science Studies: Studies of Expertise and Experience," *Social Studies of Science,* no.2 (2002): 256.
[30] Paolo Palladino, *Entomology, Ecology, and Agriculture The Making of Scientific Careers in North America, 1885-1995* (UK: Harwood Academic Publishers, 1996).
[31] James E. McWilliams, "’The Horizon Opened Up Very Greatly’: Leland O. Howard and the Transition to Chemical Insecticides in the United States, 1894-1927," *Agricultural History,* no.4 (2008): 472.
[32] Kathy J. Cooke, "From Science to Practice, or Practice to Science? Chickens and Eggs in Raymond Pearl's Agricultural Breeding Research, 1907-1916," *Isis,* no.1 (1997).

Thomas Broman, a historian of science, examines the relationship between theory and practice, or scientific and applied knowledge, finding that the public expectation that science should provide the answer to a problem or that science should be the basis of policy creation is a conflation of "applied and theoretical scientific expertise."[33] Further, Broman identifies the act of combining these two types of knowledge as a possible reason for differing scientific opinions. Historian Alan I. Marcus discusses experiment station scientists' assertions that "modern agriculture depended on the application of science" and that they, the scientists, were the producers of that knowledge, while farmers had the knowledge of how best to apply the knowledge they created.[34] Within this dissertation, the reader will find a variety of porous and impermeable scientific boundaries.

My primary concern are the relationships between scientific and non-scientific groups. Rebecca Ellis, Lecturer in Environment and Development at Lancaster University, and sociologist Claire Waterton discuss the "vital contract," an agreement covering the exchange of information between amateur naturalists and professionals involved with natural history in the United Kingdom. The reciprocity this exchange is traditionally based upon is the expectation by the amateurs that their data will "contribute to the advancement of a wider good" (greater scientific knowledge) and will be added to a database, thereby maintaining the knowledge in perpetuity.[35] The research included in this dissertation shows that this reciprocal concept was prevalent in non-scientific groups in Oregon, and agrees with Ellis's finding

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[33] Thomas Broman, "The Semblance of Transparency: Expertise as a Social Good and an Ideology in Enlightened Societies," *Osiris,* no.1 (2012): 208.
[34] Alan I. Marcus, *Science As Service Establishing and Reformulating American Land-Grant Universities, 1865-1930*, ed. Alan I. Marcus (Tuscaloosa: The University of Alabama Press, 2015), 297.
[35] Rebecca Ellis and Claire Waterton, "Caught between the cartographic and the ethnographic imagination: the whereabouts of amateurs, professionals, and nature in knowing biodiversity," *Environment and Planning D: Society and Space, no.*23 (2005): 684-685.

that the field data collected by non-scientists was valued and needed by scientists.[36] It should also be noted that this sentiment, of non-scientists believing in the importance of scientific information, fits nicely into the ideals of the progressive era.

While any historical investigation into agricultural expertise needs to acknowledge the role of federal and state governments' support for institutions like the USDA, land-grant universities, experiment stations, and the extension service, historian Deborah Fitzgerald, in 1991, pointed out that the creation of expertise for progressive era agriculture should not limit itself to this one aspect.[37] One

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[36] Rebecca Ellis and Claire Waterton, "Caught between the cartographic and the ethnographic imagination: the whereabouts of amateurs, professionals, and nature in knowing biodiversity," *Environment and Planning D: Society and Space,* no.23 (2005).
[37] Deborah Fitzgerald, "Beyond Tractors: The History of Technology in American Agriculture," *Technology and Culture,* no.1 (1991).
Looking at creation of expertise within the British colonies, Clark has identified a "professional civil servant scientist" whose expertise is based in "rational knowledge and bureaucratic authority."
J.F.M. Clark, "Bugs in the System: Insects, Agricultural Science, and Professional Aspirations in Britain 1890-1920," *Agricultural History,* no.1 (2001): 97.
Timeline:
1862 Morrill Act see: Alan I. Marcus, *Agricultural Science and the Quest for Legitimacy Farmers, Agricultural Colleges, and Experiment Stations, 1870-1890* (Ames: Iowa State University Press, 1985); May R. Berenbaum, *Bugs in the System Insects and Their Impact on Human Affairs* (Reading: Helix Books Addison-Wesley Publishing Co., 1995); Paolo Palladino, *Entomology, Ecology, and Agriculture The Making of Scientific Careers in North America, 1885-1995* (UK: Harwood Academic Publishers, 1996).
1863 Congress establishes the U.S. Department of Agriculture, however the civil war based in the issue of federal vs state authority, made the idea of a federal agency (federal involvement in local agricultural decisions and practices) repugnant and led congress to give the USDA very little authority.
Palladino.
1872 Congress believed experimental farms "indispensable" for achieving the "best results from the agricultural college" and went on to say that careful experiments and publication of their results was the most "useful" thing agricultural colleges could do.
Marcus. 139.
1876 Congress creates the US Entomological Commission.
Berenbaum.
1878 - 1894 Charles V. Riley is appointed Federal Entomologist, after which he transferred the power of the Entomological Commission to his newly created Bureau of Entomology in the USDA.
Palladino.

early exception to this limited examination of agricultural expertise was Alan Marcus' 1985 book, *Agricultural Science and the Quest for Legitimacy: Farmers, Agricultural Colleges, and Experiment Stations, 1870-1890*, which focuses on the very beginning of the progressive era. Marcus claims that by the late nineteenth century, farmers were feeling the need for a modern system of rational farming married with vocational experience and that this became known as systematized agriculture, where record-keeping was viewed as data collection within a personalized agricultural system.[38]

Since Deborah Fitzgerald's 1991 article, historian Stéphane Castonguay has investigated post-World War II Canadian economic entomology and found that government laboratories created expertise by performing basic science to address specific problems and by educating future scientists. These two functions provided agricultural scientists with a foundation for claims of expertise within their discipline, within industrial circles, and within agricultural communities.[39] John Rudolph, professor of history of science and educational policy studies, claims the role of education in any university was to indoctrinate the public with an appreciation of science, thereby providing a supportive constituency.[40] Land grant

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1887 Hatch Act, every state gets an experiment station. Minimal federal oversight led experiment station scientist to be vulnerable to local constituencies.
May R. Berenbaum, *Bugs in the System Insects and Their Impact on Human Affairs* (Reading: Helix Books Addison-Wesley Publishing Co., 1995); Paolo Palladino, *Entomology, Ecology, and Agriculture The Making of Scientific Careers in North America, 1885-1995* (UK: Harwood Academic Publishers, 1996).
1914 Smith-Lever Act, which created extension service.
Berenbaum; Palladino.
[38] Alan I. Marcus, *Agricultural Science and the Quest for Legitimacy Farmers, Agricultural Colleges, and Experiment Stations, 1870-1890* (Ames: Iowa State University Press, 1985).
[39] Stéphane Castonguay, "The Emergence of Research Specialties in Economic Entomology in Canadian Government Laboratories after World War II," *Historical Studies in the Physical and Biological Sciences,* no.1 (2001).
Marcus also believes that the perception was that scientists created knowledge and farmers applied it. Marcus.
[40] John L. Rudolph, *Scientists in the Classroom: The Cold War Reconstruction of American Science Education* (Palgrave: Macmillan, 2002).

universities, experiment stations, and extension services have always reached out to the public, providing information about their activities as a way to justify their existence and to influence the activities of farmers. Despite this, Marcus claims many farmers in the 1880s believed agricultural universities had done little to support them and that government funds had been misappropriated and used for university activities unrelated to agriculture, which caused a general suspicion of agricultural universities among the agricultural community.[41] I did not find a suspicion of experiment station scientists by the rural communities in the agricultural activities I investigated. Although government agricultural scientists were not always able to provide solutions, both beekeepers and apple growers in Oregon continued to seek their opinions. This is clearly evident in the chapters that follow.

The historiography covering the role of land-grant universities and scientists in popularizing the use of agricultural chemicals presents conflicting viewpoints. Historian Steven Stoll examined the development of expert status for land-grant universities in California, claiming that by promotion of "chemical cures" the universities became central to development of industrial farming and the agricultural chemical industry.[42] In this version chemical solutions were pushed onto farmers by the universities. Palladino, takes the opposite view, claiming that local constituencies were important supporters of experiment stations and the pressure experiment station scientists felt to produce a quick solution for local farmers' problems encouraged their turn toward scientific chemical solutions.[43] James E. McWilliams and Deborah Fitzgerald both claim that the turn of the twentieth century was a time

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[41] Alan I. Marcus, *Agricultural Science and the Quest for Legitimacy Farmers, Agricultural Colleges, and Experiment Stations, 1870-1890* (Ames: Iowa State University Press, 1985), 127 and 202.
[42] Steven Stoll, "Insects and Institutions: University Science and the Fruit Business in California," *Agricultural History,* no.2 (1995).
[43] Paolo Palladino, *Entomology, Ecology, and Agriculture The Making of Scientific Careers in North America, 1885-1995* (UK: Harwood Academic Publishers, 1996).

when cultural values in the United States changed, giving priority to efficiency and quick results, hallmarks of chemical solutions and components of the progressive milieu. McWilliams has identified the “hero-scientist,” a persona created because chemical insecticides gave scientists the ability to solve even the most horrendous problems quickly and relatively cheaply. Additionally, chemical solutions were a sign of modernity for farmer and scientist alike. McWilliams adds the idea that because chemicals were used in World War I to help bring the United States to victory and because during this period crops had been heavily covered in pesticides to ensure enough food for the troops, chemicals became more acceptable to farmers.[44] Marcus’s 1985 book, mentioned above, disagrees with the idea that chemistry was the paramount agricultural science, that it was the reason for experiment station success, that it was the motivation for professionalization of agricultural science, or that it caused agricultural science to focus only on knowledge created in a laboratory. However, he does not look at the early 20th century.[45] Within this dissertation, both the chapter on the codling moth and the chapter on pollination give readers an understanding of the role of chemical insecticides in turn of the twentieth century Oregon. Additionally, science was not always successful, or at times was too successful, in the issues I cover in this dissertation. This variety of experiences with science helps illustrate the complexity present whenever a historian examines a topic and supports my contention that the decision-making process is context specific.

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[44] Deborah Fitzgerald, "Beyond Tractors: The History of Technology in American Agriculture," *Technology and Culture,* no.1 (1991); J.F.M. Clark, "Bugs in the System: Insects, Agricultural Science, and Professional Aspirations in Britain 1890-1920," *Agricultural History,* no.1 (2001); James E. McWilliams, "’The Horizon Opened Up Very Greatly’: Leland O. Howard and the Transition to Chemical Insecticides in the United States, 1894-1927," *Agricultural History,* no.4 (2008).
[45] Alan I. Marcus, *Agricultural Science and the Quest for Legitimacy Farmers, Agricultural Colleges, and Experiment Stations, 1870-1890* (Ames: Iowa State University Press, 1985).

The relationship between science and policy has also been contested among historians and social scientists. Cordula Kropp, applied social scientist, and Jost Wagner of the *Gesellschaft für Ausbildungsforschung und Berufsentwicklung*, have looked at the motivation of policy-makers when they seek expert advice and found that normal practice is for policy-makers to find experts with similar opinions to their own.[46] The ability of policy-makers to "shop around" for expertise has been addressed by proponents of the Sociology of Scientific Knowledge (SSK) and British sociologist Steven Yearly identifies four reasons scientific knowledge can be questioned – corporate sponsorships, shifting scientific conclusions, scientific conclusions based on preliminary research, and other mutually held goals may have higher priority than scientific knowledge.[47] Thomas Broman, while agreeing that political factors can influence the direction of science, disagrees with the perception that science is at the mercy of societal whims, claiming that if science were as vulnerable to social factors as SSK claims it would not have achieved and maintained its present status as the knowledge to be used by experts.[48] Botanist Piotr Köhler examined Lysenkoism in Poland and supports Broman's conclusion, as Köhler found that

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[46] Cordula Kropp and Jost Wagner, "Knowledge on Stage: Scientific Policy Advice," *Science, Technology & Human Values,* no.6 (2010).
[47] Steven Yearley, "Skills, Deals, and Impartiality: The Sale of Environmental Consultancy Skills and Public Perceptions of Scientific Neutrality," *Social Studies of Science,* no.3 (1992).
Also see Bonneuil who discusses the WTOs ability to force accepted experts in several scientific fields to validate WTO policy by creating a framework that limits what the experts can say.
C. Bonneuil and L. Levidow, "How does the World Trade Organization know? The mobilization and staging of scientific expertise in the GMO trade dispute," *Social Studies of Science,* no.1 (2012), doi: 10.1177/0306312711430151.
For more on the modern view of science as part of culture rather than separate from culture and the idea that knowledge is predicated on the individual's worldview see:
Steven Shapin and Simon Schaffer, *Leviathan and the Air- Pump: Hobbes, Boyle, and the Experimental Life* (Princeton: Princeton University Press, 1985); and, Charles Rosenberg, "Science in American Society: A Generation of Historical Debate," *Isis,* no.3 (1983).
[48] Thomas Broman, "The Semblance of Transparency: Expertise as a Social Good and an Ideology in Enlightened Societies," *Osiris,* no.1 (2012).

good science is more enduring than any political organization.[49] H.M. Collins and Robert Evans blame science and technology studies for popularizing the public view of science as value laden rather than objective.[50]

For experiment stations, Rosenberg argues that "to succeed was to succeed in convincing farmers that agricultural science had something to offer them and thus to intensify their demands for advice and information."[51] This idea is particularly pertinent in the chapter on foul brood, where scientists were unable to find a cure for that disease during the time period I examine. Because they had nothing new to offer beekeepers, scientists were forced to find other ways of making themselves relevant in discussions about foul brood taking place in professional beekeeping settings.

As discussed above, the transition of local knowledge from agriculturists to scientists through recordkeeping was one way scientists buffered their position. Additionally, as Alvin I. Goldman stated, by becoming the keepers of the most information scientists justified their positions as experts. Deborah Fitzgerald agrees that scientists need local information as a foundation for their claims to expertise and authority. However, she sees the role of local information as giving experiment station scientists from outside the areas they served a knowledge set that was applicable to their location. “It was important for these experts to have the facts, not only so they would have material to teach in their agricultural courses, although this was important, but also because those facts were the constitutive basis for farm

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[49] Piotr Kohler, "Lysenko affair and Polish botany," *Journal of Historical Biology,* no.2 (2011), doi: 10.1007/s10739-010-9238-4.
[50] Harry Collins and Robert Evans, *Rethinking Expertise* (Chicago: University of Chicago Press, 2007).
[51] Charles Rosenberg, *No Other Gods On Science and American Social Thought* (Baltimore: The Johns Hopkins University Press, 1997), 196.

experts' credibility. Knowing what was going on in the surrounding countryside was essential for new professors of agriculture."[52]

In my investigations I found many government agricultural scientists who were also beekeepers or apple growers. There are situations where this could be as much a deficit as a benefit in justifying expertise, such as occasions when there appears to be some conflict of interest in the scientist's recommendation. Thomas Broman touches on this issue in his discussion of intellectual property, stating that scientists' ability to "claim their discoveries as intellectual property…have contributed to making science look increasingly like just another form of profit-driven enterprise."[53] However, my research indicated that having personal experience in the field, as a fellow agriculturist, was a way for agricultural scientists to gain credibility within a rural community. This builds on Deborah Fitzgerald's idea of having local knowledge, by adding personal experience, within a local setting. Charles Rosenberg mentions rural disdain for purely theoretical knowledge, although he found that "laymen still entertained a number of ingenuously optimistic scientific hopes."[54]

According to biologist Thomas D. Seeley, bees themselves can provide a model for the relationship between decision-making and expertise. In his research on swarm intelligence (SI), he has found that "honeybees make a democratic decision based on face-to-face, consensus-seeking assembly" when they decide to create a new home through swarming.[55] His comparison of the discussion between scout bees who have found potential new home sites and the discussion that takes place at a town

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[52] Deborah Fitzgerald, *Every Farm a Factory* (New Haven: Yale University Press, 2003), 40.
[53] Thomas Broman, "The Semblance of Transparency: Expertise as a Social Good and an Ideology in Enlightened Societies," *Osiris,* no.1 (2012): 190.
[54] Charles Rosenberg, *No Other Gods On Science and American Social Thought* (Baltimore: The Johns Hopkins University Press, 1997), 147.
[55] Thomas D. Seeley, *Honeybee Democracy* (Princeton: Princeton University Press, 2010), 1.

meeting is another way to look at this review of decision-making strategies and expertise evaluation. Seeley finds more common characteristics then differences when making this comparison. First, both are collective forms of decision-making, in that many people outside of leadership positions have control over the decision-making process. Second, the group simultaneously gathers and processes information from a variety of sources and that information can extend over a vast array of topics or sources.

> By virtue of having numerous individuals examining a problem and presenting possible solutions to it, both a bee swarm and a town meeting are much more capable than any solitary bee or single person in coming up with a broad range of alternative options. And the broader this range of options, the more likely it will include the one best option.[56]

Finally, Seeley believes that in both town meetings and bee discussions, the group chooses the action that will be followed "by staging an open competition among the proposed alternatives." Each person with a suggestion is allowed to present it, each listener then makes an independent decision whether or not to accept that suggested option. Supporters of an option will often let their support be known to the rest of the group and "these endorsements often recruit still more supporters for this option." The option with the most supporters may eventually gain enough consensus that the option becomes the community's choice.[57]

Many people have written on honey bees, including their entry into the U.S. and the development of beekeeping. However, few have been historians, and no one has explored the creation of commercial pollination service in the U.S. with the underlying themes I use in this dissertation. One author every person who has spent any time reading about honey bees is familiar with is Eva Crane (1912-2007). Trained as a quantum mathematician, she had an unending curiosity about honey bees and

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[56] Thomas D. Seeley, *Honeybee Democracy* (Princeton: Princeton University Press, 2010), 74.
[57] Seeley, 74.

wrote some of the most important books on bees and beekeeping throughout time. I am particularly grateful to her as her books are where I started learning about the history of honey bees and beekeeping. One of my regrets is never having met her. Gene Kritsky, Professor of Biology at the College of Mount St. Joseph, Adjunct Curator of Entomology with the Cincinnati Museum Center and Editor-in-Chief of *American Entomologist*, is another prolific writer on the topic of honey bees whom I always look forward to reading. His love of bees and beekeeping led him to become an Indiana bee inspector in 1979 combining this unique experience, and what he calls the "Zen of beekeeping" into the ethos of all his research and writing.[58] I was thrilled to run into Adam Ebert, Associate Professor of History at Mount Mercy University, at an Agricultural History conference a couple years ago as I have read everything he has published on honey bees. I am eagerly awaiting his pending book *Hive Society: The Popularization of Science and Beekeeping in the British Isles, 1609 –1913*, based on his PhD dissertation.

As a historian of science I hope to add to conversations within agricultural, environmental, technology, and science history. Because there are so few historians looking at this activity, I believe I have much to contribute. Additionally, as this dissertation will show, beekeeping provides a lens for looking at other issues, including expertise creation and evaluation, decision-making processes, specialization, globalization, and policy creation. This dissertation does not illuminate a single pathway, or mandate a law to be found every time X and Y are present. If anything I wanted to complicate the discussions taking place in these fields by adding another historical viewpoint from which to examine these issues. Finally, bees and beekeepers today are in their present situation because of a complex set of seemingly disparate decision-making moments in the past. Before making any more decisions about pollination, a historical view of this process would be beneficial.

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[58] Gene Kritsky, *The Quest for the Perfect Hive* (Oxford: Oxford University Press, 2010), ix.

2 Bees in Oregon

Early Oregon beekeeping was international. From the first bees brought to Oregon to the names given those bees you can trace the influence of discussions and events taking place across Europe and Britain pertaining to how science, and beekeeping, should be conducted in a shrinking world. The spread of honey bees across America and the development of Oregon beekeeping provides glimpses of the push westward by Euro-Americans and the continual creep of railroads and roads. Beekeeping organizations, local and national, as well as books and journals provided a sense of cohesiveness between Oregon, British and European beekeepers. This story, like much of American history, begins in Jamestown, Virginia.

2.1 Honey Bee Immigrants

It is hard to imagine what your backyard would look like without honey bees.[59] Some people might think it was an improvement, at least those who teach their children to run when they see a bee, as though in fear for their lives. I've often thought about this question and believe it is impossible to envision. There are too many subtle, unseen, unknown connections that we overlook when undoing honey bee impact on our backyards. Oh, I can imagine many sensory things I'd miss – the drone of the bees as they work over my dogwood tree, their beauty as they fly through the air, a little drunkenly when they stagger under the weight of loaded corbiculae and much more linear and purposeful as they head toward their nectar or pollen destination for a fill-up. But what flowers might I no longer plant because the bees weren't around to pollinate them? What pollinators would take the bees' place?

[59] When referring to honey bees I am referring to *Apis mellifera*.

Would I have more butterflies, beetles, or flies as pollinators? Is there a Native Oregon pollinator, possibly one European immigrants never noticed, that went extinct because honey bees outcompeted them for resources?

Many Americans might be shocked to learn that honey bees are an exotic species for the United States, and for the Americas. Honey bees' first arrival in the Americas seems to have been in an early shipment to Jamestown. A letter from the Council of the Virginia Company in London dated Dec 5, 1621 was sent to the Governor and Council in Virginia. In this letter it stated, "Wee haue by this Shipp and the Discouerie sent you diurs [divers] sortes of seedes, and fruit trees, as also Pidgeons, Connies, Peacockes Maistiues, and Beehives, as you shall by the invoice pceiue [perceive]; the preservation & encrease whereof we respond vnto you…"[60] Sixteen years later, in 1638, a second importation of honey bees arrived in Newbury, Massachusetts, where a municipal apiary was created in 1640. This was intended to be a combination educational experiment station and welfare program. Eels (first name unknown), from a town now called Hingham, was put in charge of the apiary, which was placed on a farm rented by John Davis. For several reasons the apiary was not a success and Eels became the town's first pauper.[61]

[60] Susan Myra Kingsbury, *The Records of the Virginia Company of London The Court Book, From the Manuscript in the Library of Congress 1619 – 1622*, Vol.1 (Washington D.C.: Government Printing Office, 1906).
Several sources mention 1622 as the date honey bees first arrive in America, which would have been the year the ship landed in Jamestown. Two of these sources are: Eva Crane, *A Book of Honey* (New York: Charles Scribner's Sons, 1980); and, Elizabeth B. Pryor, *Honey, Maple Sugar and Other Farm Produced Sweeteners in the Colonial Chesapeake* (Accokeek: The National Colonial Farm Research Report, 1983). Imirie specifies that it is the old, dark bee that first arrives in 1622.
George W. Imirie Jr., "History of Honey Bees," GImasterBK@aol.com, 2000.
[61] George W. Adams, "Some Early Beekeeping History," *American Bee Journal*, July (1921); Hilda M. Ransome, *The Sacred Bee in ancient times and folklore* (Boston: Houghton Mifflin Co., 1937); Frank Chapman Pellett, *History of American Beekeeping* (Iowa: Collegiate Press, Inc., 1938); Eva Crane, *Honey: A Comprehensive Survey* (London: William Heinemann Ltd., 1975); John B. Free, *Bees and Mankind* (London: George Allen and Unwin Ltd., 1982); Brenda Kellar, "One methodology for the incorporation of

Interest in beekeeping in America continued to grow, along with the honey bee population. Beekeeping had long been touted in Europe as a cheap way to make some extra income or to provide a little something extra for your family in the way of wax and honey. According to Philip Mason, whose dissertation focused on American bee books, the first American single-subject book on beekeeping was Isaiah Thomas' book, published in Massachusetts in 1792.[62] Mason goes on to note that many early American bee, or beekeeping, books were plagiarized versions of English or European books. One example would be Thomas' 1792 book, *A Complete Guide for the Management of Bees, Throughout the Year*, which was a copy of the Englishman Daniel Wildman's popular 1773 book of the same name.[63]

The first American beekeeping journal, *The American Bee Journal* (*ABJ*), appeared much later, in 1861. This journal was established by Samuel Wagner (1798-1895), and the Civil War soon interrupted its publication. It resumed publication in 1866. Like the early American beekeeping books, the early American beekeeping journals were composed of reprints of articles from European beekeeping journals – mainly German in the case of the *ABJ* since Wagner spoke German and could translate the journals himself – and news about or written by beekeepers and others from across the U.S. The *ABJ* is still being published today by Dadant and Sons and "the Journal has the honor of being the oldest English language beekeeping publication in the world."[64] Needless to say, some of these books and journals were available to early Oregon beekeepers.

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entomological material in the discipline of historic archaeology using the honey bee (*Apis mellifera L.*) as a test subject" (M.A. Thesis, Oregon State University, 2005).

[62] Philip A. Mason, "American Bee Books: An Annotated Bibliography of Books on Bees and Beekeeping From 1492 to 1992" (PhD Dissertation, Cornell University, 1998) 4.

[63] The pseudonym used by Thomas was "a Farmer of Massachusetts."
Mason, 5-6.

[64] "History," *American Bee Journal*, http://americanbeejournal.com/.

2.2 On the Move

It took quite a bit of effort to get honey bees to Oregon. The treeless prairies and Rocky Mountains were geographic barriers to the westward expansion of feral honey bee colonies. Their only possibility of entry was with human assistance, which could be by wagon or by ship. Some speculated it was not worth the effort to bring bees to Oregon because they would not do well in a region with so much rain. In 1853 Charles Stevens wrote:

> There is one thing that I have always wanted to mention, but it has alwais [sic] slip my mind, and if you ever come to Oregon you must not make any calculations on keeping Bees, for they cannot be raised here, the winters are not cold enough to keep them in, they come out of the hive to fly about, and a little shower of rain will catch them and in that way the whole swarm will soon be destroyed.[65]

Nonetheless, there were several attempts in the 1850s, some successful, to import bees to Oregon.

The earliest story of the first honey bees in Oregon is the story of Tabitha "Grandma" Brown's bee tree at her school in Forest Grove, 1849.[66] No one knows where these bees came from, but supposedly several people knew of the bee tree. Three years later, Dr. D.W. Baker made an attempt to bring honey bees to Portland, Oregon from somewhere back east. He returned west "by way of Panama" and then continued to San Francisco, where the bees were transferred to a steam vessel for transport to Portland, accompanied by Dr. Baker.[67] At the time of the exchange the bees were alive and

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[65] Catherine Williams, "Bringing Honey to the Land of Milk and Beekeeping in the Oregon Territory," *The American West 'The Magazine of Western History Association',* no.1 (1975).
[66] Williams.
Wilson, entomologist for the Oregon Agricultural Experiment Station at the beginning of the twentieth century claimed the first honey bees imported to Oregon came from California and arrived in 1849. H.F. Wilson, *Beekeeping for the Oregon Farmer* Extension Service Series II, No. 25, ed. the Oregon College of Agriculture Extension Service (Corvallis, OR: Oregon College of Agriculture Extension Service, 1909), 4.
[67] The Panama Canal would not be completed until 1914. For that reason I am assuming the trip through Panama was an overland trip.

doing well. When the steam ship arrived in Portland the bees were found dead, and there was evidence that sailors or passengers, in robbing the honey from the hives, either caused the bees to starve to death or blocked all air holes, which caused the bees to suffocate.[68]

Mr. Buck of California replicated Dr. Baker's transport path when he successfully brought honey bees to Portland, Oregon one year later, in 1853. Mr. Buck imported several colonies of honey bees from the apiary of John I. Wood of Sullivan County, New York. Once again the bees were transported by way of the Isthmus of Panama, up to San Francisco, where they stayed for "some considerable time" before being shipped to Portland, Oregon. According to a contemporary account, "Mr. Jas. Terwilliger, of South Portland, had the good fortune to receive the first colony sold by Mr. Buck in Oregon, paying $125 therefor. Mr. Thos. Stephens bought the second one sold, paying the same price."[69] The Consumer Price Index website calculates that $125 in 1853 is equivalent to $3,598.50 in 2016.[70]

Mr. Buck's success bred more attempts to bring honey bees to Oregon. However, the journey was long and difficult, and the skill of those caring for these first Oregon honey bee arrivals is unknown. According to Catherine Williams, in August 1, 1854 the *Oregon Statesman* published a story about John Davenport of Marion County, south of Portland, who had just brought a hive of bees overland from back

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[68] "Bees in Oregon," *American Bee Journal,* no.48 (1883): 605.
[69] "Bees in Oregon."
You can find references to this first sale of a honey bee colony in Oregon in future issues of ABJ, e.g. "I think it [Oregon] is a good place for bees, for the settlers say there is a good number of wild bees in the woods, and it has been less than 30 years since the first were brought here and sold for $140 per colony."
David Rice, "Selections from our Letterbox: From Oregon," *American Bee Journal,* no.11 (1882): 170.
[70] $125 (719.7/25) = $3,598.50
"Consumer Price Index (Estimated) 1800-," Federal Reserve Bank of Minneapolis, https://www.minneapolisfed.org/community/financial-and-economic-education/cpi-calculator-information/consumer-price-index-1800.

east. The paper stated these were the first in the area. However, by the time the article appeared the bees were not doing well. Unfortunately, I cannot find this article.[71]

Within a few short years more and larger shipments of honey bees were arriving in Oregon. Charles Knowles of the Tualatin Plains area (present-day Forest Grove-Hillsboro area) brought thirty colonies of honey bees from California on the steamer *Columbia* in 1858. These thirty colonies increased to one hundred within two years and he was also able to sell colonies for $125 each. After that success he moved himself and his apiary to the lower Columbia River area (from about present-day Oregon City to the coast) and began anew.[72] This was just before Oregon became a state, in 1859. The civil war began two years later.

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[71] Catherine Williams, "Bringing Honey to the Land of Milk and Beekeeping in the Oregon Territory," *The American West 'The Magazine of Western History Association',* no.1 (1975): 34.
[72] "Bees in Oregon," *American Bee Journal,* no.48 (1883): 605.

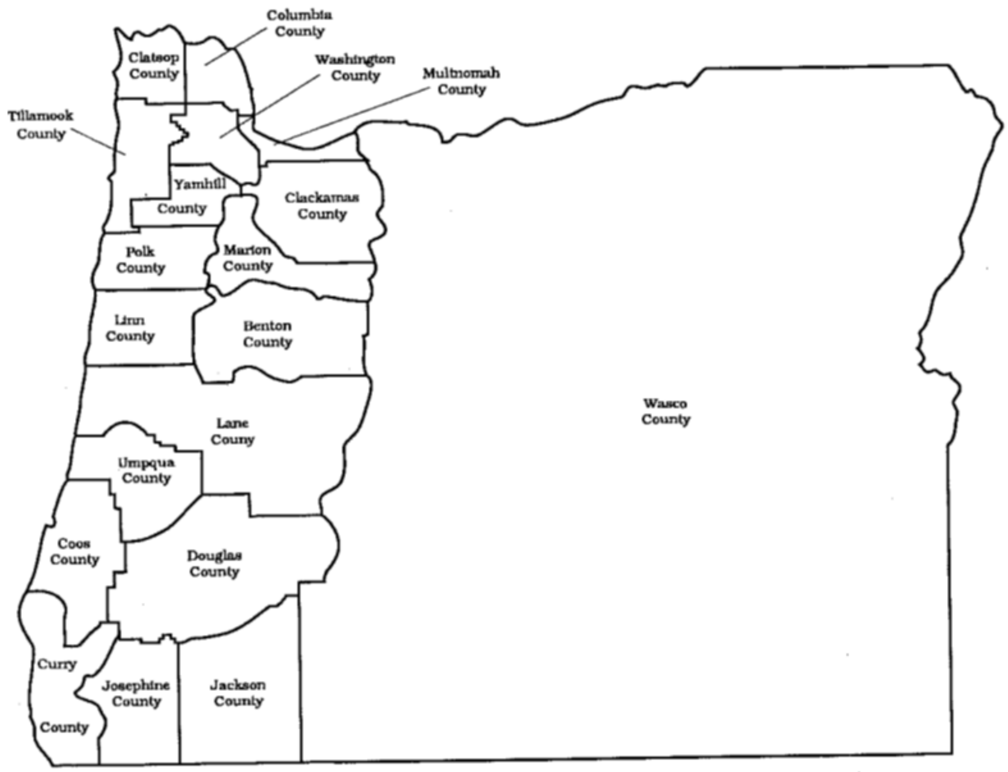

Figure 1 Oregon Territory in 1859, the year Oregon became a state. The white population was approximately 53,000. Wasco County was large, but its white population only numbered 1500.[73]

Soldiers in western Oregon during the civil war (1861-1865) had little to do. The Grand Ronde and Siletz reservations were fairly peaceful, with bored and drunken soldiers one of the biggest problems. In eastern Oregon soldiers oversaw rowdy mining sites and searched for Native raiding parties who excelled at eluding their pursuers.[74] In 1862 the Oregon Steam Navigation (OSN) Company established the first Oregon railroad over the old Ruckel and Olmstead cart-rail system in the Gorge. This

[73] "Oregon Territory, 1859," *Oregon.gov*, State of Oregon, http://www.oregon.gov/SOLL/publishingimages/oregon_territory_1859.pdf.
Similar image: "Historical Oregon maps," *Oregon.gov*, State of Oregon, http://sos.oregon.gov/archives/records/provisional-guide/Pages/oregon-maps.aspx.
[74] Stephen Dow Beckham, "Oregon Blue Book 'Oregon History: Civil War in Oregon'," *Oregon.gov*, State of Oregon, http://bluebook.state.or.us/cultural/history/history16.htm.

was a five mile stretch from Tanner Creek to the head of the Cascades. Another fourteen mile stretch from The Dalles to Celilo expanded the rail service available and greatly enlarged the OSN transportation network of steamboats, portage railroads, and freight lines.[75] The growing infrastructure as well as the burgeoning Oregon population helped support a nascent Oregon beekeeping business.

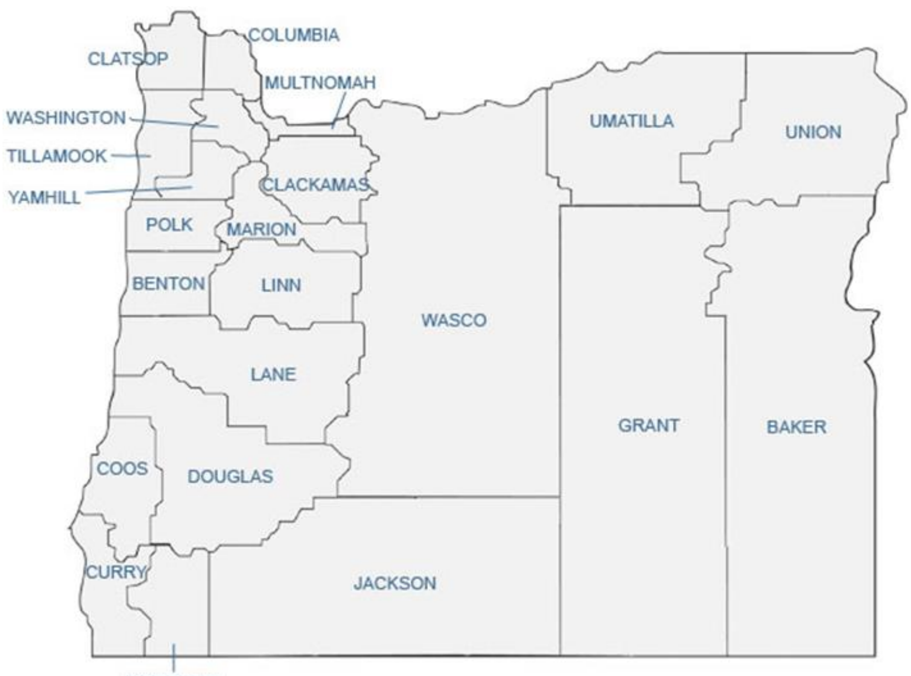

Figure 2 Oregon map, 1865. Within six years the white population in Oregon had grown and Oregon had gone from nineteen to twenty-two counties.[76]

In 1875, bees were still rare enough in Oregon to demand high prices. In Portland, D.D. Briggs had thirty-two hives "in good condition."[77] He had begun the year with twenty-six colonies, only four of which were in moveable frame hives.[78] By allowing these colonies to swarm he increased his apiary by

[75] Stephen Dow Beckham, "Oregon Blue Book 'Oregon History: Emerging Economies'," *Oregon.gov*, State of Oregon, http://bluebook.state.or.us/cultural/history/history21.htm.
[76] "Historical Oregon maps," *Oregon.gov*, State of Oregon, http://sos.oregon.gov/archives/records/provisional-guide/Pages/oregon-maps.aspx.
[77] D.D. Briggs, "Voices from among the Hives," *American Bee Journal,* no.1 (1876): 8.
[78] I speak in more detail about moveable frame hives in chapters 4 and 6.

six colonies at the year’s end, even after destroying weaker hives to harvest the honey and wax. Despite the increasing population of people and bees in Oregon, many people still commented on the scarcity of honey bees in their area. It may be that these migrants from back east had already forgotten that honey bees were also fairly new to the eastern United States. After all, it had been only 250 years since honey bees had first arrived in Jamestown, Virginia.[79]

Nineteenth century beekeepers in Oregon, however, worried that there were already too many honey bees in Oregon. This fear was perhaps engendered by the extremely rapid increase in the honey bee population, managed and feral. David Rice arrived in Albany, Oregon in 1881 and one year later was living in Lebanon, Oregon. He found a beekeeper “on the other side of the Santiam river” who would sell him a colony. This person had five colonies of bees and was willing to sell Rice one because “there was danger of over-stocking.”[80]

Oregon beekeepers were trying to establish their business in territory that, to them and the bees, was new and unknown in many respects. Beekeeping books and journals were a great source of general information about bees and beekeeping, but offered little information specific to the local conditions Oregon bees and beekeepers faced. Granted, the journals usually had a section devoted to letters from their readers where local conditions were described, and occasionally these journals would include a copy of an article published by a local Pacific Northwest agricultural paper, but the information was usually minimal, sometimes misleading, and frustratingly incomplete. Oregon beekeepers turned to

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[79] This first shipment of honey bees to the new English colony of Jamestown was in 1622 as discussed earlier in this chapter.
Brenda Kellar, “One methodology for the incorporation of entomological material in the discipline of historic archaeology using the honey bee (*Apis mellifera L.*) as a test subject” (M.A. Thesis, Oregon State University, 2005), 27.

[80] David Rice, "Selections from our Letterbox: From Oregon," *American Bee Journal,* no.11 (1882): 170.

each other for support. The Oregon Beekeeping Society was established in 1882 and by 1885 the Willamette Valley Bee-Keepers' Association held its second meeting in Lafayette, Oregon, with F.S. Harding as president and E.J. Hadley as secretary.[81] The Willamette Valley Bee-Keepers' Association was the only Oregon beekeeping association included in the list of beekeeping associations published by the *ABJ* in 1891, despite "the list [being]…much longer than we expected to find it, when the work of listing was commenced. It shows life and abiding interest."[82]

2.3 Honey Production

For thousands of years the relationship between bees and humans was based on the human desire for honey and wax, sweetness and light. After humans began keeping bees that did not change. As time went on, the demand for both honey and wax increased as more uses were found for both – medicines and lubricants being two – as well as for the other products bees create. However, it was not until the mid-nineteenth century that anyone in the United States made a living just from beekeeping. Moses Quinby (1810-1875) is possibly the first U.S. beekeeper whose sole support was from his bees. He began beekeeping around 1830, and like most beekeepers of that period, he started with a few colonies

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[81] First officers of the Oregon Beekeeping Society:

Morris, Dr. J.W.	President
Warner, A.	Vice-President
Chairman, E.E.	Secretary
Miller, A.F.	Treasurer
Rusk, J.D.	Executive Committee member, Clackamas, OR
Ensley, M.V.	Executive Committee member, Yamhill, OR
Riggs, T.L.	Executive Committee member, Multnomah, OR

"Convention Notes: Oregon Convention," *American Bee Journal,* no.49 (1882): 776; "Selections from our Letterbox," *American Bee Journal,* no.48 (1884): 764.

[82] "Bee-Keepers' Associations," *American Bee Journal,* no.26 (1891): 826.

in common hives. For over twenty years, from 1853 until 1875, beekeeping was his principal occupation.[83]

Before Quinby, and for some time after him as well, beekeeping in the U.S. was thought of as a sideline, something to supplement the family income while providing an example of how to live a wholesome, productive life. Adam Ebert has claimed that early modern beekeepers with influence on the practice of beekeeping were middle-class clergy and professionals who also saw beekeeping as a form of rural improvement rather than a source of income.[84] These early beekeepers believed that profit was less important than the social instruction and example of social structure provided by honey bees. Ebert's research focuses on England, however early American beekeepers of note, those who wrote books and articles telling other beekeepers how to be successful, were often also clergy or professionals, a demographic that slowly began transforming into professional beekeepers from the mid-nineteenth to the early twentieth centuries. In the U.S., the idea that beekeeping was a socially redeeming activity was present from a very early period. Possibly the earliest example is the 1640 creation of a municipal apiary in Newbury, Massachusetts, mentioned earlier.[85]

2.4 New Technologies

In the last half of the nineteenth century beekeeping journals were telling their readers that to be successful they had to produce large yields of honey. To do this they needed movable frame hives, a

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[83] For more information on Moses Quinby see chapter 4 in this dissertation.
[84] Adam Ebert, "Nectar for the Taking: The Popularization of Scientific Bee Culture in England, 1609-1809," *Agricultural History,* no.3 (2011).
[85] Brenda Kellar, "One methodology for the incorporation of entomological material in the discipline of historic archaeology using the honey bee (*Apis mellifera L.*) as a test subject" (M.A. Thesis, Oregon State University, 2005).

honey extractor, a honey knife, bee veils, rubber gloves, a smoker, empty hives at the ready, and a subscription to a beekeeping journal.[86] Promotion of honey production as a professional, rational full-time occupation by beekeeping journals was usually described as only possible with the use of the new beekeeping technologies – moveable frame hives, extractors, smokers, and wax foundation.

The first technical innovation that promoted large-scale beekeeping was the moveable frame hive, invented by Lorenzo L. (L.L.) Langstroth (1810-1895), author of *On the Hive and Honey Bee*. When Langstroth patented his hive in 1852, it was the only truly moveable frame hive in existence anywhere, an innovation that transformed beekeeping from that point forward.[87] Langstroth's frames were moveable because of "bee space," the void bees leave between combs and between combs and walls in a natural hive so they can easily move about the interior. Langstroth had left about three-eighths of an inch of space between the frames and the hive walls, which turned out to be just the right amount of space for bees to leave it as a void. Previous hive designs with different sized spaces, or no space, between frames or combs and the walls of the hive meant the bees would immediately begin filling the void with propolis, gluing comb sections to each other or to the walls and making the combs impossible to move without harming some of the comb sections and possibly the integrity of the hive itself or the brood area. However, looking at the patent Langstroth submitted for his hive, it appears that he did not know he had invented bee space. He simply thought he had invented a new hive design, and he certainly did not realize all of the impacts bee space would lead to for beekeeping.[88] The 1908 edition of *ABC and*

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[86] "Among our Exchanges: How to Commence Bee-keeping?" *American Bee Journal,* no.29 (1881).
[87] L.L. Langstroth, "Beehive" (Patent, United States Patent Office, 1852).
Dzierzon created the top bar hive, which became the European equivalent of the moveable frame hive in the U.S. See chapter 4 in this dissertation for more information on Dzierzon's top bar hive.
[88] Tammy Horn disagrees, stating that Langstroth did know his innovation was the small space around the frames.

XYZ of Bee Culture stated that small harvests of "dirty chunk honey per skep was considered a good yield; but after the Langstroth invention, by which the brood-nest of the colony could be investigated and manipulated, yields of anywhere from thirty five to seventy-five pounds per colony of beautiful honey were common averages."[89] Intensive hive management became the standard for all rational beekeepers, since the heart of the hive was now available for inspection whenever beekeepers deemed it necessary. This easy access to the interior of the hive produced an expectation that beekeepers must have greater control of swarming, which I discuss later in this chapter, and greater knowledge of the natural history of their bees, something I discuss in the foul brood chapter.

Soon after the moveable frame hive came into use, there were two more significant innovations – wax comb foundation in 1857 and the centrifugal honey extractor in 1865. Wax comb foundation, which is a sheet of wax with shallow hexagonal shapes stamped in that provide cell wall platforms, enhanced consistently straight, high-quality combs with predominantly worker/honey cells.[90] The extractor allowed beekeepers to uncap honeycomb and extract the honey by spinning the honey-filled frames. This process did not damage the comb as the old method had (crushing or melting sections of comb to separate honey and wax), which allowed the beekeepers to reinsert the framed comb saving the bees the time and labor to create more wax comb. Bees could instead expend this time on collection

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Tammy Horn, *Bees in America: How the Honey Bee Shaped a Nation* (Lexington: University Press of Kentucky, 2006).

[89] A.I. Root and E.R. Root, *The ABC and XYZ of Bee Culture: A Cyclopedia of Everything Pertaining to the Care of the Honey-bee; Bees, Hives, Honey, Implements, Honey-plants, etc. Facts Gleaned from the Experience of Thousands of Bee-keepers, and Afterward Verified in Our Apiary* (Medina: The A.I. Root Co., 1908), Introduction.

The ABC and XYZ of Bee Culture was first published in 1877.

[90] E.C. Martin, E. Oertel, N.P. Nye, and others, *Beekeeping in the United States* Agricultural Handbook Number 335, ed. the United States Department of Agriculture (Washington D.C.: U.S. Government Printing Office, 1980), 3-4.

of nectar, increasing the beekeeper's honey harvest and resulting in greater profits.[91] It also allowed beekeepers to more easily strain the extracted honey because the amount of comb pieces, bee body parts, and hive detritus was much less than what was present in the honey using the old extraction methods. The result was pure, golden honey that could be displayed in glass jars.[92]

Not all technological innovations that helped focus beekeepers on commercial honey production were directly related to beekeeping. One side-effect of the electrification movement across the United States, and the damming of many rivers and tributaries for the production of electricity and for flood control, was the availability of water in previously arid regions through irrigation. For beekeepers this was highly significant as some of the most commonly irrigated commercial crops – clover, alfalfa, and legumes – were also some of the most prized nectar crops for beekeepers. In Oregon, especially in the Hood River area, irrigation made cover-cropping of orchards possible in the early twentieth century, a practice that exacerbated the problem of bee poisonings. Separate chapters below (5 and 6) on the codling moth, and pollination, respectively provide additional details.

2.5 I crave a little sweetness

Other events happening outside of the beekeeping world also led to a demand for more honey. The production of cane sugar on plantations in various colonial regions had created a greater craving for

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[91] This practice of reusing foundation was also a contributing factor for the spread of disease among colonies. See chapter 4 in this dissertation for more information.

[92] It also resulted in adulterated honey being sold as pure honey and a distrust by the public for any honey not sold in combs. "Until quite recently the general public has been rather opposed to the use of extracted honey and suspicious of its purity. Improved methods of extractions, pure food regulation, and the use of blends for improving and standardizing the flavor have, however, developed a highly satisfactory product for common use."

Etta H. Handy, "The Value of Honey in the Diet," in *First Annual Report of the Division of Apiculture to the Governor of Washington*, ed. A.L. Melander (Olympia: Frank M. Lamborn, Public Printer, 1921), 111.

sweet food items in the general public. Anthropologist Sidney Mintz (1922-2015) has tied this idea to the rise of industrialization, where people were working long hours, including women who were often responsible for producing family meals. This growing working class needed a cheap, fast source of carbohydrates. More specifically Mintz focuses on England and her colonies, discussing the combination of caffeine and quick carbs available in hot, sweetened tea in conjunction with the changing role of tea as it became cheaper and transitioned from a status item available only to the rich to an item readily available for little cost to everyone, much like cane sugar.[93]

For several reasons, two being the lower cost of cane sugar and the social status attached to it, honey began to be replaced by sugar on home dining tables and kitchens in the last half of the nineteenth century. However, honey was discovered to provide a degree of preservation and moistness to many baked goods that cane sugar just could not contribute, and the demand for honey within commercial baking operations rose rapidly.[94] In the first few years of the twentieth century, the National Biscuit Company began placing larger orders for honey, with one request being for one hundred train cars. The Independent Bakers' Association was established at the beginning of the twentieth century in part so they could place bulk orders, which included orders for anywhere from ten to twenty-five train cars of honey at one time.[95] Manufacturers of ready-to-consume food items were experimenting with different sweeteners for new, popular food items like ready-to-eat baked goods and soda pop, and the

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[93] Sidney W. Mintz, *Sweetness and Power The Place of Sugar in Modern History* (New York: Penguin, 1985).
[94] A.I. Root and E.R. Root, *The ABC and XYZ of Bee Culture: A Cyclopedia of Everything Pertaining to the Care of the Honey-bee; Bees, Hives, Honey, Implements, Honey-plants, etc. Facts Gleaned from the Experience of Thousands of Bee-keepers, and Afterward Verified in Our Apiary* (Medina: The A.I. Root Co., 1908), Introduction.
[95] Root and Root.

future for honey seemed to be booming as beekeepers could now produce more honey with the same number of colonies while new honey markets were opening up.[96]

While World War I (WWI) had a big impact on Oregon apple production, helping to open British and British colonial markets for Oregon apple growers, there appears to be no similar, direct impact for Oregon honey producers. Tammy Horn, author of *Bees in America* (2006), has discussed the increased demand for American honey due to sugar shortages in WWI as well as disruption of European beekeepers' lives and apiaries.[97] This led to a general increase in the price of honey, which Oregon beekeepers also felt, but they also were subject to the decrease in honey prices after the war was over.[98] The Berkeley agricultural economist Edwin C. Voorhies (1892-1967) and his co-authors claimed that "table honeys, such as orange, sage, and star thistle did not suffer as severe a price decline in post-war [WWI] years as did honeys which were used to a considerable extent for manufacturing purposes, such as alfalfa and wild-flower honeys."[99] It would not be until 1930 that table honey prices became significantly lower.[100]

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[96] A.I. Root and E.R. Root, *The ABC and XYZ of Bee Culture: A Cyclopedia of Everything Pertaining to the Care of the Honey-bee; Bees, Hives, Honey, Implements, Honey-plants, etc. Facts Gleaned from the Experience of Thousands of Bee-keepers, and Afterward Verified in Our Apiary* (Medina: The A.I. Root Co., 1908).

[97] Tammy Horn, *Bees in America: How the Honey Bee Shaped a Nation* (Lexington: University Press of Kentucky, 2006).
It took a while after the war to rebuild the sugar supply chain for the U.S. "There is only one thing to do – appeal to the housewife and others to put into practice every patriotic conservation measure. Everybody must help as they did during the war. The first step is to take the sugar bowl off the table."
B.F. Kindig, "The Sugar Situation," *The Domestic Beekeeper,* no.11 (1919): 335.

[98] "During the shortage of sugar the latter years of the recent world war, honey came into its own very rapidly."
George W. York, "Beekeeping in the North-west," *The Domestic Beekeeper,* no.11 (1919): 334.

[99] Edwin C. Voorhies, Frank E. Todd, and J.K. Galbraith, *Economic Aspects of the Bee Industry* Bulletin 555 (Berkeley: University of California Experiment Station, 1933), 4.

[100] Voorhies*, et al*., 4.

Perhaps the most significant impact of the WWI domestic sugar shortage for beekeepers was the difficulty they had in acquiring sugar to feed their bees. “The following note appears in the current issue of *Gleanings* in the form of a telegram from Dr. E.F. Phillips: Beekeepers unable to get granulated sugar to prevent starvation of bees should notify the United States Sugar Equalization Board, 111 Wall St., New York City, N.Y.”[101] Beekeepers would struggle with this issue again during WWII. By that time, Oregon apiaries were inspected and licensed, and apiary inspectors were expected to provide official statements as to the degree of need and number of colonies. During WWII the Oregon Ration Board was allowing ten pounds of sugar per colony to prevent starvation of bees. If the situation was extreme a maximum twenty five pounds per colony could be issued.[102]

January 6-8 of 1919, at the Muehlebach Hotel in Kansas City, the American Honey Producers League was created through the action of representatives of beekeepers from across the U.S. This was the largest gathering of U.S. beekeeping representatives ever. That same year, 1919, the *Domestic Beekeeper*, the journal for the National Beekeepers’ Association, was conducting a survey to uncover the best way to serve their current readership. One of their questions - “Shall membership be open to anyone or shall it be confined to bona-fide honey producers?”[103] Honey production was now a professional occupation, its practitioners worthy of their own associations and possibly their own journal.

[101] B.F. Kindig, "The Sugar Situation," *The Domestic Beekeeper,* no.11 (1919): 336.
[102] A. Burr Black, letter to Matt Maddess, November 9, 1945.
[103] B.F. Kindig, "Letter from the President of the National Association," *The Domestic Beekeeper,* no.4 (1919): 297.

2.6 Bee Breeding

Oregon beekeepers sought improvement of their stock through breeding. For beekeepers this meant careful selection of queens. Honey bee queens breed only one time, but with several drones. The semen from each drone is either accepted into the spermatheca of the queen, or all or part of the semen is ejected from the queen's body right after mating. The semen that is accepted is mixed with semen from other drones with whom the queen mates during her wedding flight. Workers and new queens develop from eggs randomly fertilized by the semen mixture in the queen's spermatheca. Drones develop from eggs that are not fertilized, i.e. through parthenogenesis.

Jan Dzierzon (1811-1906), a Roman Catholic Priest in Carlsmarkt, Silesia, was a beekeeper who spent years making careful observations of the bees' habits.[104] Because of these observations Dzierzon, in 1845, was the first to publish a theory of parthenogenesis for honey bees, in *Bienenzeitung* of Eichstadt. His article covered most of the aspects of honey bee reproduction outlined above, which were controversial claims for beekeepers and biologists at that time. Dzierzon finished his article by saying, "This is certainly only a hypothesis, and will probably remain so, but one to which every close observer will be no more able to refuse his assent, than the hypothesis of Copernicus" and that the reason it must be accepted was because it explained all the mysteries of honey bee reproduction.[105] This article caused

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[104] A.J. Cook, *The Bee-Keepers' Guide; or Manual of the Apiary* (Lansing: *n.p.*, 1884).
To make ever more careful observations and to more easily manipulate the hive and its inhabitants, Jan Dzierzon invented the top-bar hive, which increased the ease of removing comb for honey processing, re-queening, disease control, and observation of the activities taking place in the heart of the hive. Because of this innovation and his theory of honey bee reproduction Dzierzon is known as the Father of Modern Beekeeping in Europe.
Some references use the name Johann instead of Jan for Dzierzon.

[105] Carl Theodor Ernst von Siebold (1804-1885) re-printed Dzierzon's article in his book.
C.T.E. von Siebold, *On a True Parthenogenesis in Moths and Bees; A Contributions to the History of Reproduction in Animals*, Trans. W.S. Dallas (London: John Van Voorst, 1857), 40-41.

an uproar in the beekeeping community, but had little or no impact in biology circles. Even when Dzierzon published his theory as a book, *Theorie und Praxis des neuen Bienenfreundes, oder neue Art der Bienenzucht mit dem günstigsten Erfolge angewendet und dargestellt von Dzierzon*, 1849, and strengthened his stance from hypothesis to theory, most biologists paid no attention.[106]

U.S. beekeepers were following the debates on honey bee reproduction at least as early as 1866 when Lorenzo L. Langstroth wrote an article for the *American Bee Journal* (*ABJ*) titled, "On the Impregnation of the Eggs of the Queen Bee."[107] As usual, the *ABJ* made sure American readers had the latest scientific information pertaining to honey bees no matter the language it was originally published in. By the late nineteenth century U.S. beekeepers were aware of honey bee reproduction and how difficult that made human control of bee breeding. Their best hope was to ensure they knew the lineage of any drone that might breed with a virgin queen.

Instrumental insemination of queen bees only became reliable in the 1940s. Before then attempts to control the breeding of queens had relied on isolation. Virgin queens had been placed in netted areas or greenhouses with drones of the desired lineage, but few breeders claimed this to be successful and some claimed the queens killed themselves by throwing themselves repeatedly at the constricting netting or glass rather than spending any time mating with the drones. Isolation of queen

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Siebold received an M.D. in 1828 from the University of Berlin and was mentored by Karl Ernst von Baer (1792-1876) from 1831-34. In 1841, with the help of Alexander von Humboldt (1769-1859) he became the chair of zoology and comparative anatomy at the Friedrich Alexander University in Erlangen, where he insisted that his students become proficient in use of the microscope. In 1848 Siebold published *Lehrbuch der vergleichenden Anatomie der wirbellosen Thiere* (Textbook of comparative anatomy of invertebrates) which included his argument for identification of protozoa as single-celled organisms.

[106] Siebold, however, was taking notice.
C.T.E. von Siebold, "True Parthenogenesis in the Honey Bee," *American Bee Journal,* no.5 (1868): 5.

[107] L.L. Langstroth, "On the Impregnation of the Eggs of the Queen Bee," *American Bee Journal,* no.4 (1866).

breeders' apiaries was the only assurance of purity for the queens bred and sold by beekeepers.[108] In Germany, Baron von Berlepsch, in the second half of the nineteenth century, went so far as to send his servants out scouting for several miles around his apiaries in search of feral colonies.[109] If found, these colonies were destroyed, thus ensuring Berlepsch's queens would breed only with drones he released from his apiary. However, in most cases American queen breeders did not take feral bee colonies into consideration. Situating their breeding apiary at least six miles from any other apiary seems to have been all the assurance they needed that their virgin queens would breed only with their drones.[110]

When ordering a new queen from a breeder, beekeepers nearly always wanted an Italian queen. According to Langstroth two separate successful importations of Italian honey bee colonies to the United States took place in 1859, one by Samuel Wagner and his partner and a second by P.G. Mahan.[111] Italian bees were noted for their gentleness, cold tolerance, and their ability to reproduce rapidly. I discuss Italian honey bees in more depth later in this chapter.

2.7 Queens by Steam, Rail and Mail

Most new queens In Oregon arrived through the mail and the earliest queen bee mailed to a beekeeper in Oregon, that I have found, was in the 1870s. She was mailed to Thomas Brasel in Portland,

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108 John R. Harbo and Thomas E. Rinderer, "Breeding and Genetics of Honey Bees," in *Beekeeping in the United States* Agricultural Handbook Number 335, eds. E.C. Martin, E. Oertel, N.P. Nye, and others (Washington D.C.: Government Printing Office, 1980).
109 Berlepsch was a lawyer and beekeeper who owned an estate in Thuringia, which is a historic region in the current east-central part of Germany.
110 "Controlled mating by instrumental insemination, developed between 1925 and 1945, has been used by a few queen producers for breeding and lately is beginning to be used for mass produced queens." Kenneth W. Tucker, "Queens, Package Bees, and Nuclei: Production and Demand," in *Beekeeping in the United States* Agricultural Handbook Number 335, eds. E.C. Martin, E. Oertel, N.P. Nye, and others (Washington D.C.: Government Printing Office, 1980), 61.
111 L.L. Langstroth, *On the Hive and Honey Bee* (Hamilton: Charles Dadant & Son, 1889).

Oregon. He ordered three Italian queens for $5 each from somewhere back east, but all had arrived dead, despite being mailed express.[112] His next order was from a queen breeder in southern California, again mailed express and costing $5, but this queen arrived live and "soon [his] hives [were] mostly filled with Italian bees."[113] Queens could also be shipped by steamer from California to Oregon as J.D. Enas discovered in 1881.[114] Often Oregon beekeepers would purchase queens from great distances, such as the queen that Gustav Murhard of Portland purchased in 1885 from Carniola, a historic region now part of Slovenia. Murhard's queen was a Cyprian that had been mated with a Carniolan drone in Carniola. He wanted to evaluate the differences between this cross and the Mt. Lebanon/Carniolan queen he had been using previously. The idea behind this mating was a desire to decrease the Cyprian propensity to sting and swarm.[115]

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[112] Consumer Price Index: 2016 Price = 1875 Price x (2016 CPI / 1875 CPI); $5 X (719.7/33); $5 X 21.81; 2016 price = $109.04.
"Consumer Price Index (Estimated) 1800-," Federal Reserve Bank of Minneapolis, https://www.minneapolisfed.org/community/financial-and-economic-education/cpi-calculator-information/consumer-price-index-1800.
[113] Thos. Brasel, "Foul Brood, &c," *American Bee Journal,* no.6 (1878): 191.
[114] J.D. Enas, "Selections from our Letterbox: California Notes," *American Bee Journal,* no.18 (1882): 282.
[115] Gust. Murhard, "Selections from our Letterbox: Bee-Keeping in Oregon, etc.," *American Bee Journal,* no.36 (1886).

Figure 3 Map of historic Austria-Hungary. 4 – Carniola; 11 – Silesia. Ljubljana is the current capital of Slovenia.[116]

The history of shipping queens remains murky, with conflicting claims for priority. C.J. Robinson, of Richford, N.Y., claimed to be the first person to send a queen through the mail, in 1863. Further, he stated he continued shipping queens by mail for the next three years and that at that time there were no restrictions on shipments of that type.[117] In the 1889 edition of L.L. Langstroth's *On the Hive and Honey Bee*, the first bees sent by mail are attributed to J.H. Townley and H. Alley who individually mailed bees in 1868.[118] David Edwards, contributor to *Bee Culture*, claims Moses Quinby advertised that he would ship queens by mail for short distances in 1868, but Edwards suggests that the practice did not

[116] IMeowbot, "Austria-Hungary Map," Original work, Wikimedia Commons, https://en.wikipedia.org/wiki/Carniola#/media/File:Austria-Hungary_map.svg.
[117] C.J. Robinson, "Bees by Mail," *American Bee Journal,* no.14 (1890).
[118] L.L. Langstroth, *On the Hive and Honey Bee* (Hamilton: Charles Dadant & Son, 1889), 311.

become common because of a postal restriction on this type of mail.[119] There is evidence that shipments of queens were causing a bit of a ruckus in post offices. As late as 1912, newspapers were writing stories about the scare given to postal clerks when they received a package with a queen and her attendants.[120] However, bees did continue to be shipped by mail after postal restrictions and in 1868 and 1887 Gustav Murhard, of Portland, complained that postal workers harmed queens sent through the mail by shaking the little shipping boxes to see if the queen would buzz, which would indicate she was still alive.[121] The mail code Edwards is probably referencing may be the same one referenced by Robinson in 1890, which Robinson refers to as the eighth sub-division of the section "which reads: 'Queen-bees and their attendants bees may be sent in the mails when properly put up, so as not to injure the persons of those handling the mails, nor soil the mail-bags or their contents.'"[122]

Two other pieces of legislation impacting the movement of queens and/or bee colonies were the Federal Honey Bee Act passed in 1922 and the 1933 Oregon Bee Law. The Honey Bee Act of 1922 was "passed primarily to prevent spread of the mites into the United States."[123] Tammy Horn believes the 1922 Honey Bee Act was a reflection of the post WWI isolationist spirit within the U.S. and the

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[119] David Edwards, "Moses Quinby America's Father of Practical Beekeeping," *Bee Culture Magazine*, (2014), http://www.beeculture.com/moses-quinby/.

[120] "Bees in mail scare girls" was the headline of the article about a Vancouver, Washington post office's receipt of a queen in her cage with her attendant worker bees. "The animated mail consists of queen bees, which hum and buz in their cages until the nerves of the female clerks are 'all shot to pieces.'" "Bees in Mail Scare Girls," *Morning Oregonian* (Portland, OR), May 21, 1912, 1.

[121] Gust. Murhard, "Shaking Queen-Cages in Transit," *American Bee Journal,* no.14 (1887). Murhard claimed to have been a beekeeper for thirty years.
Gust. Murhard, "Drone-Laying Worker Bees," *American Bee Journal,* no.42 (1883).

[122] C.J. Robinson, "Bees by Mail," *American Bee Journal,* no.14 (1890): 234.

[123] William Michael Hood, "Honey Bee Tracheal Mite," Clemson Cooperative Extension, https://www.clemson.edu/extension/beekeepers/fact-sheets-publications/tracheal-mite-honey-bee.html.

conflation of immigrants and disease.[124] It is true that both the 1922 federal Honey Bee Act and the 1933 Oregon Bee Law were meant to stop the spread of disease and/or pests and I'll be talking more about the Oregon Bee Law in the chapters on foul brood and pollination.

By the 1920s, mailing "package bees" to Washington or Oregon was a popular practice. Most package bees sent to Oregon came from California or the southern United States. Package bees were sold and shipped in 2, 3, or 5 pound packages. The cost of the packages containing a queen would fluctuate depending on the value of the queen in the package. C.L. Farrar, entomologist with the Massachusetts Agricultural College, stated that an average price for a 3 pound package of bees would be about $4.75 in 1929, which is equivalent to $66.26 in 2016.[125] Beekeepers would purchase package bees to strengthen weak colonies or to increase the number of colonies in their apiary. Orchardists would purchase package bees for pollination, something I will expand on in the chapter on pollination.

2.8 Names and Races

"Species are about power, about possession, about capital and the status of naturalists."[126]

From the early 19th century, monetary values were associated with species names. It was impossible to sell anything until you had a name for it. Rarity, desirability, and value were assessed

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[124] Tammy Horn, *Bees in America: How the Honey Bee Shaped a Nation* (Lexington: University Press of Kentucky, 2006), 165.
[125] C.L. Farrar, *Bees and Apple Pollination* Special Circular No. 7, ed. Massachusetts Agricultural College Department of Entomology (Amherst: Massachusetts Agricultural College, 1929), 9.
2016 Price = 1929 Price x (2016 CPI / 1929 CPI); $4.75 (719.7/51.6); $4.75 X 13.95; $66.26
"Consumer Price Index (Estimated) 1800-," Federal Reserve Bank of Minneapolis, https://www.minneapolisfed.org/community/financial-and-economic-education/cpi-calculator-information/consumer-price-index-1800.
[126] Gordon R. McOuat, "Species, Rules and Meaning: The Politics of Language and the Ends of Definitiions in 19th Century Natural History," *Studies in History and Philosophy of Science,* no.4 (1996): 477.

based on the name of the species-commodity being offered for sale. If it was a new species, or a rare species, or a species desired because of specific characteristics, it was worth more money. Sales taking place at a distance depended on standardized naming of these species commodities for assigning price and assuring the buyer was getting exactly what he thought he was purchasing.[127]

It is evident that even the earliest honey bees arriving in Oregon were from a variety of regions around the United States and the world. What beekeepers, and even some scientists, called races at the turn of the twentieth century are what today we would call a subspecies. These third wheels to the scientific binomial were usually an indication of the region the honey bee was from.

The race desired above all others by most American beekeepers was the “Italian” bee (*Apis mellifera ligustica*). Italians were believed to be more resistant to cold, have more prolific laying-queens, and to be better defenders of the hive against other insect pests. In addition, they would hardly ever sting and they were more industrious. Their only bad quality was that they were more likely to rob other hives. The probable race of the first honey bees brought to North America was the Common (also known as the Black, or European, or German) bee with the scientific name of *Apis mellifica* or *Apis mellifera* depending on the time period when the name was used.

In the mid-19th century, many species were being sold under various names, which could include a local (common) name, or various scientific binomials given by multiple “discoverers.” Colonization of multiple locations by several different countries, in addition to several naturalist-scientist-explorers

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[127] Gordon R. McOuat, "Species, Rules and Meaning: The Politics of Language and the Ends of Definitiions in 19th Century Natural History," *Studies in History and Philosophy of Science,* no.4 (1996); James T. Costa, "Synonymy and its Discontents: Alfred Russel Wallace's Nomenclatural Proposals from the 'Species Notebook' of 1855-1859," *The Bulletin of Zoological Nomenclature,* no.2 (2013); Gordon R. McOuat, "Naming and Necessity: Sherborn's Context in the 19th Century,’’ ed. E. Michel, from *Anchoring Biodiversity Information: From Sherborn to the 21st century and beyond,* conference in London, January 7, 2016.

canvasing these newly colonized territories for harvestable resources, had led to multiple discoveries by Europeans of the same species, with each discovery being given a name by its discoverer and resulting in many species with more than one scientific binomial name. Additionally, as naturalist-scientists explored un-colonized new territories, the same thing would occur, resulting in even more species with more than one “discoverer” and more than one name. The many and diverse forms of scientific naming schemas as well as the numerous common names that had been assigned to species before Carl Linnaeus’ binomial system was universally accepted added even more confusion, so that when an eighteenth century naturalist-scientist wrote about his investigations of a species, his readers might be uncertain just what species he was talking about.

Carl Linnaeus (1708-1778) created the binomial genus and species naming system that was to become accepted by the international community of scientists and naturalists. His first publication using his system was *Systema Naturae* in 1735.[128] However, the 10th edition (1758), where he consistently used his system of naming, became the text used in issues of priority for names of species by the International Commission on Zoological Nomenclature (ICZN) at the end of the nineteenth century.[129]

Confusion over the correct scientific name for the European honey bee was due to changing ideas about what an appropriate scientific name should be. Originally, in 1758, Linnaeus named the

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[128] "Carl Linnaeus," University of California Museum of Paleontology, http://www.ucmp.berkeley.edu/history/linnaeus.html.

[129] Gordon R. McOuat, "Species, Rules and Meaning: The Politics of Language and the Ends of Definitiions in 19th Century Natural History," *Studies in History and Philosophy of Science,* no.4 (1996); James T. Costa, "Synonymy and its Discontents: Alfred Russel Wallace's Nomenclatural Proposals from the 'Species Notebook' of 1855-1859," *The Bulletin of Zoological Nomenclature,* no.2 (2013); "Carl Linnaeus." In the 2016 article McOuat states it is the 12th edition of *Systema Naturae* that becomes the text used in issues of priority.
McOuat, "Naming and Necessity,’’ 63; “About the ICZN,” International Commission on Zoological Nomenclature, http://iczn.org/content/about-iczn.

familiar European honey bee *Apis mellifera*, which means honey-bearing. However, eight years later Linnaeus must have learned that honey bees do not carry honey back to the hive, they carry nectar to the hive where it is stored and evaporated, transforming the nectar into honey much like tree sap is transformed into maple syrup, and he changed the name in his 1766 edition of *Systema Naturae* to *Apis mellifica*, which means honey maker.[130] Thus, 19th century, and earlier, writings about the European honey bee used the scientific name *Apis mellifica*.

Linnaeus' binomial naming system was originally created to be arbitrary, meaning that the intention of naming was not to describe exactly some attribute or characteristic or essential essence of the species, but to give a name that was unique to that species.[131] Using an artificial naming system like this meant the name and species would become inextricably bound through their relationship with each other, rather than any morphological, character trait, or regional affiliation. Other associations that might exist for any of the words present in the name, e.g. mellifica, would not diminish the unique relationship created by the association of the name and the species. However, it is clear that Linnaeus often used a name for the species that was descriptive, and his decision to rename the honey bee in 1766 must have been one such moment for him.

The Stricklandian Code, 1842, was a British attempt to bring order to the chaos of names in existence at that time.[132] The first provision of the Stricklandian Code was the "Law of Priority," which

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[130] "ID: 35061 mellifera Apis, Linnaeus, Syst. Nat., ed. 10, 1758, 576 ; ed. 12, 1767, 955 [mellifica].
ID: 35062 mellifica Apis, v. mellifera, Linnaeus, Syst. Nat., ed. 12, 1766, 955."
Charles Davies Sherborn, "Index Animalium," Smithsonian Institution Libraries, 2017, http://www.sil.si.edu/DigitalCollections/indexanimalium/.

[131] Gordon R. McOuat, "Species, Rules and Meaning: The Politics of Language and the Ends of Definitiions in 19th Century Natural History," *Studies in History and Philosophy of Science,* no.4 (1996): 479-480.

[132] The Stricklandian code was named for Hugh Edwin Strickland (1811-1853). Strickland was a British ornithologist and geologist.

stated that the first name conforming to the Linnaean binomial system that was assigned to a species and accompanied by a complete description of that species would become the official name. A species with a commonly used name that did not meet the standard of the Law of Priority was to be abandoned in favor of the correct scientific name.[133] And this is how the honey bee changed its name again in the late nineteenth century.

Instrumental to this renaming was Frank Benton (1852-1919). He earned both his B.S. (1879) and M.S. (1886) at the Michigan Agricultural College (M.A.C., now Michigan State University). He was a well-known apiarist who became the federal Apicultural Agent at the U.S. Apiculture Station in Aurora, Illinois between 1891 and 1907. A lack of funding caused a step-out for him from 1896-1897. During his time at the Aurora Station, he focused on finding new bees from around Europe for importation to the U.S.[134] According to the January 27, 1914 issue of the *M.A.C. Record*, Benton traveled to Palestine "to investigate the bee industry, and as a result of his efforts there is now in this country a particular strain of bees known as Holy Land bees, which are scattered widely over the United States."[135] Langstroth stated that Benton was also the first person to successfully mail queens across the ocean in 1868.[136]

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[133] "The Code Online," eds. W.D.L. Ride (chair), H.G. Cogger, C. Dupuis, O. Kraus, A. Minelli, F.C. Thompson, and P.K. Tubbs, International Commission on Zoological Nomenclature (ICZN), 1999, http://www.iczn.org/iczn/index.jsp; James T. Costa, "Synonymy and its Discontents: Alfred Russel Wallace's Nomenclatural Proposals from the 'Species Notebook' of 1855-1859," *The Bulletin of Zoological Nomenclature,* no.2 (2013): 134-135.

[134] E.C. Martin, E. Oertel, N.P. Nye, and others, *Beekeeping in the United States* Agricultural Handbook Number 335, ed. the United States Department of Agriculture (Washington D.C.: U.S. Government Printing Office, 1980), 8.

[135] "Frank Benton Papers," Michigan State University Archives and Historical Collections, http://archives.msu.edu/findaid/062.html.

[136] L.L. Langstroth, *On the Hive and Honey Bee* (Hamilton: Charles Dadant & Son, 1889), 311

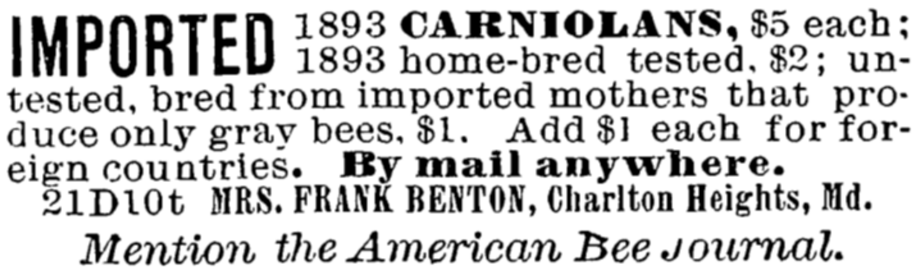

Figure 4 Advertisement in the *American Bee Journal* (*ABJ*), 1894.[137]

According to Benton himself, he was the first person to re-use Linnaeus' original name for the European honey bee – *Apis mellifera* – in his 1899 text*, The Honey Bee: A Manual of Instruction in Apiculture.* [138] This name first appeared early in chapter 1, "Of the genus *Apis* the only representative in this country is *mellifera*, although several others are natives of Asia and Africa."[139] Benton published an explanation for his use of the name *Apis mellifera* in the *American Bee Journal*, July 20, 1899 and in the *American Bee Keeper*, July, 1899, two of the most prominent beekeeping journals of the time. However, despite the extra effort by Benton to explain his use of the name *Apis mellifera* confusion still existed, among scientists as well as beekeepers, as evidenced by the 1900 request by Dr. A.J. Cook, Professor of zoology and entomology at Michigan Agricultural College, 1868-1893, for an explanation of Benton's use

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[137] Mrs. Frank Benton, "Advertisement for Carniolan Queens," *American Bee Journal*, no.3 (1894): 95.

[138] "As my own book (Bulletin No. 1, n. s., Division of Entomology, "The Honey Bee,") was the first work on apiculture, so far as I am aware, to use the term *Apis mellifera*, I may be allowed to explain the matter…After a careful examination of this subject I adopted the scientific name *mellifera* in the third edition of my " Manual," which appeared in the early part of 1899, and a brief statement of the reason was given by me in the American Bee Journal for July 20, 1899, page 456, and also in the American Bee keeper for July, 1899, page 128."
Frank Benton, "Scientific Names," *Gleanings In Bee Culture,* no.5 (1904): 232.

[139] Frank Benton, *The Honey Bee: A Manual of Instruction in Apiculture*, 3rd ed. (Washington D.C.: Government Printing Office, 1899), 11.

of *Apis mellifera*.[140] The reasons Benson gave for using *Apis mellifera* instead of *Apis mellifica* in his 1899 text were Dr. Karl Wilhelm von Dalla Torre's (1850-1928) publication of Linnaeus' earlier name for the honey bee – *Apis mellifera* – in volume ten of Dalla Torre's *Catalogus Hymenoptorum* and the establishment of the International Commission on Zoological Nomenclature (ICZN) in 1895 along with the rules of nomenclature this organization adopted.[141] For several years beekeepers continued to express confusion about the name change in beekeeping journals and newspapers, resulting in Benton once again publishing the reasons underlying the need for the name change in *Gleanings* in 1904.[142] Despite this, some lay people continued using *Apis mellifica* as late as 1920 in Oregon. In an article on the life of bees, Sheba Childs Hargreaves, an *Oregonian* journalist who focused on home and garden issues, used the term *Apis mellifica*:

> Zoologically speaking, the honey bee is known as *apis mellifica*. It belongs to the hymenoptera, the highest of the insects. If we except the silk worm, the bee is our most useful insect, and so far as intelligence is concerned, it divides honors with its cousin, the ant.[143]

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[140] Dr. Albert John Cook, "Professor of Biology, Pomona College, Claremont, and Curator Museum, 1894-1911. Conductor Agricultural extension work, University of California, 1894 to 1905. First to make kerosene emulsion (1877), and to demonstrate and advocate the use of the arsenites as a specific against the codling moth in 1880."
Natalie Huntley, "Dr. Albert John Cook," California State Officials Biographies 1911, http://freepages.genealogy.rootsweb.ancestry.com/~npmelton/stateb1.htm: Ancestry.com.
"A year or so later Prof. A. J. Cook, when revising his "Bee-keepers' Guide," for an edition which appeared in 1900 or 1901, wrote to this Department to learn our reasons for the change in the scientific name of the honey bee. The matter was referred to me, and I gave a full explanation with the references to the publications. This information he made, later, the basis of an extended article on the subject, which was published in the American Bee Journal for June 13, 1901, page 372. Prof. Cook also adopted the name *mellifera* in the next edition of his book."
Frank Benton, "Scientific Names," *Gleanings In Bee Culture,* no.5 (1904): 234.
[141] Benton; "About the ICZN," International Commission on Zoological Nomenclature, http://iczn.org/content/about-iczn.
[142] Gleanings was first started in 1873 by A.I. Root who wrote under the pseudonym of Novice.
[143] Sheba Childs Hargreaves, "Three Castes Live in Every Colony, Queens, Drones and Neuters – Utmost Respect Shown Mother of Swarm. Useless Insects Quickly Put Out of Way," *Sunday Oregonian* (Portland, OR), July 23, 1920.

Beekeepers not only wanted a scientifically correct name for their honey bees, they wanted to properly identify the sub-species, or race, of their bees for many of the same reasons the Stricklandian code was first developed for standardized nomenclature at the species level. Some bee sub-species were considered more valuable than others, and a lot of money and time were being invested in the breeding of a "coming" or perfect bee. Beekeepers and experiment station scientists looked to Darwinian ideas about species when discussing bee races. Each honey bee race was usually identified by the territory they originated from – Italians from Italy, Carniolans from Carniola, Holy Land bees from Jerusalem, and so on. The belief was that each honey bee race had developed particular characteristics because of the stresses that a particular environment had placed on the species *Apis mellifera* over an extended period of time. These sub-species had been isolated from each other long enough to develop behavioral and morphological characteristics that made them identifiably different from each other, but not so much so that they could not inter-breed: the definition of a variety, or sub-species, or "race." They had not yet become separate species. A.J. Cook wrote:

> In the study of races, which have been developed by Nature, and not man, we should always remember the environment. Where circumstances press hard, the law of natural selection, of necessity, produces greater excellence. We should expect then, that the Carniolan bees, the Italians, the Cyprians, and the Syrians, would each possess very valuable characteristics. The crowded colonies, the restricted areas, and, especially in Syria, the frequent and excessive drouths, all combine to weed out the less prolific, and the less industrious colonies. We might reasonably expect, then, to find in these races, longer tongues, larger honey-stomachs, increased industry, greater endurance and prolificness, than in races of a less trying environment.[144]

The use of regional names as the third part of the trinomial for a sub-species not only provided an obvious linkage to the environment responsible for the characteristics exhibited by each race, but

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[144] A.J. Cook, "Races of Bees," *American Bee Journal,* no.3 (1890): 39.

also was a nod to the ideas present in late 19th century American field-based zoology. Elliot Coues (1842-1899) and Joel A. Allen (1838-1921), two American ornithologists, created a set of nomenclatural rules that were adopted by the American Ornithological Union (AOU). These rules basically followed the Stricklandian code with the addition of a sub-species designator which referred to the geographic distribution of the species. In this AOU nomenclatural system each species could only be correctly identified when the three-part scientific name was used.[145] The AOU system was in direct opposition to the most basic tenet of the Stricklandian system, which was the idea that all parts of the scientific species name should be arbitrary, that they should not be descriptive. According to historian Gordon McOuat, “This [AOU system] was liable to abuse, and would destabilize [sic] the system of authority so deeply established by rules and by the museum."[146]

Linnaeus’ binominial system, while adopted universally by scientists, in no way eradicated the usage of common names. Beekeepers felt they needed to know their bees down to the subspecies level and often used only the common name for the subspecies, e.g. Italian or golden bees instead of *ligustica*. However, it was expected that all beekeepers would immediately associate the common name with the more scientific *Apis mellifera ligustica*, as beekeepers were expected to have read the latest bulletin sent out by the state experiment station or USDA, which would have used the scientific name for any bee they were discussing. Knowledge of scientific nomenclature was a sign of beekeepers’ professionalism as rational beekeepers.

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[145] Gordon R. McOuat, "Naming and Necessity: Sherborn's Context in the 19th Century,’’ ed. E. Michel, from *Anchoring Biodiversity Information: From Sherborn to the 21st century and beyond,* conference in London, January 7, 2016, 65.
[146] McOuat, 67.

2.9 The Italian Bee

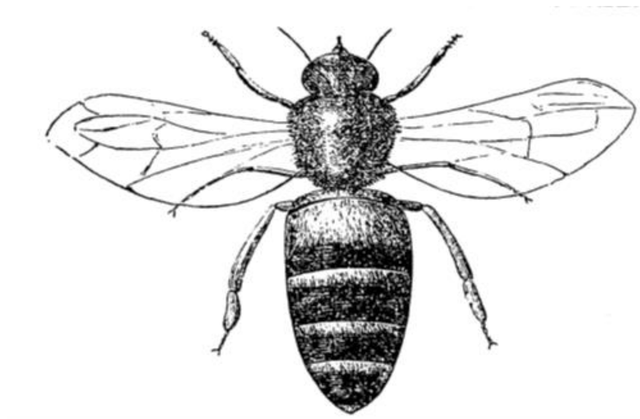

Figure 5 The Italian worker bee.[147]

References to Italian bees in beekeeping journals often skipped over the second part of the honey bee's scientific name and used a short-hand binomial system of genus and sub-species, e.g. *Apis ligustica*, instead of *Apis mellifera ligustica,* especially before the International Commission on Zoological Nomenclature (ICZN) was established. *Apis ligustica* was first named and fully described by Maximilian Spinola (1780-1857) in his *Insectorum Liguriae species novae aut rariores.*[148] Spinola found this bee in the Piedmont area, Liguria, in Italy, in 1805, and he believed this was the bee described by Aristotle.[149] Langstroth also espoused this view:

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[147] E.P., "The Italian Worker," *American Bee Journal,* no.4 (1861): 84.

[148] *Insectorum Liguriæ Species Novæ aut Rariores, quas in agro Ligustico nuper detexit, descripsit, et iconibus illustravit* was first published in 1806. The second volume*, Insectorum Liguriae species novae aut rariores, quae in agro Ligustico nuper detexit, descripsit et iconibus illustravit Maximilianus Spinola, adjecto Catalogo spiecierum auctoribus jam enumeratarum, quae in eadam regione occurrunt, Vol. 2*, was published in 1808. I am unsure from Langstroth's reference exactly which text Langstroth is referencing.

[149] This bee was also referred to as the Ligurian bee or the Alpine bee by beekeepers.
L.L. Langstroth, *On the Hive and Honey Bee* (Hamilton: Charles Dadant & Son, 1889), 282-283.

> The Italian bee, *Apis Ligustica*, spoken of by Aristotle and Virgil as the best kind, still exists distinct and pure from the common kind, after the lapse of more than two thousand years…it has victoriously stood the test of practical bee-keepers, side by side with the common bee. The ultimate superseding of the common bee by the Italian in this country [the United States] is but a matter of time.[150]

The Italian bees began their journey around the world in 1843 when Captain Baldenstein purchased a colony in Italy and had it transported to his home in Switzerland. Ten years later, Jan Dzierzon, who was the first to publish on honey bee parthenogenesis, worked through the Austrian Agricultural Society in Vienna to purchase a colony of Italians from Mira, Italy. Dzierzon used the artificial division (a.k.a. artificial swarming) method of increasing the number of Italian colonies in his possession. This process involves separating a robust colony into two colonies. There were many ways of achieving this, but one of the most common, and recommended by Frank Benton when there would be a heavy nectar-flow immediately following the division, was to move the queen along with a chunk of comb and worker bees into a new hive. If the old hive already had a mature queen cell, then the old hive would have a new queen within a few days. A second method recommended by Benton was to make nuclei. A nucleus is a small, starter hive with three to five frames containing sealed brood, unsealed brood, and stored honey and pollen that has been removed from the parent hive. Within twenty four hours the nucleus will begin creating a queen cell unless a new queen is introduced into the nucleus before that time. These nuclei can only be created early enough in the season to allow the nuclei to grow into full, strong colonies that will survive the winter. Benton told his readers that, "on the whole, a rational method of artificial increase is preferable to natural swarming; but experience and judgment in carrying it out are required to make it advantageous. It should be cautiously undertaken by the

[150] L.L. Langstroth, *On the Hive and Honey Bee* (Hamilton: Charles Dadant & Son, 1889), 283.

beginner."[151] According to Dzierzon, within the first year he grew his one colony of Italian bees into twenty seven using the artificial method, while Baldenstein had lost all pure Italian colonies within ten years because he had only used natural swarming to increase his colonies. It is easy to see the advantage to splitting your hives at the time of your choosing, rather than possibly missing the natural swarming of a colony. Additionally, any new colony created in this manner will be pure Italian as long as the Italian queen within the colony is bred with only Italian drones. As Dzierzon, in 1882, stated, I "have since that time sent away thousands of Italian stocks, swarms, and fertile queens, to all the countries of Europe, and even to America. By artificial division, extraordinary results may be attained."[152]

Samuel Wagner, who established the *ABJ*, attempted to import a colony of Italians to the United States in 1856, but all of the bees died during the voyage. Later, in 1859, Wagner partnered with Richard Colvin of Baltimore and they successfully imported a colony of Italians from Dzierzon's apiary. According to Langstroth, in the same year another group of Italian colonies from a different Italian apiary were also successfully imported to the United States by P.G. Mahan of Philadelphia.[153] However, Langstroth stated that the first "large successful importations were made by Adam Grimm of Wisconsin, in 1867, from the apiary of Prof. Mona of Bellinoza" and then by himself in 1874, from the apiary of "Signor Giuseppe Fiorini of Monselice, Italy."[154] When Langstroth's 1889 edition of *On the Hive* was published, he stated that "this valuable variety of the honey-bee is now extensively disseminated in North America."[155] Once

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[151] Frank Benton, *The Honey Bee: A Manual of Instruction in Apiculture*, 3rd ed. (Washington D.C.: Government Printing Office, 1899), 101.
[152] J. Dzierzon, *Dzierzon's Rational Bee-keeping: or The Theory and Practice of Dr. Dzierzon of Carlsmarkt*, ed. Charles Nash Abbott, Trans. H. Dieck and S. Stutterd, (London: C. N. Abbott, Houlston and Sons, 1882), 193.
[153] L.L. Langstroth, *On the Hive and Honey Bee* (Hamilton: Charles Dadant & Son, 1889), 287.
[154] Langstroth, 288.
[155] Langstroth, 288.

Langstroth established his Italians, he began selling Italian queens for $20 each, which is $533.20 in today's currency values.[156]

Figure 6 Lorenzo L. (L.L.) Langstroth at the age of 82.[157]

[156] Edwards claims L.L. Langstroth was the first to import Italian honey bees to the United States. David Edwards, "Moses Quinby America's Father of Practical Beekeeping," *Bee Culture Magazine*, November (2014).
Langstroth claimed his first importation of Italians was in 1863.
L.L. Langstroth, *On the Hive and Honey Bee* (Hamilton: Charles Dadant & Son, 1889), 288.
Langstroth talks in-depth about the attributes of Italians in his *On the Hive and the Honey Bee*. Langstroth, 282-288.
Consumer Price Index: 2016 Price = 1860 Price x (2016 CPI / 1860 CPI); $20 X (719.7/27); $20 X 26.66; 2016 price = $533.20.
"Consumer Price Index (Estimated) 1800-," Federal Reserve Bank of Minneapolis, https://www.minneapolisfed.org/community/financial-and-economic-education/cpi-calculator-information/consumer-price-index-1800.

[157] "Lorenzo L. Langstroth," *Gleanings In Bee Culture,* no.24 (1895): 929.

By 1881 even general agricultural journals like the *Northwestern Farmer* published in Portland, Oregon, were advocating Italians for those who wanted to start beekeeping.

> A gentleman, resident in the city, whose time is occupied from 7 a.m. to 6 p.m. in other duties, procured 5 colonies of Italians last spring, and gave them such care as he could. The cost and result of his experiment is as follows: Five colonies at $10, $50; 7 new hives at $2, $14, or a total of $64 outlay. He sold 240 pounds of comb honey during the season at 25 cents, $60, and had 7 new colonies of bees at $10, $70. Good as 200 per cent on his investment.[158]

Beekeepers who were successful with the common, or black, bee were also convinced to make a switch to Italians because of all of the discussion of their superiority by people who were considered authorities in beekeeping. Herbert Pruner of Douglas County, Oregon, was just such a beekeeper. He increased his colonies from nine to fourteen and harvested three hundred pounds of honey in 1889, but still intended to "Italianize" the following spring.[159]

Because of the great variation in morphological features in Italian honey bees and the subjectivity of evaluating behavioral characteristics within bee colonies, beekeepers often were confused about what type of bees they had – pure Italians, hybrids, a different but similar race, or a variety of the Italian race. J.H. Berry of Gales Creek, Oregon, wrote an article for the *ABJ* in 1894 that described a queen that was supposed to be a five-banded Italian, but that only had three bands. He was unsure if these three-banded bees were the same as the five-banded Italians.[160] This confusion also led to new beekeepers often getting something other than what they had thought they were purchasing. T.E.G. of Oregon City asked Dr. C.C. Miller (1831-1920) of the *ABJ*, in 1894, what he should do next as a

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[158] "Among our Exchanges: How to Commence Bee-keeping?" *American Bee Journal,* no.29 (1881): 229.
[159] Herbert Pruner, "A Report from Oregon," *American Bee Journal,* no.6 (1899): 94.
[160] J.H. Berry, "Wintering Bees in Oregon, Etc.," *American Bee Journal,* no.5 (1894): 147.

new beekeeper. T.E.G. had purchased twenty-three colonies of Italians, only to find out they were hybrid Italian/Black bees.[161]

H.F. Wilson, an entomologist for the Oregon Agricultural College, claimed that by 1909 there were two varieties of Italian bees in the United States. The first to be imported, which were leather colored and "which we still find as a standard," and in addition, "by a long process of selection, a secondary variety of the Italians has been evolved known as the Golden Italian."[162] Wilson claimed that beekeepers were not in agreement as to which of the varieties was the best for highly managed beekeeping, but he stated that either was better than the common, black bees which were much more excitable.[163]

Dr. Marla Spivak of the University of Minnesota, and Dr. W. Steve Sheppard, of Washington State University, claim that a total of eight Old World honey bee subspecies were imported to the United States, but only three became popular with American beekeepers – the Italians, the Carniolans, and the Caucasians. Modern bee breeders have changed their focus to "local, regionally adapted strains of honey bees through small scale queen production" and to bees that are more tolerant of mites and resistant to diseases.[164]

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[161] C.C. Miller, "General Questions: Transferring - Introducing – Poultry," *American Bee Journal,* no.11 (1894): 330.
Dr. C.C. Miller was a physician who gave up his medical practice to become a commercial beekeeper.

[162] H.F. Wilson, *Beekeeping for the Oregon Farmer* Extension Service Series II, No. 25, ed. The Oregon College of Agriculture Extension Service (Corvallis, OR: Oregon College of Agriculture Extension Service, 1909), 9.

[163] For more information on recent genetic analysis of Italian honey bees see: P. Franck, L. Garnery, G. Celebrano, M. Solignac, and J.M. Cornuet, "Hybrid Origins of Honeybees from Italy (Apis mellifera ligustica) and Sicily (A.m. sicula)," *Molecular Ecology,* no.9 (2000).

[164] Dr. Marla Spivak, and Dr. W. Steve Sheppard, "Current State of Knowledge of Bee Genetics, Breeding, and Best Management Practices," National Honey Bee Health Stakeholder Conference, Alexandria, Virginia, October 15-17, 2012, 20.

2.10 Oregon Honey Bees

Late nineteenth and early twentieth century honey bees were becoming intensively managed, but they were imperfectly domesticated. This meant that while vigilant beekeepers could manage many aspects of hive life, such as diseases, pests, and swarming, they did not always succeed and it was inevitable that some swarms would not be retrieved by Oregon beekeepers. One swarm that almost got away belonged to Mr. Keene in the Rock Creek area of Eastern Oregon. He noticed some of his bees going in and out of a crack in one of his pumpkins and when he opened the pumpkin he found the bees had created a small hive and had already stored six pounds of honey in their new pumpkin home![165] By the early twentieth century there was a healthy population of feral honey bees in Oregon and some of these feral colonies were "pure Italian bees."[166] The feral bee population led to successful honey tree hunting for many. George Stipp of Douglas County, Oregon, cut down six honey trees the summer of 1898, harvesting a total of 136 pounds of honey.[167]

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165 "Editorial," *American Bee Journal,* no.10 (1887): 147.
166 H.F. Wilson, *Beekeeping for the Oregon Farmer* Extension Service Series II, No. 25, ed. the Oregon College of Agriculture Extension Service (Corvallis, OR: Oregon College of Agriculture Extension Service, 1909), 5.
167 George Stipp, "General Items: Bees and Grapes - Fruit-Drying," *American Bee Journal,* no.5 (1898): 76.

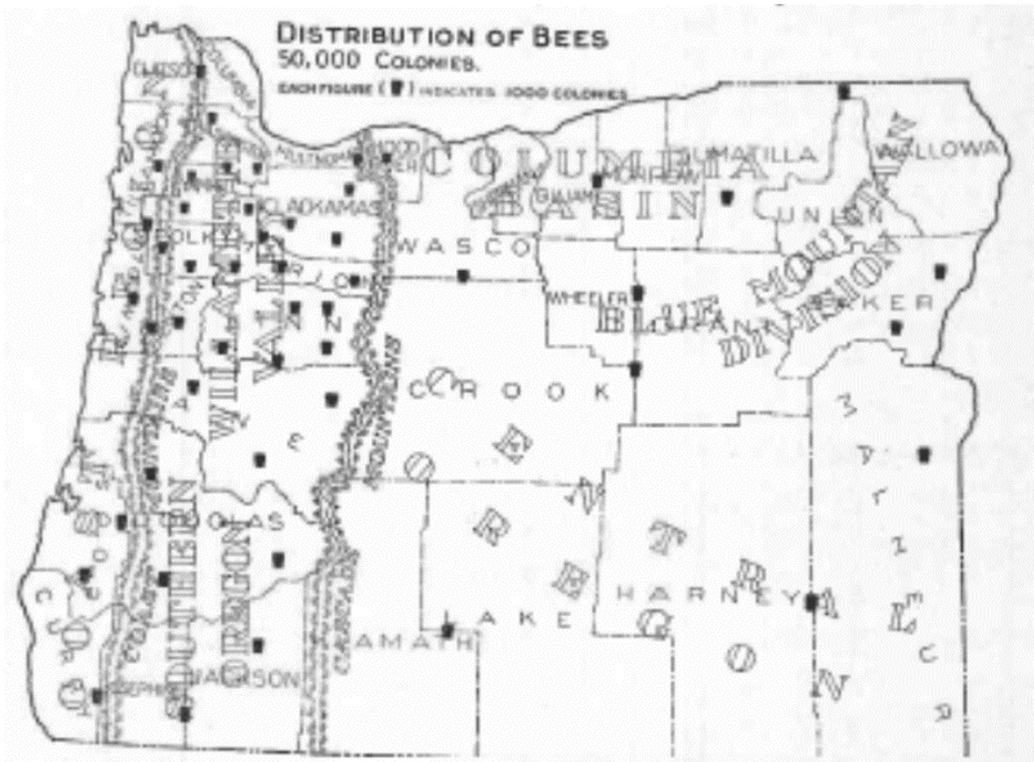

Figure 7 Oregon honey bee distribution map used by H.F. Wilson, 1909. Each hive-shaped icon indicates the presence of 1,000 honey bee colonies.[168]

According to the map above, used by O.A.C. entomologist Wilson, there were 50,000 managed colonies of honey bees in Oregon in 1909.[169] However Wilson also stated, “With such data as we have at hand, it would be impossible to estimate correctly the status of beekeeping in Oregon.”[170] One of the most misleading aspects of this map is that central Oregon, where most of the largest commercial apiaries were located in 1909, is under-represented, while southern Oregon is over-represented. This is because the general agricultural survey used to create this map only surveyed one apiary in southern

[168] H.F. Wilson, *Beekeeping for the Oregon Farmer* Extension Service Series II, No. 25, ed. the Oregon College of Agriculture Extension Service (Corvallis, OR: Oregon College of Agriculture Extension Service, 1909), 5.
[169] Wilson, 5.
[170] Wilson, 5.

Oregon, and it happened to be the largest. However, for the survey it was used as an average size to estimate the number of honey bee colonies in southern Oregon apiaries, which caused the number of honey bee colonies in southern Oregon to be grossly overestimated. In central Oregon only two medium-sized apiaries were surveyed and the average of these two apiaries was used to estimate the number of honey bee colonies present in central Oregon, underrepresenting the number of honey bee colonies in what Wilson called the area of Oregon with the largest commercial apiaries. Despite these issues, Wilson felt that on average the survey gave a good idea of the number of Oregon farms with bees in 1909, which was one in every four. These farms kept honey bees either as a source of honey for the family or as a source of additional income as well as family use. Since the 1910 census, Wilson claimed the number of honey bees in Oregon had increased both for small scale beekeepers and commercial beekeepers and he attributed this increase to the use of honey bees as pollinators for orchards.[171] I'll be talking more about honey bees and pollination in the chapter on pollination.

Both bees and new beekeepers were steadily arriving in Oregon by the early years of the twentieth century. In fact, Wilson claimed that "in eastern Oregon bees are usually imported in car load lots."[172] Newspaper stories about local beekeepers often included information about their beekeeping history: "Douglas Hewitt, 4210 Sixty-fifth street Southeast, [Portland, Oregon] who has several colonies of the honey makers, reported early swarming yesterday." Hewitt was a fairly recent immigrant to Oregon who had kept bees in both Kansas and Missouri before his arrival.[173]

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[171] H.F. Wilson, *Beekeeping for the Oregon Farmer* Extension Service Series II, No. 25, ed. the Oregon College of Agriculture Extension Service (Corvallis, OR: Oregon College of Agriculture Extension Service, 1909), 6.
[172] Wilson, "Development of Bee Culture in Oregon," *The Bee-keepers' Review,* no.1 (1915): 27.
[173] "Swarming Breaks Record," *Morning Oregonian* (Portland, OR), May 4, 1918, 1.

2.11 The Hood River Bee Man

As a case study of turn-of-the-twentieth-century beekeeping in Oregon, William W. Dakin is a good exemplar. He pursued more than one beekeeping product, in his case honey and selling queens; he kept up on beekeeping literature; and he wrote for the local newspaper, the *Hood River Glacier*. Dakin appears to be a large-sized commercial beekeeper for that period in Oregon and is an example of the type of beekeeper I can find as a historian. Unfortunately, the smaller beekeepers, or beekeepers who did not send letters to editors, win prizes at local or state fairs, contribute articles to various journals or newspapers, or present at beekeeping conferences can only be seen as reflections imposed by the beekeepers who did leave traces of themselves through these activities.

William W. Dakin was one of the two largest beekeepers in Hood River, Oregon in the early twentieth century.[174] An anonymous reporter for *The Hood River Glacier* in 1912 called him the "Hood River bee man."[175] He had over a hundred colonies placed in various locations around the city of Hood River as well as within the city. Dakin produced both queens and honey, moving the hives he used for honey production to various areas in the region, following the nectar flow. According to the *Glacier*, "Mr. Dakin will first take out the superfluous honey that is now in his hives and extract it and then he will load the hives on wagons and transport them to the fields of fire weed. They will be moved down the ridge toward the Columbia, as the blossoms of each district are relieved of their honey."[176] Dakin began this nectar-driven journey within the Cascade Range Forest Reserve, which included the land

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[174] A.J. Brunquist is identified as the second Hood River beekeeper of considerable size. "Bee Keepers Are Offered Premiums," *The Hood River Glacier* (Hood River, OR), July 17, 1913.
[175] "Dakin's Bees to Migrate," *The Hood River Glacier* (Hood River, OR), July 11, 1912.
[176] "Dakin's Bees to Migrate," 1.

above current Parkdale, Oregon "where fireweed, the best honey producer in the northwest, grows luxuriantly."[177] The Cascade Range Forest Reserve had been created in 1893 when land was added to the Bull Run Timberland Reserve. The name was changed at this same time. In 1908 the Cascade Range Forest Reserve was "dismantled into smaller forests" and "the Oregon National Forest was established, managed, and operated by the U.S. Forest Service." The name of the forest land above Parkdale would become the Mount Hood National Forest in 1924.[178] The *Glacier* concluded, "Mr. Dakin expects to have large fat hives by early fall."[179]

Hood River, Oregon was a campsite for Lewis and Clark in 1805, called Waucoma, or "place of big trees." The camp was near the confluence of Hood River, then called Dog River, and the Columbia. Hood River, the town, was incorporated in 1895 as a part of Wasco County. Later, in 1908, Hood River County was separated from Wasco County.[180] As the town of Hood River grew, owning an urban apiary became more problematic. A *Glacier* article in 1914 reported, "Councilman Taft, of the police committee, who on the presentation of a petition on complaint, investigated the apiary of W. W. Dakin, reported that there were 90 swarms of bees at the apiary and stated that he considered it a nuisance. The council accepted the report of Councilman Taft and instructed City Attorney Wilbur to take the necessary legal steps to abate the nuisance."[181] Despite whatever steps were taken by the City Attorney, Dakin continued with his urban apiary for many years.

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[177] "Dakin Leaves With Bees for Vacation," *The Hood River Glacier* (Hood River, OR), July 24, 1913.
[178] "History and Culture," U.S. Forest Service Mount Hood National Forest, https://www.fs.usda.gov/main/mthood/learning/history-culture.
[179] "Dakin's Bees to Migrate," *The Hood River Glacier* (Hood River, OR), July 11, 1912.
[180] "The City of Hood River," City of Hood River, http://ci.hood-river.or.us/pageview.aspx?id=18183
[181] "Sieg Declares Outlook Good," *The Hood River Glacier* (Hood River, OR), April 23, 1914.

The apples and pears produced at Hood River, Oregon are known world-wide as some of the best fruit grown, and the fruit growing tradition, as well as the reputation of the Hood River fruit, goes back to the late nineteenth century. The Fruit Growers' Club of Hood River was organized December 14, 1889 with forty members.[182] By the early twentieth century many orchardists had "a hive or two of bees in their orchards."[183] The expansion of fruit growing in Hood River illustrates the complexity of industrializing agriculture and is tied to two world wars, growing scientific knowledge, growing globalization and market forces, new technologies, and expanding and improving infrastructure. One aspect of industrializing fruit growing was an increased use of pesticides and as early as 1913 Dakin was expressing concern for his bees. An anonymous reporter for the *Hood River Glacier* told readers:

> W. W. Dakin, who has an apiary on the Heights warns the growers to be careful with their spraying while the apple blossoms are fully open. If they spray at this time they may kill thousands of bees, and thus rid themselves of some of their best friends. Many growers in the district now have bees to aid them in the pollenization [sic] of their fruit, and Mr. Dakin's warning will no doubt tend to prevent the death of many of the industrious insects.[184]

At this same time the Hood River County plant pathologist, Professor Lawrence, had "advised the growers that it would be well to have a hive of bees for every few acres."[185] Fruit growers were experiencing pressure from many sides as export fruit buyers demanded more and better quality fruit and agricultural scientists were telling them to use more pesticides and at the same time to use honey

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[182] C.P. Heald, "Hood River Fruit Growers' Club," in *First Biennial Report of the Oregon State Board of Horticulture,* ed. the Oregon State Board of Horticulture (Portland, OR: A. Anderson & Co., 1891).
Fruit Growers' Club of Hood River officers:
Chair – C.P. Heald
Secretary – N.C. Evans
Corresponding Secretary – E.L. Smith
Treasurer – T.R. Coon
[183] "Bee Keepers Are Offered Premiums," *The Hood River Glacier* (Hood River, OR), July 17, 1913.
[184] "Spray May Kill Many Working Bees," *The Hood River Glacier* (Hood River, OR), May 1, 1913.
[185] "Spray May Kill Many Working Bees."

bees for pollination. I will explore this complex relationship more fully in the chapters on the codling moth and pollination.

Dakin was also a successful queen breeder who mailed queen bees across the Atlantic Ocean as well as supplying more local beekeepers with new queens. "Each queen is placed in a small box about two or three inches long, a half inch deep and about an inch wide. The cover over one end is perforated so that the bee maiden that is going to rule over some distant hive may be able to secure air. The boxes are sent through the mail."[186] In 1921 there were only four Oregon queen breeders listed in the *First Annual Report of the Division of Apiculture to the Governor of Washington* and Dakin was the only queen breeder listed for Hood River.[187]

2.12 Conclusion

Beekeeping in the nineteenth century became an international pursuit, even in frontier areas such as Oregon. Beekeepers and honey bees were both European immigrants moving rapidly westward across the United States. Both changed the landscape and displaced Native populations, although in the case of the honey bee we know very little about possible Native pollinators that were displaced or that even went extinct because they were outcompeted by honey bees for pollen, nectar and space to create a hive. We do know that the feral honey bee population was about six miles in front of early white settlements on the eastern half of the U.S. and that geographic barriers like prairies and the Rocky Mountains blocked the advance of the feral honey bee, but did little to slow the advance of beekeepers who brought their managed colonies with them. In Oregon these first managed honey bee colonies

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[186] "Dakin's Bees to Migrate," *The Hood River Glacier* (Hood River, OR), July 11, 1912.
[187] "Dakin's Bees to Migrate."
I discuss foul brood in more depth in chapter 4.

would arrive by ship to the Isthmus of Panama, then travel overland to the Pacific where they once again boarded a ship for the trip north.

The knowledge early Oregon beekeepers brought with them was also international. Many of the earliest beekeeping books in North America were reprints, often under a different name and author, of established British works. Additionally, the earliest American beekeeping journals translated articles from British and European beekeeping journals and then printed them for their American readers. The names given to bees and the knowledge about honey bee breeding were a combination of European, British, and American ideas.

When American beekeepers wanted to create a “coming” bee they looked back to Europe and places even further away. One of the interesting aspects of early American beekeeping is that it was not just individual queen breeders looking for something exotic, and therefore worth more money, who were searching for new honey bee races to import, it was also the U.S. government. In the case of Frank Benton, a government apiculturist who also had a private queen breeding business overseen by his wife, we see the mixing of science and vocation, a theme that will appear over-and-over in this dissertation.

In the next chapter, Apples in Oregon, we see European immigrants bringing another European species, the apple tree, into the Northwest and then Oregon. The rapid expansion, with a few hiccups along the way, of the apple trees within Oregon, including a feral (abandoned) apple tree population, reflects the desire and ability of early Oregon immigrants to change their environments, as well as their reliance upon, and desire for, familiar comforts of home that could generate income.

3. Apples in Oregon

"The Hood River fruit industry has within the past ten years made fortunes for scores of men." – Hood River Commercial Club, 1909[188]

As the twentieth century began, before the world experienced its first world war, the Hood River Apple Growers' Association in Oregon began creating the perfect apple. Apples were already a popular, if common, fruit and Hood River apples were mostly good quality even after traveling to areas as distant as Australia and Japan. However, the Hood River Apple Growers' Association realized they were beginning to compete with other good apples from European colonies and, perhaps even more of a threat, they were now competing for consumers with the newly available tropical fruits like oranges, bananas and pineapples. Kathryn Cornell Dolan, has called these tropical fruits "a sign of Thorstein Veblen's conspicuous consumption" and reminds us that Henry David Thoreau (1817-1862), in *Wild Fruits*, based his discussion of "domestic and international expansion and commercialization, even imperialism" on the international fruit market of the mid-nineteenth century.[189]

I will expand on Hood River, Oregon's decision to produce, brand and market perfect apples for a global market in the chapter on the codling moth. However, we first have to understand how Hood River, Oregon became a center for apple production. The people who became the first Hood River apple growers were not the usual turn of the twentieth century American orchardists. Their decision to pursue a niche high-end market to the exclusion of local markets speaks to their ambition, their view of the world as a global marketplace, and the reason they needed a perfect apple.

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[188] *Hood River, Oregon* (Hood River, Oregon: Hood River Commercial Club, 1909), 2.
[189] Kathryn Cornell Dolan, *Beyond the Fruited Plain Food and Agriculture in U.S. Literature, 1850-1905* (Lincoln: University of Nebraska Press, 2014), 93-94.

3.1 Apples Arrive in the Pacific Northwest

In 1869, just eighteen years after the first apple was produced in Oregon, the Oregon State Agricultural Society (OSAS) published data collected by an OSAS committee on the "Agricultural Development, and Natural and Industrial Resources" of Oregon.[190] At this time there were twenty-two counties in Oregon and only six counties were growing apples commercially. These early Oregon commercial apple growers were mainly in the Willamette Valley and produced enough apples to ship 3197 packages of dried apples out of Portland, Oregon down to San Francisco, California in the first half of 1869.[191] From the beginning, Oregon apple production focused on distant markets.

Apples are not native to the Pacific Northwest or even to North America. In fact, they are an exotic species imported to North America by early colonists who used the apples mainly for cider and other processed apple products as well as animal food. The story of how apples were first introduced in the Pacific Northwest is a romantic tale of happenstance.[192] In the 1820s Captain Simpson of the Coast Survey Service was preparing to leave for the Pacific Northwest when he was invited to a dinner party in London. Apples were served at the end of the meal and one of the women "took the seeds from an apple that she was eating and dropped them into the pocket of Captain Simpson's waistcoat, with the

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[190] A.J. Dufur, *Statistics of the State of Oregon; Containing a description of its agricultural development, and natural and industrial resources. Together with the physical, geographical, geological and mineral statistics of the state* (Salem, OR: Office of the "Willamette Farmer," 1869).
[191] The county of Hood River would not be established until 1908 and the area that would be Hood River county was not growing apples at this time.
These packages of dried apples are of unknown size.
[192] There are many versions of this story and Terri Taylor does a good summation in her report.
Terri A. Taylor, "Fort Vancouver Cultural Landscape Report: I. FORT VANCOUVER: 1824-28," National Parks Service, 1992, http://www.nps.gov/parkhistory/online_books/fova/clr/clr2-1c.htm.

admonition that when he reached this Northwest wilderness he should plant them."[193] The Captain forgot about this event and a year later he was once again the guest of honor at a dinner party, this time at Fort Vancouver, and he was wearing the same waistcoat. Captain Simpson found the seeds in his pocket during the dinner and gave them to the Fort's gardener, who planted them. From these seeds two apple trees sprouted, probably the first apple trees anywhere in the Pacific Northwest.[194]

As with most stories of early settlement, some aspects have become confused, forgotten, or mythical. In this case Captain Aemilius Simpson was a real person who was at Fort Vancouver in November of 1826.[195] Further support for Captain Simpson being the person responsible for the first apple trees in the Pacific Northwest comes from at least two prominent early Oregon residents. Narcissa Whitman's journal, 1836, mentions a man who put the seeds of grapes and apples in his pocket during a London dinner party and who then went to the Pacific Northwest where he left the seeds, which were planted and, by the time she made her journal entry, these seeds had multiplied greatly.[196] In 1868, Jesse Applegate, who had come to Oregon in 1843, told a friend a story about Captain Simpson similar to the one above stating that he had gotten it directly from John McLoughlin, Chief Factor of the Hudson's Bay Company stationed at Fort Vancouver from 1825 to 1846.[197] One alternate version, provided by Dr. James Robert (J.R.) Cardwell, a dentist and the first president of the Oregon State Board of Horticulture, has a group of young Hudson Bay Company men at a London dinner party where several

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[193] E.W. Allen, "A Review of the Fruit Industry," in *The Second Biennial Report of the Oregon State Board of Horticulture,* ed. the Oregon State Board of Horticulture (Salem, OR: Frank C. Baker, State Printer, 1893), 99.
[194] Allen.
[195] Terri A. Taylor, "Fort Vancouver Cultural Landscape Report: I. FORT VANCOUVER: 1824-28," National Parks Service, 1992, 62, http://www.nps.gov/parkhistory/online_books/fova/clr/clr2-1c.htm.
[196] Taylor, 63.
[197] "John McLoughlin," Oregon State Archives, http://sos.oregon.gov/archives/exhibits/highlights/Pages/john-mcloughlin.aspx.

young women put the seeds of apples, grapes, and all the other fruits offered after dinner into the young men's pockets, telling the men they should have them planted when they arrived at the fort. This the young men did, giving the seeds to James Bruce, the company's gardener, who planted them in 1825.[198]

3.2 The Land of the Big Red Apples

Figure 8 Seth Lewelling, early Oregon nurseryman and originator of the Bing cherry.[199]

The story of Henderson Luelling, who brought yearling fruit trees from Iowa to Oregon by wagon train in 1847, has also been told by many people in many places, including Seth Lewelling, Henderson's

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[198] J.R. Cardwell, *Brief History of Early Horticulture in Oregon* (Portland, OR: *n.p.*, 1906), 4.
[199] Seth Lewelling, "Horticulture in Early Days," in *The Second Biennial Report of the Oregon State Board of Horticulture,* ed. the Oregon State Board of Horticulture (Salem, OR: Frank C. Baker, State Printer, 1893), 244; Earl Pearcy, "Pioneers in Oregon Horticulture No. 2 Seth Lewelling, Pioneer Nurseryman of Oregon. Originator of Black Republican and Bing Cherry," *The Oregon Grower,* no.5 (1922): 9.
There is some confusion about who the originator of the Bing cherry actually was. In a 1907 issue of *Better Fruit* that credit goes to a different person, named Bing. A photo of Bing, "originator of the Bing cherry" can be found at:
"How to Form Fruit Growers' Associations," *Better Fruit,* no.9 (1907): 11.
Dr. J.R. Cardwell claims Seth Lewelling originated the Bing cherry and named it after a "failthful old Chinaman."
Cardwell, 6.

brother, at the October 1892 meeting of the Oregon State Board of Horticulture.[200] The young, grafted trees were stubbed into boxes full of soil and loaded onto Henderson Luelling's two wagons. The boxes were heavy and the trees needed consistent and frequent watering, making the six month trip to Oregon even more difficult. However, Henderson persevered and finally settled in Milwaukie, Oregon, clearing a forested area where he could plant an orchard and his nursery stock.[201] William Meek, another Oregon immigrant who planned to start a nursery in Oregon, brought apple seeds with him on his journey. He probably chose apple seeds because they were so much easier to transport than young apple trees. However, there was a big drawback to bringing seeds, since apple seeds do not breed true to their source and you never know what you will end up with when planting an apple seed. The fruit Henderson's apple trees would produce was assured of being the same as that produced by the tree the scions were taken from. These young trees would eventually be the donors of more scions that Henderson could use to expand his nursery stock, providing assurance to his customers that they were planting the variety of apple they thought they were buying.

These two men, Luelling and Meek, created a partnership, and the first nursery in Oregon, in 1848.[202] For the next two years they struggled to find appropriate root stock to graft slips onto, until

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[200] According to Pearcy, Henderson Lewelling preferred to spell his last name "Luelling" while Seth, Henderson's brother, spelled his last name "Lewelling."
Earl Pearcy, "Pioneers in Oregon Horticulture No. 2 Seth Lewelling, Pioneer Nurseryman of Oregon. Originator of Black Republican and Bing Cherry," *The Oregon Grower,* no.5 (1922).
Cardwell discusses why the brothers used two different spellings for their last name.
J.R. Cardwell, "President's Report," in *First Biennial Report of the Oregon State Board of Horticulture,* ed. the Oregon State Board of Horticulture (Portland, OR: A. Anderson & Co., 1891), 12; Seth Lewelling, "Horticulture in Early Days," in *The Second Biennial Report of the Oregon State Board of Horticulture,* ed. the Oregon State Board of Horticulture (Salem, OR: Frank C. Baker, State Printer, 1893).
Seth arrived in Oregon in 1850, bringing fruit seeds from back east.
[201] In an area that was part of the Meek donation land claim.
Lewelling.
[202] Cardwell.

they purchased some fruit tree seeds from Mr. Pugh, a recent Oregon immigrant. Luckily some of these seeds produced saplings that worked as root stock for Luelling and Meek's grafts. In 1851 they got the first fruit from their grafted trees.[203] Dr. J.R. Cardwell stated in 1891:

> It is related, that one root graft in the nursery the first year bore a big red apple, and so great was the fame of it, and such the curiosity of the people, that men, women and children came from miles around to see it, and made a hard beaten track through the nursery to this joyous reminder of the old homestead so far away.[204]

In 1853 the Luelling brothers and Meek put 100,000 grafted trees in four nursery locations.[205] These nurseries sold hundreds of young apple trees to homesteaders who wanted an apple tree or two for their own use. The nurseries were also the source of apple trees that created the first Oregon apple orchards, established in the French Prairie, Waldo Hills, and Salem areas of the Willamette Valley. At that time the common apple varieties available in Oregon were the American Pippin, Baldwin, Blue Pearmain, Genet, Gloria Mundi, Gravenstein, Jennetting, Little Romanite, Rambo, Red Astracan, Red Cheek Pippin, Red June, Rhode Island Greening, Seek-no-further, Spitzenburg, Summer Sweet, Swaar, Talman's Sweet, Talpahockin, Virginia Greening, Waxen, White Winter Pearmain, Winesap, and a "spurious Yellow Newtown Pippin – since called Green Newtown Pippin – a worthless variety which has since caused much trouble to nurserymen, orchardists and fruit buyers" according to Dr. Cardwell.[206] A

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[203] Seth Lewelling, "Horticulture in Early Days," in *The Second Biennial Report of the Oregon State Board of Horticulture,* ed. the Oregon State Board of Horticulture (Salem, OR: Frank C. Baker, State Printer, 1893).

[204] J.R. Cardwell, "President's Report," in *First Biennial Report of the Oregon State Board of Horticulture,* ed. the Oregon State Board of Horticulture (Portland, OR: A. Anderson & Co., 1891), 12-13.

[205] By 1850 two more Oregon nurseries had been established and, perhaps in response to this competition, Luelling went back east for new stock. Like the first Oregon honey bees these trees arrived in Oregon by way of the Isthmus of Panama.
Lewelling.
By 1857 both Henderson Luelling and Meek had quit the nursery business leaving it to Seth Lewelling. Cardwell, 14.

[206] Cardwell, 13.

few of these varieties can still be purchased at local farmer's markets in Oregon, such as Gravenstein, Pippin, Winesap and even the Spitzenburg. Most of these apples were multi-purpose apples used for eating, cooking, drying, and cider. Many of the ones still familiar to us are those that could be stored for long periods of time, providing a reminder in the dead of winter that warmer days were coming.

Henderson Luelling sold one of the first boxes of apples produced by his orchard on a street corner in Portland. It did not take long for a crowd to gather and Luelling sold individual apples for one dollar apiece, the equivalent of $29 an apple today, earning a total seventy-five dollars.[207] Soon he and other Oregon orchardists were selling boxes of apples for as much as one dollar a pound to Portland retailers who then sold the apples to the public for a dollar and fifty cents a pound. Encouraged by this

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Baldwin – a late season good keeping apple used for eating, cooking and drying;
Blue Pearmain – a late variety of eating, cooking and drying apple (the bloom is blue);
Gloria Mundi – an eating apple famous for its large size;
Gravenstein – mid-season eating, cooking and drying apple;
Newton Pippin – a very late season good keeping apple used for eating, cooking, drying and cider;
Rambo – an eating, cooking and drying apple;
Red Astracan – an early eating, cooking and cider apple;
Red June – an early cooking, drying and cider apple;
Rhode Island Greening – a late season good keeping apple used for eating, cooking, drying and cider;
Spitzenburg – a late season good keeping apple used for eating, cooking and drying;
Swaar – an eating apple best after being stored for a period;
Talpahockin (aka Fallawater) – a late season cooking and drying apple;
Virginia Greening – a late season good keeping apple;
White Winter Pearmain – an eating apple;
Winesap – a late season good keeping apple used for eating, cooking, drying and cider;
Talman's Sweet, Summer Sweet, Genet, Jennetting, Seek-No-Further, American Pippin, Red Cheek Pippin, Little Romanite, Waxen – unknown.
Many of these varieties can be found at one of the following websites:
Orange Pippin, https://www.orangepippin.com/apples/n.
Vintage Virginia Apples Albemarle Ciderworks, https://www.albemarleciderworks.com/orchard/apple-varieties.

[207] $1 in 1850 is worth $29.37 in 2017. His 75 apples would have sold for a total $2,203 today! "Consumer Price Index (Estimated) 1800-," Federal Reserve Bank of Minneapolis, https://www.minneapolisfed.org/community/teaching-aids/cpi-calculator-information/consumer-price-index-1800; J.R. Cardwell, *Brief History of Early Horticulture in Oregon* (Portland, OR: *n.p.*, 1906), 12.

success Henderson Luelling became the first to export Oregon apples outside of the state, in 1853. This first export market was San Francisco, where Luelling earned one dollar a pound for his apples. Other Oregon apple growers quickly followed Luelling's example and that fall other Oregon orchardists shipped their first boxes of apples to San Francisco. These first few boxes of apples were so valuable the boxes were strapped in iron to prevent thieves from stealing apples from the boxes. Upon arrival in San Francisco the apples were sold for two dollars a pound, the equivalent of $59 a pound today. This started the Oregon apple-rush. The very next year Oregon orchardists shipped five hundred bushels of apples to San Francisco, selling between a dollar and fifty cents to one dollar a pound.[208] The next year, 1855, Oregon orchardists shipped six thousand bushels of apples to San Francisco, selling for twenty to thirty dollars a bushel. As the young Oregon orchards matured into full production Oregon fruit-growers produced twenty thousand bushels of apples in 1856.[209]

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[208] Seth Lewelling claimed Henderson Luelling's first San Francisco box of apples sold for one dollar a pound, but Cardwell claimed they sold for two dollars a pound. Seth's account of early Oregon apple production is more conservative in many respects than Cardwell's.

[209] J.R. Cardwell, "President's Report," in *First Biennial Report of the Oregon State Board of Horticulture,* ed. the Oregon State Board of Horticulture (Portland, OR: A. Anderson & Co., 1891); Seth Lewelling, "Horticulture in Early Days," in *The Second Biennial Report of the Oregon State Board of Horticulture,* ed. the Oregon State Board of Horticulture (Salem, OR: Frank C. Baker, State Printer, 1893); J.R. Cardwell, *Brief History of Early Horticulture in Oregon* (Portland, OR: *n.p*., 1906).

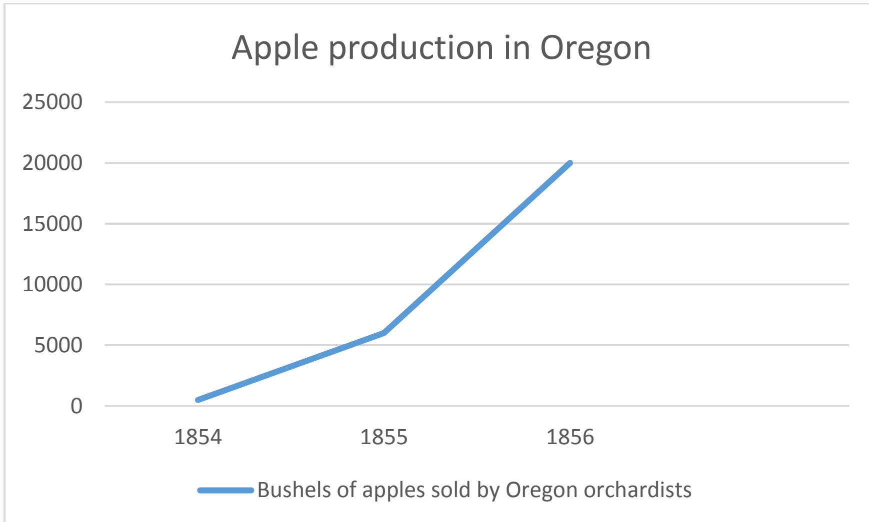

Table 3.1 Chart created by Brenda Kellar, 2018.

From 1856 to 1869 there were bi-monthly shipments of Oregon apples to San Francisco during apple season, consisting of the fall and winter months. Each steamer carried, on average, between three and six thousand boxes of apples. The nine years between 1860 and 1869 saw a slow decrease in the number of Oregon apples headed to San Francisco as California apple orchards began to mature and produce their own apple crop. By 1870 only winter varieties that would hold until the California apple crop ripened were shipped fresh from Oregon and those amounted to only a few boxes per steamer. California apples, which ripened before Oregon's earliest varieties, were being shipped to Oregon.[210] The flow of export fruit had reversed.

Price dropped rapidly as more Oregon orchards matured and more Oregon apples were shipped to California and in 1856 plummeted to only twenty-five cents a pound. According to Seth Lewelling, "from that time the price tended constantly downward" as Oregon apples began competing with

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210 J.R. Cardwell, "President's Report," in *First Biennial Report of the Oregon State Board of Horticulture,* ed. the Oregon State Board of Horticulture (Portland, OR: A. Anderson & Co., 1891), 14.

California apples in the marketplace.[211] The Oregon apple-rush was over and many Oregon apple orchards were abandoned, becoming the perfect place for newly arrived apple diseases and pests to thrive.[212]

A few years later, in the 1870s, falling rail freight prices helped to make new export markets in Alaska, Australia, British Columbia, China, Japan, Louisiana, Mexico and Texas accessible to Oregon fruit growers, renewing their interest in producing apples.[213] Kathryn Cornell Dolan claims that the first time a refrigerated train car was used to transport agricultural items was in 1849, while Barbara Krasner-Khait, states that the refrigerated railroad car was patented by J.B. Sutherland of Detroit, Michigan in 1867.[214] The earliest refrigerated train cars were cooled with ice and one of the reasons for this innovation was to transport meat to the miners scattered across America. Fred Albert Shannon (1893-1963), historian and author of *The Farmer's Last Frontier*, stated that "marketing methods were more thoroughly worked out on the West coast. While the Easterner grew fruits mainly for local consumption, the Pacific states were in the business of supplying the nation."[215] This was especially true once the fourth transcontinental railroad, after 1880, created more competition in shipping prices and the development of refrigerated train cars increased the distance fresh fruit could be shipped. However,

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[211] Seth Lewelling, "Horticulture in Early Days," in *The Second Biennial Report of the Oregon State Board of Horticulture,* ed. the Oregon State Board of Horticulture (Salem, OR: Frank C. Baker, State Printer, 1893), 243-244.
[212] J.R. Cardwell, *Brief History of Early Horticulture in Oregon* (Portland, OR: *n.p.*, 1906), 13.
[213] H.B. Miller, "Fruit Production and Markets," in *The Second Biennial Report of the Oregon State Board of Horticulture,* ed. the Oregon State Board of Horticulture (Salem, OR: Frank C. Baker, State Printer, 1893).
[214] Kathryn Cornell Dolan, *Beyond the Fruited Plain Food and Agriculture in U.S. Literature, 1850-1905* (Lincoln: University of Nebraska Press, 2014); Barbara Krasner-Khait, "The Impact of Refrigeration," *The History Magazine,* no.February/March (2018).
[215] Fred A. Shannon, *The Farmer's Last Frontier Agriculture, 1860-1897*, *The Economic History of the United States* (Armonk: M.E. Sharpe, Inc., 1973), 262.

even with these innovations Shannon claimed that “there were problems of furnishing a consistent stream of goods, so as to maintain the markets."[216] In 1910 a contributor to *Better Fruit* claimed that “the market for the Pacific Coast apples is not likely to reach into the million dollar class until the completion of the Panama canal.” Their expectation was that most shipments of fruit from the Pacific coast would be transported by refrigerated steamships at that point.[217]

The old abandoned orchards mainly composed of poor keepers or apples that did not transport well, continued to provide sanctuary for apple pests and diseases, and by the 1890s these spaces were such a nuisance for new fruit-growers that much of the educational efforts of horticultural associations focused on how to handle the old orchard problem. These old orchards were one of the main motivations for increased spray schedules. No matter how well cared for your orchard might be, there was probably an old, abandoned apple tree (or several) somewhere nearby where pests and diseases were continually reproducing and then infesting your trees. The codling moth chapter below investigates this issue in more detail.

3.3 Stronger Together

“Orcharding is an art for the hobbiest and a science for the commercial fruit grower.”[218]

Oregon fruit-growers banded together to fight newly introduced diseases and pests, especially the codling moth. Several independent groups came and went, or merged with other organizations,

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[216] Fred A. Shannon, *The Farmer's Last Frontier Agriculture, 1860-1897*, *The Economic History of the United States* (Armonk: M.E. Sharpe, Inc., 1973).
[217] "Europe as a Market for our Apples and Pears," *Better Fruit,* no.3 (1910): 34.
[218] Abram Sharples, "Some Observations In the Orchard," in *First Biennial Report of the Oregon State Board of Horticulture,* ed. the Oregon State Board of Horticulture (Portland, OR: A. Anderson & Co., 1891), 115.

before the state government stepped in. The Oregon Pomological Society was created in 1885 and in October of that year members gathered in the courthouse at The Dalles, Oregon, a town east of Portland along the Columbia River, where they elected W. Lair Hill (1838-1924) as president and James A. Varney as secretary.[219] W. Lair Hill was a prominent Oregon attorney and editor of the Portland newspaper *The Oregonian* from 1872 to 1877. After leaving *The Oregonian* he moved to The Dalles for his health and took up fruit growing.[220] James A. Varney was a fruit grower who would become the Oregon State Board of Horticulture (OSBH) Commissioner for district four, which included The Dalles, and in 1890 would become the Oregon State Fruit Inspector. Despite the prestigious membership, the Oregon Pomological Society did not succeed. The secretary of the Oregon Pomological Society, E. P. Roberts stated in 1891, just six years after the creation of the organization, that "the society has not met since May 31, several of the officers being absent or sick. We hope to re-organize and get to work soon."[221]

The Fruit Growers' club of Hood River (FGHR) organized December 14, 1889, with 40 members. The FGHR Chair was C.P. Heald, a Hood River fruit grower, and the corresponding secretary was E.L. Smith, who owned a thirty acre commercial apple orchard in Hood River and who would become the Oregon Horticultural Society (OHS) President four years later and the

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[219] All elected officers: President – W. Lair Hill; Vice-President – C. Waters; Treasurer – E. Schanno; Directors – T.M. Denton, G.R. Snipes and S. Creighton; and Secretary – James Varney.
E.P. Roberts, "Oregon Pomological Society," in *First Biennial Report of the Oregon State Board of Horticulture,* ed. the Oregon State Board of Horticulture (Portland, OR: A. Anderson & Co., 1891), 137-138.
Tripti Joshi, "William Lair Hill," Alchetron, https://alchetron.com/William-Lair-Hill.
[220] "Hill, William," Oregon Genealogy Trails, http://www.genealogytrails.com/ore/wasco/biographies/bio2.html.
[221] Roberts, 138.

Oregon State Board of Horticulture (OSBH) President in 1900.[222] The FGHR held a “grand basket picnic” June 1890 in Hood River as a booster activity.

> Believing that an extended acquaintance, and friendly gathering of those engaged in fruit growing will be mutually beneficial, and that the delightful ride up the Columbia will give zest to such a meeting. The club extends a cordial invitation to you and your friends to participate.[223]

The club had convinced the Union Pacific to charge a reduced rate for the roundtrip from the Willamette Valley to Hood River on the day of the picnic.

Evidently this was successful enough to replicate, without the picnic, in 1893. The second train excursion to Hood River was both a booster activity and an apple competition to determine whose apples would be sent to the 1893 World’s Fair in Chicago. Growers from the Willamette Valley and Columbia Gorge were invited as well as the Washington Press Associations. George F. Sargeant, secretary of the OSBH, and Fred T. Smith, “horticultural commissioner for the South Australian Agricultural Society and correspondent for several Australian papers” were among the train passengers headed to Hood River. On display were over a hundred varieties of apples including the “Gloria Mundi, some of which, by actual measurement, exceeded 13 inches in circumference.”[224] These two examples of the cooperation between the railroads and agriculturalists illustrate their shared economic interest in increasing

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[222] Edwin Battistella, "Pears and the Pear Industry," The Oregon Encyclopedia, https://oregonencyclopedia.org/articles/pears_the_pear_industry/#.WqBxGnxG3IV.
The FGHR secretary was N.C. Evans and the treasurer was T.R. Coon.
C.P. Heald, "Hood River Fruit Growers’ Club," in *First Biennial Report of the Oregon State Board of Horticulture,* ed. the Oregon State Board of Horticulture (Portland, OR: A. Anderson & Co., 1891).
[223] "To Horticulturalists," *The Corvallis Gazette* (Corvallis, OR), May 30, 1890, 1.
[224] Upon reaching Hood River the passengers were met by C.L. Smith, chair of the reception committee, C.P. Heald and Emile Schanno.
"Fruits of Oregon," *The Oregonian* (Portland, OR), October 1, 1893, 6.

production and export sales. Unfortunately, the Fruit Grower's club of Hood River, like many local clubs, seems to have faded quickly.

In 1889 the Oregon Legislative Assembly created Oregon State Board of Horticulture (OSBH).[225] "The OSBH is not a society, but is an official organization of the state, and is wholly distinct from the Oregon State Horticultural Society."[226] The Board was composed of "six members, who shall be appointed by the Governor, one from the State at large, and one from each of the five horticultural districts."[227] Each district commissioner had to reside within their district. One purpose of the board was to prevent the spread of diseases and pests of fruit and fruit trees, and to ensure that packaging of fruit products including fruit, scions, nursery stock and any "transportable articles dangerous to orchards, fruits, and fruit trees" was disease and pest-free.[228] The original five districts were:

> First District: Multnomah, Clackamas, Yamhill, Washington, Columbia, Clatsop & Tillamook Counties
> Second District: Marion, Polk, Benton, Linn & Lane Counties
> Third District: Douglas, Jackson, Josephine, Coos, Curry & Lake Counties
> Fourth District: Morrow, Wasco, Gillam, Crook & Sherman Counties
> Fifth District: Baker, Wallowa, Malheur, Grant & Harney Counties

As more Oregon counties were established these districts were modified to reflect those changes and Hood River County, once it was established in 1908, became a part of district four. Dr. J.R. Cardwell was President, R.S. Wallace was Treasurer, and Ethan W. Allen was Secretary in

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[225] J.R. Cardwell and E.W. Allen, "Report" in *First Biennial Report of the Oregon State Board of Horticulture,* ed. the Oregon State Board of Horticulture (Portland, OR: A. Anderson & Co., 1891).
[226] Secretary of the Oregon State Board of Horticulture, letter to Lorian P. Jefferson, Research Secretary, Agricultural College, Amherst, Mass., July 24, 1914.
[227] Cardwell and Allen, 6.
[228] Cardwell and Allen, 7.

1889 when the OSBH was first organized. Dr. Cardwell would remain President of the OSBH until 1899.[229]

Unlike the OSBH which was a government supported entity, the Oregon Horticultural Society, a professional organization for horticulturists, had been established in 1885. This organization was closely allied with the Horticulture Department at the Oregon Agricultural College (OAC) and, once extension activities were established at OAC, a custom arose whereby the horticulturalist for extension activities was the secretary of the Oregon Horticultural Society.[230] The OAC, originally named Corvallis College and currently named Oregon State University, became Oregon's Land Grant college in 1862 and struggled for the next twenty years to sustain both a budget and a student body. The Hatch Act, 1888, helped to create the experiment station associated with OAC and provided for more college staff focused on agricultural issues. By 1911 OAC faculty were doing a lot of work for communities outside of the Corvallis area and the Board of Regents established the OAC Extension Service.[231] It would not be until 1914 that the Smith-Lever Act would create an extension service at every Land Grant College.

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229 The Oregon State Board of Horticulture (OSBH) was established at a meeting in Salem, OR, in 1889. By 1893 Klamath County was added to the third district, and Umatilla and Union counties were added to the fifth district.
The Second Biennial Report of the Oregon State Board of Horticulture, ed. the Oregon State Board of Horticulture (Salem, OR: Frank C. Baker, State Printer, 1893), preface.
Klamath County was not established until 1882, however Union and Umatilla counties were established in the 1860s. Their late inclusion may be due to not having any serious fruit producers in that area, or OSBH not having the ability to serve those remote areas.
230 "Oregon State Horticultural Society Records, 1890-1964," Oregon State University Libraries, Special Collections and Archives Research Center, http://archiveswest.orbiscascade.org/ark:/80444/xv28050/pdf.
231 "Oregon State University Extension Service: Our History," Oregon State University Extension Service, http://extension.oregonstate.edu/about/our-history.

Professional standards and new techniques were conveyed by a number of journals directed at orchardists. This is especially true for those journals published by fruit growers' associations or unions, which included many of the most popular fruit growing journals. *Better Fruit*, a journal originally published and edited by E.H. Shepard and E.A. Franz in Hood River, was supported by subscriptions and advertising for the first year. However, this became unsustainable, and *Better Fruit* changed organizational affiliation several times throughout the twentieth century.[232] This journal was created with progressive ideals of efficiency and production in mind: an early editorial stated, "This is the age of specialism...Now, fellow growers, we are giving you an opportunity to have a reliable, clean, moral, up-to-date fruit paper, devoted solely to the one subject of better fruit."[233] W.H. Paulhamus, the manager of the Puyallup and Sumner Fruit Growers Association, wrote the first article in the first issue, titled "Importance of Fruit Growers Associations."

The Oregon Growers' Cooperative Association had a very informal start that included meetings held by like-minded people within the Umpqua and Willamette Valley communities for several years before formally organizing June 16, 1919.[234] This organization also published a journal – *The Oregon Grower* – begun in August 1919 and which had a circulation of about 10,000 within the first few years of publication.[235] C.I. Lewis, Chief of the Division of Horticulture

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[232] Official publication of the Northwest Fruit Growers Association, Dec. 1907-June 1918; of: Washington State Apple Advertising Commission, Nov. 1938-June 1951; of: Oregon-Washington Vegetable & Fruit Growers Association, Mar.-June 1967.
"Better Fruit," Internet Archive, https://archive.org/details/CAT30991733051.
[233] "Better Fruit," *Better Fruit,* no.1 (1906): 22.
[234] Robert Murkland Haley, "The Oregon Growers Cooperative Association With an Analysis of the Causes for its Failure" (M.S., Oregon Agricultural College, 1927) 16.
[235] Haley, 37-38.

at OAC and Vice Director of the Oregon Experiment Station for fourteen years, became the Assistant General Manager for the Oregon Growers' Cooperative Association, sometime around 1920, where he remained until May of 1922, moving on to become Managing Editor of *American Fruit Grower*, "the largest fruit paper in America."[236]

As early at 1899 Dr. N.G. Blalock, a physician and president of the Northwest Fruit Growers' Association, told attendees of the Northwest Fruit Growers' Association annual meeting held in Walla Walla, Washington:

> The papers read before our association by able teachers and professors in our agricultural colleges and practical businessmen engaged in the fruit business and allied branches have so ably and scientifically presented their subjects as to have a great influence in directing and moulding the public mind in the way it should go in order to attain the highest degree of perfection and it does seem to me that there is scarcely any excuse left for the businessman, who has been able to avail himself of these advantages by attending these meetings and listening to the wise, scientific, up-to-date teachings of these able men and has failed to do so.[237]

Within the Oregon fruit growing world, holding office in a society, union, association, or other professional group, as well as contributing articles to and, at times editing, professional journals was an excellent way to establish a position of authority within fruit growing circles. This brief review of some of the people involved with some of these early organizations and journals makes it clear that these authority figures participated in a variety of these activities and groups and I suggest that the more often their names appeared within publications created by the organizations, the greater their authority grew. Name recognition is an accepted standard of measurement for someone's right to speak on any subject that matters, even today.

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[236] Earl Pearcy, "C.I. Lewis," *The Oregon Grower,* no.9 (1922): 7.
[237] N.G. Blalock, M.D., "President's Address," Northwest Fruit Growers' Association Conference, Spokane, WA, January 24-27 (Tacoma, WA: Horticulturist Publishing Co., Printers, 1899), 4-5.

3.4 Hood River, Oregon

> "It is a highly specialized fruit region which has developed its own name, its own methods, and determined its own success. In many respects it is entirely different from other important apple-growing districts." – S.M. Thomson, Scientific Assistant & G.H. Miller, Assistant Agriculturist, both for the USDA Office of Farm Management, 1917[238]

In 1852, Nathaniel Coe and his family began setting up their homestead "at what is today the heart of Hood River City" located about sixty three miles east of Portland, along the Columbia River.[239] That first year they set out orchards which did well enough to encourage later Hood River settlers also to plant orchards. However, it was not until 1890 that the first commercially important orchards were planted.[240] According to the homestead application of Frank Sherrieb, he had planted 600 fruit trees by fall of 1891.[241] An early apple orchardist, Peter Mohr, had 400 apple trees consisting of 43 varieties in 1893.[242] Some of the early Hood River orchardists therefore committed to large orchard investments, despite fruit growing being a new endeavor with little to no local guidance.

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[238] S.M. Thomson and G.H. Miller, *The Cost of Producing Apples in Hood River Valley* Bulletin 518, ed. the Office of Farm Management, United States Department of Agriculture (Washington, D.C.: USDA, 1917), 5.

[239] *History of Hood River County, Oregon 1852-1982*, ed. the Hood River County Historical Society (Dallas, TX: Taylor Publishing Company, 1982), 12.

[240] Thomson and Miller, 8; *History of Hood River County, Oregon 1852-1982*.

[241] *History of Hood River County, Oregon 1852-1982*. 41.

[242] *History of Hood River County, Oregon 1852-1982*. 13.

In 1893 James Varney listed Peter Mohr as owner of a new orchard in the Hood River area. Other new orchards (fruit type not specified) in Hood River were owned by: M.V. Rand; Mr. Turner; Mr. Calkin; B. Warren; Mrs. Hutton; W. J. Baker (mostly apples); and several others that are not named. D.K. Ordway is listed as the owner of an older orchard in the Hood River area. C.P. Heald is identified as purchasing a badly neglected orchard that Varney did not think possible to rehabilitate.

James A. Varney, "Report of Inspector of Fruit Pests," in *The Second Biennial Report of the Oregon State Board of Horticulture,* ed. the Oregon State Board of Horticulture (Salem, OR: Frank C. Baker, State Printer, 1893), 61-63.

In 1893 the Hood River Fruit Growers' Union was incorporated, the first farmers' cooperative in the Pacific Northwest, and just three short years later construction of Cascade Locks along the Columbia River was completed, allowing Hood River fruit to travel more quickly to Portland and from there to more distant markets.[243] By 1912 the Hood River Fruit Growers' Union had more than a hundred members and between 1908 and 1912 "this association raised the price of apples from 85 cents to $2.50 and $3.15 per box, according to grade and variety of the fruit. Apples shipped to England in 1906 netted the Hood River growers $1.32 per box for the same grade that sold for 85 cents in the United States" according to James B. Morman, A.M., and securities examiner for the Federal Government.[244] In a 1908 letter written by the OSBH to Professor S.A. Beach, Director of Horticulture at Iowa State University, the OSBH writer claimed that the reputation of the Hood River Fruit Growers' Union was so firmly established that Eastern purchasers no longer required inspection before purchase of the association's apples.[245]

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[243] James B. Morman, "Business Cooperative Organizations in Agriculture," in *Cyclopedia of American Agriculture: A Popular Survey of Agricultural Conditions, Practices and Ideals in the United States and Canada*, ed. L.H. Bailey (New York, NY: The Macmillan Company, 1912); *History of Hood River County, Oregon 1852-1982*, ed. the Hood River County Historical Society (Dallas, TX: Taylor Publishing Company, 1982), 13.
Hood River Fruit Growers' Union Articles of Incorporation and By-Laws.
C.I. Lewis, *The Apple From Orchard to Market*, Bulletin No. 94, ed. the Department of Horticulture (Corvallis, OR: Oregon Agricultural College Press, 1907).
[244] Morman, 262.
"The Hood River organization now has a membership of over one hundred and controls approximately ninety per cent of the fruit of the valley. In four years it has been able to raise the price from 85 cents to $3.15 for the best grade of Spitzenbergs, and $2.50 for the best Yellow Newtowns. The prices range somewhat as regards size and quality. As an experiment this past fall the association sent nine carloads of fall apples to England. These apples were selling here at approximately 85 cents a box. After all expenses were paid they netted the Hood River growers $1.32 per box."
Lewis, 1.
[245] Oregon State Board of Horticulture, letter to S.A. Beach, Head of Horticulture, Iowa State College, November 18, 1908.

While the Hood River Fruit Growers' Union concentrated mainly on marketing strawberries, intensifying apple production in the Hood River area encouraged the creation of a cooperative specifically for apples, the very successful Hood River Apple Growers' Association, established sometime before 1907 and now known as Diamond Fruit Growers, Inc.[246] The Hood River Historical Society claims: "Its formation, then considered a daring and radical idea, was an act of desperation following years of bumper crops without adequate storage facilities and lowered prices resulting from a flood of apples glutting the markets across the country."[247]

Because of the multiple hats worn by many in the apple growing business, it is not surprising that in 1906 the manager of the Hood River Fruit Growers' Union and the manager of the Hood River Apple Growers' Association were the same person, E. H. Shepard.[248] Additionally, as I mentioned above, 1906 is the year that E.H. Shepard and his partner started the horticultural journal *Better Fruit*. Shepard was steeped in orchard culture as his father had been a successful pioneering California pear grower and Shepard himself owned a forty acre orchard in Hood River.[249]

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[246] Oregon State Board of Horticulture, letter to S.A. Beach, Head of Horticulture, Iowa State College, November 18, 1908.
[247] *History of Hood River County, Oregon 1852-1982*, ed. the Hood River County Historical Society (Dallas, TX: Taylor Publishing Company, 1982), 14
The Hood River Apple Growers' Association "motto founded on long years of experience, viz: 'Hood River can successfully compete against the world in the fruit industry, but she cannot successfully compete against herself.'"
"Association Returns are Flattering," *The Hood River Glacier* (Hood River, OR), June 15, 1916.
[248] E.H. Shepard and E.A. Franz, "List of Fruit Growers Unions and Horticultural Societies," *Better Fruit,* no.9 (1907): 16.
[249] "E.H. Shepard Born to Fruit Business," *The Hood River Glacier* (Hood River, OR), May 27, 1915.

The Hood River Branch of the OAC Experiment Station opened in 1912 with LeRoy Childs becoming the entomologist in 1914 and the superintendent in 1916.[250] Gordon G. Brown arrived in 1916 to fill the role of Horticulturist. The Hood River Historical Society states that at the time the Experiment Station was established in Hood River "carload lots of Hood River apples were winning prizes for excellence. Superficially it seemed that there would be little for him [Brown] to do."[251]

In 1915 the USDA chose Hood River as one of three important apple growing areas in the United States where they undertook a study of the cost of apple production. The other two areas were the Wenatchee Valley, Washington and Western Colorado. Hood River was the last of the three studies to be completed and printed.[252] As a part of this study the USDA compared the Hood River area to average conditions within other areas of rural America and they found Hood River superior in many ways, with a more educated community, more costly and larger farm homes situated closer to town and to each other, electricity, telephones and churches, which allowed the farmers and their families to participate in a rich social and artistic lifestyle. Rather than generalized farming, most Hood River farmers specialized in intensive fruit farming

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250 *History of Hood River County, Oregon 1852-1982*, ed. the Hood River County Historical Society (Dallas, TX: Taylor Publishing Company, 1982), 15.
Office and lab facilities were rented in Hood River and the following appointments were made – Mr. C.C. Starring as Horticulturist, and Mr. J.R. Winston as Plant Pathologist. Entomological investigations were headed by Mr. Leroy Childs, Assistant Entomologist of the Oregon Agricultural College Experiment Station.
A.B. Cordley, *Report of the Hood River Branch Experiment Station for 1913-1914*, ed. the Oregon Agricultural College Experiment Station (Corvallis, OR: Oregon Agricultural College, 1915).
251 *History of Hood River County, Oregon 1852-1982*, 42.
252 S.M. Thomson and G.H. Miller, *The Cost of Producing Apples in Hood River Valley* Bulletin 518, ed. the Office of Farm Management, United States Department of Agriculture (Washington, D.C.: USDA, 1917), 1.

on small acreages which left little room for anything other than some hay for horses and a kitchen garden. The average price of land for a working orchard in Hood River was $1,000 an acre and S.M. Thomson and G.H. Miller, the authors of the USDA study, attributed this high price to the history of successful fruit growing and the natural beauty of the area, which attracted a high number of settlers: "the price of land increased with the demand for it, and finally rose to a figure which practically prohibited the man of small means from purchasing land suitable for growing fruit. Men with considerable capital settled in Hood River Valley."[253]

Other areas that focused on intensive fruit production, like the Wenatchee, Washington area, was probably closer to what Thomson and Miller expected of such a region. Many of the Wenatchee orchardists in the early twentieth century lived in Chicago and hired orchard managers to live in Wenatchee and run the business. According to the Hood River Glacier in 1910:

> A Wenatchee paper tells of the recent organization of the Wenatchee Club, of Chicago, with 30 members. The club is composed of persons who own land in the Wenatchee country and who contemplate going there eventually to raise apples…The greatest handicap for Hood River doing what Wenatchee has done in the eastern city is that Hood River orchard owners generally move on to their places right away and do not stick around in their former homes long enough to form a club. They are anxious to get here that they may enjoy the pleasures of the climate and the Hood River life instead of just buying a place to work at long distance and make a fortune. Hood River orchardists get as much pleasure out of living here as they do out of the money they make from their crops[254]

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[253] S.M. Thomson and G.H. Miller, *The Cost of Producing Apples in Hood River Valley* Bulletin 518, ed. the Office of Farm Management, United States Department of Agriculture (Washington, D.C.: USDA, 1917), 14.
"We were told that some of the land we passed was valued at from $250 to $1,000 per acre, and we think that it was too much for any land to be worth for orchard purposes."
Purcell C. McCue, "A Virginian in Hood River," *American Fruit Grower,* no.1 (1916): 5.
[254] "Hood River Clubs," *The Hood River Glacier* (Hood River, OR), November 10, 1910.

Of the fifty-four Hood River farms studied by the USDA, the average size was about thirty-nine and a half acres with twelve and a half acres of producing fruit trees (mainly apple) and just over six acres of young trees. The largest farms in Hood River were owned by pioneers of the area with extensive agricultural experience specific to the Hood River area ecosystem.[255] The fruit growers who owned the fifty-four orchards participating in the study were mostly composed of college graduates and retired professional men or tradesmen, a demographic Thomson and Miller claimed was typical for Hood River fruit growers. A good example of this Hood River farmer was E.H. Shepard who had a bachelor's degree in philosophy and belonged to several Portland and Hood River cultural and fraternal associations as well as being a business man, journalist, and fruit grower.[256]

Just before the USDA study, the OAC Division of Horticulture began a four-year study in 1911 on the *Economics of Apple Orcharding* in the Pacific Northwest.[257] The study included a thousand orchards located in Oregon, Washington, Idaho, and British Columbia. One interesting observation from this study was that "the average fruit ranch maintains too many horses for economical management."[258] At this time there were fifteen automobiles and one hundred and one horses in Hood River.[259] The OAC study also emphasized the importance of matching the

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[255] S.M. Thomson and G.H. Miller, *The Cost of Producing Apples in Hood River Valley* Bulletin 518, ed. the Office of Farm Management, United States Department of Agriculture (Washington, D.C.: USDA, 1917).
[256] "E.H. Shepard Born to Fruit Business," *The Hood River Glacier* (Hood River, OR), May 27, 1915.
[257] C.I. Lewis and H.A. Vickers, *Economics of Apple Orcharding,* Experiment Station Bulletin 132, ed. the Oregon College of Agriculture Experiment Station (Corvallis, OR: Oregon Agricultural College, 1915).
[258] Lewis and Vickers, 3.
[259] "Summary of Assessment Roll, Hood River County," Book 4, (Salem, OR: Oregon State Archive, 1915). Miller and Thomson found that Wenatchee averaged two horses per orchard in 1914.
G.H. Miller and S.M. Thomson, *The Cost of Producing Apples in Wenatchee Valley, Washington*, USDA Bulletin No. 446, ed. the Office of Farm Management, United States Department of Agriculture (Washington D.C.: USDA, 1917).

apple variety to the specific location of the orchard. The USDA report found that Hood River growers focused mainly on two varieties – Yellow Newtown and Esopus (a.k.a. Spitzenbergs[260]) – which, although not as heavy bearing as most other varieties, Thomson and Miller claimed grew to "perfection" in the Hood River valley.[261]

C.I. Lewis and H.A. Vickers, authors of the OAC report, noted that the fruit growers of Hood River were finally keeping thorough and accurate records of their operations. One of the main reasons for this study was that data obtained by surveys in previous years had been based on fruit growers' best guesses rather than actual data. This OAC study consisted of an outline of possible costs sent to fruit growers to be filled out, followed periodically by more forms sent to the fruit growers asking for additional information. Personal correspondence with many of the growers and site visits for some orchards helped Lewis and Vickers fill in missing information and gather information on maintenance that they did not believe could be obtained in any other manner. This is similar to the method used by S.M. Thomson and G.H. Miller of the USDA in their study.[262] Lewis and Vickers wrote, "We have already had the pleasure of noting, however, that,

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260 C.I. Lewis and H.A. Vickers, *Economics of Apple Orcharding,* Experiment Station Bulletin 132, ed. the Oregon College of Agriculture Experiment Station (Corvallis, OR: Oregon Agricultural College, 1915), 93. "These varieties, viz: Spitzenbergs and Newtowns, represent practically two thirds of the apples shipped through the Association."
"Association Returns are Flattering," *The Hood River Glacier* (Hood River, OR), June 15, 1916.

261 S.M. Thomson and G.H. Miller, *The Cost of Producing Apples in Hood River Valley* Bulletin 518, ed. the Office of Farm Management, United States Department of Agriculture (Washington, D.C.: USDA, 1917), 7.

262 "The Office of Farm Management has therefore developed the method of studying cost of production by means of the farm survey, in which information is obtained from a large number of farmers by direct interviews. In many instances it has been possible to compare averages thus obtained with accurate records, and the results justify the conclusion that when the survey method is properly and skillfully used the information obtained by it is ordinarily as accurate as the results secured in carefully conducted field experiments."

as a result of our work the past three years, a much keener interest has developed on the part of the growers. For example, men who could give us nothing two or three years ago, are now keeping accurate accounts of their costs and realize the benefit of this work."[263]

There have been many interpretations of expertise within the progressive era, some of which I touched on in the introduction. Historian, Alan I. Marcus, in 1985, who saw three levels of expertise within farming at the beginning of the progressive era, 1870 to 1890. Systematized agriculture, where record-keeping was viewed as data collection within a personalized agricultural system, married rational farming and vocational experience. Scientific farmers were between systematized farmers and agricultural scientists, like the USDA and experiment station scientists. These scientific farmers had some training in chemistry, geology, meteorology, botany, horticulture, biology, zoology, or entomology and based conclusions on informed observations. Marcus has claimed that disagreements between the scientific farmers, often public events taking place in professional journals or at conferences, were impossible to resolve because their expertise was based on personal experience and informed observation, which led to professional journals filled with conflicting expert advice and a general devaluation of agricultural expertise. According to Marcus, agricultural scientists, using experiment, which required informed observation and detailed recordkeeping, grabbed the expertise vacuum with relative ease because systematic and scientific farmers were disorganized and therefore unable

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G.H. Miller and S.M. Thomson, *The Cost of Producing Apples in Wenatchee Valley, Washington*, USDA Bulletin No. 446, ed. the Office of Farm Management, United States Department of Agriculture (Washington D.C.: USDA, 1917), 1.

[263] C.I. Lewis and H.A. Vickers, *Economics of Apple Orcharding,* Experiment Station Bulletin 132, ed. the Oregon College of Agriculture Experiment Station (Corvallis, OR: Oregon Agricultural College, 1915), 6.

to make a concerted objection to the basis for agricultural scientists' claims of expertise.[264] As I mentioned in the introduction, in 1996 historian, Paolo Palladino, emphasized the similarity of method between early entomologists who worked in the field, using observation and recordkeeping as markers of research advancement, and farmers whose experience and authority had also been created in the field through observation and recordkeeping.[265] In Hood River at the beginning of the twentieth century, fruit growers and agricultural scientists wore multiple hats, with professional fruit growing organizations and journals being the overlapping arenas between farmers and scientists. I argue that the personal success some farmers brought to their arguments was difficult to refute, giving their words more weight than Marcus allows for in this schema.

3.5 Predictable Perfection

> Fresh from London and the thrills of Zeppelin raids, S. B. Moomaw, general European agent of the [Hood River] Apple Growers Association and other prominent apples sales agencies throughout the northwest, arrived here last week for his annual conference with local shippers. Mr. Moomaw is the largest distributor of American boxed apples in Europe, and despite the chaotic conditions attendant on the European war has by his close study of the workings of the foreign market succeeded in the past year in placing at handsome prices 200,000 boxes of the Northwest's fruit abroad. Seventy five per cent of the apples handled by the foreign agent were shipped by the local Association. The total tonnage sent abroad last year from the Northwest reached 428,655 boxes. "More than 60 per cent of this," says Mr. Moomaw, "was consumed in the British Isles." – Hood River Glacier, June 8, 1916[266]

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[264] Alan I. Marcus, *Agricultural Science and the Quest for Legitimacy Farmers, Agricultural Colleges, and Experiment Stations, 1870-1890* (Ames: Iowa State University Press, 1985).

[265] Land-grant colleges produced agricultural scientists who were often the sons of farmers, creating a progressively deeper relationship between farmers and agricultural scientists.
Paolo Palladino, *Entomology, Ecology, and Agriculture The Making of Scientific Careers in North America, 1885-1995* (UK: Harwood Academic Publishers, 1996), 23.

[266] "Moomaw Optimistic Over Foreign Deal," *The Hood River Glacier* (Hood River, OR), June 8, 1916.

Because most Hood River fruit growers belonged to the Hood River Apple Growers' Association or some other cooperative organization, the growers' goal was to create an apple that was consistent across orchards, with the same quality and packaging. Fruit growers across Oregon were not trying to distinguish themselves from their fellow fruit growers, they were trying to create a product that was homogenous with the product their fellow association members were creating. In the early twentieth century it seems that Oregon growers believed the best way to achieve consistency in packaging was to create legislation that made clear what was acceptable for all Oregon growers, whether they belonged to an association or not, "Establishing Standard Sizes of Apple Boxes (Chapter 123, Laws of 1911)."[267]

The apple grading and packing rules for the Hood River Apple Growers' Association were printed in the 1917 OSBH *Biennial Report*. Extra Fancy (Blue Diamond grade), Fancy (Red Diamond grade), and Defiance, or Mountain, (C grade) were the only three grades allowed to be sold in boxes. Each apple, no matter the grade, had to be handpicked and "free from all insect pests, worms, worm holes, infectious diseases, skin puncture, bruises or broken skin."[268] At this time each boxed apple was individually wrapped in a paper specifically sized and labeled for the

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[267] "Be It Enacted by the People of the State of Oregon: Section 1. There is hereby created and established a standard size for apple boxes for the State of Oregon. Section 2. The standard size of an apple box shall be eighteen inches long, eleven and one-half inches wide, ten and one-half inches deep, inside measurement. Section 3. That the special size of apple boxes shall be twenty inches long, eleven inches wide, and ten inches deep, inside measurement."
"Establishing Standard Sizes of Apple Boxes," in *The Fourteenth Biennial Report of the Board of Horticulture, State of Oregon,* ed. the Oregon State Board of Horticulture (Salem, OR: State Printing Department, 1917), 43.

[268] "Standard Packing and Grading Rules of the Apple Growers Association, Hood River, Oregon," in *The Fifteenth Biennial Report of the Board of Horticulture, State of Oregon,* ed. the Oregon State Board of Horticulture (Salem, OR: *n.p.,* 1919), 131.

grade of apple it would cover.[269] Additionally, each apple was to be wiped, so as to present a clean, bright appearance when the customer removed the wrapper. Only some varieties of apple were allowed in each grade and each variety needed to meet the color standard for that variety, i.e. Spitzenbergs had to have "not less than three-fourths good red color."[270] Each box had to be labeled to conform with the example given (figure 9).[271] In the upper left corner is the size (number of apples in the box) and on the upper right corner is the grower's number. Each packer was also given a number and this number was stamped in the upper right of the opposite end of the box. By 1921 the Hood River Apples Growers' Association was handling about seventy percent of apples grown in the Hood River Valley.[272]

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[269] "As we are advertising very extensively it is very important that you pack all the Blue Diamond grade under the Blue Diamond wraps; the Red Diamond grade under the Red Diamond wraps and the Combination grade, being the Blue and Red combined, is shipped out under our Red Diamond label and must be wrapped in Red Diamond paper. The misuse of this printed paper would work to the detriment of your association."
"Standard Packing and Grading Rules of the Apple Growers Association, Hood River, Oregon," in *The Fifteenth Biennial Report of the Board of Horticulture, State of Oregon,* ed. the Oregon State Board of Horticulture (Salem, OR: *n.p.,* 1919), 133.

[270] "Standard Packing and Grading Rules of the Apple Growers Association, Hood River, Oregon," 130.

[271] "Standard Packing and Grading Rules of the Apple Growers Association, Hood River, Oregon," 134.

[272] Gordon G. Brown, *Hood River Apple Orchard Management With Special Reference to Yields, Grades, and Value of Fruits* Experiment Station Bulletin 181, ed. the Oregon Agricultural College Experiment Station Hood River Branch (Corvallis, OR: Oregon Agricultural College, 1921), 9.

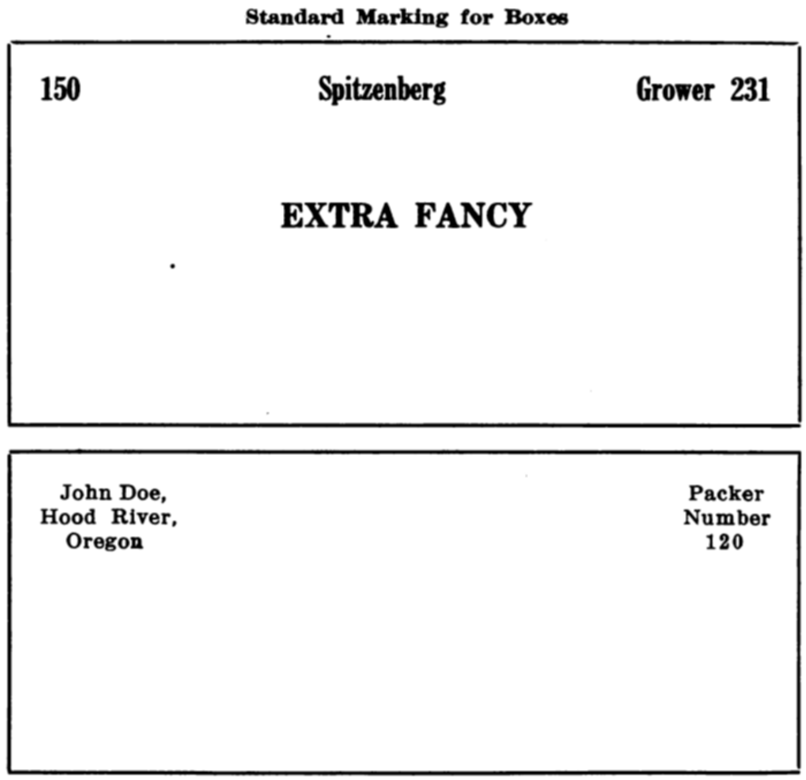

Figure 9 Apple Box Labels.[273]

Four years later the Oregon horticultural organizations, apple growers' associations and their growers once again decided that voluntary compliance by association members was not sufficient, that there needed to be a statewide standard for apples and packing, and in May of 1921 legislation went into effect that did just that.[274] This legislation went beyond the 1911 legislation that mandated specific box sizes for apples to mandated statewide apple grades. These new grades kept some aspects of the Hood River Apple Growers' Association grades with the extra fancy grade also identified as blue grade, and the fancy grade also identified as red

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[273] "Standard Packing and Grading Rules of the Apple Growers Association, Hood River, Oregon," in *The Fifteenth Biennial Report of the Board of Horticulture, State of Oregon,* ed. the Oregon State Board of Horticulture (Salem, OR: *n.p.,* 1919), 134.
[274] "Standard Grading Rules for Oregon," *The Hood River Glacier* (Hood River, OR), September 22, 1921.

grade. The other three grades included in this legislation were C grade, combination, and orchard run. All five grades were still required to be handpicked, but now fancy apples were allowed one healed worm sting and C grade were allowed two healed worm stings. Additionally, C grades were now only required to be "practically free from infection, bruising, or broken skin."[275] Interestingly this legislation was unenforceable.

> Growing and shipping of apples and pears under the Oregon standard rules are not compulsory, but any individual or association desiring to ship under the rules, may upon application to the state board of horticulture have the fruit inspected and certified that it has been graded and packed in accordance with the law. The cost of inspection shall be paid by the shipper.[276]

Between 1913 and 1918 the Hood River branch OAC Experiment Station undertook a study, authored by Gordon G. Brown, Horticulturist, which looked at who the Hood River apple producers were and what successful apple producers were doing differently from unsuccessful producers. Fifty one Hood River orchards were included in the study and all data referring to "yields, grades, sizes, and prices per box were taken from accurate records, secured from the books of the selling agent" with all other data based on the best estimate of the orchardists.[277] Despite Lewis' claim, in 1915, that his study had helped Pacific Northwest fruit growers realize the value of keeping thorough and accurate records, at least at the beginning of Brown's study he did not find that to be the common practice in Hood River. During the six years of Brown's study he found there were two distinct epochs – 1913 to 1915 when clean tillage (a.k.a. clean

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[275] "Standard Grading Rules for Oregon," *The Hood River Glacier* (Hood River, OR), September 22, 1921.
[276] "Standard Grading rules for Oregon."
[277] Gordon G. Brown, *Hood River Apple Orchard Management With Special Reference to Yields, Grades, and Value of Fruits* Experiment Station Bulletin 181, ed. the Oregon Agricultural College Experiment Station Hood River Branch (Corvallis, OR: Oregon Agricultural College, 1921), 4.

cultivation) was the norm and apple scab populations were little understood and growing rapidly; and 1916 to 1918 when cover crops and chemical fertilizers were the norm and spray schedules were fine-tuned.[278]

The idea behind clean tillage was to reserve all soil nutrients for the trees, in the belief that even nitrogen-fixing crops could remove, or block, other essential nutrients and water from the soil that otherwise would be available to the trees in the orchard. Clean tillage was also believed to reduce insect pests because there was no cover that could provide food or shelter for pests in various larval, imago, and adult stages.[279] As early as 1907 some agricultural scientists were recommending a cover crop because established orchards were clearly suffering from depleted soils.[280] This recommendation was founded on the premise that nitrogen-fixing plants could add nutrients to the soil and that they, and other non-nitrogen fixing plants, could be tilled into the soil as green fertilizer. In Hood River irrigation for orchards became available in 1897, at least on the west side of the valley.[281] The USDA study in 1917 found that orchards in

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[278] "Since 1916 very little loss has occurred from apple-scab."
Gordon G. Brown, *Hood River Apple Orchard Management With Special Reference to Yields, Grades, and Value of Fruits* Experiment Station Bulletin 181, ed. the Oregon Agricultural College Experiment Station Hood River Branch (Corvallis, OR: Oregon Agricultural College, 1921), 5.

[279] E.R. Lake, *The Apple in Oregon*, Experiment Station Bulletin 82, ed. the Oregon College of Agriculture Experiment Station (Corvallis, OR: Oregon Agricultural College, 1904); *Hood River, Oregon* (Hood River, Oregon: Hood River Commercial Club, 1909), 20.
By 1916 many orchards were switching from clean tillage (aka clean cultivation) to planting cover crops like alfalfa or clover, which were often hayed or hogged off.
Purcell C. McCue, "A Virginian in Hood River," *American Fruit Grower,* no.1 (1916).

[280] "The cover crop is coming more into favor in this state. Most soils are losing their humus, through continued working and production, and the cover crop is the ideal thing to restore them to their former condition."
C.I. Lewis and W.H. Wicks, *Orchard Management* Bulletin No. 93, ed. the Department of Horticulture (Corvallis, OR: Oregon Agricultural College, 1907), 16.

[281] *History of Hood River County, Oregon 1852-1982*, ed. the Hood River County Historical Society (Dallas, TX: Taylor Publishing Company, 1982).

Hood River with cover crops were irrigated and only twenty seven percent of clean cultivated orchards were irrigated.[282]

Brown's 1921 study separated Hood River orchardists into three groups: Group I – with average yields of more than 301 packed boxes per acre, twenty five percent of orchards in study group; Group II – with average yields of 221 to 300 packed boxes per acre, thirty seven and a half percent of orchards in study group; and, Group III – with average yields of less than 220 packed boxes, thirty seven and a half percent of orchards in study group. This study found that high yields were directly related to high value of the yield and that Hood River apple growers' yearly production averages had 40.8 % extra fancy grade apples over the six years of the study. One of the most important aspects of this study was that at the end Brown stated, "the survey as a whole standardizes orchard management upon the basis of merit. It points out striking differences in management as related to high or low standards of success."[283] This is telling because success as a fruit grower (merit/profit) is being held up as the standard in determining orchard management practices, not science.

My research has focused on irrigation, cover cropping, and pest and disease management practices. However, the experiment stations and USDA also provided recommendations on pruning, soil amendments, varieties to plant, and more, which were based on scientific investigations. For the orchard management practices I did research, Hood River

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[282] S.M. Thomson and G.H. Miller, *The Cost of Producing Apples in Hood River Valley* Bulletin 518, ed. the Office of Farm Management, United States Department of Agriculture (Washington, D.C.: USDA, 1917), 18.
Irrigation also added to problems with erosion in clean cultivated orchards.

[283] Gordon G. Brown, *Hood River Apple Orchard Management With Special Reference to Yields, Grades, and Value of Fruits* Experiment Station Bulletin 181, ed. the Oregon Agricultural College Experiment Station Hood River Branch (Corvallis, OR: Oregon Agricultural College, 1921), 34-35.

orchardists appear to have an inconsistent pattern of adherence to scientific recommendations. I have identified several reasons for this. First, the fast pace of new knowledge production meant that recommendations made two years earlier might be modified or completely overturned because of information learned from new scientific investigations. This rapid succession of changing recommendations, I suggest, devalued new information coming from science, and, possibly, added value to recommendations that had been in place for some time, the idea being that they were true because they had proven to work over an extended period of time. Second, some recommendations required a large financial investment, and not all orchardists had the resources to invest in a new practice. This could have been especially true for recommendations that had not been tested by the more wealthy neighboring orchardists. Finally, there is the very human urge to over-indulge in any practice that seems to work. For orchardists this was true for spray recommendations, with many orchardists unable to resist spraying more often or at higher quantities of the pesticide or fungicide than was recommended by the experiment station scientists.

Brown did not base his argument for certain management practices on their scientific merit, but supported his argument by the success of certain practices for fruit growers' bottom line. I argue that using this standard to support certain practices gave the words of successful fruit growers the same, if not more, weight than recommendations coming from non-fruit growing agricultural scientists or even less successful fruit growing agricultural scientists. Science became secondary to profit as an indication of expertise.

Hood River apple producers were catering to a niche, high-end market, something Thomson and Miller highlighted in their study: "Popularity of Hood River apples is due to their consistent good quality, not the quantity produced."[284] A comparison with the apple production in Wenatchee, as illustrated by another study that was also undertaken by Thomson and Miller, highlights Hood River's apple growers' reliance on quality as the key to profit. In the four years from 1911 to 1914 Wenatchee apple growers shipped an average 4339 train cars of boxed apples per year, while Hood River in the same period shipped an average 1025 train cars of boxed apples. This difference could be attributed to the larger area under apple production in the Wenatchee Valley. Comparing the average number of train cars of boxed apples per acre produces information that is questionable at best and for that reason I will ignore it except to note it in a footnote for someone who loves math more than I do.[285] The main point of this mathematical exercise is that Hood River apple producers only had so many acres that could be put into production and this restriction on growth might be one of the reasons Hood River chose to pursue a niche market. They realized they could not compete with the larger orcharding districts for American markets. Every Hood River apple needed to be perfect.

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[284] S.M. Thomson and G.H. Miller, *The Cost of Producing Apples in Hood River Valley* Bulletin 518, ed. the Office of Farm Management, United States Department of Agriculture (Washington, D.C.: USDA, 1917), 7.

[285] I believe the problem is that the car load totals are for all orchards in each area and not just the study participants.

Lewis claimed that the number of apple boxes per train car could be as low as five hundred or as high as eight hundred.

C.I. Lewis, "Handling the Apple Crop of the Northwest," *Better Fruit,* no.3 (1910): 23.

Wenatchee: Avg number of acres producing apples = 6; avg number of train cars produced in a year = 4339; number of orchardists in study = 87

87 X 6 = 522 acres in production; 4339/522 = 8 train cars per acre; 8 X 500 bxs per car = 4000 bxs per acre

Hood River: Avg number of acres producing apples = 12.4; avg number of train cars produced in a year = 1025; number of orchardists in study = 54

54 X 12.4 = 669.6 acres in production; 1025/669.6 = 1.53 train cars per acre; 1.53 X 500 bxs per car = 765 bxs per acre.

Stringent oversight of all phases of apple production by Hood River Apple Growers' Association fieldmen, adherence to the association's grade and packing standards, and an aggressive marketing campaign by the association are the main reasons for the success of the Hood River Apple Growers' brand. Fieldmen visited the orchards frequently, providing guidance in spraying, thinning, cultivating, packing, and other matters. Robert G. McNary, Head of Fresh Fruit Sales for the Oregon Growers' Cooperative Association stated, "The field department has become one of the most important and indispensable parts of the organization."[286] By 1922 the success of this strategy for the Hood River Apple Growers' Association could be seen in their rapid growth in the first quarter of the twentieth century. In 1922 the Hood River Apple Growers' Association signed a contract with the Oregon Growers' Co-operative Association, the association that handled most of Oregon's fruit sales outside of Hood River, to market their growers' produce. In the 1921-22 season the Hood River Apple Growers' Association was selling strawberries, pears, cherries, peaches, several berry varieties, and prunes, as well as apples, and grossed almost three million dollars. To handle this rapid growth, the Hood River Apple Growers' Association had established offices in New York, Omaha, Los Angeles and San Francisco, in charge of salaried men – men who specialized in apples. Additionally, the association had relationships with about 175 different brokerage firms.[287] By the 1920s, the

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[286] Robert G. McNary, "Cooperative Marketing Success Hood River Apple Growers Association on Firm Business Basis; Nearly Three Million Dollars Worth of Business Transacted During 1921-22 Season," *The Oregon Grower,* no.2 (1922): 5.
McNary had previously been the Assistant Sales Manager for the Hood River Apple Growers' Association.
Earl Pearcy, "Looking Forward," *The Oregon Grower,* no.2 (1922): 9.
[287] McNary, 5.

Hood River Apple Growers' Association was irrevocably tied to the fluctuations and demands of the global commodities market.

3.6 Conclusion

Hood River apple growers came of age in the midst of the progressive era, a time when the ideals of efficiency, technology, and a belief in the wholesome benefits of agriculture for the farmers, consumers, and nation wove through all aspects of how apple production manifested, at least in Hood River. The creation of cooperative and marketing associations embodied the idea of efficiency, cleanliness, and consistency leading to greater profits for the grower and a predictable product for the consumer. It also supported the economic growth of the United States, which was just transitioning from agriculture to manufacturing, while at the same time marrying agriculture to the principles of industrial manufacturing. Finally, it was thought to provide a wholesome lifestyle for the fruit growers and their families.

Oregon apple producers established their first orchards in a utopian disease and pest-free environment, leading to the first apples being of exceptional quality compared to what was available from eastern orchards and the enduring slogan – The Oregon Big Red Apple – was established early. From the beginning these early Oregon apple growers saw the profit potential in distant markets, beginning with San Francisco and not stopping until they were marketing to multiple countries around the globe. Access to export networks dictated their markets, but the apple growers were always looking at distant markets rather than local, Oregon markets. The horticultural organizations, apple associations, and agricultural scientists encouraged this niche market of exceptional fruit being sold to distant markets, focusing their scientific research, regulatory, and educational efforts on the creation of apples that could be shipped long distances and compete with not only any other apple, but with the newly available oranges, pineapples and other tropical fruits. The familiar, comforting apple at its best – predictably perfect.

4 Foulbrood

"Foul brood is now the bee-keeper's terror." – A.J. Cook, 1890[288]

Foulbrood was one instance where science was unable to provide a solution, despite a hundred years of research. The disease called foulbrood in the nineteenth century and earlier was eventually determined to be two diseases – American foulbrood and European foulbrood. American foulbrood, considered to be the more virulent of the two foulbrood diseases, is now known to be caused by a spore-forming bacterium, *Paenibacillus larvae*. D.C. de Graaf, with the Laboratory of Zoophysiology, Ghent University, and his international research collaborators, in 2006, claimed that "worldwide, American foulbrood (AFB) is the most devastating bacterial disease of the honey bee (*Apis mellifera*)."[289]

This chapter is not a comprehensive review of everyone who did research on American foulbrood, rather it highlights the research that was prominent in beekeeping journals at the turn of the twentieth century. These are names beekeepers in Oregon would have been familiar with and it includes a mix of beekeepers, inspectors, microscopists, physicians, entomologists and bacteriologists. The relationships between these people, and their willingness to acknowledge the research done by others, is a big part of the story I tell in this chapter. However, just as relevant is the way government scientists validated their right to direct the discussion of foulbrood in the beekeeping community despite their inability to provide a cure or even an effective disease management strategy.

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[288] A.J. Cook, "Foul Brood: Bulletin by the Michigan Agricultural College," *American Bee Journal,* no.21 (1890): 350.

[289] D.C. de Graaf, A.M. Alippi, M. Brown, J.D. Evans, M. Feldlaufer, A. Gregorc, M. Hornitzky, S.F. Pernal, D.M.T. Schuch, D. Tite˘ra, V. Tomkies, and W. Ritter, "Diagnosis of American foulbrood in honey bees: a synthesis and proposed analytical protocols," *Letters in Applied Microbiology,* no.6 (2006): abstract.

4.1 Oregon

"The worst enemy to bees in Oregon is foul brood, now chiefly contained to those who keep bees in box-hives."[290]

There are two important points within this quote. First, it tells us that by the 1880s, Oregon beekeepers were expected to be aware of, and conform to, use of the icon of rational, modern beekeeping – the moveable frame hive – even in Oregon, where honey bees were introduced just thirty years previously. The name, box hive, pretty much says it all. The box hive, sometimes called a common hive, was a hollow box that honey bees could use as shelter for their combs and themselves. The bees would attach the combs to the walls and ceiling, thereby making it impossible for beekeepers to see more than was visible if they tipped the hives over, exposing the open bottom. Earlier in American beekeeping a log hive had often been used. These log hives were hollowed out sections of tree trunks or branches. At times they were the location of a wild honey bee hive that the honey-hunter cut down and carried home. What made the moveable frame hive preferable for modern beekeepers was that it allowed beekeepers to open the hive and pull up comb frame-by-frame for examination with no damage to the bees or the comb, something that could not be done in the earlier hive forms. I'll be talking more about moveable frame hives in the pollination chapter. For now, what is important to know is that the moveable frame hive gave beekeepers the ability to more intensively manage their hives, thereby requiring that they intervene in disease progression. I say require, because that was the expectation of

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[290] "Among Our Exchanges: Will Bees Pay in Oregon?" *American Bee Journal,* no.28 (1881): 221.
Official records have the earliest appearance of foulbrood in Oregon at 1907.
A. Burr Black, "History and Distribution of Bee Diseases in Oregon" (M.S. Thesis, Oregon State College, 1939), 26.

turn-of-the-twentieth century beekeepers within all levels of the American beekeeping community, and because the moveable frame hives made the passage of legislation demanding proactive disease intervention by beekeepers possible.

The second point this quote highlights is that it took less than thirty years for foulbrood to catch-up with the honey bees in Oregon if we accept that the writer of the quote is correctly identifying the disease as foulbrood. What is surprising is that foulbrood did not arrive in Oregon sooner with the thousands of honey bees that were imported to Oregon from back east where foulbrood had been present for at least two hundred years.

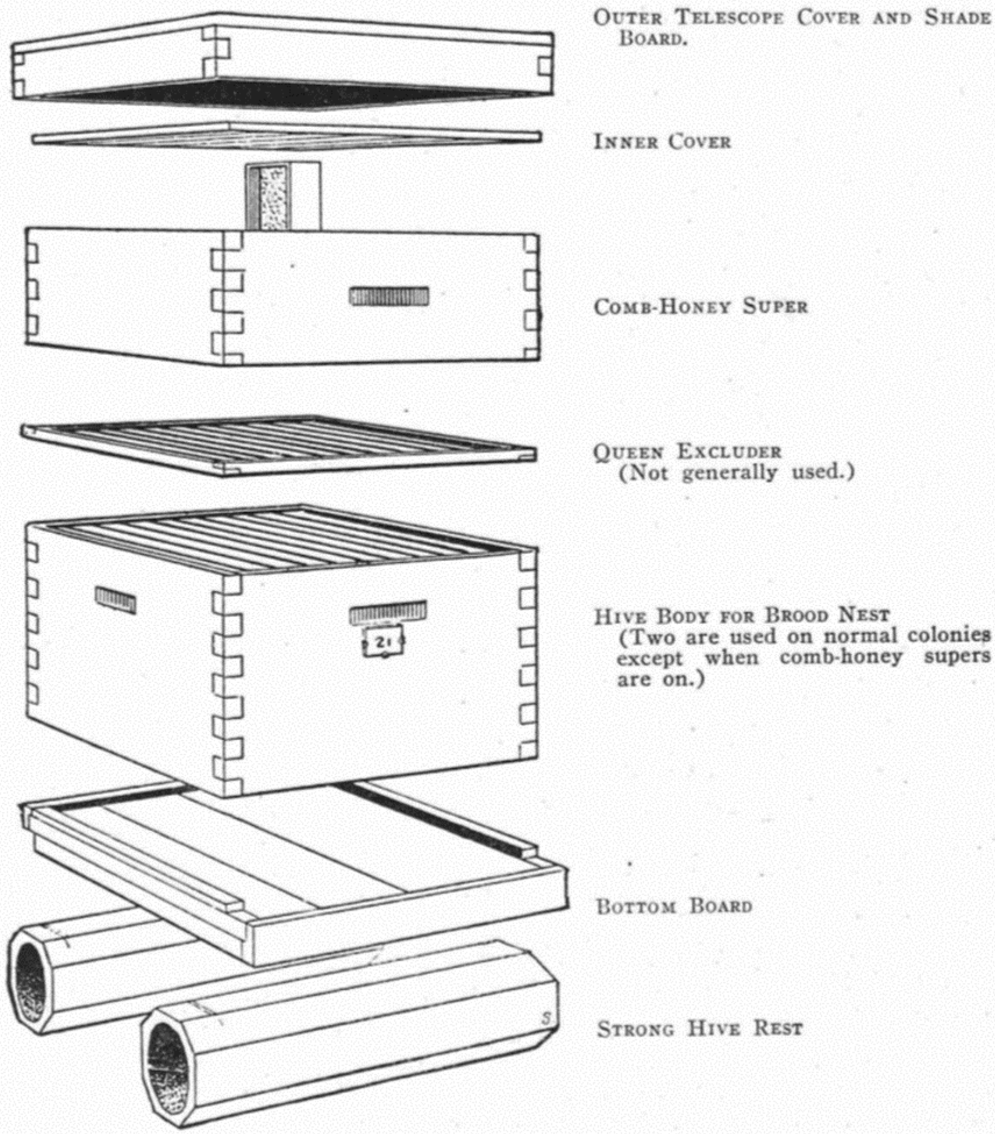

Figure 1. A ten-frame hive with comb-honey super.

10 Moveable frame hive. Each box is a hive. When stacked, each hive is called a super, or story. In this case there are ten frames holding comb in each hive. This illustration was used in 1909 and again in 1933 by the Oregon Agricultural College.[291]

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[291] H.A. Scullen, *Beekeeping in Oregon* Extension Bulletin 462, ed. the Oregon State Agricultural College Extension Service (Corvallis, OR: Oregon State Agricultural College, 1933), 7.
Same illustration used by Wilson in his 1909 beekeeping bulletin.
H.F. Wilson, *Beekeeping for the Oregon Farmer* Extension Service Series II, No. 25, ed. the Oregon College of Agriculture Extension Service (Corvallis, OR: Oregon College of Agriculture Extension Service, 1909).

4.2 Moses Quinby

Fig. 152. Moses Quinby.

Figure 11 Moses Quinby, the Father of Practical Beekeeping[292]

Moses Quinby (1810-1875), possibly the first full-time beekeeper in the U.S. and owner of a system of apiaries that, at one point, consisted of 1200 colonies, conducted an extensive investigation of foulbrood out of necessity. He needed to protect his main source of income. Within his first six years of keeping bees, around 1834-36, Quinby, who lived in New York, had foulbrood within his apiary. Quinby's investigations into foulbrood extended over the next several decades and included his own experiments as well as a review of what he learned from other beekeepers.[293] However, he did not use either of the

[292] A.J. Cook, "Quinby, Moses," in *Cyclopedia of American Agriculture: A Popular Survey of Agricultural Conditions, Practices and Ideals in the United States and Canada*, ed. L.H. Bailey (New York, N.Y.: The Macmillan Company, 1912), 607.
[293] Quinby says he first observed foulbrood in his hives about five or six years after he started keeping bees and he obtained his first bees when he was 20 (1830).

new technologies that would eventually lead to our current understanding of foulbrood – the microscope and the moveable frame hive.

Despite Jan Dzierzon's top-bar hive being in wide use in Europe by the late 1830s and being known in America, Quinby had started beekeeping using common, box hives and would continue with the hives he was familiar and comfortable with until 1856 when a friend sent him a copy of L.L. Langstroth's *On the Hive and Honeybee*.[294] From that point on Quinby became an avid proponent of Langstroth's moveable frame hive, changing all of his colonies to this new hive design and telling readers of his book, *Mysteries of Bee-keeping*, to use Langstroth's moveable frame hive in their apiaries.

Quinby was able to turn his observations -- even when using the common hive and examinations unaided by the microscope -- into a theory on foulbrood that others could engage with because his observations created what historian of science Lorraine Daston has called an ontology of scientific observation, expert observation which "discerns and stabilizes scientific objects for a community of researchers."[295] Quinby took the observations he gleaned from the beekeeping community as well as

A.J. Cook, "Quinby, Moses." in *Cyclopedia of American Agriculture: A Popular Survey of Agricultural Conditions, Practices and Ideals in the United States and Canada*, ed. L.H. Bailey (New York, N.Y.: The Macmillan Company, 1912).
In *Mysteries of Beekeeping* Quinby claims he got his first bees in 1828. Quinby discusses his research into foulbrood in his book on beekeeping, *Mysteries of Beekeeping*, which was first published in 1854. M. Quinby, *Mysteries of Beekeeping Explained Being a Complete Analysis of the Whole Subject* 8th ed. (New York, N.Y.: C.M. Saxton, 1864), 1.
Quinby was solely supported by his beekeeping from 1853 until he died in 1875, and it is possible he is the first beekeeper in the U.S. who could say that. "In 1865, the last year of the war, he shipped eleven tons of honey to New York City, causing both quite a stir in the press and a strain in the market." Philip A. Mason, "American Bee Books: An Annotated Bibliography of Books on Bees and Beekeeping From 1492 to 1992" (PhD Dissertation, Cornell University, 1998) 484.
[294] Langstroth had patented his new moveable frame hive in 1852.
L.L. Langstroth, "Beehive" (Patent, United States Patent Office, 1852).
[295] Lorraine Daston, "On Scientific Observation," *Isis,* no.98 (2008).

his own and distilled them down to four observations that, when all were present, indicated the presence of foulbrood:

1. The bee larva were prone and extended in their cells;
2. The bee larva were a dark color;
3. The larval cells remained capped; and
4. There was an extremely foul smell emanating from the dead larva.

This created a landscape or a wholeness of perception for foulbrood that had not existed before. Granted, we now know that some of these symptoms are not diagnostic, but his idea, to create a diagnostic symptomology for a bee disease, was new for beekeepers and scientists at that time.[296] As we will see later in this chapter scientists were focused on diagnoses through identification of the cause rather than a symptomology.

It is true that Quinby only ever described one disease, which he identified as foulbrood. This could be because his apiary only experienced what is now known as American foulbrood, or he could have misidentified the less virulent European foulbrood as a milder form of American foulbrood. Because of his careful observations I believe Quinby would have noticed that European foulbrood did not meet all four of the standards he created for identification of foulbrood and for this reason I think his apiary entirely, or mainly, experienced American foulbrood.

Other beekeepers had observed some of Quinby's elements – especially the smell! – but none had placed them together to identify a single phenomenon, foulbrood. Usually one or more of the symptoms Quinby included in his landscape were present and described by beekeepers experiencing

[296] Later, in the twentieth century, a diagnostic symptom was the stringiness of the decayed larva. "Each [brood] disease develops symptoms peculiar to itself; and when these symptoms alone are present, it is not' difficult to determine the specific disease…Finally, [in American foulbrood] when decay is well advanced, the larva loses its shape and melts down. In this stage the mass is quite stringy or ropy." H.F. Wilson, *How to Control American Foulbrood* Bulletin 333, ed. the Agricultural Experiment Station, University of Wisconsin (Madison, WI: University of Wisconsin, 1921), 4.

foulbrood. These traditional, and varied, descriptions of symptoms continued to be used in beekeeping journals when discussing foulbrood, providing an inconsistent symptomology. Quinby's idea of requiring all four elements to be present for the indication of a specific disease was an idea that got lost and he was never acknowledged as having advanced the ability to properly diagnose foulbrood. [297]

Quinby published the results of his foulbrood experiments and observations in his book – *Mysteries of Bee-Keeping,* first published in 1854 – as well as in journal articles. He concluded that honey was a reservoir of disease, containing, preserving, and spreading foulbrood within and among bee colonies. It was spread from hive-to-hive when the honey in a diseased colony was fed to a healthy colony or when a colony weakened by disease had their honey stolen by the bees from a stronger, disease-free colony. Quinby was unsure what exactly the essence of foulbrood was that resided within the honey, but in his book he stated that in "nineteen cases in twenty" the initial cause was a contagion, just like it was for several human contagious diseases. At another point Quinby told his readers that it was a virus contained in the honey and that the virus could be killed if the honey was boiled. At that point the honey was safe to feed to healthy bees.[298] John Snow (1813-1858), an English physician, after investigating a cholera outbreak in Soho, 1854, came to a similar conclusion about the spread of disease being due to some substance which both contained and spread the infection. In the Soho cholera outbreak, Snow identified water as the substance possessing and spreading the disease.

Quinby also thought it was possible that the bad smell, or the decay present due to dead brood, could trigger disease and that the miasma created by the smell, the decay, or both was what was

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[297] M. Quinby, *Mysteries of Beekeeping Explained Being a Complete Analysis of the Whole Subject* 8th ed. (New York, N.Y.: C.M. Saxton, 1864), 278.
[298] Moses Quinby, *Mysteries of Bee-Keeping Explained: Being a Complete Analysis of the Whole Subject*. (New York, N.Y.: C.M. Saxton, Agricultural Book Publisher, 1854), 275.
This is in both the 1854 and 1864 editions.

absorbed by the honey. Quinby believed this absorption was only possible when honey and decaying brood were in cells that shared a side wall.[299] The concept of miasmas causing disease was a part of the Galenic disease tradition, still popular in nineteenth century human medical practice. This theory was based on the idea that disease causing miasmas could be present in the air, often creating a foul odor or created by the foul odor, and that a person could become sick when they breathed in the miasma.[300]

Quinby's disease theory was a combination of these two disease theories that were present, and popular, in the nineteenth century – contagion and miasma. However, I believe even Quinby himself would have said his foulbrood etiology was sketchy. What he did that was different from others looking at foulbrood at that time was to create a schema of identifying symptom characteristics and then to use the ideas attached to miasma and contagion theories to create a treatment. I will talk about treatments a little later in this chapter. For now, let's examine the process of discovering what causes foulbrood.

4.3 Foulbrood Etiology

In 1912, Dr. Everett Franklin (E.F.) Phillips, head of the Bee Culture Division of the USDA Bureau of Entomology, and Dr. G.F. White, Bee Specialist for the USDA Bureau of Entomology, claimed that the first time the names American foulbrood and European foulbrood were used was in 1906, in a USDA Bureau of Entomology circular that had been written by Phillips and entitled, *The brood diseases of*

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[299] M. Quinby, *Mysteries of Beekeeping Explained Being a Complete Analysis of the Whole Subject* 8th ed. (New York, N.Y.: C.M. Saxton, 1864).
This is in both the 1854 and 1864 editions.
[300] Robert Gaynes book has a good discussion of Galenic humoral theory, including miasmas.
Robert Gaynes, *Germ Theory: Medical Pioneers in Infectious Diseases* (Washington: ASM Press, 2011).

bees.[301] Although these two diseases shared part of their name – foulbrood – they were completely different. The shared descriptive name was due to tradition and legislation.

Foulbrood was the name that had been used by European, British and American beekeepers for any disease that caused the death and decay of brood within brood comb. Edward Bevan (1770-1860), a physician and beekeeper who wrote *The Honey Bee Its Natural History, Physiology and Management* first published in 1827, gave the credit for the first use of the name foulbrood (*Faux Couvain*) to Adam Gottlob Schirach, in 1771.[302] Bevan went on to say that Schirach, an avid beekeeper as well as pastor in Kleinbautzen, Upper Lausatia during the 1760's, believed the disease was caused by an egg being deposited in the cell incorrectly by the queen bee and/or insufficient, or unhealthy, food given to the larva, or, less likely, to the larva becoming chilled.[303]

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[301] E.F. Phillips, *The Treatment of Bee Diseases* USDA Farmers' Bulletin 442, ed. the United States Department of Agriculture (Washington D.C.: USDA, 1911).
E.F. Phillips and G.F. White, *Historical Notes on the Causes of Bee Diseases*, ed. the Bureau of Entomology (Washington, D.C.: USDA, 1912).
White's PhD thesis includes some early thoughts on American foulbrood.
Gershom Franklin White, *The Bacteria of the Apiary, With Special Reference to Bee diseases*, ed. the Bureau of Entomology (Washington, D.C.: USDA, 1906), 2.
[302] Edward Bevan, *The Honey Bee Its Natural History, Physiology and Management* (London: Baldwin, Cradock and Joy, 1827), 192.
Edward Bevan, *The Honey Bee Its Natural History, Physiology and Management* (Philadelphia: Carey and Hart, 1843), 70.
Phillips and White also credit Schirach with the first use of the name 'foul brood.' They also cite the source: *Histoire naturelle de la reine des abeilles, avec l'art de former des essaims*, 1771.
Phillips and White, 13.
According to Mazzolini the *Histoire* was a French translation of Schirach's papers on bees.
Renato G. Mazzolini, "Adam Gottlob Schirach's Experiments on Bees," in *The Light of Nature: Essays in the History and Philosophy of Science*, ed. J.D. North and J.J. Roche (Boston, MA: Martinus Nijhoff Publishers, 1985), 77.
[303] Phillips and White also claim these as the causes of foulbrood identified by Schirach.
Information about Schirach's life and bee experiments can be found in:
Mazzolini.

The other reason the two diseases shared part of their names, foulbrood, at the turn-of-the-twentieth century, was because of state laws that had been passed in the United States using the stand-alone name foulbrood for both diseases. According to Phillips he decided to use the names American foulbrood and European foulbrood in his 1906 publication "only after consultation with a number of the leading bee keepers in America, who agreed that the names were well chosen."[304] The geographic portion of the names came from the location where "the diseases were first seriously investigated."[305] Both diseases existed in Europe and America at the time Phillips chose the names American foulbrood and European foulbrood.

Some of the earliest investigations into the cause of foulbrood were done by those who had both an interest in bees and access to a microscope. Two mid-nineteenth century men who meet this description and who also independently determined that there were two distinct types of foulbrood were Molitor-Mühlfeld, a contributor to *Bienenzeitung*, and Dr. Preuss, a physician in Dirschau, Prussia. Molitor-Mühlfeld was someone others coming after him would reference, usually to point out his errors. He concluded that the less virulent form of foulbrood was caused by the larvae becoming chilled, but that the virulent form was caused by "a small parasitic ichneumon fly," which he named *Ichneumon apium mellificarium*.[306] Dr. Preuss stated that he could find no trace of this fly in brood comb – in adult, egg, or larval stages.[307] He also thought there was a mild and a virulent form of foulbrood, however he concluded the virulent form was caused by a fungus, which he named *Cryptococcus alvearis*.[308] When

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304 E.F. Phillips and G.F. White, *Historical Notes on the Causes of Bee Diseases*, ed. the Bureau of Entomology (Washington, D.C.: USDA, 1912), 75.
305 E.F. Phillips, *The Treatment of Bee Diseases* USDA Farmers' Bulletin 442, ed. the United States Department of Agriculture (Washington, D.C.: USDA, 1911), 8.
306 Phillips and White, 15.
307 Baroness Lina Berlepsch, "Foulbrood," *American Bee Journal,* no.5 (1868): 81.
308 Berlepssh, 81; Phillips and White, 16.

Baroness Berlepsch submitted her article on Dr. Preuss' foulbrood research to the *American Bee Journal* in 1868, she described Dr. Preuss' microscope in detail, a clear form of justifying expertise through technology.

> In order to make the required microscopic examinations, it is necessary to employ a microscope with a magnifying power of at least from 200 to 400. The splendid instrument used by Dr. Preuss is by Brunner, of Paris, and he makes his observations with a power of 600. Its micrometer allows of measurements to 1-10,000 millimeter, or 1-20,000 of a line.[309]

The Baroness also spent time describing the room, the light, and Dr. Preuss's method of placing samples on the microscope, providing readers with the best possible sense of being present when the microscopic observations were made, as well as giving readers the ability to judge for themselves how meticulous and correct Dr. Preuss's observations must have been.

Dr. Preuss's final conclusion – that the foulbrood fungus (*Cryptococcus alvearis*) and the fermentation fungus (*Cryptococcus fermentum*) belonged to the same species, and that, under the right circumstances, the fermentation fungus could transform into the foulbrood fungus, seems to indicate he was aware of the work on fermentation being done by other researchers.[310] In 1837 three researchers had independently provided significant insight into yeasts - Charles Cagniard-Latour (1777–1859) described several yeasts and identified them as plants; Theodor Schwann (1810–1882) proved that living yeast was needed for fermentation; and, Friedrich Traugott Kützing (1807-1893) whose observations supported Cagniard-Latour's and Schwann's analyses. However, until Louis Pasteur's (1822-1895) identification, in the 1860s, of several fermentation processes and the individual microorganisms responsible for each type of fermentation, most scientists continued to believe that fermentation was a

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309 Baroness Lina Berlepsch, "Foulbrood," *American Bee Journal,* no.5 (1868): 81.
310 Berlepsch, 82.; E.F. Phillips and G.F. White, *Historical Notes on the Causes of Bee Diseases*, ed. the Bureau of Entomology (Washington, D.C.: USDA, 1912), 16.

purely chemical process. Robert Gaynes, Professor of Medicine at Emory University School of Medicine, claims that Pasteur is responsible for moving "science to the biological rather than chemical basis of fermentation."[311] Those conducting research on honey bees in the nineteenth century were well aware of relevant research being undertaken in other fields.

The next twenty years would lead to many discoveries of micro-organisms responsible for various diseases of humans, plants and animals.[312] The 1880s brought new research on foulbrood as well. The work of Frank Cheshire (1833?-1894), a beekeeper, Fellow of the Linnaean Society (FLS) and Fellow of the Royal Microscopical Society (FRMS), was often mentioned in British and American Beekeeping Journals. Cheshire's obituary in *Gleanings*, 1894, told readers "probably there has never been anything printed in the English language, in the way of scientific bee-literature at least, that is the equal of" Cheshire's two volume *Bees and Bee Keeping*, first published in 1886.[313] Cheshire determined the causative agent was a bacillus, not a fungus, which he named *Bacillus alvei.*[314] Describing this bacillus in 1884, Cheshire stated, "This particular bacillus seems not unlike '*bacillus anthracis*,' which the researches of Pasteur have lately brought so much before public attention."[315] Cheshire agreed with

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[311] Robert Gaynes, *Germ Theory: Medical Pioneers in Infectious Diseases* (Washington: ASM Press, 2011).
[312] Robert Koch (1843-1910) – *Bacillus anthracis* (anthrax), *Mycobacterium tuberculosis* (tuberculosis), and *Vibrio cholera* (cholera).
Thomas Jonathan Burrill (1839-1916) – *Micrococcus amylovorus* (pear fire blight).
Albert Neisser (1855-1916) – *Neisseria gonorrhoeae* (gonorrhea).
These are a few examples.
[313] "Death of Cheshire," *Gleanings In Bee Culture*, no.20 (1894): 805.
[314] Cheshire, in the October 8, 1884 issue of the *American Bee Journal*, has this to say about naming the bacillus he identified as causing foulbrood, "I suggested to the Rev. Herbert R. Peel that he should be sponsor to a new name meaning Bacillus of the hive. He consents, but his sponsorship will, I am sure, in this instance, consist not in training and guarding, but in pursuing to the death that terrible and nauseous pest hereinafter to be called 'bacillus alvei.'"
Frank Cheshire, "Foul Brood, its Propagation and Cure," *American Bee Journal,* no.41 (1884): 646.
[315] Cheshire, 646.

Preuss that there were two distinct foulbrood diseases. Later he would write that he had been mistaken about there being two types of foulbrood and that further research had led him to the conclusion that there was only one type of foulbrood. He claimed this mistake was due to his observation of the bacillus in different stages of development and misidentifying these different stages as different bacilli. The debate in turn-of-the-twentieth century beekeeping journals about whether or not foulbrood was caused by a plant (fungus) or animal (bacillus) began with Cheshire's claim. White, in 1906, claimed that William Watson Cheyne (1852-1932), a surgeon, bacteriologist and colleague of Joseph Lister (1827-1912), was the one who named *Bacillus alvei,* in 1885.[316] Cheyne did his own investigation of foulbrood using samples provided by Cheshire, and in August 1885, Cheyne and Cheshire worked together on foulbrood research.[317] Whether or not it was Cheshire, Cheyne or the two of them together that first named the bacillus they identified as the cause of foulbrood is unclear.

Phillips identified White as the first person who was able to link American foulbrood to a specific organism, during White's 1906 PhD research. In Phillips's opinion, all other identifications of a causative organism had been flawed as the media used to produce cultures for examination, he believed, did not create samples pure enough for inoculation tests.[318] Robert Koch (1843-1910), a German physician and microbiologist, refined contemporary ideas about the creation of a causative relationship between microorganism and disease, and then published his postulates in 1890. The need for pure cultures of the disease microorganism and for the culture to produce the expected disease when introduced into an

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[316] "Cheyne on antiseptic surgery," Kings College London, Online Exhibits, Special Collections Exhibitions, http://www.kingscollections.org/exhibitions/specialcollections/lister/books-with-lister-associations/cheyne; Gershom Franklin White, *The Bacteria of the Apiary, With Special Reference to Bee diseases*, ed. the Bureau of Entomology (Washington, D.C.: USDA, 1906), 27.
[317] E.F. Phillips and G.F. White, *Historical Notes on the Causes of Bee Diseases*, ed. the Bureau of Entomology (Washington, D.C.: USDA, 1912), 25-29.
[318] Phillips and White, 80.

animal (inoculation test) were two of Koch's four postulates.[319] If the culture used for an inoculation test was not pure, then the test population could present symptoms created by the stowaway micro-organism(s), and, microscopic examination of tissue from the test population might include more than one microbe, thereby confusing identification of the microorganism that was the causative agent.

Cheshire had used brood larvae as the growing medium in his experiments.[320] White also used honey bee brood as a base for his growing medium, crushing healthy pupae and straining the juice from their crushed bodies into water. This mixture was then strained through two different filtering systems and the resulting liquid was added to purified agar.[321] White was associating *Bacillus larvae* with American foulbrood in 1906 and by 1911 Phillips agreed, calling the organism that caused American foulbrood *Bacillus larvae* in the USDA Farmers' Bulletin 442 on the treatment of bee diseases.[322]

Gaynes writes that Pasteur began thinking about the fermentation process as diseased when other microorganisms were introduced into the process and created a product other than expected, e.g. when wine becomes vinegar. This led Joseph Lister (1827-1912), a British surgeon and pioneer in antiseptic surgery, to begin thinking of the putrefaction of a wound as a diseased wound, in which

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[319] The other two are that the disease must always be present in the tissue of the organism exhibiting the disease and that after inoculation of a test animal that test animal will have the disease microbe in its tissues.
Robert Gaynes, *Germ Theory: Medical Pioneers in Infectious Diseases* (Washington: ASM Press, 2011), 186-187.
[320] E.F. Phillips and G.F. White, *Historical Notes on the Causes of Bee Diseases*, ed. the Bureau of Entomology (Washington, D.C.: USDA, 1912), 20.
[321] Phillips and White, 81.
For more information on how White processed his bee larva medium and information about all of the mediums he tried see his PhD research.
Gershom Franklin White, *The Bacteria of the Apiary, With Special Reference to Bee diseases*, ed. the Bureau of Entomology (Washington, D.C.: USDA, 1906), 40-43.
[322] White, 42.; E.F. Phillips, *The Treatment of Bee Diseases* USDA Farmers' Bulletin 442, ed. the United States Department of Agriculture (Washington, D.C.: USDA, 1911), 13.

disease causing microbes had been introduced.[323] Pasteur built on this first step toward germ theory with his research on silkworms in southern France, which he began in 1865 and completed five years later. Scratching a diseased silkworm with a needle he then pricked a healthy silkworm with the same needle, after which the healthy worm became ill. This, and the fact that eggs exhibiting symptoms of the disease produced diseased silkworms, led Pasteur to the conclusion that the disease was contagious. Unable to find one microorganism responsible for the disease he finally realized there were two diseases in the silkworm population and was able to identify the two specific causes.[324] The idea that specific microorganisms cause specific diseases, germ theory, was being investigated by others as well, but Pasteur's many investigations, prominence, and publications provided the bulk of evidence for germ theory.

[323] Robert Gaynes, *Germ Theory: Medical Pioneers in Infectious Diseases* (Washington: ASM Press, 2011), 157, 218-219.
[324] Gaynes has a chapter on Pasteur.

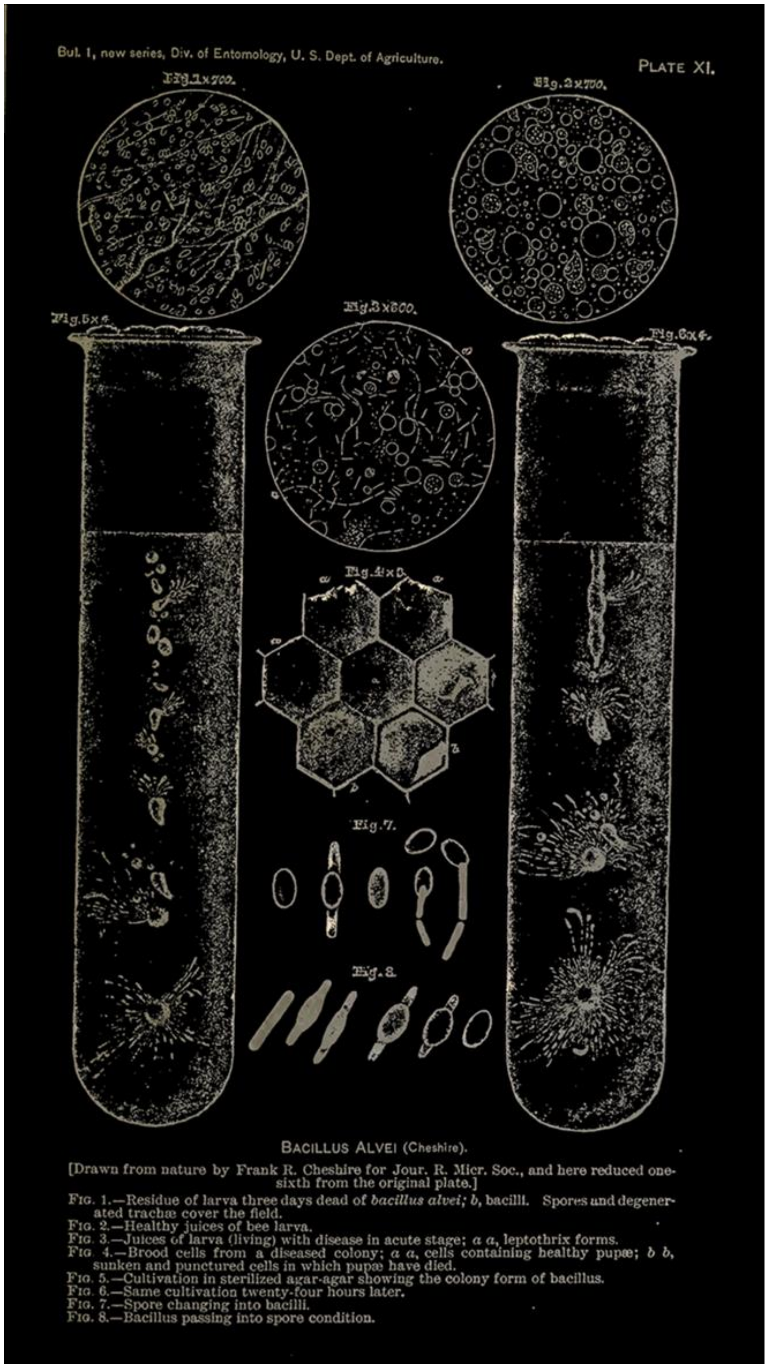

Figure 12 *Bacillus Alvei*. Frank Benton credits Cheshire with discovery of the cause of foulbrood, the disease “dreaded most of all by the bee keeper.”[325]

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[325] Frank Benton, *The Honey Bee: A Manual of Instruction in Apiculture*, 3rd ed. (Washington D.C.: Government Printing Office, 1899), between 112 and 113.

4.4 Disease Transmission: Direct or Indirect?

As I stated above, Moses Quinby believed honey was the agent of transmission for foulbrood and that direct contact with contaminated honey was required for the disease to move from one organism to another. This point, whether or not direct contact was required for disease transmission, is highly significant as treatments would be based on two factors; first would be the cause of the disease and second would be the manner in which the disease spread to others. However, finding an avenue for direct contact often seemed impossible or illogical. In brood diseases, not every cell became infected at the same time, despite direct contact with diseased brood. Why? The reverse was also true and puzzling. How could a hive, with no apparent direct contact from the diseased hive, become infected? Quinby's honey transmission theory answered questions about how the disease appeared to infect apiaries that were distant, and he spent quite a bit of time describing bee activities that would spread diseased honey across hives and to distant apiaries.

N.W. McLain, Apiculture Agent for the U.S. Apicultural Station, Aurora, IL, published his thoughts on foulbrood in the Apiculture report he sent to Dr. C.V. Riley, Dec 31, 1886.[326] McLain was the first apiculturist hired by the federal government to do research on bees. His investigations focused on the three main issues faced by American beekeepers at that time – to discover if honey bees harmed fruit and/or fruit trees, bee breeding, and to find a solution to the foulbrood problem.[327] Phillips and White were not kind to him in their 1912 treatise on foulbrood, stating:

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[326] William R. Howard, M.D., *Foul Brood Its Natural History and Rational Treatment* (Chicago: George W. York and Co, 1894).
[327] Ralph Benton, "Government Help in Apiculture," *Pacific Rural Press* (San Francisco, CA) December 5, 1908, 344.
"In 1860 William Bruckisch, a German immigrant, suggested that the U.S. Government should conduct investigations in beekeeping, and money was set aside to start such research in 1885." Those responsible for the US bee research:

> In estimating the value of this work by McLain, it must be borne in mind that McLain had evidently a very indefinite conception of the phenomena which are encountered and must be dealt with in the study of disease; that he devoted but little time to the study of the disease he referred to as foul brood, and that he was probably unduly influenced by the writings of Cheshire. For these reasons it is advised that his reports be not taken too seriously.[328]

I have been unable to find information on McLain's educational background. Most refer to him as mister or professor rather than doctor and only one article I found called him an entomologist. He only retained the position of U.S. Apiculture Agent for two years as Riley was then forced to remove all funding for this position. It would remain vacant until 1891 when Frank Benton was appointed Apicultural Agent.

McLain and Cheshire both were vehement that honey was not the agency of disease transmission, as Quinby stated, although neither mention Quinby by name. Cheshire believed the feet and antenna of the bees moved the foulbrood germs about, adding that diseased nurse bees could infect larva while feeding and upon becoming foragers would deposit foulbrood germs in the nectaries of plants as they gathered nectar. This accounted for a disease-free hive that was some distance from a

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"N. W. McLain—1885-87, discontinued because of lack of funds.
Frank Benton—1891-1907, work suspended in 1896-1897; no funds. Spent much of his time locating and shipping stock from Europe.
E. F. Phillips—1905-06, acting; 1907-24
J. I. Hambleton—1924-58
C. L. Farrar—1958-61
F. E. Todd—1961-65
S. E. McGregor—1965-69
M. D. Levin—1969-75
E. C. Martin—1975-79"
E.C. Martin, E. Oertel, N.P. Nye, and others, *Beekeeping in the United States* Agricultural Handbook Number 335, ed. the United States Department of Agriculture (Washington D.C.: U.S. Government Printing Office, 1980).
[328] E.F. Phillips and G.F. White, *Historical Notes on the Causes of Bee Diseases*, ed. the Bureau of Entomology (Washington, D.C.: USDA, 1912), 38.

diseased hive and with no apparent connection to each other that would suddenly present symptoms of foulbrood.[329] McLain disagreed. He postulated that pollen was the repository for the foulbrood germs and that it was the beekeepers, or the bees, that were the major cause of disease transmission, spreading the germs about an apiary and between apiaries. According to McLain's theory, beekeepers would accidentally gather foulbrood germs, along with pollen grains, on their clothing as they tended diseased colonies and then sprinkle them about as they went through their day. For bees, their hairy bodies would collect foulbrood germs, and pollen grains, which were sloughed intermittently as they conducted their daily duties or as they groomed themselves. A secondary cause identified by McLain was the wind, which he believed could sweep the tiny foulbrood germs off the decomposing bodies of larva and deposit them in areas where bees would pick them up.[330]

About twenty years later, in 1911, Phillips, head of the Bureau of Entomology Bee Culture unit, postulated that "the common means of carrying the virus is in honey which has become contaminated." This could happen when bees were fed diseased honey, when a healthy colony robbed from a diseased colony, or when bees scavenged diseased honey from honey processing tools or containers.[331] This conclusion matches Moses Quinby's, but at no point in Phillips' discussion of foulbrood does he mention the work of Quinby.

[329] Frank Cheshire, "Foul Brood, its Propagation and Cure," *American Bee Journal,* no.41 (1884): 647.
[330] E.F. Phillips and G.F. White, *Historical Notes on the Causes of Bee Diseases*, ed. the Bureau of Entomology (Washington, D.C.: USDA, 1912), 36-38.
[331] E.F. Phillips, *The Treatment of Bee Diseases* USDA Farmers' Bulletin 442, ed. the United States Department of Agriculture (Washington, D.C.: USDA, 1911), 12-13.

4.5 Treatment

In 1854 Quinby published the results of his foulbrood experiments and observations in his book – *Mysteries of Bee-Keeping* – as well as in journal articles. As discussed previously, he had concluded that honey was the reservoir of disease. Based on this theory he developed a management practice for control of foulbrood that involved re-hiving the colony in a disease-free hive that either contained disease-free honey or where the beekeeper could supply syrup until the bees worked the diseased honey out of their system. This process was combined with increased vigilance and a greater number of inspections conducted by the beekeeper to find the disease in its earliest stages.

Despite the popularity of Quinby's beekeeping text, which continued to be published in various iterations for nearly thirty years, a rival text emerged.[332] Amos Ives (A.I.) Root (1839–1923), another well-known nineteenth century beekeeper, published his beekeeping text, *The ABC of Bee Culture* (1877), twenty-four years after Quinby's text.[333] Root's discussion of foulbrood never mentioned Quinby, although he agreed that honey from a diseased colony could cause the disease to appear in another colony. Interestingly, Root agreed with Dr. Preuss's etiology, which assigned the cause of foulbrood to a fungus, but, he never mentioned Dr. Preuss by name. Because of his belief that foulbrood was caused by a fungus, Root told his readers that both high temperatures, attained by scalding the

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[332] Quinby first published his Mysteries beekeeping text in 1854.
M. Quinby, *Mysteries of Beekeeping Explained Being a Complete Analysis of the Whole Subject* 8th ed. (New York, N.Y.: C.M. Saxton, 1864); Philip A. Mason, "American Bee Books: An Annotated Bibliography of Books on Bees and Beekeeping From 1492 to 1992" (PhD Dissertation, Cornell University, 1998) 485.
In 1879 L.C. Root, Quinby's son-in-law, published Quinby's New Beekeeping, which was updated and reprinted for many years by one of the Roots.
Mason, 483.

[333] Amos Ives Root began keeping bees in 1865. There is some confusion about the first publication date for his beekeeping text, *The ABC of Bee Culture.* There is some indication it was first available in 1877, however, it is clear the book continued to be updated and published through the 1895 edition. The 1899 publication went through drastic revisions and was edited by Ernest Root.

honey, and freezing temperatures could kill these plant-based disease organisms. However, his remedy was much more similar to Quinby's and involved removing the bees from the hive where the disease was present and then to deny the bees food for a twenty-four to forty-eight hour period, which was long enough for any honey in the bees' honey sacs to process through the bees' bodies, thereby flushing the disease out of their system. Root actually described the bee removal process as "shaking the bees from their combs."[334] Root's discussion of foulbrood would continue in much the same form for the next fifteen years throughout the many editions of his beekeeping text. More importantly, removal of a diseased colony to a disease-free hive would be part of every foulbrood eradication method from this point on, whether due to scientific concern about fungi or bacilli remaining viable despite attempts to sterilize the hive and comb, or as a basic aspect of bee disease management.

Oddly enough, Root's name for the fungus responsible for foulbrood, *Cryptococcus Alveario*, is slightly different than Dr. Preuss's, *Cryptococcus alvearis,* and Root's remedy does not include a fungicide.[335] Dr. Preuss's treatment recommendation was to remove the bees from the hive and then use a ten percent solution of sulfuric acid (a common fungicide) to wash any comb exhibiting disease. The empty hive also needed to be cleansed with clean water and then boiled for several hours. Any extensively diseased comb and brood had to be burned. Finally, the soil in front of the hive, where worker bees would have tossed dead bees and hive detritus, had to be spaded over and sprinkled with sulfuric acid.[336]

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[334] A.I. Root, *The ABC of Bee Culture: A Cyclopedia of Everything Pertaining to the Care of the Honey Bee: Bees, Honey, Hives, Implements, Honey Plants, &c., &c.: Compiled From Facts Gleaned From the Experience of Thousands of Beekeepers, All Over Our Land, And Afterward Verified By Practical Work in Our Own Apiary* (Medina, OH: A.I. Root, 1883), 93.
[335] Root, 93.
[336] E.F. Phillips and G.F. White, *Historical Notes on the Causes of Bee Diseases*, ed. the Bureau of Entomology (Washington, D.C.: USDA, 1912), 16.

Quinby never had an etiology for foulbrood, instead offering a transmission agent (honey) and a very precise disease symptomology. Perhaps this is why Root chose to combine Quinby and Dr. Preuss's foulbrood research into his own discussion of foulbrood. Quinby first published *Mysteries of Beekeeping* with his foulbrood recommendations in 1854 and Dr. Preuss's foulbrood article was published in *Bienenzeitung* in 1868, while Root published *The ABC of Bee Culture* in 1877. At that point the only published foulbrood etiology was Dr. Preuss's, but why didn't Root agree with Dr. Preuss's use of a fungicide as a treatment? I have to suppose that Root, who had been a beekeeper for twelve years, and in 1883 had seven apiaries with about five hundred colonies as well as a beekeeping supply company, which he started in 1869, had tried Dr. Preuss's fungicide treatment and found it ineffective. Root tells readers of *The ABC of Bee Culture*, "various remedies have been given for the malady [foulbrood], many of which are claimed to be perfectly successful; but as the years pass by, one after another of them seems to have been dropped, and the apiarist has been obliged to feel the truth of the old adage, that prevention is better than cure."[337]

By the late 1880s, N.W. McLain, who had identified pollen as the disease transmission agent, told beekeepers to use a salicylic acid mixture for foulbrood.[338] Salicylic acid is an anti-inflammatory commonly known as aspirin. McLain's instructions were to add one pint of dairy salt to three pints of soft water and heat this mixture to eighty degrees Fahrenheit stirring until the salt was dissolved. In a

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[337] A.I. Root, *The ABC of Bee Culture: A Cyclopedia of Everything Pertaining to the Care of the Honey Bee: Bees, Honey, Hives, Implements, Honey Plants, &c., &c.: Compiled From Facts Gleaned From the Experience of Thousands of Beekeepers, All Over Our Land, And Afterward Verified By Practical Work in Our Own Apiary* (Medina, OH: A.I. Root, 1883), 92.

[338] Root claimed the idea of using salicylic acid as a foulbrood remedy came from Germany, that some of the solution could be fed to the bees, and that an atomizer was the best way to apply the solution to the combs and hive. This was three years before McLain's published recommendation of salicylic acid. Root, 93.

separate pint of warm soft water four tablespoons of bicarbonate of soda in crystal form was added and then stirred until the solids were dissolved. The two solutions would be mixed together with sugar or honey to slightly sweeten the mixture. Finally the beekeeper was to add one-fourth ounce of pure salicylic acid and mix everything thoroughly before letting the mixture stand until any residue had settled to the bottom of the container. McLain recommended using an atomizer to spray the combs and inside of the hive with the mixture as well as any bees that were present as the bees would then consume a small portion of the solution as they cleansed themselves. If the beekeeper wanted, they could add some of the solution to the honey from the diseased hive to feed the bees as McLain believed this solution would kill any of the germs present in the honey. The solution needed to be applied two or three times a day for three days. McLain claimed, “I have prescribed this treatment with entire satisfaction and uniform success for the past two years.”[339]

The international scientific community continued to perform research on foulbrood, but the next person to significantly add to the foulbrood conversation was William McEvoy, a Canadian beekeeper who experienced his first case of foulbrood in 1875 and who would become the Foulbrood Inspector for Ontario in 1890.[340] Like Quinby, McEvoy never addressed the issue of what caused foulbrood, instead focusing on disease management. McEvoy was the originator of the “shaking method” of curing foulbrood, so called because his method required beekeepers shake the bees from a diseased hive into a clean, disease-free hive with no other treatment than leaving the bees without food for a

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[339] N.W. McLain, "Foul Brood - Prevention and Cure," *American Bee Journal,* no.38 (1886): 584.
[340] Thomas Shaw, "Biographical: William McEvoy," *American Bee Journal,* no.13 (1893): 394.

four day period to clear the disease from the bees' bodies.[341] If this sounds familiar, that is because it is nearly the same process recommended by both Quinby and A.I. Root, the only difference being the amount of time the bees were left shut up without food or with a disease-free food source. However, McEvoy never acknowledged either beekeeper. Because of the cheapness of implementing this cure, and because it relied on management practices familiar to beekeepers rather than chemicals, many beekeepers were devoted fans of McEvoy's Shaking Method.

Beekeepers, however, were torn. They wanted to be labeled modern and rational, which meant using the most up-to-date scientific research and the newest technologies. On the other hand, they also needed an effective treatment and they had a long tradition of using cultural management practices to deal with disease in their colonies. Granted, the most traditional practice was to kill colonies too weak to make it through the winter or so riddled with disease that they could be subject to robbing, thereby spreading the disease through the apiary and any neighboring apiaries, but this was an effective solution to the problem of spreading a disease about the local beekeeping community. McEvoy also encouraged burning all hives and colonies in an advanced state of the disease. For beekeepers, which McEvoy was, the most important aspect of any disease treatment system was the preservation of as many colonies as possible, even if that meant the sacrifice of a few colonies. Practical economic reality nearly always took precedence for

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[341] "I have handled many hundreds of colonies in the Province of Ontario, and cured them of foul brood without getting a single hive scalded or disinfected in any way, and these colonies are cured right in the same old hives."
Wm. McEvoy, *Foul Brood Its Cause and Cure* (New Jersey: Naar, Day & Naar Printers, 1895), 5-6.

beekeepers when they made a choice about what beekeeping recommendation to follow. At this time, traditional disease practices were more effective than anything science could offer.

By 1903 the Hamilton County Bee-keepers' Association was calling the McEvoy Shaking Method "the world-renowned McEvoy system, the most universally successful in the treatment of the malady that has yet been given to the public."[342] As I have mentioned, one of the reasons McEvoy's Shaking Method became so popular was the seeming inability for the chemical solutions to be universally, or even mostly, effective against foulbrood. By 1911, even E.F. Phillips, in charge of bee research for the USDA Bureau of Entomology, said that prevention was better than cure for both foulbrood diseases and that the goal of any treatment was "not to save the larvae that are already dead or dying, but to stop the further devastation of the disease by removing all material capable of transmitting the cause of the trouble."[343]

In 1920, E.R. Root, a beekeeper and editor for *Gleanings*, described what the Bureau of Entomology had been doing to aid beekeepers in their fight against brood diseases. The investigations had begun in 1906 and at the time of this publication were being conducted by Arnold P. Sturtevant, a bacteriologist, who worked under the direction of E.F. Phillips. During those fourteen years the Bureau had been unable to provide beekeepers with a cure for either American foulbrood or European foulbrood. What they had accomplished was to identify the cause of three brood diseases which I believe are

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[342] H.E. Hill, "Hamilton County Bee-Keepers' Association," *The American Bee-Keeper,* no.9 (1903): 206.
[343] E.F. Phillips, *The Treatment of Bee Diseases* USDA Farmers' Bulletin 442, ed. the United States Department of Agriculture (Washington, D.C.: USDA, 1911), 13-14.

American foulbrood (*Bacillus larvae*), European foulbrood (*Bacillus alvei*), and (possibly) sac brood, but none of the diseases are mentioned by name. Secondly, the Bureau had gathered information and established the distribution of these diseases across the U.S., and thirdly, they had gathered information on treatments. When it came to treatments for diseases, E.R. Root told his readers that:

> It is the function of the scientific investigator to explain methods, to tell us why the methods work rather than to discover the methods themselves. So in the matter of bee diseases. Before the Bureau of Entomology did its work on bee diseases we used the shaking treatment for American foul brood without knowing why it is necessary…It cannot be stated too strongly that prevention is more important than cure, and this is the chief effort of work of the Bureau with this disease.[344]

The Bureau, unable to find an effective chemical treatment for any of the brood diseases, were forced to recommend traditional, cultural beekeeping practices to manage the diseases.

Where the Bureau could be effective was in affecting legislation. "The Bureau has also played a large part in having the right kinds of laws passed by the various States for the control of these diseases."[345] The Bureau had focused on changing legislation that allowed the governor to appoint the state apiary inspector as this had resulted in appointment of politicians with little or no beekeeping experience, or interest, in several states. The Bureau pushed for the state apiary inspector to be a part of each state's entomology office, which E.R. Root claimed was a position that was unpopular among most beekeepers. However, as many states changed their laws to place the state apiary inspector under the auspices of

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[344] E.R. Root, "Uncle Sam's Helping Hand What the Bureau of Entomology Has Done and Is Doing for the Beekeepers of the United States," *Gleanings In Bee Culture,* no.1 (1920): 14.
[345] Root, 14.

the state entomology office, and beekeepers saw the improvements this brought to their own apicultural interests, most beekeepers had become supporters of this type of legislation by 1920.[346]

In Oregon, by 1933, the control method recommended in Extension Bulletin 462 on beekeeping, written by Herman A. Scullen, an Oregon Agricultural Experiment Station apiary specialist and commercial beekeeper, was to kill the infected colonies using “cyanogas” and then to burn the frames, combs and dead bees after placing them all in a hole at least two feet deep. Once the fire had turned everything to ash the beekeeper needed to cover the ash with a “good layer of soil.”[347] The hive bodies, bottoms and covers, if in good condition, could be cleansed by scraping them out and then using a blow torch to char the exposed surfaces. “All of this should be done on a cool day or toward evening when the bees are not flying” so that they do not become infected by coming in contact with any of these items before they could be destroyed or cleansed.[348] This might seem like drastic measures, and a reversion back to the earliest beekeeping disease management strategy, however Scullen claimed that too many beekeepers were not skilled enough, or diligent enough, to use any other method successfully. He had found that when other methods had been used “there is generally a large percentage of colonies that show a return of the disease.”[349] Additionally, Scullen was a beekeeper, reliant for some portion of

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[346] E.R. Root, "Uncle Sam's Helping Hand What the Bureau of Entomology Has Done and Is Doing for the Beekeepers of the United States," *Gleanings In Bee Culture,* no.1 (1920): 14.
[347] H.A. Scullen, *Beekeeping in Oregon* Extension Bulletin 462, ed. the Oregon State Agricultural College Extension Service (Corvallis, OR: Oregon State Agricultural College, 1933), 30.
[348] Scullen, 30.
[349] Scullen, 30.

his income on the success of his apiary, and he understood that protecting the healthy colonies in an apiary was vital to the success of any beekeeper.

Six years later, A. Burr Black, in his M.S. thesis, discussed efforts by the Iowa Experiment station to breed an American foulbrood-resistant strain of honey bees.[350] These efforts continued for years by various groups. However by 1953, Black told attendees of the Apiary Inspectors of America meeting in San Jose, California that these efforts had “not proven too successful.” The reasons for the lack of success were that the resistant strains never remained pure, they were extremely aggressive with beekeepers, and strains resistant to American foulbrood were susceptible to European foulbrood.[351]

Government scientists, unable to provide a chemical or biological solution for foul brood, still staked their claim to authority on the production of knowledge. However, instead of creating knowledge about a cure, they created knowledge of the disease by collecting data and creating statistics. Their authority was based on the breadth of their knowledge, the number of beekeepers they had spoken with, and the statistics they created from that information, which highlighted the most successful disease management practices. This is an interesting contrast to historian Alan Marcus’ discussion of systematized agriculture in the progressive era in that Marcus identifies record-keeping as the incipient professionalization of farmers. For Marcus the single phenomenon that separated farmers from scientists was experiment.[352] In the case of foul brood, scientists’

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[350] A. Burr Black, “History and Distribution of Bee Diseases in Oregon” (M.S. Thesis, Oregon State College, 1939), 6-7.
[351] John F. Long, "Apiary Inspectors of America Meeting San Jose, California,” *Wisconsin Horticulture,* no.6 (1953): 151.
[352] I talk more about Marcus’ concept in chapter 3.

experiments, while identifying the cause of foul brood, had been unsuccessful in providing a cure and therefore the authority normally vested in scientists through experiment was missing. However, beekeepers were experimenting with management strategies and it was the knowledge created by these uncontrolled experiments that government scientists used as data and to support their authority as repositories of vast amounts of information. Information which scientists used to create the most effective recommendations. The boundary between science and traditional knowledge became very thin, especially since both the scientists and beekeepers were judging success through an economic lens.

About the same time Scullen was recommending that beekeepers kill any colonies infected with American foulbrood, a sulfa drug was discovered by Gerhard Domagk (1895-1964), a German bacteriologist. Sulfa drugs do not kill bacteria, instead inhibiting their ability to reproduce, however they became a common item in WWII first aid kits.[353] These drugs quickly began being tested on American foulbrood by apicultural scientists and beekeepers. However, in 1945 Jas. I. Hambleton, Senior Apiculturist at the Bureau of Entomology and Plant Quarantine, USDA, sent a letter to Herman A. Scullen stating that the experiments in the Bureau's laboratory did not indicate any impact on American foulbrood by sulfa drugs.

> In work in the laboratory we have found that the sulfa drugs generally do not inhibit growth in culture of the bacillus that causes American foulbrood, nor do they prevent it from forming spores. Quite a number of beekeepers, however, have reported success in using these drugs in their apiaries. Under the circumstances we are reserving our

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Alan I. Marcus, *Agricultural Science and the Quest for Legitimacy Farmers, Agricultural Colleges, and Experiment Stations, 1870-1890* (Ames: Iowa State University Press, 1985).

[353] "Sulfa Drug," Encyclopaedia Britannica, https://www.britannica.com/science/sulfa-drug#ref263956; "Gerhard Domagk," Encyclopaedia Britannica, https://www.britannica.com/biography/Gerhard-Domagk.

> judgement in the matter until the Missouri experiments are repeated under controlled conditions. If any of the drugs do have a favorable effect when given to a colony, we are inclined to believe that this result is secondary, and that primarily the drug promotes the health of the brood, thus enabling it to ward off the disease.[354]

Initial results seemed to indicate a long feeding period was required before there was an impact by the sulfa drug and this delay meant the diseased colony would be maintained, in a diseased condition, within the apiary for an extended period, increasing the likelihood of infecting other hives within several miles of the diseased colony. For practical purposes beekeepers were much better off continuing to practice traditional beekeeping disease management methods as late as the mid-twentieth century.

4.6 Conclusion

I believe Quinby was not acknowledged by contemporary beekeepers for advancing the fight against foulbrood for two reasons. First, the treatment he recommended was based on traditional beekeeping disease management strategies, e.g. removing the surviving bees to a new hive or killing colonies too devastated by disease to recover. Second, he provided a symptomology, but neither beekeepers nor scientists were interested in a symptomology. For the beekeepers, Quinby's treatment method was too generalizable to require a specific disease diagnosis. Removal to a new hive and/or killing weak colonies was an effective disease management strategy for a number of bee diseases and bee pest issues. Scientists were looking for a cause, believing that a cure could only come from knowledge of the cause of the disease, and Quinby's treatment did nothing to make them rethink that belief. In addition, Quinby was a beekeeper, with no specialized scientific knowledge or even any of the

[354] Scullen forwarded this letter to A. Burr Black.
Jas. I. Hambleton, letter to H.A. Scullen, November 30, 1945.

technology needed for the new science being practiced in the mid-nineteenth century, such as the microscope.

The foulbrood research done by Cheshire, a beekeeper with a microscope, was published in beekeeping journals in Britain and America. Additionally, he collaborated with Cheyne, a bacteriologist, which seems to indicate that he was accepted within scientific circles as someone capable of conducting sound scientific research. It is interesting that White, an entomologist, gave credit for discovery of *Bacillus alvei* to Cheyne, rather than Cheshire, while Cheshire or the team of Cheshire and Chayne were the name(s) most frequently mentioned in turn of the twentieth century beekeeping journals in relation to any discussion of foulbrood.

A.I. Root's championing of Dr. Preuss's etiology could be explained as due to Dr. Preuss having the only scientific etiology for foulbrood when Root first published his beekeeping text. However, I believe it is also another indication of beekeepers' desire to be on the cutting edge of science. Within beekeeping journals of this period are extended articles on the most recent scientific discoveries that pertain in any way to beekeeping. Root's decision to base his discussion of foulbrood around Dr. Preuss's etiology is a manifestation of the tradition of beekeepers and naturalists, and beekeepers and scientists, working together. Root's decision to continue with traditional beekeeping disease management practices instead of a fungicide as recommended by Dr. Preuss is the result of commercial beekeepers who are dependent on their beekeeping practices for a livelihood. Theory is fine and good, but what works is more important when it comes to feeding your family.

I believe McEvoy's Shaking Method, based on traditional beekeeping disease management practices, gained popularity not only because it was the most reliable treatment option available, but also because of his status as a government official. His authority, like government scientists investigating foul brood, came from the breadth of his knowledge of the disease. As an inspector, he met with numerous individual beekeepers, collecting a large amount of data on the disease and what practices worked. Other successful beekeepers (Quinby and A.I. Root) had offered the same treatment, without the catchy name, but they had not been lauded in beekeeping journals as discovering the best treatment for foulbrood. In addition, Quinby had spent years collecting information from beekeepers, going so far as to advertise in an agricultural paper, the *Cultivator*, and offering a reward for any treatment that worked.[355] However, Quinby did not have the authority of a government position. None of the three beekeepers, Quinby, A.I. Root, or McEvoy provided an etiology or used a microscope. What sets McEvoy apart is his status as a government official – Foulbrood Inspector for Ontario – and the fact that at this time government scientists working on foulbrood were basing their authority on data collected from beekeepers.

Finally, I am fascinated by the way in which government scientists justified their authority. As Thomas Broman, a historian of science, has stated, “In our society, we require scientists to tell us things about the world that we hold to be true, but we also require them to function as occupational experts who, like butchers, bakers, and candlestick makers, have special skills that can be used to produce new technologies or implement solutions to problems.”[356] This is especially true for agricultural government scientists. However, these very scientists failed to provide a cure for foulbrood. This forced them to recommend traditional beekeeping disease management practices for foulbrood mitigation. To justify their position to both governmental budgeting bodies as well as the agriculturists they served, the USDA

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[355] Moses Quinby, *Mysteries of Bee-Keeping Explained: Being a Complete Analysis of the Whole Subject* (New York, N.Y.: C.M. Saxton, Agricultural Book Publisher, 1854), 268-270.
[356] Thomas Broman, "The Semblance of Transparency: Expertise as a Social Good and an Ideology in Enlightened Societies," *Osiris,* 27 (1): 208.

and experiment station scientists were reduced to collecting data on the disease from beekeepers and then using that data to create statistics, projections and to support creation of new legislation. Their success was measured to a great extent in the economic success of American beekeepers, rather than the advancement of scientific knowledge about foulbrood.

5 Codling Moth

“Its work is to be seen everywhere, and the damage it has wrought exceeds that done by all the other insect pests with which we have been afflicted.” – James Varney, Oregon Fruit Pest Inspector, referring to the codling moth, 1891.[357]

The previous chapter on apples in Oregon discussed the development of private and government bodies in support of agriculture and more specifically in support of apple production in Oregon. This chapter also examines the apple industry in Oregon by looking more closely at the codling moth’s impact on science and policy recommendations produced by agencies addressing this threat. The commercial honey bee pollination service in Oregon was shaped by the scientific recommendations and policies created in response to the codling moth invasion.

This chapter also builds on the exploration of scientific nomenclature as a system of colonizing knowledge about nature, an exploration I began in the chapter on honey bees in Oregon. Who had a right to name a species and what that right was based on speaks directly to my discussion of expertise and authority in agriculture and science. In this chapter the nomenclature used for the codling moth does not conform to the International Commission on Zoological Nomenclature (ICZN) decision to use Linnaeus’ tenth edition of *Systema Naturae* in issues of priority for scientific naming. Currently, the scientific community is split, with American and Canadian scientists using a North American scientific name and European and Asian scientists using a different scientific name, neither faction being willing to concede to the other or to the ICZN standard and both claiming the authority to choose the correct

[357] James A. Varney, "Report Of The Inspector Of Fruit Pests," in *First Biennial Report of the Oregon State Board of Horticulture,* ed. the Oregon State Board of Horticulture (Portland, OR: A. Anderson & Co., 1891), 27.

scientific name. This is a simple, but telling, instance of dissention in the international scientific community.

5.1 What do you call it?

The codling moth was known to Europeans from very early times, but under several different spellings and several different names.[358] According to M.V. Slingerland, Assistant Entomologist at the Cornell Experiment Station in 1896 and someone who has been widely cited in discussions of codling moth nomenclature, the common name, codling, was being spelled “codlin” in the United States at the turn of the twentieth century and earlier.[359] Slingerland believed the name codling came from the old English word “querdlying,” which he said meant “any immature or half-grown apple” in the fifteenth century and in the seventeenth century was “being applied to a variety [of apple] suitable to be cooked while still unripe.”[360] The Oxford English Dictionary states it is possible later forms of the word, quodling and codling, could be “corruptions of the earlier querdling” meaning “hard-berried, hard.” However, this

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[358] B.F. Hurst, "Methods of Combating the Codling Moth," *Better Fruit,* no.1 (1906).
This is just one of the sources that state that the codling moth has been known to Europeans for at least 2,000 years. Many cite Cato’s mention of wormy apples or Theophrastus’ mention of the codling moth in 371 B.C.
Also frequently mentioned as the closest link to Cato or Theophrastus’ mention of the codling moth is: *The biology of the codling moth* (*Carpocapsa pomonella L.*) *as the basis for its control*: Jabūcni smotavac (*Carpocapsa pomonella L.*) *biologija koa osnova za njegovo suzbijanze*. Translation from Serbo-Croatian Milrod D. Tadíc, David Tornquist, translator. 1963

[359] O.J. Lowrey, "Convention Proceedings Vermont Bee-keepers' Convention Report," *American Bee Journal,* no.25 (1896).
Slingerland stated that some writers were using “coddling” at the turn of the twentieth century. However, he went on to say that “neither of these forms or variations have any etymological evidence to support them, and the name of the insect should be spelled “codling moth;” as originally given in 1747.”
M.V. Slingerland, "The Codling Moth," in *The Sixth Biennial Report of the Board of Horticulture*, ed. the Oregon State Board of Horticulture (Salem, Oregon: W.H. Leeds, 1900), 285.

[360] Slingerland, 285.

source goes on to say “this is not very satisfactory either in form or in sense…the form querdling, the late appearance of the verb coddle, and want of early examples of a descriptive phrase ‘coddling apple’, all tend to indicate that this association was non-original and incidental.”[361]

The scientific name for the codling moth is even more confusing and depends on the time period you are researching as well as the country. Currently in North America the name used is *Cydia pomonella*, but Europe and Asia continue to use a different, historical, scientific name for the codling moth - *Laspeyresia pomonella*.[362] Carl Linnaeus (1708-1778), in the tenth edition of *Systema Naturae* (1758), named the codling moth *Lepidoptera Phalaena Tinea pomonella*.[363] *Phalaena* was a category of *Lepidoptera* Linnaeus used for moths that were not butterflies or hawk moths and *Tinea* designating a fungus moth. Finally, *pomonella*, referred to the specific species and comes from the Latin “*pomum*” for fruit. I will be using “codling moth” when referring to this insect.

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361 "codling | codlin, n.2," *Oxford English Dictionary*, Oxford University Press, http://www.oed.com/view/Entry/35613?redirectedFrom=codlin
The OED online entry for codling moth: “codling-moth n. a species of moth (*Carpocapsa pomonella*), the larva of which feeds on the apple.”

362 J.W. Brown, "Scientific Names of Pest Species in Tortricidae (*Lepidoptera*) Frequently Cited Erroneously in the Entomological Literature," *American Entomologist,* no.3 (2006).

363 Carl Linnaeus, *Systema Naturae*. *Holmiae: Impensis Direct. Laurentii Salvii*, (*n.p.,* 1758), 538.
“This great naturalist named it pomonella, and his description of it consists of only six words: “Alis nebulosis postice masularubra aurea.”” Fabricius, 1775, named it pomana; Schiffenmuller, 1776, named it pomonana.”
M.V. Slingerland, "The Codling Moth," in *The Sixth Biennial Report of the Board of Horticulture*, ed. the Oregon State Board of Horticulture (Salem, Oregon: W.H. Leeds, 1900), 285.
“pomonella Phalaena (Tinea), Linnaeus, Syst. Nat., ed. 10, 1758, 538; ed. 12, 1767, 892.”
Charles Davies Sherborn, "Index Animalium," Smithsonian Institution Libraries, 2017, 769, http://www.sil.si.edu/DigitalCollections/indexanimalium/.

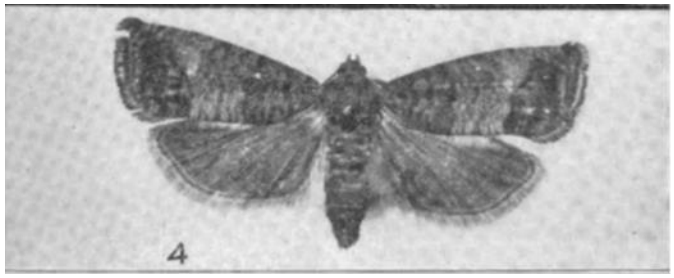

Figure 13 Codling moth.[364]

5.2 Oregon's First Apple Boom and Bust

The first apple slips and seeds that arrived in Oregon, 1847-1853, were pest-free. Because of Oregon's relative isolation and the fact that Oregon was mainly exporting apples, rather than importing them, Oregon orchards remained pest free for over twenty years and some early Oregon fruit-growers believed "that Oregon's soil and climate made it impossible for the pests to exist in this state."[365] This is the first golden age of Oregon apple production, when Oregon was shipping thousands of boxes of apples to the California gold fields monthly during fall and winter for good prices.[366] The fruit growers had minimal expenses, mainly pruning, harvesting, and shipping, and that, along with the profits from the California market, encouraged many Oregon residents to take up fruit-growing.

The number of Oregon orchardists that had apples available to sell increased rapidly, which deflated apple prices just as rapidly. In 1853 Seth Lewelling, Henderson Luelling, and William Meek jointly started four nurseries – Salem, near Spring Valley, on the Long Tom, and near Albany – all

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364 Ezra Dwight Sanderson, *The Codling Moth and How to Control it by Spraying*, Bulletin 143, ed. the Department of Entomology (*n.p.*: New Hampshire Agricultural Experiment Station, 1909), 68.

365 E.W. Allen, "Report of the Secretary," in *First Biennial Report of the Oregon State Board of Horticulture,* ed. the Oregon State Board of Horticulture (Portland, OR: A. Anderson & Co., 1891), 39.

366 "The great immigration to California caused by the discovery of gold, created a market for every eatable and the 'big red apples' from Oregon were sold at enormous prices to miners and others." Ethan W. Allen, "Horticulture in Oregon," in *Second Biennial Report of the Oregon State Board of Horticulture*, ed. the Oregon State Board of Horticulture (Salem, OR: Frank C. Baker, 1893), 149.

overseen by hired managers. The year before they had hired fourteen full-time men to graft apple trees and had stocked the nurseries with 100,000 trees.[367] Between 1856 and 1869 Oregon was shipping 6-12,000 boxes of apples a month to California during the fall and winter. However, by 1870 California apple orchards matured into production. With their reduced transportation costs, they quickly replaced Oregon apples in California markets.[368] Perhaps even worse for Oregon fruit-growers, California orchards began supplying Oregon with fruit in the next ten years.

Many of the early Oregon apple-speculators had not foreseen the loss of their main market, and had just planted acres of young apple trees. These new, non-producing orchards as well as many established, productive orchards were abandoned and would become fertile ground for the codling moth.[369] Additionally, most homesteaders planted one to four apple trees for family use and possible small-scale sales when there was a large harvest. These individual trees were often minimally cared for, providing many small codling moth refugia scattered throughout Oregon.

The railroad and steamship routes within Oregon and between Oregon and California had grown and by the 1880s were available for transport of California grown products to Portland and from there

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[367] Seth Lewelling, "Horticulture in Early Days," in *The Second Biennial Report of the Oregon State Board of Horticulture,* ed. the Oregon State Board of Horticulture (Salem, OR: Frank C. Baker, State Printer, 1893).
[368] Lewelling, 243.
[369] E.R. Lake, *The Apple in Oregon*, Experiment Station Bulletin 81, ed. the Oregon College of Agriculture Experiment Station (Corvallis, OR: Oregon Agricultural College, 1904).
This reference can be found in pages 7, 8, and 10. Lake gives a good summary history of the apple industry in Oregon in this bulletin.
First apple trees in Pacific Northwest – at Fort Vancouver, from seed.
Ethan W. Allen, "A Review of the Fruit Industry," in *The Second Biennial Report of the Oregon State Board of Horticulture,* ed. the Oregon State Board of Horticulture (Salem, OR: Frank C. Baker, State Printer, 1893), 99.
See chapter 3 in this dissertation for a more comprehensive history of the introduction of apples and the beginnings of the apple orchard industry in Oregon.

to points throughout Oregon. In the Secretary's Report for the OSBH in 1891 Ethan W. Allen stated: "Thus it was that during the seasons of 1885 and 1886, the codlin [sic] moth and some others of the pestiferous insects began to be noticeable in the orchards and fruits contiguous to the railroads in the Willamette valley."[370] By 1889 nearly every part of Oregon had become invaded by the codling moth, with only the far eastern areas, which were ranching, and wheat and alfalfa growing districts with few apple trees, remained free of the codling moth.[371]

5.3 Cultural Controls

Two of the earliest cultural control methods used by apple growers against the codling moth was to pasture hogs in the orchard or to wrap the trunks of the trees. Both methods were used in Oregon and were meant to reduce the number of larvae, thereby reducing the codling moth damage.

Adult codling moths emerge from cocoons in early spring and will only mate once temperatures at dusk exceed 62^{o} F. After mating the female deposits individual eggs on the leaves, fruit, nuts and spurs of a tree. The eggs hatch into immature larvae which bore into immature fruit or nuts where the larvae remain until fully developed. These mature larvae then drop to the ground where they begin the search for a site to pupate, such as in leaf debris on the ground, in the soil, and, in some cases, crawling back up the tree to find a nice spot in the

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[370] E.W. Allen, "Report of the Secretary," in *First Biennial Report of the Oregon State Board of Horticulture,* ed. the Oregon State Board of Horticulture (Portland, OR: A. Anderson & Co., 1891), 39.
[371] Ethan W. Allen, "Minutes" (Oregon State Board of Horticulture, Salem, OR, May 21-22, 1889).

tree bark, where they create a cocoon and the cycle goes on. Codling Moths sometimes produce four generations in one year depending on the ambient temperature.[372]

Pasturing hogs in the orchard was attractive to orchardists because the hogs could feed on the apples that dropped to the ground thereby reducing the amount of hog feed needed from other sources while reducing the number of codling moth larva at the same time. The hogs were then sold or eaten by the family. The Oregon State Board of Horticulture (OSBH) was recommending this method by the 1890s.[373] Pasturing hogs in orchards became popular again in the 1910s, but not as a method of controlling the codling moth. By this time experts were recommending a cover crop in orchards to maintain moisture in the soil while also returning nutrients to the soil. C.I. Lewis, Horticulturist with the Oregon Agricultural College Experiment Station, stated that “Many fruit growers write the Experiment Station asking about combining hogs and orcharding, the idea being to raise certain crops among the trees for hogging off.”[374]

The second popular cultural control for codling moth was to wrap the trunk of the apple trees in cloth, a method commonly referred to as ”banding.” By wrapping cloth around the trunk of the tree many larvae that looked for shelter on the trunk of the tree instead would shelter in the folds of the cloth where they could be discovered and killed. The OSBH Bulletin #7

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[372] J.L. Caprile and P.M. Vossen, “Pest Notes: Codling Moth, Publication 7412,” ed. M.L. Fayard (Davis, CA: University of California Statewide Integrated Pest Management Program, 2011).

[373] E.W. Allen, "Report of the Secretary," in *First Biennial Report of the Oregon State Board of Horticulture,* ed. the Oregon State Board of Horticulture (Portland, OR: A. Anderson & Co., 1891), 41; Ethan W. Allen, "Bulletin #7," in *The Second Biennial Report of the Oregon State Board of Horticulture,* ed. the Oregon State Board of Horticulture (Salem, OR: Frank C. Baker, State Printer, 1893), 92. Allen tells readers that spraying is a better preventative than hogs or wraps and is cheaper. Allen, "Report of the Secretary," 44.

[374] C.I. Lewis and H.A. Vickers, *Economics of Apple Orcharding,* Experiment Station Bulletin 132, ed. the Oregon College of Agriculture Experiment Station (Corvallis, OR: Oregon Agricultural College, 1915), 35.

recommended that the cloth be removed every six days and scalded in water to kill all the larvae. The cloth could then be replaced and once again affixed with a string or some tacks.[375] This method remained popular into the twentieth century and it was recommended by A.I. Lovett, an Entomologist with the Oregon Agricultural College (OAC), that it be used in addition to chemical sprays in 1923 when there was an extreme outbreak of codling moth. Banding "has fallen into disuse and disrepute because of its abuse. Banded trees must be visited regularly and the accumulated worms destroyed or else the system is worse than useless." By this time the recommended time between inspections of bands had changed to every 12 days between mid-June and early September. Lovett suggested that "a twelve-year old boy supplied with a stool or bench having a back to which an old wringer is attached could handle the bands in good shape, simply jerking the bands from the trees, running them through the wringer and adjusting them in place once more."[376]

5.4 Biological Controls

By the time the OSBH was established in 1889, the codling moth had infiltrated nearly all areas of Oregon, and at one of their first meetings James Hendershott, Commissioner for the Fifth District, was the only commissioner who could report that there was no codling moth in his area.[377] J.R. Casey, Commissioner of the Third District, claimed "that most of the orchardists were ready and willing to apply those remedys [sic] that would destroy these pests."[378] Dusting

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[375] Ethan W. Allen, "Bulletin #7," in *The Second Biennial Report of the Oregon State Board of Horticulture,* ed. the Oregon State Board of Horticulture (Salem, OR: Frank C. Baker, State Printer, 1893), 92.
[376] A.L. Lovett, "Let's Whip the Codling Moth in '23," *The Oregon Grower,* no.7 (1923): 31.
[377] Ethan W. Allen, "Minutes" (Oregon State Board of Horticulture, Salem, OR, May 21-22, 1889).
[378] Allen. "Minutes."

or spraying for pests was new for Oregon at this time and there was a shortage of equipment and knowledge about chemical pest-control among orchardists. Additionally, both the United States Department of Agriculture (USDA) Bureau of Entomology, directed by Charles V. Riley, and the OSBH endorsed the use of biological controls (beneficial insects) when possible.[379] Riley's success in controlling the cottony-cushion scale (*Icerya purchasi*), which was ruining the California citrus industry in the 1880s, with the 1889 importation of the Australian ladybird beetle (*Rodolia cardinalis*) was atypical, but provided support for the effective use of biological controls. Leland Ossain (L.O.) Howard, who succeeded Riley as the USDA Chief of the Bureau of Entomology, stated in 1911:

> The astonishing results of the practical handling of *Novius* [*Rodolia cardinalis*] drew attention more forcibly than ever before to the possibilities of this kind of warfare against injurious insects, and although its perfect success as an individual species has never been duplicated, very many efforts in this direction have been made, some of which have met with measurable success and some with very positive results of value.[380]

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[379] Ethan W. Allen, "Minutes" (Oregon State Board of Horticulture, Portland, OR, October 23, 1893); George Sargent, letter to William S. Crowell, April 16, 1895; George Sargent, letter to S.D. Evans, May 4, 1895; T.J. Henneberry, *Federal Entomology Beginnings and Organizational Entities in the United States Department of Agriculture, 1854-2006, With Selected Research Highlights*, ed. the Agricultural Research Service (Washington, D.C.: USDA, 2008), 10.
The OSBH endorsed the use of beneficial insects and had been supporting the use of Ladybird beetles (*Chilocorus bipustulatus*) against San Jose scale (*Quadraspidiotus perniciosus*), another recently arrived Oregon apple pest.
The president's report "pointed out the urgent necessity for the board carrying on new lines of work and broadening its field of work." He endorsed the efforts to import beneficial insects and "in a clear manner the beneficial results that would be obtained by the fruit growers from their introduction." "Minutes" (Oregon State Board of Horticulture, Portland, OR, October 15, 1894).

[380] L.O. Howard and W.F. Fiske, *The Importation Into the United States of the Parasites of the Gipsy Moth and the Brown-Tail Moth: A Report of Progress, With Some Consideration of Previous and Concurrent Efforts of this Kind*, ed. the United States Department of Agriculture Bureau of Entomology (Washington D.C.: Government Printing Office, 1911), 30.

By 1895 the OSBH were importing Ladybird beetles into Oregon from California in an attempt to control the newly introduced pest San Jose scale (*Quadraspidiotus perniciosus*). Unlike Riley's biological control research, which was a focused search for a predator of the cottony-cushion scale, the importations into Oregon seem to have been based on the idea that any beetle that preyed on one species of scale might also prey on the San Jose scale.

Federal entities responsible for entomological research were established as early as 1854, when the Office of the Entomologist was created as part of the Patent Office's Agricultural section. T.J. Henneberry, Director of the Arid Land Agricultural Research Center in 2008 and author of a federal government sponsored history of federal entomology states that Townend Glover, "The first Federal entomologist received his appointment in 1854 as an expert in assembling statistics and other information on seeds, fruits, and insects in the United States."[381] This federal entity lasted until 1863 when the Division of Entomology was created as part of the USDA.[382] Glover transitioned with the position, remaining with the Division of Entomology until 1878 when Charles V. Riley took over as Entomologist for the USDA. Riley remained with the Division until 1894 when Leland Ossain (L.O.) Howard assumed that position.

While many historians discuss Riley's successful biological control as being a reason Howard and others at the turn of the twentieth century continued to support biological control

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[381] L.O. Howard, "Progress in Economic Entomology in the United States," in *Yearbook of the United States Department of Agriculture, 1899*, ed. George William Hill (Washington, D.C.: USDA, 1900), 138; T.J. Henneberry, *Federal Entomology Beginnings and Organizational Entities in the United States Department of Agriculture, 1854-2006, With Selected Research Highlights*, ed. the Agricultural Research Service (Washington, D.C.: USDA, 2008), ii.
[382] Henneberry.

methods, there were drawbacks to this method.[383] The extensive work needed to understand the life cycles of pest and predator species meant they were slow to implement, slow to impact pest populations once implemented, and, often despite years of research, these importations were unsuccessful. Historian of science Paolo Palladino claims it was a societal ethos rather than Riley's stunning success that supported the continued use of biological controls, that there was an underlying "pervasive, popular notion that different animal populations were maintained in their proper, balanced relationships by the divinely ordained mechanisms of predation and parasitism."[384] Palladino's premise does not fit with early Oregon Agricultural College (OAC) Pest control recommendations, as evidenced by the OAC Experiment Station, which tagged some of their 1913 Hatch Act federal funding for the introduction of the codling moth parasite, *Calliephialtes messor Graves*.[385] This is despite Howard's 1911 publication that this parasitic import was not effective. Early twentieth century entomologists at OAC believed in biological control methods, but perhaps even more importantly they were desperate to find a cheap and simple solution to the codling moth problem.

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[383] "Perhaps the most notable of his [Riley's] achievements was his support of exploration and introduction of natural enemies for biological control of insect pests. He was responsible for initiation of classical biological control in Federal entomology."
T.J. Henneberry, *Federal Entomology Beginnings and Organizational Entities in the United States Department of Agriculture, 1854-2006, With Selected Research Highlights*, ed. the Agricultural Research Service (Washington, D.C.: USDA, 2008), 13.
"While Riley pioneered the area of natural and biological control of insects, Howard expanded and developed these areas as well as uncovering the role of insects in relation to human disease." Henneberry, 14.
[384] Paolo Palladino, *Entomology, Ecology, and Agriculture The Making of Scientific Careers in North America, 1885-1995* (UK: Harwood Academic Publishers, 1996), 75.
[385] Ethan W. Allen, "Minutes" (Oregon State Board of Horticulture, Salem, OR, May 21-22, 1889); James Withycombe, *Report of the Agricultural Experiment Station 1912-1914*, ed. the Oregon Agricultural College Experiment Station (Corvallis, OR: Oregon Agricultural College, 1914), 13.

5.5 Early Pesticide Use

Farmers have been using various substances as pesticides, probably from a very early time period, but at least as early as the 16th century.[386] These solutions included tobacco, capsicum, whale oil, soot, sulphur, hellebore, pyrethrum, soap, and lime alone or in combinations. As new items were introduced they often replaced older substances, as when kerosene replaced the use of whale oil.[387] Historian J.F.M. Clark points out that most of these early insecticides were only practical if used in a small area.[388] It was the farmer who would purchase the ingredients and then create the mixtures, such as tobacco and whale oil, when they were to be used.[389]

5.6 Chemical Pesticides

Paris Green and London Purple were the two most popular of the chemical insecticides at the turn of the twentieth century. Both have arsenic as an active ingredient, however, London Purple was cheaper and remained suspended in liquid more easily than Paris Green. The main draw-back was that it tended to scorch the leaves of some trees.[390] Even with the problem of scorched leaves, the *First Biennial Report* of the OSBH recommended London Purple over Paris Green because, "it is soluble, more

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386 V.G. Dethier, *Man's Plague? Insects and Agriculture* (Princeton: Darwin Press, 1976); May R. Berenbaum, *Bugs in the System Insects and Their Impact on Human Affairs* (Reading: Helix Books Addison-Wesley Publishing Co., 1995); J.F.M. Clark, "Bugs in the System: Insects, Agricultural Science, and Professional Aspirations in Britain 1890-1920," *Agricultural History,* no.1 (2001). These are three sources that discuss early pest solutions.

387 Dethier.

388 Clark.

389 Dethier.

390 "Gleams of News: Spraying for Noxious Insects," *American Bee Journal,* no.18 (1890): 292.

adhesive and less poisonous than Paris green and therefore is to be preferred."[391] Despite this, Paris Green became the chemical insecticide of choice in the early twentieth century.

According to Palladino, arsenic had been used as an insecticide for hundreds of years, but the first U.S. arsenic-based insecticides were marketed in the 1870s. These were in powder form and within the first five years farmers began making a slurry out of the powder and painting it on plants, which was quickly followed by applying the insecticide slurry with a syringe and spray pump for a faster application process.[392] The insolubility of Paris Green was first thought to be an advantage, especially in the rainy areas of Oregon, as once it adhered to the tree it was unlikely to wash off.[393] However, it also required the person spraying to continually agitate the solution in the tank.[394] According to L.O. Howard, C.V. Riley had called Paris Green "eminently dangerous" and claimed it should only be used as a last resort.[395] Some researchers have claimed that C.V. Riley was actually responsible for the turn toward chemical pesticides, either through promotion of chemical pesticide use, by inventing a better spray nozzle, or through his efforts to standardize chemical pesticide composition, thereby creating a more reliably effective pesticide. Other historians focus on the intensification of chemical pesticide use in the twentieth century and Howard's promotion of quick solutions to insect problems.[396] I believe all these

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391 E.W. Allen, "Report of the Secretary," in *First Biennial Report of the Oregon State Board of Horticulture,* ed. the Oregon State Board of Horticulture (Portland, OR: A. Anderson & Co., 1891), 41. Later, on page 47, in the same document there is information on complaints about scorched leaves.

392 Paolo Palladino, *Entomology, Ecology, and Agriculture The Making of Scientific Careers in North America, 1885-1995* (UK: Harwood Academic Publishers, 1996), 21-22.

393 Allen. 41.

394 "Gleams of News: Spraying for Noxious Insects," *American Bee Journal,* no.18 (1890): 292.

395 L.O. Howard, "Progress in Economic Entomology in the United States," *Yearbook of the United States Department of Agriculture, 1899*, ed. George William Hill (Washington, D.C.: USDA, 1900).

396 Berenbaum discusses Riley's nozzle and claimed that Riley initiated and encouraged chemical pesticide use.
May R. Berenbaum, *Bugs in the System Insects and Their Impact on Human Affairs* (Reading: Helix Books Addison-Wesley Publishing Co., 1995).

factors played a part and would like to add the pressures of an expanding global marketplace which demanded perfect fruit that could travel long distances without rotting in transit, something that was only possible by having a harvest untouched by the codling moth.

In 1891, R.S. Wallace, Commissioner for the OSBH Second District, said that "40% of the apples were infested with the Codlin [sic] Moth. Very little spraying had been done."[397] Oregon fruit growers remained unconvinced that spraying with chemical pesticides was necessary for several reasons. First, Oregon had been free of the codling moth for over twenty years, and James Henderschott, Commissioner of the OSBH Fifth District, claimed that his district was still free of this pest at the end of the nineteenth century. Additionally, the market for Oregon apples at this time was small and mainly local and many orchardists were not convinced spraying would result in a larger or better quality crop that would allow them to recoup the cost of spraying. Some orchardists who had dusted or sprayed complained to the OSBH that the chemical application had been ineffective.

Two years later, in 1893, C.P. Heald, OSBH Commissioner for the Fourth District (which included the area that became Hood River County in 1908) stated that the Board's spray recommendations were being challenged by fruit growers in his district because the few who had tried sprays had experienced poor results. Heald attributed these poor results to improper application, improper compounding, use of the wrong spray, wrong equipment being used, or to shoddy application work.[398] By 1895, many fruit

McWilliams focuses on Riley's attempt at standardization of chemical pesticides, but attributes Howard as being responsible for the turn toward chemical pesticide use.
James E. McWilliams, "'The Horizon Opened Up Very Greatly': Leland O. Howard and the Transition to Chemical Insecticides in the United States, 1894-1927," *Agricultural History,* no.4 (2008).
[397] Ethan W. Allen, "Minutes" (Oregon State Board of Horticulture, Portland, OR, October 12, 1891).
[398] C.P. Heald, "Report of Commissioner, Fourth District," in *The Second Biennial Report of the Oregon State Board of Horticulture,* ed. the Oregon State Board of Horticulture (Salem, OR: Frank C. Baker, State Printer, 1893), 46.

growers still remained unconvinced that spraying was needed, despite the OSBH and the Oregon Horticultural Society (OHS) continuing to recommend that apple growers spray for the codling moth. In a letter written by George Sargent, Secretary for the OHS, you can feel his frustration.[399] "In regard to the Codling Moth, all you can do is to advise the gentleman, that for his own financial good, he had better spray."[400] This is just one of the many letters Sargent sent out in reply to various queries addressed to the OHS.

Upon hearing fruit growers' doubt about the effectiveness of spraying, the OSBH board members' first thought was that the orchardists, inexperienced in spraying or dusting for pests, were not doing it properly. To prove that numerous, thorough applications produced quantifiable results, A.H. Carsen, 1893 Second Vice-President for the OSBH, performed an experiment on his own apple trees.[401]

He sprayed fifty apple trees "using ½ teaspoonful of Paris green to five gallons of water – and sprayed May 20th, June 5th & 20th, July 10th & 25th, and last time early part of August," a total of six applications. He then randomly chose twenty apples from each tree, a thousand in total, and inspected them for evidence of the codling moth. He found that only 3.33% were infected with this pest.[402] That same year, 1893, Henry E. Dosch, OSBH Commissioner of the First District, also reported on an experiment he had performed on his own orchard where he sprayed sections of his apple orchard at different times and frequencies. Those he sprayed four times were 90% clear of codling moth, those he

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[399] George Sargent was the Oregon Horticultural Society Secretary and the OSBH Inspector for District 1 in 1893, and he was the OSBH Secretary in 1895.
[400] George Sargent, letter to G.A. Hobbs, May 8, 1895.
[401] Carsen was living in Grants Pass, Oregon and in 1900 he was the Commissioner for the Third District.
[402] Ethan W. Allen, "Minutes" (Oregon State Board of Horticulture, Grants Pass, OR, April 11, 1892).

sprayed three times were 70% codling moth free, and those he sprayed twice were only 50% free of the codling moth. The section of trees he left unsprayed as a control group were "riddled" with worms.[403]

These commissioners performed their experiments for several reasons. First, they understood that Oregon had a very different climate and fruit-growing culture than the locations where some of the USDA experiments had taken place and that this could affect the results. Their experiments were a way for them to test the USDA recommendations under local conditions and on apple varieties being grown in Oregon. This also provided them with first-hand information about what the spray process was like, how much it cost, how long it took, and any problems they encountered, that could be passed along to local orchardists with the USDA recommendation. Finally, the results proved that fruit growers could increase their profits because apples without codling moth damage sold for higher prices than apples with pest damage and their experiments had shown that more undamaged apples were produced on trees that had been sprayed. This first-hand experience gave the commissioners expertise on two fronts – as fellow apple growers who had experience using spray and as scientific experts who had performed their own experiments to test the effectiveness of spraying – which should have increased their authority and the likelihood that the apple-growers would follow their advice.

In response to the smaller orchardists' complaints that they did not have the money to purchase spray equipment nor did they have the expertise to compound specialized spray mixtures needed by the new spray rigs, some of the Commissioners began allowing the smaller orchardists to use their spray equipment and the OSBH contracted with chemical supply companies and a well-known compounder to

[403] Henry E. Dosch, "Report of Commissioner, First District," in *The Second Biennial Report of the Oregon State Board of Horticulture,* ed. the Oregon State Board of Horticulture (Salem, OR: Frank C. Baker, State Printer, 1893), 27-28.

make easy-to-use spray compounds that could be purchased from the Board.[404] Each federally recommended pesticide was being tested on several levels: first by the OSBH Commissioners to see how effective the spray was when used under conditions specific to their districts, and then again by individual fruit growers who wanted assurance that the time and money spent would produce increased profits, or at the very least not cause any harm to their trees.

Nonetheless, even as late as 1915, the ineffectiveness of chemical pesticides was a frequent complaint and at that time A.B. Cordley, Director of the Hood River branch OAC experiment station, believed "that the failures are not normally a result of the poor quality of the insecticides used, or of careless applications, but are rather due to a lack of knowledge on the part of the grower of the life-history of the insect in question."[405] Even with the aid of chemical pesticides it was necessary to understand the life cycle of the pest you sought to destroy, especially with an insecticide that was only effective when the insect ingested it.

In its 1893 *Second Biennial Report*, the Oregon State Board of Horticulture (OSBH) recommended that "the best and most opportune time to commence spraying the tree is soon after the fruit is set, and when it is about the size of a small pea; and this should be continued with an interval of two weeks until the middle of June on early varieties, and until September on late ones."[406] Part of the reason an almost continual spray program was being recommended was because of the many

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[404] In the handwritten minutes for the October 15, 1894 meeting of the OSBH Emile Schanno, who was living in The Dalles and was OSBH Commissioner of the Fourth District, stated that he often had to supply fruit growers with a spray pump and go with them to show them how to use it. "Minutes" (Oregon State Board of Horticulture, Portland, OR, October 15, 1894).

[405] A.B. Cordley, *Report of the Hood River Branch Experiment Station for 1913-1914*, ed. the Oregon Agricultural College Experiment Station (Corvallis, OR: Oregon Agricultural College, 1915), 40.

[406] Ethan W. Allen, "Bulletin No.5," in *The Second Biennial Report of the Oregon State Board of Horticulture,* ed. the Oregon State Board of Horticulture (Salem, OR: Frank C. Baker, State Printer, 1893), 74.

abandoned and neglected orchards, or neglected individual trees, from which the codling moth could launch an attack on any neighboring fruit tree. Three years later the codling moth infestation continued to increase and U.P. Hedrick, horticulturalist and botanist for the Oregon Agricultural Experiment Station, stated,

> Of all fruits, the apple suffers most from pests in Oregon. Out of the 128 apple orchards visited by the Survey workers this fall, all were affected with apple scab and Codling moth…and but few orchardists had done anything to check either… it is believed, at a conservative estimate, that nine-tenths of the apples in Willamette Valley were this year made unsalable by these two pests. The outlook for the apple grower would be bad, indeed, were it not for the fact that those who have tried have succeeded in effectually checking both pests by means of fungicides and insecticides.[407]

H.E. Dosch, OSBH Commissioner of the First District, in his 1894 annual report stated that while most fruit growers were happy to see him and comply with his directions, the law gave him no recourse to force the clearing out of "old, worthless, and badly infected trees." He went on to say that the law needed to be changed so that the commissioners could declare such places a public nuisance.[408] In 1895, OHS Secretary George I. Sargent, in a letter sent to G.A. Hobbs, a Horticultural Inspector, stated that the codling moth "cannot be prevented flying from orchard to orchard and we doubt whether you could put into effect a general rule compelling everyone to spray, unless you knew they had the moth."[409]

By 1899 just such a piece of legislation was put in place – An Act to Protect the Fruit and Hop Industry of Oregon, approved Feb 17, 1899. Section two of this act made it mandatory for anyone with plant materials infested with any insect pest to spray or destroy the infected plant materials "in such manner as the fruit commissioner for his district may direct." Not complying with this act was a

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[407] U.P. Hedrick, *Prunes, Apples, and Pears in Oregon* Station Bulletin 40, ed. the Oregon Agricultural College Experiment Station (Corvallis, OR: Oregon Agricultural College, 1896), 82.
[408] "Minutes" (Oregon State Board of Horticulture, Portland, OR, October 15, 1894).
[409] George Sargent, letter to G.A. Hobbs, May 8, 1895.

misdemeanor and the fine could be anywhere between twenty-five and one hundred dollars, which is equivalent to $734 to almost three thousand dollars today.[410] When the OSBH met a year later they could list several Oregon orchards where spraying continually and correctly were producing harvests with 95% or higher clean fruit showing no damage from the codling moth.[411] By 1913 the spray recommendation had once again changed. Spray rigs had become more powerful and efficient, and lead arsenate sprays were created with smaller particles that remained suspended in solution and that were of standardized strengths, which provided a more complete protection to the fruit. Rapidly changing knowledge and technology caused spray recommendations to change continually in the first half of the twentieth century, which had a significant impact on beekeepers and the move toward commercial pollination service. I'll be talking more about that in the chapter on pollination.

5.7 Technology

> New and improved spraying outfits are coming into general use, and apple and pear-growers realize that to have good, sound merchantable apples and pears they must spray with Paris green or London purple; and that when once started it is a simple and inexpensive process, and the best paying investment on the farm. – J.R. Cardwell, President, Oregon State Board of Horticulture (OSBH), 1893[412]

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[410] L.O. Howard, *The Laws in Force Against Injurious Insects and Foul Brood in the United States*, ed. the Bureau of Entomology (Washington, D.C.: USDA, 1906), 120.
The fine in today's dollars would be $734.25 to $2937.00.
"Consumer Price Index (Estimated) 1800-," Federal Reserve Bank of Minneapolis, https://www.minneapolisfed.org/community/financial-and-economic-education/cpi-calculator-information/consumer-price-index-1800.

[411] "Minutes" (Oregon State Board of Horticulture, Portland, OR, April 10, 1900).

[412] J.R. Cardwell, "Report of the President," in *The Second Biennial Report of the Oregon State Board of Horticulture,* ed. the Oregon State Board of Horticulture (Salem, OR: Frank C. Baker, State Printer, 1893), 25.

In 1915, when the USDA did a study on the cost of producing apples in the Hood River Valley, Oregon, they collaborated with fifty-four orchards. All fifty-four were using spray equipment with forty-three, or 80%, of the orchardists owning their own spray rigs. Some of the equipment was using old technology – steam powered rather than gasoline – and the pressure achieved varied from 150 to 225 pounds. This made a significant difference in the ability of the spray rig to reach the top of the trees for complete coverage and could leave the tops of the trees vulnerable to access by the codling moth. The eleven orchardists that did not own their own spray rigs rented them. For a dollar an hour the orchardist could hire a man, the equipment, and a team of horses.[413] Development of new spray technologies continued at a rapid pace, forcing entomologists and orchardists to keep learning new systems, purchasing improved equipment, and performing experiments to verify or improve efficacy and reduce cost. Leroy Childs, Superintendent of Hood River Branch Experiment Station, in 1920 stated:

> The evolution which has taken place in spraying equipment from the bucket and barrel pumps to our modern sprayers equipped with power similar to that of the automobile has made it necessary that the entomologist and pathologist keep up with mechanical improvement. In order to do this, it has been essential to continue experimental work in the control of the codling moth and other orchard troubles in order that the most efficient means might be determined.[414]

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[413] S.M. Thomson and G.H. Miller, *The Cost of Producing Apples in Hood River Valley* Bulletin 518, ed. the Office of Farm Management, United States Department of Agriculture (Washington, D.C.: USDA, 1917).
[414] Leroy Childs, *Spray Gun Versus Rod and Dust in Apple Orchard Pest Control*, ed. the Oregon Agricultural College Experiment Station Hood River Branch (Corvallis, OR: Oregon Agricultural College, 1920), 5.

Figure 14 Spray rig, 1920.[415]

Leroy Childs found the quick acceptance of the spray gun by most orchardists “with little or no experimental evidence as to its effectiveness” unusual. The normal practice was for orchardists to be skeptical of new technologies until those technologies had been proven to provide a benefit to the orchard.[416] However, World War I started in 1914 and had a huge impact on apple orchard practices. By 1917, Western orchardists were under pressure to produce more apples for the troops and for export to England. At the same time they faced a labor shortage as many young men who would normally work in the orchards were now overseas serving in the military. The spray gun supported by a high-powered motor seemed the only solution as it could apply more insecticide faster and more cheaply than older equipment, reducing the labor and expense while increasing saleable harvest.

[415] Leroy Childs, *Spray Gun Versus Rod and Dust in Apple Orchard Pest Control*, ed. the Oregon Agricultural College Experiment Station Hood River Branch (Corvallis, OR: Oregon Agricultural College, 1920), 36.
[416] Childs. 22.

The high-powered sprayer was new to Western orchards in 1917 and required orchardists and entomologists to rethink their codling moth eradication strategies. Previously many Western orchardists had dusted their trees using rods or had sprayed with low-pressure rigs. Both had drawbacks. The dusts worked great for codling moth, but did not address many other orchard problems such as mildew, anthracnose, or scale insects. This made it necessary for orchardists to do multiple types of application for different issues. The spray rigs allowed orchardists to spray for multiple issues in the same application, however the lower pressure produced larger globules of insecticide, which left a lot of the exterior of the fruit bare and vulnerable to codling moth.[417]

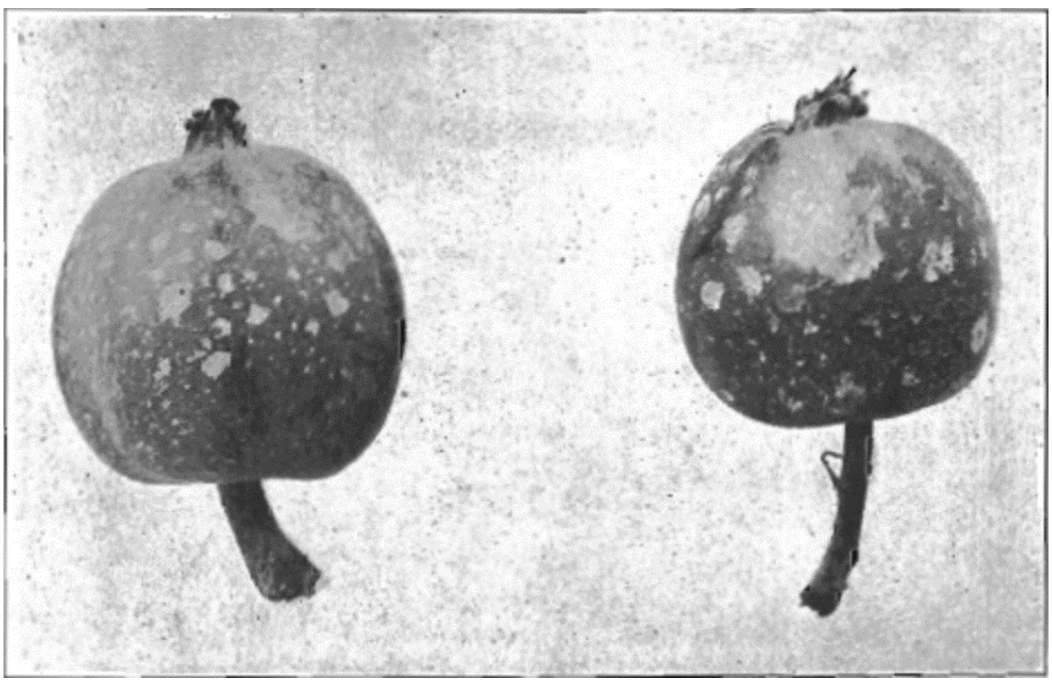

Figure 15 Large drops of spray created by low pressure spray outfits.[418]

[417] Leroy Childs, *Spray Gun Versus Rod and Dust in Apple Orchard Pest Control*, ed. the Oregon Agricultural College Experiment Station Hood River Branch (Corvallis, OR: Oregon Agricultural College, 1920).
[418] Childs. 43.

The problem with adopting the spray gun, said Childs, was that it was "a useless accessory to a poor spray outfit; it is little better than nothing and will never give good results."[419] However, with a large ten horsepower spray rig a fine spray was produced with the gun. This fine mist provided the best coverage, settling into the calyx as well as fully covering the exterior of the apple. Two years later, in 1922, despite the improved results and recommendation of the OSBH and Experiment Station, Childs stated that "orchardists of Rogue River and all other points are making the same mistake that Hood River men are making, namely, that they try to keep their orchards clean by using old fashioned spray rigs."[420] Childs seemed to have little sympathy for orchardists who may have owned their spray rigs for only a few years and were being told they were already obsolete and needed to be replaced, a very expensive investment. Some orchardists must have wondered if the new equipment would also be obsolete in just over two years.

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[419] Leroy Childs, *Spray Gun Versus Rod and Dust in Apple Orchard Pest Control*, ed. the Oregon Agricultural College Experiment Station Hood River Branch (Corvallis, OR: Oregon Agricultural College, 1920), 28.
[420] Childs, 8.

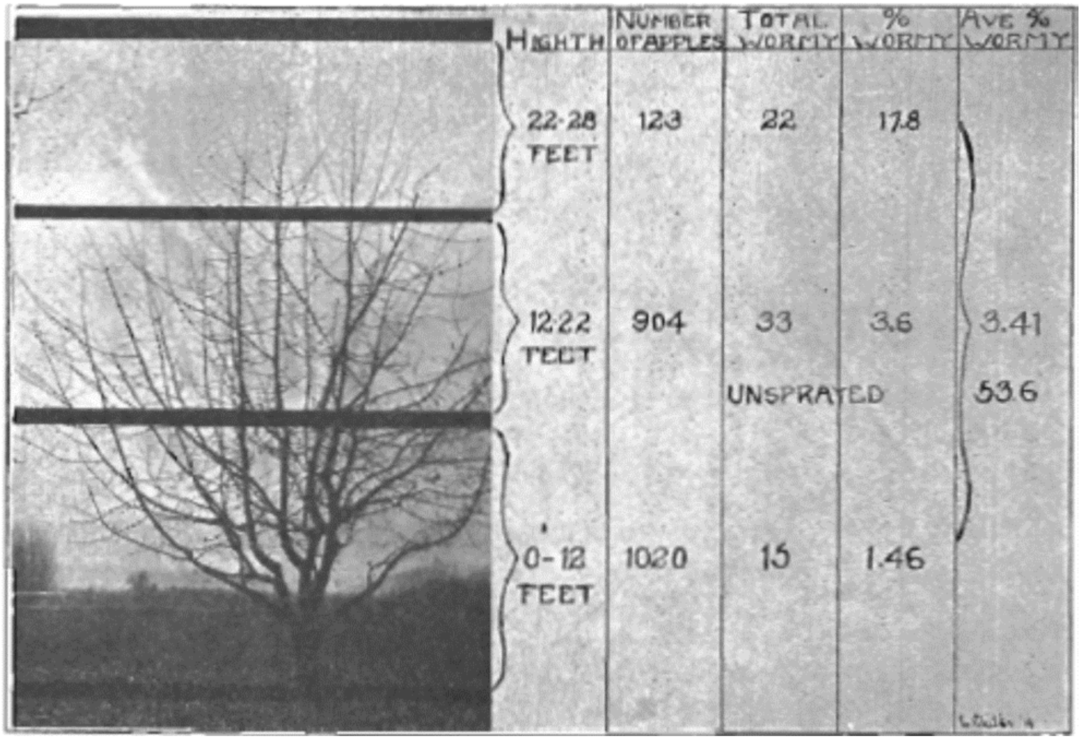

Figure 16 Spray effectiveness dependent on tree height. This speaks to the ability of the spray outfits being used in 1920 to reach the top of orchard trees. It is also of interest to note the height of the tree in this example of a typical apple tree in 1920 and compare it to the height of modern apple trees in an orchard. As David H. Diamond has stated, the space these robust trees created was very different from the space within a modern apple orchard.[421]

5.8 Economic Entomology

Economic entomology is the study of insects which have an impact on humans, directly or indirectly through interactions with animals and plants of interest, or usefulness, to humans. At the turn of the twentieth century much of the scientific research involving insects focused on how to kill them without harming humans. Modern historians James Whorton and James E. McWilliams attribute the

[421] Leroy Childs, *Spray Gun Versus Rod and Dust in Apple Orchard Pest Control*, ed. the Oregon Agricultural College Experiment Station Hood River Branch (Corvallis, OR: Oregon Agricultural College, 1920), 25; David H. Diamond, "Origins of Pioneer Apple Orchards in the American West: Random Seeding versus Artisan Horticulture," *Agricultural History,* no.4 (2010).

beginning of economic entomology to the introduction of arsenicals in the 1870s. L.O. Howard in 1900 agreed, calling Paris Green the "first great start which the new economic entomologist received."[422] May R. Berenbaum in *Bugs in the System: Insects and Their Impact on Human Affairs* disagrees, claiming Riley's successful introduction of the ladybird beetle, and thus the saving of the California citrus industry, as one of the first steps toward economic entomology.[423] In 2001, historian J.F.M. Clark introduced the idea that economic entomology did not arise out of any plea from farmers for help from scientists, but instead arose out of the idea of rebalancing nature using the "technological fix of insecticides," and the concept of public science based on efficiency and liberal reformism, both of which composed the foundation of entomologists' authority as experts.[424] Expertise was not based in agriculture; it was based in knowledge of nature, society, and politics. This view of economic entomology intimately connects it with the society in which it arose and is an aspect espoused by historian Margaret W. Rossiter in 1979, who claims that economic entomology is a creation of the U.S., and more specifically a creation of the USDA which focused on the development of insecticides, rather than the advancement of scientific theories.[425] L.O. Howard's 1900 report supports the idea that the USDA was responsible for the development of economic entomology as he stated that most

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422 L.O. Howard, "Progress in Economic Entomology in the United States," *Yearbook of the United States Department of Agriculture, 1899*, ed. George William Hill (Washington, D.C.: USDA, 1900), 146; James Whorton, *Before Silent Spring Pesticides and Public Health in Pre-DDT America* (Princeton: Princeton University Press, 1974); James E. McWilliams, "'The Horizon Opened Up Very Greatly': Leland O. Howard and the Transition to Chemical Insecticides in the United States, 1894-1927," *Agricultural History,* no.4 (2008): 479.

423 May R. Berenbaum, *Bugs in the System Insects and Their Impact on Human Affairs* (Reading: Helix Books Addison-Wesley Publishing Co., 1995).

424 J.F.M. Clark, "Bugs in the System: Insects, Agricultural Science, and Professional Aspirations in Britain 1890-1920," *Agricultural History,* no.1 (2001), 113.

425 Margaret W. Rossiter, "The Organization of the Agricultural Sciences," in *The Organization of Knowledge in Modern America, 1860-1920*, ed. Alexandra Oleson, and John Voss (Baltimore: John Hopkins University Press, 1979).

experiments on arsenical insecticides were performed in the U.S., and that the USDA was the major funder of entomology.[426] My research on the development of the apple industry in Oregon underscores a complex system of ideas and pressures that led to the development of economic entomology, including the need to create a perfect apple for the global market and government scientists involved in agricultural research using increased farm productivity and profit, two of the foundational values of the progressive era, as the justification for their governmental positions and as the foundation of their claim to expertise.

TABLE 1.—*Personnel of the agricultural experiment stations*

Title [1]	1889	1895	1900	1905
Directors and assistant directors	63	67	71	74
Substation superintendents	14	40	10	27
Agriculturists	13	55	74	58
Agronomists				44
Horticulturists	40	61	75	82
Viticulturists	5			
Foresters				4
Animal husbandmen			14	56
Poultrymen				12
Dairymen		11	30	39
Veterinarians	19	24	29	36
Farm foremen		25	24	30
Chemists	106	124	143	166
Botanists	30	36	55	56
Plant pathologists				11
Mycologists	2	7	17	4
Bacteriologists				18
Entomologists	29	43	50	65
Zoologists			6	4
Biologists	5	11	6	3
Physicists	3	3	7	5
Geologists	3	5	6	7
Meteorologists	10	15	16	8
Irrigation engineers	1	7	7	13
Librarians (1890)	5	8	10	12
Secretary-treasurers	13	26	27	30
Clerks	16	27	51	46
Miscellaneous	17	28	30	54
Total	402	557	693	845

[1] In some cases 1 person served in more than 1 capacity.

Figure 17 Experiment Station Personnel, 1937.

[426] L.O. Howard, "Progress in Economic Entomology in the United States," in *Yearbook of the United States Department of Agriculture, 1899*, ed. George William Hill (Washington, D.C.: USDA, 1900).

The recently retired Specialist in States Relations Work for the USDA, Alfred Charles True, in 1937 created the table of Experiment Station personnel above (Figure 17). True had been the Director of the Office of Experiment Stations for the USDA from 1893 to 1915. This table shows that during the period 1889-1905 the number of entomologists associated with experiment stations grew from 29 to 65, which supports the contention that the USDA was the entity responsible for creating economic entomology by choosing the questions asked by entomologists, and by focusing on applied vs. basic research.[427] Rossiter agrees that most agricultural scientists from the 1880s to the 1920s were government employees (bureaus, experiment stations, agricultural colleges) and that the rapid growth during this time period was due to the linking of agriculture, science, and government money, driving agricultural research toward specialization. Rossiter goes on to claim that the growth in funding of agricultural research was the result of over-representation of agriculture in state and federal governments, guaranteeing millions for agricultural research.[428] Her concept provides another example of the progressive idea that an expanding U.S. agriculture would result in an expanding U.S. economy and sphere of political influence within the world.

Another contemporary historian, David E. Hamilton, believes "USDA administrators perceived a need for national systems to unite public and private institutions on behalf of its vision of agricultural progress. By building an associative sector, the Department could cut across partisan, community, and regional boundaries to forge institutions dedicated to its own goals."[429] If we agree that economic

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[427] Alfred Charles True, *A History of Agricultural Experimentation and Research in the United States, 1607-1925* (n.p.: USDA, 1937), 137.
[428] Margaret W. Rossiter, "The Organization of the Agricultural Sciences," in *The Organization of Knowledge in Modern America, 1860-1920*, ed. Alexandra Oleson, and John Voss (Baltimore: John Hopkins University Press, 1979), 212-213.
[429] David E. Hamilton, "Building the Associative State: The Department of Agriculture and American State-Building," *Agricultural History,* no.2 (1990): 215.

entomology was a USDA paradigm, then the promotion of increased use of insecticides by associated organizations is an example of Hamilton's associative state. The Oregon Horticultural Society (OHS) would be an example of an associative organization and I disagree with Hamilton's premise that knowledge and influence was a trickle-down process from the USDA to these local governmental and non-governmental organizations and then through them to individual farmers. At least for the apple growing and beekeeping professions in Oregon from the 1880s to the 1930s I see influence as a loop, with associations and individuals making decisions about whether or not to follow recommendations by government entities, and further, influencing the direction of research undertaken by government entities. One example of this is Oregon apple growers' decision to use Paris green instead of the recommended London Purple. This decision forced experiment station scientists and the OSBH to focus their research on Paris green – how and when to use it and how to make it as effective as possible.

J.F.M. Clark characterizes economic entomology as reactive rather than proactive, meaning economic entomologists did not perform research to discover potential insect pests, but instead waited for the next problem to arrive and then focused all their resources on finding a solution, with no thought of tomorrow.[430] One such reaction was the energy that government entomologists at the beginning of the twentieth century put into convincing fruit growers to spray their trees.[431] L.O. Howard, in the 1899 *Yearbook of the United States Department of Agriculture,* seems to support this perception, as he stated that few orchardists used Paris Green or London Purple until experiment stations were established in 1888, the implication being that experiments performed in these facilities, the publication of their

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[430] J.F.M. Clark, "Bugs in the System: Insects, Agricultural Science, and Professional Aspirations in Britain 1890-1920," *Agricultural History,* no.1 (2001).
[431] James Whorton, *Before Silent Spring Pesticides and Public Health in Pre-DDT America* (Princeton: Princeton University Press, 1974).

results, and their advocacy for the use of arsenical sprays was the reason for the increasing level of arsenic use.[432]

The OSBH, a governmental regulatory association, worked as an intermediate step, or in David E. Hamilton's terms an associative institution, in the information chain from the USDA and other distant government scientists, providing the experimentation under local conditions often lacking in these organizations' recommendations. I suggest that the OSBH, in their capacity as experts on local conditions, did not just pass along information from other state and federal agencies, but instead would make their own independent decisions about whether or not to endorse these other agencies' recommendations. Again, I find that influence flowed in both directions, with the OSBH being influenced by fruit growers. One example is the OSBH's support of fruit growers' push for legislative initiatives.

5.9 The Poisoned Apple

The codling moth, and other introduced insect pests, pressured orchardists to modify their orchard practices. Although some biological control methods continued to be used into the twentieth century and even today, the trend was an ever increasing use of non-organic pesticides at the recommendation of federal and state scientists and professional organizations. These scientific and professional organizations drew Oregon apple growers further into industrialized agricultural practices with the goal of producing larger harvests free of codling moth damage. There were some significant drawbacks to the increasing industrialization of fruit production. First, only apples with a blemish-free exterior sold for the highest market prices. Apples not meeting that standard were used for by-products

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[432] L.O. Howard, "Progress in Economic Entomology in the United States," in *Yearbook of the United States Department of Agriculture, 1899*, ed. George William Hill (Washington, D.C.: USDA, 1900).

like jelly, cider, or sauce, and often went unsold, a complete loss for the apple grower. Consumers' fruit choices were increasing and Oregon apples at the turn of the twentieth century were competing with new tropical fruits and with other apple producers, increasing the pressure on Oregon orchardists, who were serving a niche, very high end market, to use pesticides and to provide a homogenous product across orchards.

It is interesting to note that increasingly intensive use of pesticides was not necessarily caused by increasing pest populations, but instead was self-sustaining. Gordon G. Brown, Horticulturist with the Hood River Branch Station of the Oregon Experiment Station, performed an orchard management study which found a direct correlation between the amount of spray used and the percent of fancy grade apples produced. The difference between "effective and non-effective spraying" is "the grower who does not skimp in the amount of material used, obtains most effective and indeed economical control of various orchard pests and diseases."[433] After 1899 and the Act to Protect the Fruit and Hop Industry of Oregon was passed the OSBH had the legal authority to require anyone with a codling moth infested apple tree to eradicate the moth population through destruction of the tree or a rigorous spray program. This drastically reduced the number of places where codling moths could find refuge, and seems to have halted the rapid growth of the codling moth population in Oregon. Except for the 1923 codling moth outbreak due to an especially warm spring, the percentage of codling moths to apple trees seems to have stabilized in the early twentieth century. However, the use of arsenicals remained high, and at the same frequency as when the apple growers were battling a growing codling moth population, with six sprays a year being the norm from 1893 to at least 1930. Changes in efficiency of application,

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[433] Gordon G. Brown, "Scope of Work of Hood River Station," *The Oregon Grower,* no.5 (1922): 7.

purity of solution and knowledge of the codling moth life cycle meant that six sprays in 1920 were much more effective than the same six sprays in 1900.

	Average % Extra Fancy Fruit	Spray – Gallons per Acre	Spray – Gallons per Tree
Group I	55	2181	29.34
Group II	44.9	1653	23.56
Group III	35.3	1592	24
Total	40.8	1761	24.87

Table 5.1 Quantity of spray to percentage of extra fancy grade apples. This information is from Brown's Hood River Orchard Management study. All orchards in the study sprayed more than 6 times a year during the study period. Table recreated by Brenda Kellar, 2017.[434]

When distant markets began restricting, and in some cases barring, Oregon apples and pears because of poisonous residues, first arsenic and later lead, orchardists did not decrease the number of sprays per season.[435] Instead they turned to their local experiment station for a solution. The Oregon experiment station is credited with saving the Oregon apple market in the decade between 1925 and 1935.

> The most outstanding accomplishment of the biennium was the development of a practical solution of the problem of removing spray residue from fruit, an emergency

[434] Gordon G. Brown, *Hood River Apple Orchard Management With Special Reference to Yields, Grades, and Value of Fruits* Experiment Station Bulletin 181, ed. the Oregon Agricultural College Experiment Station Hood River Branch (Corvallis, OR: Oregon Agricultural College, 1921), 27; Gordon G. Brown, "Scope of Work of Hood River Station," *The Oregon Grower,* no.5 (1922): 7.
[435] Henry Hartman, R.H. Robinson and S.M. Zeller, *The Removal of Spray Residue from Apples and Pears* Experiment Station Bulletin 234, ed. the Oregon State Agricultural College Experiment Station (Corvallis, OR: Oregon State Agricultural College, 1928), 10-11.
Normal spray schedule:
"Calyx May 14, lead arsenate 2 to 100.
"First cover June 7, oil 3/4 to 100 plus lead arsenate 2 to 100.
"Second cover June 24, oil 3/4 to 100 plus lead arsenate 2 to 100.
"Third cover July 6, oil 3/4 to 100 plus lead arsenate 2 to 100.
"Fourth cover August 2, lead arsenate 3 to 100.
"Fifth cover August 22, lead arsenate 3 to 100."
Hartman goes on to say that heavier codling moth presence often leads to double-strength sprays or an extra late spray.

> that arose during the winter of 1925-26. It made demands upon all the resources of the agricultural experiment station such as may come only once in half a century. "The value of the station findings has been estimated in millions of dollars. A better measure is the actual fact that the greater part of the fruit crop was practically embargoed until the solution of the problem was found." – unattributed quote from *The First Fifty Years of the Oregon Agricultural Experiment Station 1887-1937*[436]

The situation began when England found arsenic residue on apples from the Northwest. Since WWI, England had become one of the main markets for Oregon apples, and as was customary at the time apples were wiped before being packed for export, either in boxes for fancy grades or in barrels for lesser grades. By this time fruit packing was an industrialized process, meaning that most growers would bring their apples to a packer who would pack, store and ship the apples of several growers in mixed batches to meet purchase orders. Labor was specialized with graders, packers and nailers each with their own specialized equipment – the grading table or board, the packing table or bench, and the box press.

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[436] *The First Fifty Years of the Oregon Agricultural Experiment Station 1887-1937* Station Circular 125, ed. John C. Burtner, Oregon State College Experiment Station (Corvallis, OR: Oregon State College, 1937), 22.
This sentiment can also be found in the Oregonian. "It is not too much to say that Oregon deserves the credit for solving the problem for the American fruit industry. After experimenting with various solutions and washing devices, under leadership of Oregon State college scientists, Oregon fruit districts adopted a standard method of removing spray residue. This, or similar treatment, has been followed in other states."
"American Apples in Poland," *Morning Oregonian* (Portland, OR), January 22, 1931.

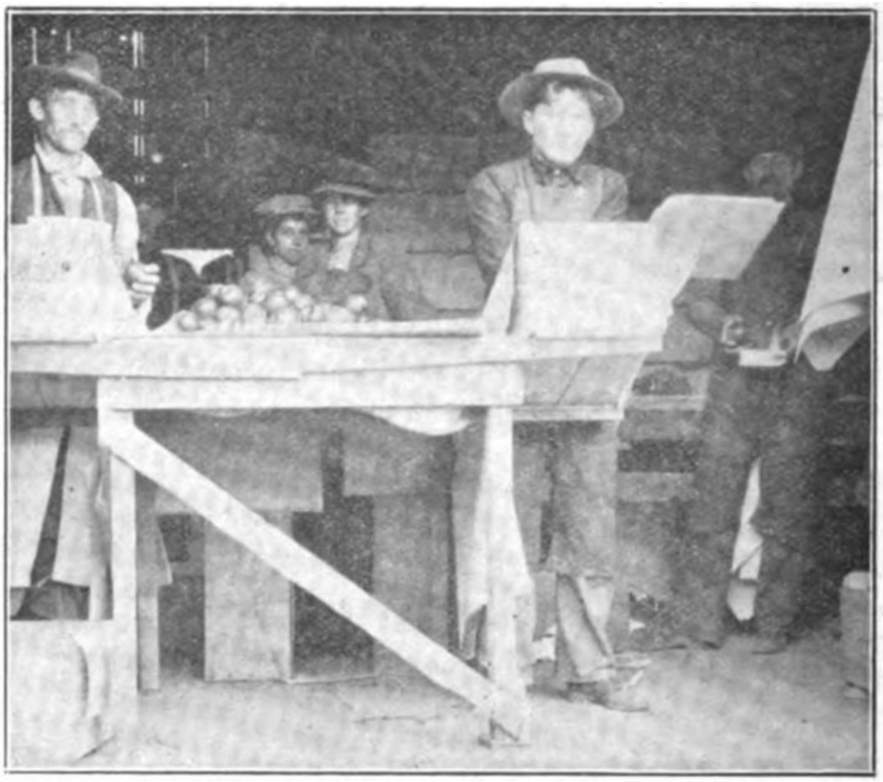

Figure 18 Packing table built for two at Hood River, Oregon, 1907.[437]

Apples were wiped either by the grader or packer, a quick rubbing over the body of the apple, which totally missed anything that might be in the dimples on the stem or calyx ends of the apple. It was a common practice at this time to wipe rather than wash fruit before eating and as a knife sliced through the apple, stem to calyx end, any residue present would be spread through the interior of the apple. When the English government tested apples imported from the Northwest of the U.S. for arsenic they found what they considered to be a significant residue. English officials gave Northwest growers a year's grace to fix the problem.[438] Northwestern apple growers in collaboration with the USDA convened

[437] C.I. Lewis, *The Apple From Orchard to Market*, Bulletin No. 94, ed. the Department of Horticulture (Corvallis, OR: Oregon Agricultural College Press, 1907), 14.
[438] "Apple Cleaning Urged," *Morning Oregonian* (Portland, OR), March 3, 1927.

a meeting in Salt Lake City, Utah to begin exploring possible solutions.[439] The March 3, 1927 *Morning Oregonian* reported: “If the English export market for northwest apples is to be saved to the industry, absolute cleaning of spray residues must be practiced from now on, according to news brought back from the Salt Lake City spray residue conference.”[440]

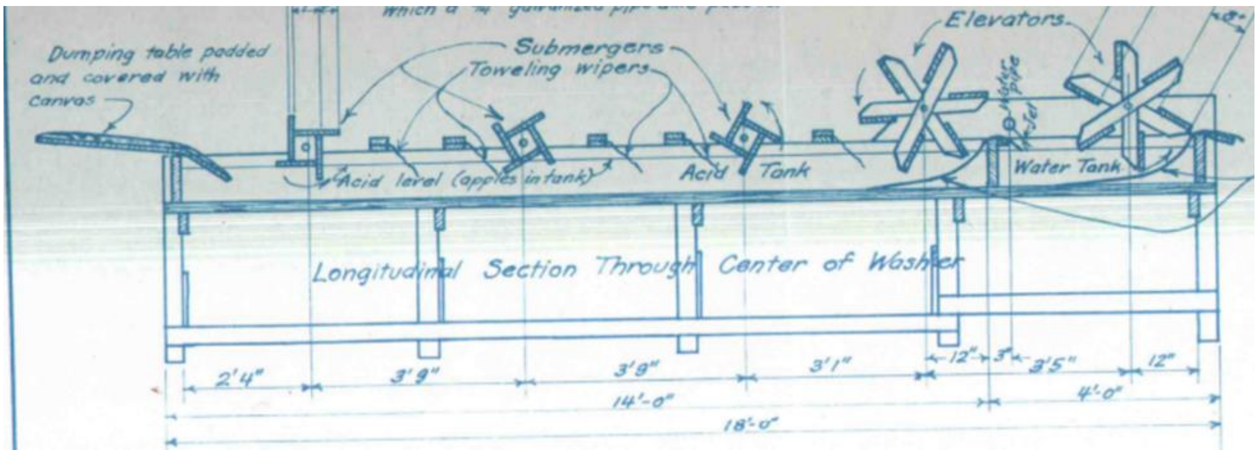

Figure 19 Blueprint of apple washer designed by the Oregon Experiment Station.[441]

The Oregon Experiment Station patented their apple washing process and machine through public service patents, which made the information free and available to everyone.[442] The design was based off the commonly called “borax bath tank” being used by orange growers in California and

[439] "Apple Meeting Called," *Morning Oregonian* (Portland, OR), February 9, 1927.
[440] "Apple Cleaning Urged," *Morning Oregonian* (Portland, OR), March 3, 1927.
[441] Henry Hartman, George Kable and R.H. Robinson, *The Oregon Fruit Washer* Circular of Information 15, ed. the Oregon Agricultural College Experiment Station (Corvallis, OR: Oregon Agricultural College, 1927), 5.
[442] *Radio Programs 1925-1926 of Station K-OAC*, Oregon Agricultural College Extension Bulletin 387, ed. the Oregon Agricultural College Extension Service (Corvallis, OR: Oregon Agricultural College, 1926).

originally developed by the USDA Bureau of Plant Industry.[443] The Oregon Experiment Station began testing various solvents in April of 1926.

> The list of compounds tried includes all acids, bases, and salts that were thought to offer possibility. These were tried not only for their solvent action upon arsenicals, but also for their action on such other forms of residue as lead, copper, and lime. The more promising ones were tried at temperatures varying between 35° F. and 95° F. They were also tried at various concentrations and for periods of time varying between 10 seconds and 20 minutes. They were tried on fruit of varying stages of maturity and with varying amounts of agitation. They were tried on fruit which had received various amounts and kinds of sprays during the season. Observations were based not only upon laboratory tests, but upon fruit treated in different ways where solvents were being used commercially. More than 500 chemical analyses have already been made in connection with this phase of the work.[444]

The washing solution chosen as the best for arsenic residue removal without causing harm to the apples or shortening the length of time they could be stored was a mixture of one gallon hydrochloric acid (HCl) for every 100 gallons of water.[445] In the early twentieth century HCl would also commonly have been called muriatic acid, which has the same chemical composition. Currently muriatic acid is considered to contain impurities, while hydrochloric acid is not. This washing solution was not problem free. The washer had to be designed so that none of the materials that came into direct contact with the acid wash would corrode. The Oregon Experiment Station recommended the washer be built from wood and that only wooden buckets be used.

> In the construction of the acid unit all the rods should be on the outside. All bolts should be imbedded in the wood so that they do not come in contact with the acid solution. All

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[443] Henry Hartman, George Kable and R.H. Robinson, *The Oregon Fruit Washer* Circular of Information 15, ed. the Oregon Agricultural College Experiment Station (Corvallis, OR: Oregon Agricultural College, 1927), 3.
[444] R.H. Robinson and Henry Hartman, *A Progress Report on the Removal of Spray Residue from Apples and Pears,* Experiment Station Bulletin 226, ed. the Oregon Agricultural College Experiment Station (Corvallis, OR: Oregon Agricultural College, 1927), 8.
[445] Hartman, Kable and Robinson.

> nails should be countersunk, and the heads should be covered with material such as beeswax, grafting wax, coal tar, or paraffin. The tanks should be painted with linseed-oil or varnish. Lead paint should not be used since it is destroyed by the action of the acid. Duco and lacquer are fairly satisfactory. All metal parts such as sprocket wheels and sprocket chain should be painted with asphaltum paint.[446]

The washing solution was also a human health issue. Until it was diluted the acid was harmful to humans if the fumes were inhaled or the liquid HCl came in contact with the user's skin. Extreme care was needed when handling the pure acid as it could eat right through clothing. The Experiment Station personnel also expressed concern that the wash solution residue could be a health hazard if not effectively removed. For this reason they recommended that the apples be rinsed by spraying the apples with fresh water and that the spray had to be forceful. If the grower could not create a forceful spray rinse then the apples would need to be totally submerged "for some time."[447] The Oregon Experiment Station recommended apple growers test for any residue left behind by the acid wash solution by placing their tongue on the cheek and calyx of an apple. "If acid is present you will feel a biting sensation on your tongue."[448]

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[446] Henry Hartman, *The Oregon Apple-Washer,* Experiment Station Circular 92, ed. the Oregon State Agricultural College Experiment Station (Corvallis, OR: Oregon State Agricultural College, 1929), 2.
[447] Henry Hartman, George Kable and R.H. Robinson, *The Oregon Fruit Washer* Circular of Information 15, ed. the Oregon Agricultural College Experiment Station (Corvallis, OR: Oregon Agricultural College, 1927), 3.
[448] Hartman, Kable and Robinson, 3.

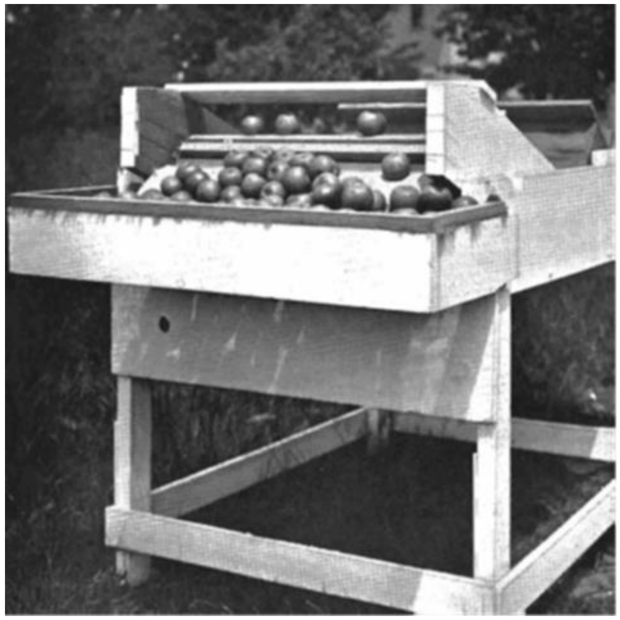

Figure 20 Front view of apple washer – elevator and rinsing area.[449]

The level of acceptable arsenic residue agreed upon was one hundredth of a grain (0.01 tolerance) of arsenic(III) oxide, commonly known as white arsenic or arsenic. In 1928, James T. Jardine, Director of the Oregon Agricultural Experiment Station, sent a letter to the apple and pear growers in Oregon reminding them that "health authorities will insist this season upon a spray residue of not more than one hundredth of a grain of As203, Arsenious oxide, to a pound of apples."[450] However, the Oregon Experiment Station could not give a recommendation for the amount of treatment needed to reach the required residue standard because the efficacy of the washing method depended on so many variables – type of spray, timing of spray, weather conditions since spraying, age of apples, variety of apple, etc. The experiment station scientists were reduced to telling apple growers that if the fruit looked clean after

[449] Henry Hartman, *The Oregon Apple-Washer,* Experiment Station Circular 92, ed. the Oregon State Agricultural College Experiment Station (Corvallis, OR: Oregon State Agricultural College, 1929), 5.
[450] Don C. Mote, *Save Oregon's Apple and Pear Crop from the Million Dollar Bandit*, Experiment Station Circular of Information 9, ed. the Oregon Agricultural College Experiment Station (Corvallis, OR: Oregon Agricultural College, 1928), 4.

washing it would usually be below the allowed limit. “This is especially true when the fruit is treated shortly after harvest and when no oil sprays were applied during the season. In case of doubt as to the efficacy of the treatment given the fruit should be subjected to a chemical analysis” or tested with their tongues, which Hartman had also suggested as a quick estimate of the success of the fruit wash.[451]

The arsenic standard was strictly enforced and 2296 boxes of apples belonging to the Suncrest Orchard Company, Medford, Oregon were seized in Chicago by Federal Food Inspectors in 1926. “The government inspectors testified that the apples carried more than the permitted amount of arsenate of lead spray residue and thus were banned under the food and drug act. The jury held that this was proper.” Carl Y. Tengwald, Secretary of the Fruit Growers’ league of Medford, said that the growers were not worried because they had been told that the spray residue could be washed off and most were willing to add this step to their packing process. “A few would like to get by with only wiping the fruit, as was done in the case of the apples belonging to the Suncrest Orchard company, involved in this test case, but this is not true of the majority.” Initially apple growers were concerned that washing the fruit would damage or decrease its storing capacity and this is the reason attributed to the Suncrest Orchard Company’s non-compliance.[452]

I cannot stop thinking about the pictures of men spraying trees at the beginning of the twentieth century, with the excess spray drifting onto them, in a rain-like shower with low-pressure spray rigs and later in a fine, enveloping mist with the more high-powered spray rigs. If they were not experiencing any apparent ill-health effects from their multiple dousings it must have been difficult to

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[451] Henry Hartman, George Kable and R.H. Robinson, *The Oregon Fruit Washer* Circular of Information 15, ed. the Oregon Agricultural College Experiment Station (Corvallis, OR: Oregon Agricultural College, 1927), 3.
[452] "Apple Men Optimistic," *Morning Oregonian* (Portland, OR), November 24, 1926.

believe that a little spray residue on a wiped apple would cause anyone harm. A 1926 staff writer for *the Morning Oregonian*, Harold M. Sims, summed up the feeling of Oregon orchardists, “The harmlessness of the arsenate of lead spray which fruit growers have used for 20 years or more is acknowledged by the department of agriculture as well as by virtually everybody else, except British interests which apparently resent competition with the superior fruit of the Pacific northwest.”[453] This sentiment would continue to resonate within professional journals and newspapers for the next several years.[454]

The orchardists were also suspicious of the U.S. government’s immediate decision to mandate a solution that was based on England’s specifications. Orchardists were used to working with government entities that used education rather than fines as a tool for change. Even though the Act to Protect the Fruit and Hop Industry of Oregon in all its revised versions gave the OSBH the right to have fines levied for non-compliance, the OSBH preferred to use education first and found that was effective in most cases. In the case of spray residue, the government instituted an educational campaign to inform orchardists of the new requirement, but when an orchardist did not immediately comply, the penalty was quickly exacted. The request by the government that orchardists not tell the public about this change in practice and why it was required “because of the ‘psychological effect,’” made this an even more exceptional interaction between orchardists and government entities at this time.[455] The government’s desire for silence about the change in practice is understandable. They had no desire to start a fruit scare that impacted all sales of U.S. fruit within the U.S. and abroad. However, the rapid change in perception by government and marketing entities for Northwest fruit, from fresh produce full

[453] Harold M. Sims, "U.S. Spray Ruling Cuts Pear Sales," *Morning Oregonian* (Portland, OR), September 11, 1926.
[454] "American Apples in Poland," *Morning Oregonian* (Portland, OR), January 22, 1931, 6.
[455] Sims.

of healthy goodness to poisoned fruit, must have been stunning for fruit growers, especially as they were following the USDA and experiment station spray recommendations.

In 1933 Oregon once again faced potential embargoes because of poison fruit, only this time it was for lead residues. R.H. Robinson, chemist, and M.B. Hatch, assistant chemist for the Oregon State Experiment Station wrote:

> The establishment of a tolerance for lead on fruits and vegetables in addition to the arsenic tolerance that has prevailed during the past few years has reopened many problems that pertain to the removal of spray residues. Chemical analyses of certain lots of washed fruits have shown that the arsenic may be removed well below the .01 grain tolerance, yet excessive amounts of lead still remain.[456]

A temporary lead tolerance level was set at 0.02 grains per pound for the 1933 harvest and apple growers were informed the tolerance level for the 1934 harvest would drop to 0.014 grains of lead per pound of fruit. In order to comply with newly instituted lead residue tolerances new technologies were required. The washing solutions that were most effective at removing the lead residue also harmed the ability of the apple to remain viable in storage for periods that allowed for overseas exports if the fruit was not dried before packing.

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[456] R.H. Robinson and M.B. Hatch, *The Removal of Lead and Arsenic Spray Residues from Apples and Pears*, Experiment Station Bulletin 317, ed. the Oregon State Agricultural College Experiment Station (Corvallis, OR: Oregon State Agricultural College, 1933), 5.

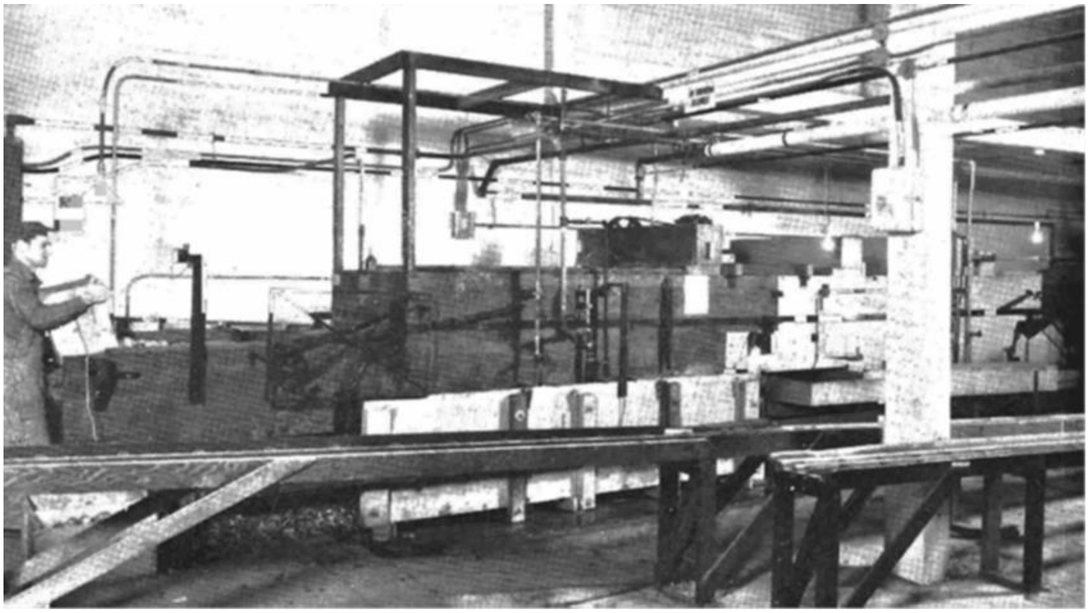

Figure 21 Modern [1937] fruit washers like the one shown above in operation cleanse the fruit in one or more chemical solutions, rinse and dry it and deliver the apples or pears to a grading and packing machine in perfect condition and in one continuous operation. – John C. Burtner, Director of the Oregon State College News Bureau and Extension Service Editor.[457]

By 1935 the lead tolerance had been lowered to 0.018 grains per pound and small orchardists were struggling to comply. “Much of the new bulletin is devoted to the problem of the small orchardist who cannot afford one of the large commercial washing machines but who desires to sell his fruit direct rather than through a commercial packer who may have cleaning equipment.”[458] In cases like this the Oregon Experiment Station continued to recommend the use of the home-made apple washer they had designed in 1927 and they were still saying that “most of the difficulty in removing spray residues comes from following unrecommended [sic] spray schedules during the growing season.”[459] The government

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[457] Photo and caption.
The First Fifty Years of the Oregon Agricultural Experiment Station 1887-1937 Station Circular 125, ed. John C. Burtner, Oregon State College Experiment Station (Corvallis, OR: Oregon State College, 1937), 3.
[458] "Spray Residue End is Told in Bulletin," *Sunday Oregonian* (Portland, OR), October 6, 1935, 5.
[459] "Spray Residue End is Told in Bulletin."

scientists were placing the blame firmly upon the fruit growers, while offering a solution that had been proven ineffective for removal of lead residues.

5.10 Conclusion

Spray recommendations counseled intensification of spraying with chemical pesticides. Efficacy was to be achieved through more effective chemical pesticides, more efficient equipment and the use of that equipment, and scientific investigation of the codling moth life cycle. The frequency of spray recommendations from 1891 to the 1930s remained at about six sprays a season, taking place at two week intervals from blossom drop to the closing of the calyx. This was true for governmental organizations like the USDA, the OSBH and the Oregon Experiment Station, and for private organizations like the OHS. As I discussed in the previous apple chapter, many of the members of these groups belonged to two or all of these organizations, so that similar ideas and recommendations being promoted by them is not surprising. Additionally, the idea of government support of increased agricultural production and efficiency through science were hallmarks of the progressive era.

Originally the intensification of spray recommendations were due to the rapidly growing population of codling moth and other agricultural pests that were newly introduced to Oregon and making themselves right at home. The many abandoned apple orchards and individual apple trees provided a safe haven for the codling moth, and the railroads, the improved and expanded road system, and bustling steamship traffic spread the codling moth from one corner of the state to the other, over and over and over as apple growers would often pack wormy apples in boxes and barrels, a common custom for the nineteenth century, and a practice stopped by legislation and the formation of cooperatives such as the Hood River Apple Growers' Association discussed in the previous apple chapter.[460] For apples that did not have to be stored for extended periods of transportation, a few wormy apples in a box were not considered as undesirable and were used by customers for pies, sauces, butters, and other processed apple products. However, Hood River apple growers were pursuing a niche, high-end market, which required they produce mainly Extra Fancy apples that could be transported long distances.

I was tempted to give the codling moth a great deal of agency in the intensification of chemical pesticide use, and in their early period in Oregon that would be true. However, I believe that changed between 1900 and 1910 when the cooperatives begin to be established and the Oregon apple becomes an increasingly desirable commodity overseas, especially with England's rapidly growing professional middle class.[461] As the previous chapter noted, most Oregon apples have always been grown for export, first to the California gold fields and later to points around the globe. As more countries began exporting agricultural commodities like apples this put the Oregon growers in direct competition with a greater number of apple growers, and they had to make their apple stand out from the crowd. Their only other

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[460] See footnote 460 below.

[461] Even before WWI the Oregon apple was a desired commodity in England. "Apples have been shipped from this State for several years across the ocean to England."
H.W. Cottle, "Proceedings of Fruit-Growers' Convention, President H.W. Cottle's Address," in *The Second Biennial Report of the Oregon State Board of Horticulture,* ed. the Oregon State Board of Horticulture (Salem, OR: Frank C. Baker, State Printer, 1893), 303.
Value in dollars of fresh apple exports to the UK: 1898 - 1.25mil; 1899 - 1 mil; 1900 - 1 mil; 1901 - 1.8 mil; 1902 - 1.36 mil.
Frank H. Hitchcock, *Distribution of the Agricultural Exports of the United States 1898-1902*, Bulletin No. 32, ed. the Division of Foreign Markets, United States Department of Agriculture (Washington, D.C.: USDA, 1903), 73.
"In the apple business, the box has almost revolutionized the trade, and for packing fancy stock it will very likely supersede the barrel. The box tends to increase home consumption, inasmuch as one might buy a bushel for family use when a barrel would constitute an over-stock."
J.W. Bawden, "Distribution and Sale of Perishable Crop Products," in *Cyclopedia of American Agriculture: A Popular Survey of Agricultural Conditions, Practices and Ideals in the United States and Canada*, ed. L.H. Bailey (New York: The Macmillan Company, 1912), 247.

options were to find other markets, where they would have to start building their reputation from scratch, or to abandon apple growing.

The Hood River Apple Growers' Association created the Blue Diamond brand which adopted a grading system for apples, which I talked about in the apples in Oregon chapter.[462] Growers who wanted to sell their apples through the Apple Growers' Association were held to a rigid system of standardized grades, sizes, and packs. Blue Diamond Apples had to be predictably perfect – every one of them, in every box – when they arrived at their final destination. The Experiment Station personnel, OSBH officers and commissioners, and the OHS officers all agreed that the cheapest and surest way to create a blemish-free apple was to spray often and effectively.

The codling moth was the rhetoric continually used in Experiment Station bulletins, OSBH pamphlets, and in articles written by these authority figures and published in professional magazines such as *Better Fruit*, a publication established by the Hood River Apple Growers' Association in 1906. The codling moth was a familiar enemy and it was easy to understand that codling moth damage to apples affected a grower's bottom-line. It was much harder to explain international market pressures and the

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[462] "In the Hood River Valley, the Apple Grower's Association has been in continuous operation since 1913, marketing its fruit under a Blue Diamond brand. Operating today as Diamond Fruit Growers, the cooperative represents about 100 growers and packs over 55,000 tons of pears a year."
Edwin Battistella, "Pears and the Pear Industry," The Oregon Encyclopedia, https://oregonencyclopedia.org/articles/pears_the_pear_industry/#.WqBxGnxG3IV.
"Be It Enacted by the People of the State of Oregon: Section 1. There is hereby created and established a standard size for apple boxes for the State of Oregon.
"Section 2. The standard size of an apple box shall be eighteen inches long, eleven and one-half inches wide, ten and one-half inches deep, inside measurement.
"Section 3. That the special size of apple boxes shall be twenty inches long, eleven inches wide, and ten inches deep, inside measurement."
"Establishing Standard Sizes of Apple Boxes," in *The Fourteenth Biennial Report of the Board of Horticulture, State of Oregon,* ed. the Oregon State Board of Horticulture (Salem, OR: State Printing Department, 1917).

economics of commodity trading. By continuing to focus on the codling moth as the greatest enemy to success in apple growing, Experiment Station scientists, OSBH and OHS members could provide a convincing argument for intensification of spraying, despite codling moth populations remaining relatively consistent.[463] I believe the codling moth was coopted by these authority figures as a way to enforce compliance with their agenda of increased production of boxes of extra fancy grade fruit, a more competitive market commodity, and a quantifiable and profitable index of their success as promoters of agriculture in Oregon. On this issue I agree with Hamilton's analysis of the associative state in early U.S. agriculture, in conjunction with the understanding that these values were the prevailing standards of measurement for the progressive era.

The push for more intensive use of insecticides fell in line with the early twentieth century paradigm of economic entomology, which was mainly focused on killing insect pests. However, in Oregon at least, beneficial insects were always a part of orchard practice and in this chapter I focused on the ladybird beetle and *Calliephialtes messor Graves*. Cultural insect eradication practices, such as banding or placing hogs in orchards, also were a part of many Oregon orchard practices, but seem to have played less a part in the Hood River apple growers' orchard management. The perceived ineffectiveness of these non-chemical methods, when compared to chemical insecticides, probably made chemical insecticides seem like the only option for Oregon orchardists. Additionally, chemical insecticides probably seemed more modern and scientific than banding or beneficial insects. It was definitely more in line with the progressive era belief that science was the answer to all questions.

[463] One exception being the 1923 outbreak caused by an early, warm spring, which created a first generation of codling moths that appeared and bred before most apple growers did their first codling moth spray.

Professional organizations also attempted to influence the actions of their membership through education, but the creation and support of status through public accolades was one of their stronger methods of persuasion, as can be seen by all of the apple shows with trophies and ribbons and local newspaper articles listing the winners of those ribbons as well as articles about winners in professional journals. A good example is the article on the 1906 Hood River fair in *Better Fruit*. That year's fair and this article were meant to influence apple growers to comply with packing standards set by the Oregon Apple Growers' Association.

> In the first place Hood River orchardists aimed to make this a commercial exhibit of apples, consequently the whole show was practically box exhibits instead of an enormous plate exhibit. The box exhibit is much more significant from every standpoint of valuable consideration…When one sees a box of apples commercially packed that is beautiful it creates a desire for purchase, which was evidenced by the large number of individual sales for delivery after the fair had closed.[464]

The drive to spray their way to a perfect apple became one of the Oregon apple growers' biggest problems when England called for low-level spray residues on apples entering their country. Whether you believed this was a market strategy to provide a space for apples produced in English colonies or you believed spray residues were a viable concern, the people most harmed by this new requirement were the smaller Oregon apple growers who did not want to participate in a local cooperative. These small orchardists often did not have the resources to comply with local cooperative demands or with many of the recommendations coming from government and private authorities. The rapid changes in technology, requiring equally rapid equipment purchases or replanting the orchard in newly preferred varieties, were too cost prohibitive for small orchardists who relied on their orchard for only a portion of their yearly income.

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[464] "Observations on the Hood River Fruit Fair," *Better Fruit,* no.5 (1906): 6.

The Oregon Experiment Station personnel, OSBH and OHS officers all had the same big agriculture goal – greater yields of Extra Fancy or Fancy apples, sold for greater profits, on a global stage. The recommendations they gave were in support of this goal, and of progressive era ideals of productivity and efficiency through science. Small apple growers could participate in this big agriculture vision if they had the resources to comply with cooperatives or private packing houses. If they did not, they were probably still implementing the recommendations that made sense for their individual situations. One example can be seen in the choice of some orchardists to continue using low-pressure spray rigs, which provided some protection from the codling moth and had probably been a significant purchase for them, while other small orchardists chose not to purchase spray equipment and instead hire someone. Both had drawbacks, with low-pressure rigs not providing as complete coverage as newer spray technologies and requiring a large up-front investment, while orchardists hiring spray rigs were competing with other orchardists for the time of the rig being hired, which could cause a delay in when your orchard was sprayed. Another example where technology became the barrier for small orchardists was the need to wash apples before they could be sold. Small apple growers unwilling to sell to a packing house or other wholesaler, were told by experiment station scientists that their best option was to continue with the OAC washer, which they knew was mostly ineffective in removing lead residues. This was a solution that was no solution at all for small apple growers.

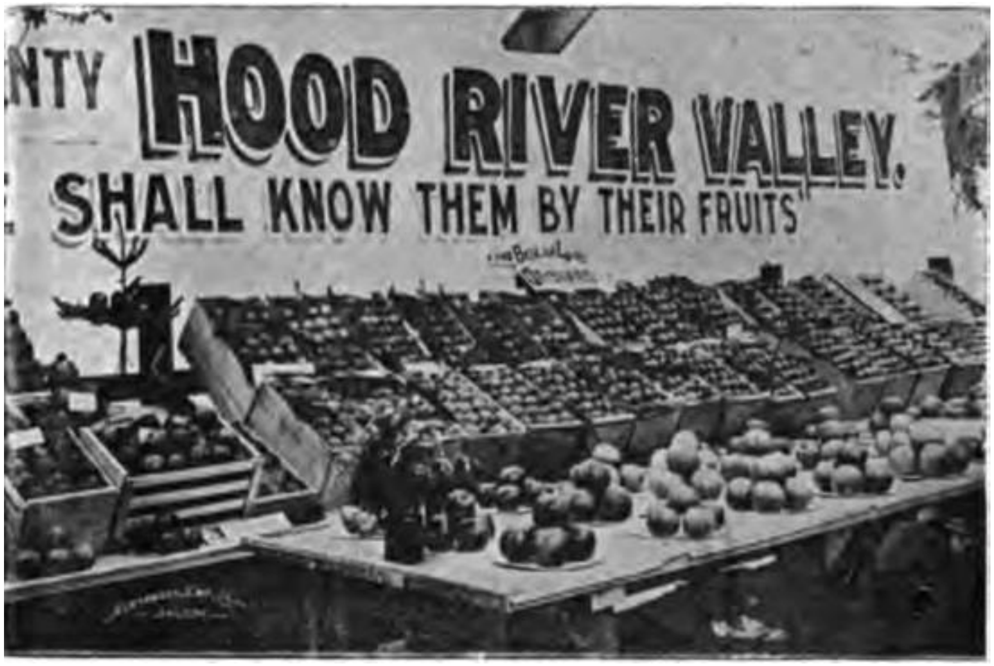

Figure 22 Display of plated and boxed apples, 1899, from Hood River, Oregon.[465]

[465] Emile Schanno, "Final Report," in *The Sixth Biennial Report of the Board of Horticulture*, ed. the Oregon State Board of Horticulture (Salem, OR: W.H. Leeds, 1900), between 70 and 71.

6 Pollination

> More and more we are seeing evidence of the desire of the orchard men to secure bees for pollenization [sic] purposes. During recent years many colonies of bees have been hauled in to The Dalles and Hood River districts from Hermiston and Central Oregon. Recently 200 colonies of bees are reported to have been brought in from California to The Dalles region. – Herman A. Scullen, beekeeper and entomologist with the Oregon Agricultural College Experiment Station, 1931[466]

Just yesterday I passed a flatbed truck on the side of the road loaded with bee hives. A small forklift was moving sections of the palleted hives from the truck to place in an orchard. It has been a warm January and I'm guessing the orchardist and/or beekeeper expect an early blooming period. Before I became interested in the history of honey bees in North America, and beekeeping as a profession, I would not have given this sight any thought. It is such a commonplace occurrence in my life that I would have driven by without even seeing this activity as anything other than something to avoid hitting. Now I know the struggle apple growers and beekeepers went through before it would be possible for me to view honey bees used for pollination as a natural part of spring. And yet, this is such a recent phenomenon. The quote above is from 1931, less than a hundred years ago. Since then pollination service has become an accepted part of beekeepers' revenue stream. Like all other revenue streams – honey, wax, royal jelly, books, queens, etc – pollination service can be the main income source for a beekeeper or a much smaller part of a system of income producing items the bees create for their keeper.

There is no straight line from where my story left off and what I saw yesterday on the side of the road. Each beekeeper and apple grower came to a decision to place bees in an orchard in their own fashion. However, there are some larger trends that help fill in the story of bees being rented for

[466] H.A. Scullen, *Oregon Beekeepers' News Letter*, no. 36 (1931), 1.

pollination service in Oregon. Beginning with the fact that beekeepers could move bees around the world on a small scale, but before they could move large numbers of bees numerous times within the same year, transportation technologies and infrastructure needed to expand. As well as a system for moving bees, beekeeping pioneers, those who were both willing and able to be the first to test the concepts of outapiaries, then migratory beekeeping, and finally commercial pollination service, were necessary. Those that followed learned from these pioneering beekeepers' mistakes and successes. The government agricultural scientists paved the way for beekeepers by advocating for fruit growers to have bees in their orchards. For pollination service to become a reality beekeepers needed customers willing to pay them for the service their bees provided, and the agricultural scientists were able to provide scientific justifications for having bees in the orchard. Finally, agriculture was becoming more specialized, with many more mono-cropped areas while at the same time the ability of wild pollinators to live within those areas diminished. Bees could be managed in such a way that they could provide pollination without having to live year-round within the orchard. The insertion of honey bees into orchards on a seasonal basis, for either nectar collection or pollination service, required negotiation of asynchronous goals for beekeepers and fruit growers.

The struggle to justify the presence of honey bees in orchards was refereed by experiment station and other government scientists. The recommendations of those scientists were often in conflict with each other, making it nearly impossible for many beekeepers or apple growers to comply with all the recommendations from one organization, or even, at times, from one person. When the authority of science was insufficient to create change or change at a rapid pace, or when science was unable to support a desired position, then both beekeepers and fruit growers lobbied for legal remedies and policy creation. Laws that were enacted often played out in unexpected ways, and then beekeepers and fruit growers once again turned to their experiment stations for a science-based solution. Although beekeepers and fruit growers seem like two entities that should go together, like peanut butter and jelly, the tensions present during the creation of the pollination service industry remain present to some extent today. That is why this chapter comes at the end of my dissertation. It is only after reading about the creation of the beekeeping and apple growing industries in Oregon, and some of the pressures affecting their decision-making processes, that we can understand the complexity of this relationship.

6.1 Auxiliary Apiaries

By the late nineteenth century, some United States beekeepers began to think of beekeeping as a profession, usually by combining two or more aspects of beekeeping to create a greater income than previous beekeepers had generated. This required beekeepers to not only spend time producing and marketing a second or third product (possibly queens or books in addition to honey and wax), but success often led to a desire by the beekeeper to enlarge their apiary. Of these many activities my focus will mainly be on beekeepers whose primary income came from honey production as they are the ones who first entered discussions with orchardists about pollination.

There are also several prominent beekeeping authorities, names often seen in professional journals, who encouraged beekeepers to think about honey and pollination as commercial enterprises rather than a sideline for home consumption. These were the voices first calling for outapiaries and were some of the first beekeepers willing to put this new business model to the test by having their own outapiaries. The fashioning of expertise through personal experience can be seen in the writings of these first outapiarists. The durableness of the effect these first outapiary beekeepers had upon the decisions made by other beekeepers can be seen in the fact that once these men demonstrated that it was possible, the practice of beekeepers having multiple apiary locations never went away and can be found today in medium and large sized beekeeping operations.

As early as 1889, L.L. Langstroth told readers of his book on beekeeping that if they planned to become full-time beekeepers they would need to keep bees in more than one location.[467] Outapiaries, which are satellite apiaries meant to stay in one place for a year or more, originated in the migratory apiary concept, where colonies are moved seasonally.[468] Both migratory and outapiaries were still at this time established for honey production, not pollination, and all benefits of the apiary were seen as falling upon the beekeeper. However, there were a lot of added expenses for the beekeeper as well, and in 1917, A.I. (Amos Ives) Root (1839-1923) and E.R. (Ernest Rob) Root (1862-1953) stated that migratory beekeeping was so expensive that few beekeepers found it profitable.[469] Despite this, a few early beekeepers were successful with the outapiary and/or migratory business model. In 1869 John Harbison, a California beekeeper, is known to have had several hundred colonies in various locations. Just a few years later, 1874, Adam Grimm of Wisconsin began publishing in the *American Bee Journal*, covering the topics of hauling bees to outapiaries and how to identify when an area was becoming overstocked.[470] An example of someone who practiced both migratory and outapiary beekeeping as late as 1921 is that of William W. Dakin, first introduced in the chapter on Bees in Oregon. Dakin would

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[467] L.L. Langstroth, *On the Hive and Honey Bee* (Hamilton: Charles Dadant & Son, 1889), 302.
[468] These two terms, outapiary and migratory beekeeping, were often used interchangeably and the distinctions I outline here are an idealized separation of the two.
[469] A.I. Root and E.R. Root, *The ABC and XYZ of Bee Culture A Cyclopedia of Everything Pertaining to the Care of the Honey-bee; Bees, Hives, Honey, Implements, Honey-plants, etc. Facts Gleaned from the Experience of Thousands of Bee-keepers, and Afterward Verified in Our Apiary (*Medina, OH: A.I. Root Co., 1917), 499.
[470] M.G. Dadant, *Outapiaries and their management* (Hamilton: American Bee Journal, 1919).

seasonally move some of his honey bee colonies to follow the nectar flow, while also having several outapiaries placed in various locations within, and not far from, the city of Hood River, Oregon.[471]

Most outapiaries were established at least three miles from any other apiary, because this minimized the forage area that overlapped between apiaries. The beekeeper would identify a location where a heavy nectar flow was expected, such as near an orchard or a field of pumpkins, buckwheat, alfalfa, clover, or one of several other domestic or wild plants known to be a good nectar source for honey production. Langstroth claimed that six apiaries of one hundred colonies each was the maximum one person could care for and that if these six apiaries were well cared for and placed in a good nectar location they would provide the beekeeper "more profit…than an intelligent farmer from half a section of land, and the outlay of money is less."[472]

If the location was distant enough to make a daily visitation to the outapiary difficult, the Roots suggested that beekeepers hire someone to tend the outapiary, requiring them to spend both night and day in that location "to ensure [the] bees are in fine fettle."[473] M.G. Dadant, writing in 1919, agreed that when outapiaries first began, the best practice was to hire someone to stay at each distant apiary, especially during the summer to watch for swarms. However, as roads improved, and cars and trucks became more affordable and reliable, it became normal practice to manage all apiaries from the home apiary. If an operation was so large as to make travel between each of the outapiaries and the home apiary difficult because of the distance or the large number of apiaries, then Dadant recommended

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[471] "Dakin's Bees to Migrate," *The Hood River Glacier* (Hood River, OR), July 11, 1912.
[472] L.L. Langstroth, *On the Hive and Honey Bee* (Hamilton: Charles Dadant & Son, 1889), 304.
[473] A.I. Root and E.R. Root, *The ABC and XYZ of Bee Culture A Cyclopedia of Everything Pertaining to the Care of the Honey-bee; Bees, Hives, Honey, Implements, Honey-plants, etc. Facts Gleaned from the Experience of Thousands of Bee-keepers, and Afterward Verified in Our Apiary (*Medina, OH: A.I. Root Co., 1917), 549.

creating several central apiaries that would serve as bases for managing the outapiaries closest to that base.[474] In 1908 Root recommended that these distant apiaries be visited by the beekeeper at least every six days.[475]

6.2 Migratory beekeeping

In 1913 two brothers, M.J. and G.R. Lee, established the largest apiary in Oregon, purchasing a thousand colonies of Caucasian honey bees which were delivered by train to Canby, Oregon. The brothers' intention was to create a migratory apiary servicing the orchards in Hood River. The hives would be moved to different locations using the newly opened Portland, Eugene & Eastern (PE&E) rail line which also gave access to the foothills of the Cascades, known for their large areas of fireweed. "When the orchards of Hood River and other portions of the state are in bloom the bees will be shipped to various points and set to work making a crop of honey and aiding in loading the trees with fruit." M.J. Lee planned on harvesting at least fifty tons of honey (the equivalent of three train cars) in 1914.[476]

Unlike outapiaries, which were meant to remain in place for at least a year, creating a system of semi-permanent satellite apiaries, migratory beekeeping was the seasonal movement of bees to follow the nectar flow. At first, this practice was frowned upon by U.S. beekeepers. The migratory beekeepers were viewed as opportunistically encroaching upon an established, stationary beekeeper's territory and as not providing the proper oversight of their hives required for beekeepers to be considered modern

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[474] M.G. Dadant, *Outapiaries and their management* (Hamilton: American Bee Journal, 1919).
[475] A.I. Root and E.R. Root, *The ABC and XYZ of Bee Culture: A Cyclopedia of Everything Pertaining to the Care of the Honey-bee; Bees, Hives, Honey, Implements, Honey-plants, etc. Facts Gleaned from the Experience of Thousands of Bee-keepers, and Afterward Verified in Our Apiary* (Medina: The A.I. Root Co., 1908).
[476] "Bees May Visit Valley Blossoms," *The Hood River Glacier* (Hood River, OR), June 26, 1913, 7.

and rational. As late as 1921 A. Norton, a beekeeper from Pacific Grove, California and contributor to *The Western Honey Bee*, the magazine of the California State Beekeeper's Association, described migratory beekeepers in a derogatory manner:

> I mean the persons, firms or corporations who are virtually professional movers of bees, who take them like predatory nomads to the places that for the time, are the most enticing, and who regard not the rights, interests or welfare of weaker persons resident in those places, whose bee ranges they have invaded.[477]

Perhaps because stationary beekeepers were tied to bee pasturage that they did not own, and had little control over, there was a continual fear that an area was becoming overstocked with honey bees.

Randall R. Howard, a journalist who contributed to many turn of the twentieth century Oregon periodicals and papers, claimed that in the 1920s, Oregon did not have much of a migratory bee business, especially when compared to California where bees were shifted from agricultural crop to agricultural crop, following the nectar flow.[478] Twenty years later, in 1939, an Oregon Agricultural Experiment Station Bulletin still claimed that Oregon beekeepers were "essentially non-migratory, except in the fireweed region, where about 75 percent of the apiaries are migratory."[479] However, this bulletin also told readers that in regions outside of the Willamette Valley, most migratory bee movements were for pollination of fruit, to move away from areas being sprayed with an insecticide, or to find a more productive area. By 1956 Herman A. Scullen, an Oregon Agricultural Experiment Station apiary specialist and commercial beekeeper, claimed that only a few areas in Oregon were capable of

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[477] A. Norton, "Professional Migratory Beekeeping," *The Western Honey Bee,* no.10 (1921): 304.
[478] Randall R. Howard, "Oregon's Bee Industry Capable of Development to From 5 to 10 Times Its Present Production," *Sunday Oregonian* (Portland, OR), April 13, 1924.
[479] A.S. Burrier, Frank E. Todd, H.A. Scullen and William W. Gorton, *Costs and Practices in Producing Honey in Oregon*, Station Bulletin 362, ed. the Oregon Agricultural College Experiment Station and the USDA Bureau of Entomology and Plant Quarantine (Washington, D.C.: USDA and Oregon Agricultural College, 1939), 30.

sustaining commercial honey production. Those areas were "the Willamette Valley, the irrigated sections of eastern and southern Oregon, and to a very limited extent the fireweed area of northwestern Oregon."[480]

By the mid-twentieth century there were not enough bees available for pollination rental in Oregon to pollinate all of the Oregon crops, and Scullen claimed that for the 1951-2 season Oregon seed producers brought in 5,000 colonies of bees from outside of Oregon for pollination purposes.[481]

> Growers confronted with the problem of securing bees for pollination have two alternatives: they can either purchase or rent them. In general it has not proven practical to purchase bees unless the grower has had previous experience in their management or is in a position to study the problems involved in their care…Renting bees for pollination purposes, therefore, has proven more satisfactory for most seed growers.[482]

Pollination was no longer something that could be taken for granted by agriculturists. The previous fifty years Oregon beekeepers had been experimenting with this new type of business and had fine-tuned their expectations and needs, so that pollination service would benefit the beekeeper as well as the grower. In Oregon the traditional practice had been for beekeepers to pay the landowner a flat rental. Finally, by the mid-twentieth century, the expectation had changed, and growers were expected to pay beekeepers to place their hives on the grower's agricultural properties. However, our story has many twists and turns before this agreement between beekeepers and Hood River apple growers is reached.

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[480] H.A. Scullen, *Bees...for Legume Seed Production*, Experiment Station Circular of Information 554, ed. the Oregon State College Experiment Station (Corvallis, OR: Oregon State College, 1956), 3.
[481] Scullen, 3.
[482] Scullen, 10.

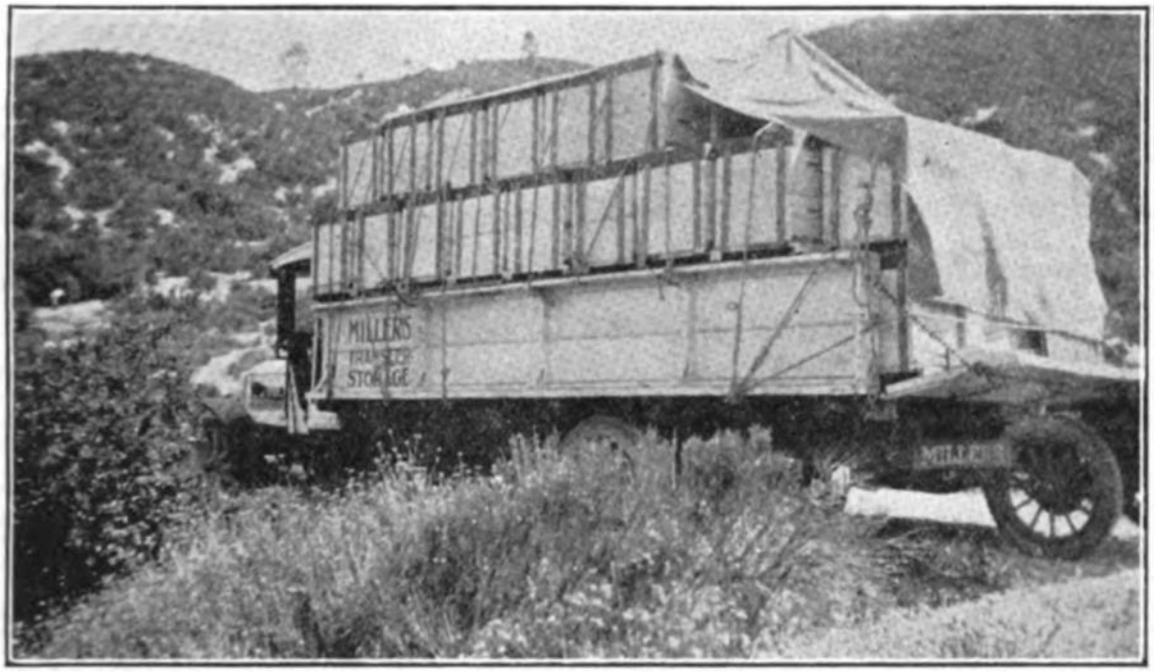

Figure 23 Mr. A.E. Lusher, migratory beekeeper, 1921.[483] "Hundreds of truckloads of bees involving thousands of colonies are moved each year into and within the state [Oregon] for pollination purposes. Anyone considering migratory beekeeping should study truck body construction and handling methods developed by some of the more experienced and extensive operators." – 1956, H.A. Scullen[484]

6.3 Paying Rent

Beekeepers in the nineteenth- and early twentieth- century U.S. usually owned little land. In fact, beekeeping was promoted as a perfect activity for people who lived in the city as the bees could be kept on the roof of a city building or the roof of a garage and forage could be found in the gardens and flower beds surrounding the houses and buildings within the city.[485] If a beekeeper wanted to establish

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[483] S.S. Knabenshue, "Migratory Beekeeping," *The Western Honey Bee,* no.4 (1921): 115.
[484] H.A. Scullen, *Bees...for Legume Seed Production*, Experiment Station Circular of Information 554, ed. the Oregon State College Experiment Station (Corvallis, OR: Oregon State College, 1956), 11.
[485] A.I. Root, *The ABC of Bee Culture: A Cyclopedia of Everything Pertaining to the Care of the Honey Bee: Bees, Honey, Hives, Implements, Honey Plants, &c., &c.: Compiled From Facts Gleaned From the Experience of Thousands of Beekeepers, All Over Our Land, And Afterward Verified By Practical Work in Our Own Apiary* (Medina, OH: A.I. Root, 1883), 11; Sheba Childs Hargreaves, "Beekeeping In Small Way Offers Big Opportunity To Reduce Cost Of Living," *Sunday Oregonian* (Portland, OR), July 18, 1920.

an outapiary or move his/her bees to a new nectar source, the beekeeper would often need to pay that land owner for the privilege of placing hives on the property. Langstroth, in 1889, suggested the beekeeper give the landowner a share of the honey and wax in payment "because we thus give him [the landowner] an interest in our success, and he is more likely to pay attention to our bees, and to produce crops that will yield some honey."[486] In 1919 M.G. Dadant said there were three ways to pay rent for the space the beekeeper needed for his bees, "by share, cash, or gift."[487] The share would be an arrangement as described above by Langstroth. An appropriate share to give the landowner, according to Dadant, was between one-fifth and one-tenth the honey produced by the colonies. For this share, the landowner was also expected to feed and house the beekeeper, providing supper as well as a bed, on the days the beekeeper came to inspect the hives if his inspection took place in the late afternoon or early evening.[488] A gift would be similar except rather than the landowner receiving a percentage of the honey and/or wax crop they would receive a set amount that could be negotiated before any bees were placed on the landowner's property. The drawback to giving a gift was that the landowner had no incentive to provide a productive environment for the bees as the gift was guaranteed no matter what the beekeeper harvested from the hives. In 1919 Dadant claimed that cash payment was most common and depended on the quality of the land being rented, fluctuating between five and fifty dollars, which is equivalent to $70.75 to $707.47 for the year 2017.[489] He recommended that for placement of seventy-five to one hundred colonies the beekeeper pay a rental fee of twenty to twenty-five dollars for the year

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[486] L.L. Langstroth, *On the Hive and Honey Bee* (Hamilton: Charles Dadant & Son, 1889), 304.
[487] M.G. Dadant, *Outapiaries and their management* (Hamilton: American Bee Journal, 1919), 33.
[488] Dadant, 34.
[489] "Inflation Calculator," U.S. Official Inflation Data, Alioth Finance, http://www.in2013dollars.com/1919-dollars-in-2017?amount=50.

($282.99 - $353.74 in 2017).[490] An additional seventy-five cents to one dollar would be paid by the beekeeper for every swarm the landowner caught and hived for the beekeeper.[491] Dadant provided a template for a rental contract in his book that beekeepers were welcome to use.[492] In 1908 A.I. Root claimed that sometimes the landowner would ask nothing of the beekeeper and he recommended the beekeeper provide "a good supply of honey for his [the landowner's] family to use during the coming year" as a goodwill gesture.[493] Root also warned that logging off or mono-cropping vast expanses in wheat could quickly make a desirable location a nectar desert, and for that reason "we want our apiaries so we can load them up at a moment's notice, and move them at practically little expense to any new field that may be more inviting."[494] S.E. McGregor, a USDA Apiculturist, claimed in 1976 that it was this creation of, and common usage of, a system of highly mobile temporary apiary sites that made the transition to mobile pollination service an easy one.[495]

At the request of the Oregon State Beekeepers' Association, the USDA Bureau of Entomology and Plant Quarantine and the Oregon Agricultural Experiment Station under the direction of A.S. Burrier performed a joint two year (1931 and 1932) study on the *Costs and Practices in Producing Honey in Oregon*.[496] The one hundred and two Oregon beekeepers who participated in the 1931-32 study all

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490 "Inflation Calculator," U.S. Official Inflation Data, Alioth Finance, http://www.in2013dollars.com/1919-dollars-in-2017?amount=25.
491 This would be $10.61 - $14.15 in 2017.
"Inflation Calculator."
492 M.G. Dadant, *Outapiaries and their management* (Hamilton: American Bee Journal, 1919), 34-36.
493 A.I. Root and E.R. Root, *The ABC and XYZ of Bee Culture: A Cyclopedia of Everything Pertaining to the Care of the Honey-bee; Bees, Hives, Honey, Implements, Honey-plants, etc. Facts Gleaned from the Experience of Thousands of Bee-keepers, and Afterward Verified in Our Apiary* (Medina: The A.I. Root Co., 1908), 313.
494 Root and Root, 318.
495 S.E. McGregor, *Insect Pollination of Cultivated Crop Plants* (Washington D.C.: Government Printing Office, 1976).
496 Research team members included:

owned at least fifty colonies of bees and had an average 4.6 apiary locations each. However, they owned only 9% of these locations. The remaining apiary locations were rented by the beekeeper (58%) or beekeepers were allowed to place hives on the land free of charge (33%). For the locations beekeepers were renting, 84% were paid for with honey and only 16% were cash rentals. The average honey rental payment was 1.8 pounds per colony placed in that location. The average cash paid for rent was thirty cents per colony, or $5.36 per colony in 2017.[497]

By 1924 Randall R. Howard, an Oregon journalist, claimed that Oregon "honey production has advanced far beyond the amateur stage. Oregon has a number of 1000-hive producers."[498] To underscore how substantial this Oregon agricultural business was, he told readers that each hive represented an investment of about twenty dollars, which in 2017 dollars would be $286.30 per hive.[499] For a beekeeper with one thousand hives that would be over $280,000 in today's value. Burrier and his research team agreed with Howard that Oregon was not a leading honey production state, but did have a significant honey industry. Over the two year period of Burrier's study, the one hundred and two

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A. S. Burrier, late Head, Oregon State College, Department of Farm Management;
Frank E. Todd, Associate Apiculturist, Pacific States Bee Culture Field Laboratory, Bureau of Entomology and Plant Quarantine, USDA;
H. A. Scullen, Oregon State College, Associate Professor, Department of Entomology; and
William W. Gorton, Oregon State College, Assistant Economist, Department of Farm Management.
A.S. Burrier, Frank E. Todd, H.A. Scullen and William W. Gorton, *Costs and Practices in Producing Honey in Oregon*, Station Bulletin 362, ed. the Oregon Agricultural College Experiment Station and the USDA Bureau of Entomology and Plant Quarantine (Washington, D.C.: USDA and Oregon Agricultural College, 1939), 7.

[497] "Inflation Calculator," U.S. Official Inflation Data, Alioth Finance, http://www.in2013dollars.com/1932-dollars-in-2017?amount=0.30.
Burrier, *et al.*, 17.

[498] "Bees May Visit Valley Blossoms," *The Hood River Glacier* (Hood River, OR), June 26, 1913; Randall R. Howard, "Oregon's Bee Industry Capable of Development to From 5 to 10 Times Its Present Production," *Sunday Oregonian* (Portland, OR), April 13, 1924.

[499] "Inflation Calculator."

participating beekeepers owned a total 34,279 colonies of bees and produced 2,182,668 pounds of honey, which is more than half the total honey production for Oregon during this two year period.[500]

6.4 Pollination

The roles of pollen and nectar were of interest to naturalists in the seventeenth to nineteenth centuries. The English microscopist, Nehemiah Grew (1641-1712), lectured to the Royal Society on plant sexuality. This talk was later published in Grew's 1682 *Anatomy of Plants,* making Grew the first to publish this idea. Grew claimed that Sir Thomas Millington (1628-1703/04), the Sedleian Professor of Natural Philosophy at Oxford from 1675 until his death, shared his idea that the pollen was the male element in seed production. Grew cited no experimental evidence for his conviction and didn't seem to have experimented himself. However, his idea was very influential and his conclusion was cited by Rudolph Jacob Camerarius (1665-1721), a professor of medicine and director of the botanical gardens at Tübingen. In Camerarius' *De sexu plantarum epistola*, which was published in 1694, he described the experiments he had undertaken to prove the function of pollen. For our discussion of honey bees it is interesting to note that Grew also identified the material within beebread as pollen, something Jan Swammerdam (1637-1680), a biologist and microscopist whose research on insects is well-known, had missed.[501]

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[500] A.S. Burrier, Frank E. Todd, H.A. Scullen and William W. Gorton, *Costs and Practices in Producing Honey in Oregon*, Station Bulletin 362, ed. the Oregon Agricultural College Experiment Station and the USDA Bureau of Entomology and Plant Quarantine (Washington, D.C.: USDA and Oregon Agricultural College, 1939), 11.

[501] Michael Proctor, Peter Yeo and Andrew Lack, *The Natural History of Pollination* (Portland, OR: Timber Press, Inc., 1996); Conway Zirkle, "Introduction," in *The Anatomy of Plants* (New York: Johnson Reprint Corp., 1965); Volker Wissemann, "Plant evolution by means of hybridization," *Systematics and Biodiversity,* no.3 (2007), 5, doi: 10.1017/s1477200007002381.

Christian Konrad Sprengel (1750-1816), like many eighteenth century naturalists, believed that everything God created had a purpose and through experimentation he came to the conclusion that flowers were designed to attract pollinators because nature “abhorred” self-fertilization, which could lead to weak offspring. [502] The many British beekeeping and husbandry books that were either sold in the U.S., or from which information was copied in U.S. beekeeping and farming journals and books, brought this knowledge to U.S. agriculturists. Nonetheless, many early U.S. beekeepers, orchardists, and experiment station scientists saw the transfer of pollen from one blossom to another by honey bees as incidental, not as the primary mechanism for pollination for many plant species.

Despite Darwin’s publication on cross and self-fertilization and the frequent retelling of Darwin’s experiments on these topics and conclusions on that topic in agricultural papers and periodicals, the belief by orchardists in the United States that many apples and pears needed a second variety for pollination came fairly late.[503] For apples, which tend to exhibit self-incompatibility, we now know that having a compatible (but not identical) variety of apple that blooms at the same time as the apple trees composing the majority of the orchard (a pollinizer) is essential for successful pollination.[504] In apples, the more successful the pollination, the greater the size and number of apples produced, as these

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[502] Holley Bishop, *Robbing the Bees A Biography of Honey the Sweet Liquid Gold that Seduced the World* (New York: Free Press, 2005), 127-128.
In 1876 Darwin published *The effects of Cross- and Self-fertilisation in the Vegetable Kingdom*. Darwin stated “Nature tells us in the most emphatic manner that she abhors perpetual self-fertilization.” Michael Proctor, Peter Yeo and Andrew Lack, *The Natural History of Pollination* (Portland, OR: Timber Press, Inc., 1996), 19.
Similar statement by Whitten in 1897, which he also attributes to Darwin.
J.C. Whitten, "Influence of Pollen upon Size, Form, Color and Flavor of Fruits," *American Bee Journal,* no.33 (1897).

[503] Darwin published *The Effects of Cross and Self-Fertilisation in the Vegetable Kingdom* in 1876.

[504] Self-incompatibility includes several mechanisms to encourage cross-pollination, and thereby the greatest genetic diversity.

characteristics are influenced by the number of viable seeds produced in each apple. At the end of the nineteenth century M.B. Waite, an Assistant Pathologist for the USDA Division of Vegetable Physiology and Pathology, wrote “The failure of orchards to yield satisfactory crops from year to year after reaching the normal bearing age is of frequent occurrence.”[505] He went on to write that his experiments, begun in 1890, highlighted the need for cross-pollination of pome fruits and that nectar and pollen are present in plants to attract insects as an aid in that process.[506]

6.5 Honey bee pollination

Many different pollinators of wild and crop plants, including apples, are present in all regions of the U.S. Why focus on honey bees? There are several reasons, and perhaps the most obvious is that honey bees were, and continue to be, a heavily managed species. For thousands of years humans have provided housing and forage for honey bees and in exchange they have received honey, wax, and other bee products in ever increasing quantities. By the early twentieth century, honey bees were a much more reliable source of pollination than the wind or wild pollinators, because the honey bees were easy to move and manipulate, and their numbers and locations could be determined by the beekeeper. Additionally, while many other animals may visit blossoms to feed on nectar or pollen, these visits do not always result in pollination.[507] When the morphology of the pollinator is not a good match for the

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[505] M.B. Waite, *Pollination of Pomaceous Fruits*, ed. the Division of Vegetable Physiology and Pathology USDA (Washington, D.C.: USDA National Agricultural Library Digital Collections, 1898), 167.
[506] Waite, 169.
There is a good description of the experiments performed by Waite in this publication.
Pome fruits are those produced by flowering plants within the family *Rosaceae* and subtribe *Malinae.* These include apples, hawthorns, medlars, pears, quince, etc.
[507] Vivian M. Butz Huryn, "Ecological Impacts of Introduced Honey Bees," *The Quarterly Review of Biology,* no.3 (1997):277.
Other sources discussing the benefit provided by bees include:

blossom, the removal of nectar or pollen and subsequent lack of effective pollination is referred to as floral parasitism. Honey bees, because they have spent thousands of years in close proximity to humans and the plants humans have chosen to keep close, have become good generalist pollinators and are considered floral parasites for a very small number of plants.[508] Many wild pollinators are specialists, collecting from only one or two plant species, or acting as floral parasites for most of the plant species from which they gather resources.

By the mid-nineteenth century the debate raged in books and periodicals: did honey bees cause more harm than good by removing nectar, wax and pollen from plants? Although we now know that worker bees create wax from glands on their abdomen, many at this time believed the wax was removed from plants by honey bees and they feared the plants needed the wax to protect the pollen on the anthers from inclement weather. It was believed that the nectar was needed to feed the organs of the plant that produced fruit.[509] The belief of many fruit growers was that by removing wax or pollen, honey bees were reducing pollination because of the diminished number of viable pollen grains available for fertilization, and by removing nectar the honey bees were ensuring that any fruit that was produced would be smaller and possibly ill-formed. This is despite publications as early as the mid-nineteenth century, such as *The Honey Bee Its Natural History, Physiology and Management* by Edward Bevan, M.D. (1770-1860), which assured readers that the amount of wax removed was negligible and

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Reverend Emerson T. Abbott, "Horticulture: The Relation of Bees to Horticulture Considered," *American Bee Journal,* no.36 (1890): 600; A.J. Cook, "Bees and Fruit - Bee-Diseases," *American Bee Journal,* no.19 (1894): 599; M.B. Waite, *Pollination of Pomaceous Fruits*, ed. the Division of Vegetable Physiology and Pathology, USDA (Washington, D.C.: USDA National Agricultural Library Digital Collections, 1898).

[508] Dave Goulson, "Effects of Introduced Bees on Native Ecosystems," *Annual Review of Ecology, Evolution, and Systematics,* (2003): 14.

[509] Another popular theory was that the nectar was needed as a sticking agent to adhere pollen grains to the pistil, which would initiate growth of the pollen tube and fertilization.

that the good provided by the bees' moving pollen from blossom to blossom was much greater than any harm they might cause through its removal.[510]

6.6 Beekeepers vs. Fruit Growers

Despite the information being shared between many in the horticulture, beekeeping, and experiment station sectors about the need for cross-pollination, especially in apples, and the role played by honey bees in achieving perfect pollination, many fruit growers and beekeepers saw their interests as competing rather than convergent, a conflict that became much more acrimonious when chemical pesticides were intensified in orchard management practices, at the recommendation of the experiment station scientists. However, orchardists' complaints about harm to their fruit caused by honey bees can be found from the late nineteenth through the first quarter of the twentieth centuries.

As early as the 1870s A.J. Cook, one of the first proponents of arsenic-based insecticides and Professor of zoology and entomology at Michigan Agricultural College, 1868-1893, was publicly defending honey bees against accusations that the bees were harming fruit, especially soft-skinned fruits like grapes, peaches, and plums. This was in direct opposition to Charles Valentine (C.V.) Riley (1843-1895), who at the time was the State Entomologist for Missouri, but who would become the Entomologist for the USDA, and who believed that bees could, and did, tear into fruit to obtain the sweet juice.[511] "If Mr. Bidwell and Prof. Riley are right, and the bee does rarely – for surely this is very

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[510] Edward Bevan, *The Honey Bee Its Natural History, Physiology and Management* (Philadelphia: Carey and Hart, 1843), 127-128.
More discussion of bees harming fruit can be found in R.I. Taylor's 1897 comments from the Buffalo Convention of the United States Bee-Keepers' Union.
R.L. Taylor, "Relation of Bees to Horticulture," *American Bee Journal,* no.48 (1897): 757-758.
[511] C.V. Riley had a long career, first as Missouri State Entomologist, 1868, then Chief of the U.S. Entomological Commission in 1876, and finally Chief of the Bureau of Entomology, USDA, in 1878. Later

rare, if ever – destroy grapes, still they are, beyond any possible question, invaluable aids to the pomologist."[512] To determine whether or not honey bees harmed ripe fruit, Cook performed an experiment.

> I have laid crushed grapes in the apiary, when the bees were not gathering, and were ravenous for stores, which, when covered with sipping bees, were replaced with sound grape clusters, which in no instance were mutilated. I have thus been led to doubt if bees ever attack sound grapes, though quick to improve the opportunities which the oriole's beak and the stronger jaws of wasps offer them.[513]

This defense, that honey bees only opportunistically took advantage of fruit torn by other animals, was frequently voiced and many diagrams of honey bee mouthparts next to wasp mouthparts were published as evidence that the shape and blunt edge of the honey bee mandibles made it impossible for them to tear into fruit.[514] In 1885 the apicultural station at Aurora, IL was established and N.W. McLain was put in charge. Over the next few years, McLain performed apicultural experiments on foul brood, controlled breeding of queens, and whether or not bees harm fruit.[515] McLain's experiments found that bees were not responsible for damaging fruit and these experiments and results were widely published,

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he was the Curator of the U.S. National Collection of Insects at the Smithsonian Museum of Natural History.
"Charles Valentine Riley Collection," USDA National Agricultural Library, Special Collections, https://specialcollections.nal.usda.gov/guide-collections/charles-valentine-riley-collection.

512 A.J. Cook, *Manual of the Apiary* (Ithica: Cornell University, 1876), 36.

513 Cook, 35-36.

514 L.L. Langstroth, *On the Hive and Honey Bee* (Hamilton: Charles Dadant & Son, 1889); Eugene Secor, *Bees and Horticulture: Some Opinions of Scientific Men, Trained Observers, Experimenters, and Fruit-Growers as to the Value of Bees in the Orchard and Garden* (*n.p.*: The National Bee-Keepers' Association, 1902); E. Kretchmer, "Bees in Horticulture," *The Rural Bee-Keeper,* no.2 (1906).
These are three examples of this defense.

515 McLain was first introduced in chapter 2.
Reverend Emerson T. Abbott, "Horticulture: The Relation of Bees to Horticulture Considered," *American Bee Journal,* no.36 (1890); William R. Howard, M.D., *Foul Brood Its Natural History and Rational Treatment* (Chicago: George W. York and Co., 1894); Ralph Benton, "Government Help in Apiculture," *Pacific Rural Press* (San Francisco, CA) December 5, 1908.

according to Frank Benton who replaced McLain as the apiculturist in charge of the Aurora Station a few years later.[516]

In California some orchardists, like olive growers, found bees a benefit for their orchards as early as 1897. However, other fruit growers were slower to accept that bees did not cause more harm than benefit. In Orange County California, 1897, an orchardist took his local beekeeper to court claiming damages for the harm the bees had done to his fruit and the resulting loss of income. The fruit grower lost his case, and at the time of publication of the case in the *American Bee Journal* the fruit grower was in the process of appealing the judgement in a higher court.[517] As late as 1920, in the Zanta, California orange groves, beekeepers and orange growers were still arguing over the issue of whether or not honey bees could harm fruit. Believing that honey bees were responsible for much of the damage to oranges in their groves, the members of the local orange growers' association appointed a committee "to devise ways and means of keeping the bees out of the groves."[518]

6.7 Legislating a spray solution?

"alas! the apple-bloom proved a 'death-warrant' to millions of bees in this immediate neighborhood."[519]

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[516] Frank Benton, "Work in Apiculture at the United States Department of Agriculture," *American Bee Journal,* no.3 (1905).

[517] George W. York, "Editorial Comments: Fruit-Growers and Bee-Keepers," *American Bee Journal,* no.47 (1897).

Bees harming peaches in a NY orchard. Original decision against the bees. Appeal with expert bee witnesses Frank Benton, A.I. and E.R. Root, jury rules in favor of beekeeper.

"Report of the Proceedings of the Thirty-Second Annual Convention of the National Bee-Keepers' Association," National Bee-Keepers' Association Conference, ed. George W. York (Buffalo, NY: George W. York & Co., Sept. 10 - 12, 1901), 63.

[518] J.D. Bixby, "Bees vs. Oranges," *Honey Producers' Co-operator,* no.7 (1920): 10.

[519] John G. Smith, "Ruined by Paris Green," *American Bee Journal,* no.21 (1889).

At the turn of the twentieth century apple growers were being urged to spray, often and thoroughly, by spray and spray equipment manufacturers as well as by fruit grower professional organizations and the experiment station and USDA scientists. These were the same experiment station and USDA scientists who were also telling orchardists to place bees within their orchard. An excellent example of this sustained push toward intensifying spray regimes is evident in the 1922 Hood River Branch Oregon Agricultural Experiment Station Report, which claimed that damage due to the codling moth had been reduced to 4% of the apple crop as the result of a pest management protocol based on a multi-spray schedule. This reduction in codling moth damage amounted to a savings of $100,000 (almost $1.5 million in 2017 dollars) for the Hood River growers.[520] The report went on to say that the difference between effective and non-effective spraying is "the grower who does not skimp in the amount of material used."[521] The global market pressures felt by early Hood River apple growers, which influenced their decision to use insecticidal sprays, is covered in more depth in the codling moth chapter of this dissertation.

While the government scientists and professional organizations urged fruit growers to avoid spraying while their trees were in full bloom, at least partially because it was the least effective time to spray, some turn of the twentieth century manufacturers were promoting spraying while in bloom. Initially, this distinction in when it was appropriate to spray fruit trees was thought to be the solution to the problem of bee poisoning both by scientists and beekeepers. However, as the effectiveness of the sprays increased, and trees were sprayed to the point of raining excess poison down on the cover-crop or whatever vegetation was present below the trees, beekeepers soon realized that banning the

[520] "Inflation Calculator," U.S. Official Inflation Data, Alioth Finance, http://www.in2013dollars.com/1922-dollars-in-2017?amount=100000.
[521] Gordon G. Brown, "Scope of Work of Hood River Station," *The Oregon Grower,* no.5 (1922): 7.

spraying of trees while in bloom was no solution at all, due to bees being continually drawn into the orchards by blooms on the vegetation under the trees. Until this realization, however, there were many calls by beekeepers for legislation that would force fruit growers to avoid spraying their trees while in full bloom. As late as 1921, A.I. Melander, the Entomologist in Charge at the State College of Washington, wrote that educational efforts undertaken by fruit growing organizations and experiment station scientists were too slow in creating a significant change to the practice of spraying trees while in bloom, resulting in the failure of many apiaries.[522] This lack of a material change in spray practices by orchardists was evident even to experiment station scientists such as Melander by the 1920s.

The Vermont Legislature on November 20, 1896 approved a spray law that stated, "If a person sprays or causes to be sprayed, or puts or causes to be put, any Paris green, London purple, or other poisonous substances upon fruit-trees while in blossom, he shall be fined not more than $40, and not less than $10."[523] This fine is equivalent to $281.71 to $1126.83 today.[524] Just a year later, 1898, New York passed a spray law, which made it a misdemeanor for anyone to spray fruit trees while in full bloom. This law was highly contested by New York fruit growers, who felt they were being barred from producing to their highest potential. After several unsuccessful attempts to have the law repealed, New York fruit growers were successful in getting the law amended so that trees in full bloom could be sprayed if it was required for experimental purposes.[525] The Geneva Experiment Station and Cornell

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[522] A.L. Melander, *First Annual Report of the Division of Apiculture to the Governor of Washington*, ed. A.L. Melander (Olympia: Frank M. Lamborn, Public Printer, 1921), 96.

[523] George W. York, "Editorial Comments: Vermont Law on Spraying," *American Bee Journal,* no.3 (1897): 41.

[524] "Inflation Calculator," U.S. Official Inflation Data, Alioth Finance, http://www.in2013dollars.com/1897-dollars-in-2017?amount=40.

[525] An article from *Gleanings* discussing the amendment of the New York law to allow spraying while in bloom for experimental purposes was reprinted by Secor: "The object of this amendment (and it appears the bee-keepers did not object to it) was to determine whether there was any advantage in

University immediately began experiments to determine any possible benefits to spraying blooming fruit trees. Professor S.A. Beach of the Geneva Experiment Station presented the results of these experiments at the New York State Association of Bee-keepers' Societies, which was later published in *Gleanings*, and then copied in a booklet edited by Eugene Secor, in 1902.[526] The experimental conclusion was that spray could harm the pollen, however if trees were sprayed before blossoms opened and again after blossoms dropped then both leaf-eating and fruit-eating insects would be killed. Finally, and perhaps most convincingly for fruit growers, trees that were not sprayed while in bloom produced significantly more fruit than the trees that had been sprayed while in bloom.[527]

Despite this and other continuing experiments, and published recommendations from experiment stations across the U.S. stating that fruit growers should not spray their trees while they were blooming, the practice continued in Oregon. The Laboratory for Horticultural Research at the Oregon State Experiment Station performed multiple experiments over several years to learn more

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spraying when the trees were in full bloom, irrespective of any damage that might accrue to the bee-keeper."
Eugene Secor, *Bees and Horticulture: Some Opinions of Scientific Men, Trained Observers, Experimenters, and Fruit-Growers as to the Value of Bees in the Orchard and Garden*, (*n.p.*: The National Bee-Keepers' Association, 1902).
Disputing the *Gleanings* article's claim that beekeepers had no objection to the amendment, the *American Bee Journal* was urging "every bee-keeper in New York State write at once to their representatives in the senate and assembly to vote against the passage of the bill. As the legislature will adjourn about April 1, it will likely be past or defeated before that time. Better write at once."
George W. York, "Editorial Comments: New York Spraying Law in Danger," *American Bee Journal,* no.12 (1900): 184.
[526] Among other things Eugene Secor was a beekeeper for forty years and in "1893 he was sole expert aparian judge at the World's Columbian Exposition. He was at one time president of the North American Beekeepers' Society, and for seven years its general manager and treasurer. He was a regular contributor to various agricultural and technical Journals. He was an active member of the Iowa Horticultural Society, at one time its president and for many years was regularly on the program of its meetings. At the time of his death [May 14, 1919] he was devoting his attention largely to horticulture." "Eugene Secor," *The Annals of Iowa,* no.5 (1920): 386.
[527] Secor, 9-10.

about the process, and possible benefits, of honey bee pollination. They published their results in 1912. Investigators searched for explanations for spring drop of immature fruit. "Careful experiments conducted along this line by several experimenters have demonstrated that when the trees were thoroughly sprayed before the blossoms had been pollinated they failed to set fruit. Usually, however, if two or three days have elapsed after pollination and before the spraying, such fruits will set perfectly."[528] Basically, if fruit growers would not spray when their trees were in bloom they were less likely to lose fruit during the spring drop.

When cover cropping became the standard orchard management practice, beekeepers soon realized that laws barring spraying while the trees were in bloom provided no protection to honey bees visiting the red clover, alfalfa, or other cover crop blooms being covered in poison from the multiple sprays given to most fruit orchards.[529] By 1907 in Oregon, cover crops, or intercropping, in orchards was coming into common use where possible.[530] These cover crops were meant to act as green fertilizer, and to provide shade for the tree roots and improved water retention of the soil. Previously, experiment station scientists had recommended clean cultivation, meaning keeping orchards free of all plant material, which had been thought to provide habitat for insect pests and to remove nutrients from the soil that otherwise would be available for fruit production. However, once the insecticidal sprays and

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[528] Laboratory for Horticultural Research, *The Pollination Question*, Station Circular 20, ed. the Oregon Agricultural College Experiment Station (Corvallis, OR: Oregon Agricultural College, 1912), 3.

[529] "Three popular cover crops – vetch, clover, and alfalfa – are all attractive to bees. Many believe vetch is the most dangerous to bees because of the extended bloom time. Blooming weeds in orchards, such as the dandelion, are also responsible for bee poisonings. The repeated pesticide sprayings occur during different bloom times for the tree, cover crop, and weeds, thereby continually poisoning nearby colonies."
A.L. Melander, *First Annual Report of the Division of Apiculture to the Governor of Washington*, ed. A.L. Melander (Olympia: Frank M. Lamborn, Public Printer, 1921), 93.

[530] C.I. Lewis and W.H. Wicks, *Orchard Managment* Bulletin No. 93, ed. the Department of Horticulture (Corvallis, OR: Oregon Agricultural College, 1907), 16.

spraying equipment became more effective the fear of pests finding refuge in cover crops under the trees disappeared. Additionally, in the hilly terrain of Hood River, clean cultivation could also lead to problems with erosion.

In Hood River, in addition to recommendations from the Oregon Agricultural Experiment Station, irrigation was a main factor in orchardists' decision to use a cover crop or not. The first irrigation in Hood River was the Farmers' Ditch, begun by Franklin Davenport, an early Hood River orchardist. The Farmer's Ditch, completed in June of 1897, was eleven miles long and irrigated about ten thousand acres on the west side of Hood River. It also caused the price of land on the west side of Hood River to triple in two years.[531] More substantial irrigation became available about 1912, and by 1917 there were three main irrigation ditches. The East Fork irrigation ditch fed the east side of Hood River and the Hood River Irrigation District and the Farmers' Irrigating Company canals fed the west side of Hood River. In 1917, S.M. Thomson, Scientific Assistant for the USDA, claimed that while 100% of orchards in Hood River with cover crops were irrigated, only 27% of clean-cultivated orchards were irrigated.[532] By 1921, Gordon G. Brown, the Horticulturalist for the Hood River Branch Experiment Station, claimed that cover cropping was the general orchard practice in Hood River.[533] In 1919, as the use of cover cropping was increasing, some Northwest beekeepers began talking about the need for legislation requiring cover

[531] *History of Hood River County, Oregon 1852-1982*, ed. the Hood River County Historical Society (Dallas, TX: Taylor Publishing Company, 1982), 13.
[532] S.M. Thomson and G.H. Miller, *The Cost of Producing Apples in Hood River Valley* Bulletin 518, ed. the Office of Farm Management, United States Department of Agriculture (Washington, D.C.: USDA, 1917), 29-30.
[533] Gordon G. Brown, *Hood River Apple Orchard Management With Special Reference to Yields, Grades, and Value of Fruits* Experiment Station Bulletin 181, ed. the Oregon Agricultural College Experiment Station Hood River Branch (Corvallis, OR: Oregon Agricultural College, 1921), 4-6.

crops be mowed down in advance of spraying the orchard when the cover crop was in bloom.[534] However, this movement for a legislated solution never gained much traction, possibly due to the inability of previously enacted laws to significantly change orchard practices.

As late as 1939, the problem of bee poisoning due to the use of insecticides remained a problem in the main Oregon orchard districts – Jackson, Hood River, and Wasco counties.[535] By 1945, in a letter written by Burr A. Black, the Oregon State Apiary Inspector, and sent to Frank McKennon, Chief of the Oregon State Division of Plant Industry, Black claimed that at least half of the Hood River and Wasco county bee population had been killed due to either crop dusting in the cherry orchards or overstocking of package bees by orchardists, causing the starvation of both the package and local bee populations that had not been killed due to aerial poisoning.[536] This is a very clear instance when the experiment station recommendations – to have more bees in the orchard and to spray – were at odds with each

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[534] George W. York, "Beekeeping in the North-west," *The Domestic Beekeeper,* no.11 (1919); George W. York, "Bees An Invaluable Aid to the Orchardist," *Better Fruit,* no.5 (1919); "Plant Specialists Form Organization," *The Hood River Glacier* (Hood River, OR), August 4, 1921; A.L. Melander, *First Annual Report of the Division of Apiculture to the Governor of Washington*, ed. A.L. Melander (Olympia: Frank M. Lamborn, Public Printer, 1921).

[535] A. Burr Black, "History and Distribution of Bee Diseases in Oregon" (M.S. Thesis, Oregon State College, 1939), 33.

[536] A. Burr Black, letter to Frank McKennon, Chief, Division of Plant Industry for the State of Oregon, July 26, 1945.

"Because of greater drift airplane application is likely to cause more damage than ground machines." H.A. Scullen, *Bees...for Legume Seed Production*, Experiment Station Circular of Information 554, ed. the Oregon State College Experiment Station (Corvallis, OR: Oregon State College, 1956), 13.

Crop dusting is a term for the aerial application of dry insecticides, a common agricultural practice in the early twentieth century. Most aerial agricultural applications today are with wet substances. Possibly the first instance of crop dusting was in 1921 as an experiment. Lt. John A. Macready, a U.S. Army pilot, using a modified Curtiss JN-6 "Super Jenny" applied lead arsenate dust to catalpa trees infested with sphinx moth larvae in Ohio. WWII increased the number of pilots and aircraft available for crop dusting, particularly after the war ended.

"The Industry's History," National Agricultural Aviation Association (NAAA), http://www.agaviation.org/industryhistory.

other and had not only impacted the effectiveness of pollination and viability of local beekeepers, but also the sustainability of the varied wild pollinator populations. The very next year, 1946, Black told readers that it was difficult to keep bees alive in Hood River during the summer due to the dusting of arsenic compounds by airplane. “Most of the poisoning apparently occurs when arsenical dusts drift onto blooming plants such as sweet clover, alfalfa and vetch although bees may be poisoned from dew collected from sprayed foliage.”[537]

6.8 Restricted Movement

At the beginning of the twentieth century, therefore, Oregon beekeepers were simultaneously fighting two of the greatest killers of honey bees; the still mysterious disease American foulbrood and the new, highly effective chemical insecticides. In an attempt to mitigate the spread of the highly contagious disease American foulbrood, beekeepers were lobbying for legislation that tracked and/or restricted the movement of honey bees both within Oregon and between Oregon and other states. This process made it impossible for beekeepers to move their bees at a moment’s notice, trapping honey bee colonies in locations close to crops where pesticides were being used and discouraging many beekeepers from initiating migratory or outapiary style beekeeping practices. The fact that most beekeepers owned little land, and were therefore reliant on other agriculturalists for bee pasturage, increased beekeepers’ feelings of vulnerability. In response they once again turned to legislation and experiment station scientists for help.

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[537] A. Burr Black, “Report on Apiary Inspections for 1945 – 1946,” unpublished report archived at the Oregon State Archive, Plant Industry Division, Apiary Records, 1946, 2.

In 1905, legislation was passed in Oregon that created a system of county bee inspectors for counties east of the Cascade Mountains. Each inspector was selected by at least seven people within that county who were "actively engaged in the culture of honeybees" and who would make nominations for the county apiary inspector position.[538]

> 5733. Duties of Bee Inspector.
> It shall be the duty of such bee inspector, when notified in writing, signed by any person, company, or corporation engaged in bee culture, or his or their duly authorized agent, to examine all apiaries, beehives, or bee appliances described in such notice, for the purpose of ascertaining whether such apiaries, or any part thereof, or the bees, comb, or honey therein, is affected with "foul brood" or other infectious disease or insects injurious to bees or their products, and after such examinations should the inspector find foul brood or other disease or insects to exist in such apiary, honey, comb, or appliances connected therewith, he shall immediately instruct the owner or owners thereof or their duly authorized agent, how to treat and care for such infected apiary, honey, honeycomb, bees, [or] appliances as shall be most likely to remove said foul brood, or other diseases or insects therefrom. [L. 1905, c. 175, p. 303, §2.][539]

If the owner of the bees did not follow the requirements of the bee inspector, then the inspector could provide the treatment or destroy any infected bees and/or equipment at the cost of the owner. If an owner refused to allow the bee inspector to examine his bees and apiary or if an owner sold, bartered or gave away any bees or bee equipment infected with foul brood it was considered a misdemeanor and the fine could be between $200 and $500,[540] thirty to sixty days in the county jail, or some combination of fine and jail time. Anyone bringing infected bees into Oregon was liable to the same judgement. Finally, anyone importing honey bees into Oregon was required to immediately notify their county

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[538] Hon. William Paine Lord and Richard Ward Montague, *Lord's Oregon Laws Showing All the Laws of a General Nature in Force in the State of Oregon*, Vol. III (Salem, OR: Willis S. Duniway, State Printer, 1910), 2102.

[539] Lord and Montague, 2102-2103.

[540] This would be $5289.18 to $13,222.96 in 2017 dollars.
"Inflation Calculator," U.S. Official Inflation Data, Alioth Finance, http://www.in2013dollars.com/1905-dollars-in-2017?amount=500.

inspector and schedule an examination of these newly imported honey bees. The possible fine for not complying with this process was slightly higher than that for the other offenses.[541] This is a significant piece of legislation with a serious penalty, which reflects how earnestly Oregon beekeepers were taking the issue of American foulbrood.

By the 1920s bee inspectors were being appointed for all counties in Oregon as qualified applicants and money became available. E.H. Bauer, "one of the most practical beekeepers in this state and…bee inspector for Multnomah county" was a new appointment for 1921 as a result of increased effort to "enforce the very rigid Oregon state laws in order to eradicate disease which last year caused the loss of many thousands of dollars to beekeepers in this and adjoining counties."[542] By 1921 the previous Multnomah bee inspector had already inspected hundreds of colonies. All Oregon inspectors preferred to use education of beekeepers and treatment of diseased colonies instead of the more forceful destruction of diseased colonies. The focus on education by all Oregon bee inspectors was summed up nicely by the Multnomah County Beekeepers' Association motto: Better bees kept better.[543] For more information about the inspection process see the chapter on foulbrood.

The beekeepers with the most to lose were the ones with the most incentive to do everything possible to eradicate the diseases in their apiaries. Many of the larger beekeepers felt that small beekeepers, those who had from one to ten colonies of bees, were not doing their share in the fight against foulbrood.[544] In an effort to ensure all beekeepers, small and large, were being monitored for

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[541] Hon. William Paine Lord and Richard Ward Montague, *Lord's Oregon Laws Showing All the Laws of a General Nature in Force in the State of Oregon*, Vol. III (Salem, OR: Willis S. Duniway, State Printer, 1910), 2104.
[542] "Bees Will Be Studied," *Morning Oregonian* (Portland, OR), May 7, 1921.
[543] "Beekeepers To Convene," *Morning Oregonian* (Portland, OR), June 20, 1921.
[544] "It is a very common opinion of beekeepers that the small beekeeper, usually a farmer who knows very little about bees and neglects them, is mainly responsible for the spread of foulbrood."

the presence of disease, Oregon passed a law in 1923 that required anyone who kept bees, even if just one colony, to license their apiary. The licensing fee was $1 per apiary.[545] By 1929 the Oregon State Beekeepers' Association was recommending the state rescind this legislation because of its ineffectiveness and the divisiveness it was creating between small and large beekeepers. The small beekeeper felt it was unfair that they pay the same licensing fee as the larger beekeepers and this resentment, in addition to feeling pressured to invest more time and money in their bees, was creating a lot of animosity among small beekeepers that was directed toward large beekeepers.[546]

Finally, in 1933, legislation enacted a new bee law transferring responsibility for apiary inspection to Charles A. Cole within the Oregon Department of Agriculture, who had been in charge of horticultural inspections since 1925.[547] Additionally, the 1933 Oregon bee law required registration of every honey bee colony with an accompanying fee based on the number of colonies registered. By 1939 there were several different fee structures, with the 1939 fees set at ten cents per colony with a minimum fee of one dollar. The maximum any beekeeper could be charged was twenty dollars. In 1940

A. Burr Black, "History and Distribution of Bee Diseases in Oregon" (M.S. Thesis, Oregon State College, 1939), 31.
"It also bears out the theory that manipulation is responsible for a large part of the spread of disease for, of the three groups, the amateurs, with 10 to 50 colonies of bees, do more manipulating and "playing around" with the bees than do the men in either of the other groups."
Black. 32.
[545] H.A. Scullen, *Oregon Beekeepers' News Letter*, no.7 (May 7, 1923), 1.
$1 in 1923 is equivalent to $14.31 in 2017.
"Inflation Calculator," U.S. Official Inflation Data, Alioth Finance, http://www.in2013dollars.com/1905-dollars-in-2017?amount=500.
[546] H.A. Scullen, *Oregon Beekeepers' News Letter*, no.31 (December 31, 1929), 1; H.A. Scullen, *Oregon Beekeepers' News Letter*, no.27 (December 27, 1928), 1.
[547] H.A. Scullen, *Oregon Beekeepers' News Letter*, no.42 (March 18, 1933), 1.
Later that same year, 1933, Cole appointed I.H. Sheer as apiary inspector for Hood River and Wasco Counties.
H.A. Scullen, *Oregon Beekeepers' News Letter*, no.43 (June 8, 1933), 1.

that would change to ten cents a colony up to two hundred colonies and five cents per colony over two hundred. Perhaps the most important aspect of the 1933 bee law was the requirement that anyone moving bees or selling bees first had to get a moving permit from their local apiary inspector. This requirement remained in all versions of the bee law including the 1940 amendment, and made it much more difficult for beekeepers to move their bees quickly, whether for honey production, pollination purposes, or to avoid spray or disease.[548]

In his 1939 M.S. thesis, Burr Black, who would eventually become the Oregon State Apiary Inspector, was the first person in Oregon to test the general feeling that small beekeepers were less vigilant in disease prevention and treatment than larger beekeepers. Below, figure 2, is the table he created with information from the 1937 inspection records for Oregon. The number of diseased colonies include any disease present in Oregon at that time by size of apiary – Group A with 1-10 colonies, Group B with 11-50 colonies, and Group C with more than 50 colonies.[549] My assumption would be that a beekeeper with from one to ten colonies would have all the colonies in one location and therefore the number of locations listed in Group A is a good indication of the number of small beekeepers in Oregon

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[548] A. Burr Black, "History and Distribution of Bee Diseases in Oregon" (M.S. Thesis, Oregon State College, 1939), 29.

[549] Diseases present in Oregon according to Black include: American foul brood, European foul brood, sac brood, nosema-disease, paralysis, dysentery, septicemia, and other fungal diseases. He makes clear that not all these diseases have any significant impact on Oregon bee colonies.
Black, Abstract.
The 1931-32 study on honey production in Oregon found that approximately "three-fifths of the operators included in this study reported American foul brood disease in their apiaries. For the entire group there was an average colony loss of 5.7 per cent from this cause. This was the only disease of widespread importance reported." Study participants had to own at least fifty colonies of bees.
A.S. Burrier, Frank E. Todd, H.A. Scullen and William W. Gorton, *Costs and Practices in Producing Honey in Oregon*, Station Bulletin 362, ed. the Oregon Agricultural College Experiment Station and the USDA Bureau of Entomology and Plant Quarantine (Washington, D.C.: USDA and Oregon Agricultural College, 1939), 6.

at that time. In this table that would be over one thousand small beekeepers. Contrast this with the total number of locations for medium and large beekeepers, which is half the number of locations for small beekeepers. Additionally, we know that many medium and large beekeepers had colonies in more than one location, making the total number of medium and large beekeepers even smaller. While there were many more small beekeepers than medium and large, the number of colonies owned by small beekeepers was 10,722 compared to the 21,779 owned by medium and large beekeepers. In other words small beekeepers owned only 33% of the honey bee colonies in Oregon at that time. However the small beekeepers were responsible for 67% of the honey bee locations in Oregon with disease present. This data seemed to confirm the perception that small beekeepers' apiaries were areas of potential infection and these areas were spread across the state. This is similar to the situation faced by apple growers in their fight against the codling moth as discussed in that chapter.

TABLE 4

INSPECTION RECORD IN 1937

GROUPED ACCORDING TO SIZE OF APIARIES

	Colonies	Dis. Col.	%	Locations	Loc. with dis.
A.	Owners with 1 to 10 colonies:				
	10,722	631	6	1,116	400--35%
B.	Owners with 11 to 50 colonies:				
	5,152	535	10.3	273	107--41.7%
C.	Owners with over 50 colonies:				
	16,627	429	2.6	272	119--44%
Totals:					
	32,501	1,595	4.9	1,661	626--37%

Figure 24 Apiary Inspection Record, 1937.[550]

[550] A. Burr Black, "History and Distribution of Bee Diseases in Oregon" (M.S. Thesis, Oregon State College, 1939), 39.

6.9 Scientific solutions?

In addition to attempts to legislate a solution to the bee poisoning problem, beekeepers turned to science for a fix. In the 1920s, experiment station scientists began looking for a bee repellent that would not harm the fruit or the fruit trees.[551] A successful bee repellent would also need to have no effect on the codling moth and other insect pests who needed to chew, or eat, some of the plant material covered in the poison and it was thought possible that something could be found that was a repellent for all insects when wet, but did not repel insects once dry. Experiments conducted by the Washington State experiment station found that creosol solution was most repellent, followed by carbon disulfide and nicotine sulfate.[552] In 1929, C.L. (Clayton Leon) Farrar, apiculturist at the Massachusetts Agricultural College, Amherst, told readers about experiments that had taken place at the Amherst Experiment Station which "indicate that if the recommended spray combination of lead arsenate, lime-sulfur, and nicotine sulfate is used, spraying should have no effect upon colonies not subject to any restrictions of flight" because of the "repellent action" of the nicotine sulfate, which would cause bees to avoid the sprayed areas.[553]

In 1918 a product called Milkol, produced by the Sulpho-Napthol Co. in Boston, Massachusetts, was fined $25 by the Insecticide and Fungicide Board, USDA, for misbranding as the label included statements that were both false and were meant to "deceive and mislead the purchaser."[554] Among the

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[551] A.L. Melander, *First Annual Report of the Division of Apiculture to the Governor of Washington*, ed. A.L. Melander (Olympia: Frank M. Lamborn, Public Printer, 1921), 95.
[552] Melander, 97.
[553] C.L. Farrar, *Bees and Apple Pollination* Special Circular No. 7, ed. the Massachusetts Agricultural College Department of Entomology (Amherst: Massachusetts Agricultural College, 1929), 4.
[554] $25 in 1918 would be $405.27 in 2017.

many claims on the label was the statement that "vermin and insects will shun floors, woodworks, sinks, pipes, etc., that are washed with Milkol." The Insecticide and Fungicide Board had found this statement to be false.[555] Despite this, Milkol became known within some agricultural areas as an insect repellent. In 1922 a beekeeper, H.N. Paul, who owned two apiaries that were close to orchards in Yakima, Washington, had a thirty gallon barrel of Milkol shipped to him so that he could give it, free, to the orchardists closest to his apiaries. "Orchardists in the Yakima Valley sow alfalfa in the orchards to serve as cover crops. Most of them do not cut it during the season, so after June 15 there is more or less bloom all summer, and as they have to spray the trees with the lead spray about every two weeks after July 1, more or less spray drips on the blossoms under the trees, where the bees get it."[556] The thirty gallons was only sufficient for one of the sprays, however Paul felt the Milkol had been successful. He followed one of the spray rigs using the Milkol mixture for a half hour in an orchard where the alfalfa under the trees was in full bloom and covered in honey bees. "As the spray rig moved along spreading spray charged with milkol one pint per 100 gallons of spray, the bees would scatter and not alight again while I was there."[557] Paul claimed the milkol not only repelled the bees while wet, it did not harm the foliage on the trees. The next year, 1923, the Insecticide and Fungicide Board once again won a judgement against the Sulpho-Napthol Co of Boston for the same false claims to which they had added a new false claim, "Milkol is the most scientific, economical and safest disinfectant, antiseptic, cleanser

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"Inflation Calculator," U.S. Official Inflation Data, Alioth Finance, http://www.in2013dollars.com/1905-dollars-in-2017?amount=500.

[555] J.K. Haywood, *Service and Regulatory Announcements*, ed. the USDA Insecticide and Fungicide Board (Washington D.C.: Government Printing Office, 1918), 414.

[556] H.N. Paul, "Spray Repellant Successful," *American Bee Journal,* no.12 (1922): 565.

[557] Paul, 565.

and curative agent that has ever been produced for stable, kennel, poultry yard and the general treatment of horses, dogs, poultry, cattle, sheep, swine, and their quarters."[558]

6.10 Bees in the orchard

In 1897, A. J. Cook wrote an article listing the reasons why every farm should have bees. First, he was concerned that the number of large apiaries then present across the U.S. had diminished the number of small beekeepers who had been scattered across rural areas, providing incidental pollination for farms. Cook feared that at that time there were areas where no bee colonies were present. For this reason he felt farmers needed to have their own bees, although he agreed that most farmers had little time or resources for a new enterprise. Cook's solution was that, unlike their other agricultural endeavors, the farmers would find beekeeping to be intellectually stimulating and spiritually calming, becoming a pleasant past-time rather than another source of work. The idea that bees provided a more elemental experience for beekeepers that was intellectually uplifting as opposed to a base drive toward material gain is in line with the progressive ideas about agriculture at the turn of the twentieth century. Cook went so far as to suggest that the pull of beekeeping would help keep young boys on the farm, a major concern as urban areas continued to grow.[559]

At the end of the nineteenth century, not only were apiaries becoming larger, so were apple orchards. In certain areas of Oregon, like Hood River, apple growing was an intensely specialized form of agriculture, creating large areas of blooms that needed pollination at roughly the same time, unlike more generalized farming areas with a number of crops blooming at different times throughout the

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558 Howard M. Gore, *Service and Regulatory Announcements*, ed. the USDA Insecticide and Fungicide Board (Washington D.C.: Government Printing Office, 1923), 1082.
559 A.J. Cook, "Value of Bee-Keeping on the Ranch," *American Bee Journal,* no.30 (1897).

year. How to have sufficient honey bees for pollination of these specialized agricultural areas was the focus of research by the USDA who concluded that "if there is no apiary in the neighborhood, therefore, each large orchardist should keep a number of hives of bees."[560] In areas like Hood River that specialized in apple growing, the problem of having sufficient bees was also true for smaller orchardists, as the large number of orchards in a fairly small area created the same pollination problem as a single large orchard – too many blooms for the bees available in the area to visit each one, much less each bloom multiple times.

By 1909, the Oregon Experiment Station scientists were encouraging farmers and orchardists to have a few stands of bees for both pollination and honey for home use. H.F. Wilson, an entomologist for the Oregon Agricultural Experiment Station, wrote *Beekeeping for the Oregon Farmer*. "Prepared for beginners in beekeeping, and especially for the farmer or orchardist who desires a few stands of bees for pollinizing purposes."[561] Beekeepers approved of the effort to get orchardists to keep a few bees, firmly believing that this would change the orchardists' spray practices as orchardists saw the effect of

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[560] M.B. Waite, *Pollination of Pomaceous Fruits*, ed. the Division of Vegetable Physiology and Pathology USDA (Washington, D.C.: USDA National Agricultural Library Digital Collections, 1898), 180.
S.W. Fletcher, a horticulturist at Cornell University, also expressed concern at the turn of the century. "There are many kinds of insects which aid more or less in the cross-pollination of orchard fruits, principally bees, wasps and flies. Of these, the wild bees of several species are probably the most important. In a wild thicket of plums or other fruits, they are usually numerous enough to insure a good setting of fruit. But few, if any, wild bees can live in a large orchard, especially if it is well tilled. As the extent and thoroness [sp] of cultivation increases, the number of these natural insect aids to cross-pollination decreases; hence it may become necessary to keep domestic honey-bees for this purpose." George W. York, "Editorial Comments: Pollination of Orchards," *American Bee Journal,* no.39 (1900): 612.
Same quote, I believe incorrectly attributed to G.W. Fletcher
G.W. Fletcher, "Pollination in Orchards," in *The Sixth Biennial Report of the Board of Horticulture*, ed. the Oregon State Board of Horticulture (Salem, OR: W.H. Leeds, 1900), 207.

[561] H.F. Wilson, *Beekeeping for the Oregon Farmer* Extension Service Series II, No. 25, ed. the Oregon College of Agriculture Extension Service (Corvallis, OR: Oregon College of Agriculture Extension Service, 1909), 4.

the spray on their own hives. Despite this encouragement from the experiment station and beekeepers, the number of farms with bees present continued to decrease. The Berkeley agricultural economist Edgar Voorhies and his co-authors found that in California, "the number of farmers keeping bees has declined almost 25 percent from 1900 to 1930; there was a somewhat similar decline in the number of colonies on farms."[562] This trend was evident across the U.S. The agricultural census figures show that in 1900 12.3% of farms kept bees, but by 1930 only 7.3% reported having bees.[563] Perhaps the most important information Voorhies found was that the decrease in the number of farms with bees was creating a pollination crisis. “So acute has the situation become in some fruit-growing and clover-seed regions that farmers are either renting bees during blossom time from bee specialists or purchasing package bees for pollination purposes."[564]

By 1929, experiment stations were looking for other pollination alternatives for farmers that did not involve the farmer becoming a beekeeper. C.L. Farrar, an entomologist with the Massachusetts Agricultural College, outlined two options orchardists had for increased pollination if they did not want to care for the bees themselves or to rent bees from a beekeeper. The first was for fruit growers to create a pollination cooperative. The cooperative would purchase from thirty to one hundred colonies

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[562] Edwin C. Voorhies, Associate Professor of Agricultural Economics at the University of California, Berkeley, and Agricultural Economist for the Experiment Station and the Giannini Foundation;
Frank E. Todd, Associate Apiculturist, Pacific States Bee Culture Field Lab, USDA, Bureau of Entomology; and
J.K. Galbraith, Research Assistant on the Giannini Foundation.
Edwin C. Voorhies, Frank E. Todd, and J.K. Galbraith, *Economic Aspects of the Bee Industry* Bulletin 555 (Berkeley: University of California Experiment Station, 1933), 3.
[563] Voorhies, *et al.*, 7.
[564] Voorhies, *et al.*, 7.
Table 27 shows that for the years 1930, 1932 & 1933 California package bee breeders were shipping about 4% of the package bees produced in California to Oregon.
Voorhies, *et al*., 101.

of bees, whatever was needed by the members of the cooperative, and would also hire a manager for the cooperative's many satellite apiaries. "It should be possible to work out a plan that would insure its financial stability."[565] Farrar's second suggestion was for the orchardist who needed at least thirty colonies to assign management of the apiary to one of the orchardmen. "The two-year students majoring in Pomology here at the college take 6 credits of work in beekeeping, and many of these, in addition to making good orchard men, are capable of caring for colonies with considerable skill."[566]

Many orchardists chose to use package bees for pollination. Package bees came in one, three, or five pound wire and wood boxes. Each pound of bees amounts to approximately four thousand bees. A three pound package of bees, placed in an empty hive, will take between sixty and ninety days to reach full colony strength.[567] Kenneth W. Tucker, Research Entomologist with the Science and Education Administration, Bee Breeding and Bee Stock Research Station in Baton Rouge, Louisiana, claims that the use of package bees began in the late 1870s, became more significant in the 1910s, and only became a common practice in the second half of the twentieth century.[568] He identifies new and improved transportation technologies and infrastructure as the reason for the increased use of package bees between 1910 and 1950. Reliable railway express service gave way to high-speed highways and package

[565] C.L. Farrar, *Bees and Apple Pollination* Special Circular No. 7, ed. the Massachusetts Agricultural College Department of Entomology (Amherst: Massachusetts Agricultural College, 1929), 9.
[566] Farrar, 9-10.
[567] Michael Burgett, Stan Daberkow, Randal Rucker, and Walter Thurman, "U.S. Pollination Markets: Recent Changes and Historical Perspective," *American Bee Journal,* no.1 (2010).
[568] Kenneth W. Tucker, "Queens, Package Bees, and Nuclei: Production and Demand," in *Beekeeping in the United States* Agricultural Handbook Number 335, eds. E.C. Martin, E. Oertel, N.P. Nye, and others (Washington D.C.: Government Printing Office, 1980).
Nolan claims package bees had been shipped in combless packages since the 1880s.
W.J. Nolan, *The Development of Package-Bee Colonies*, ed. the Bureau of Entomology United States Department of Agriculture (Washington, D.C.: USDA, 1932), 1.

bees delivered by truck.[569] As we have seen in previous chapters the creation of infrastructure and new transportation technologies have impacted bee breeding in the U.S. as well as the ability of beekeepers to integrate migratory or outapiary practices into their beekeeping operation. Currently, package bees are mainly purchased by beekeepers to strengthen weak colonies or to expand an apiary.

In the 1920s package bees did not include any comb or brood and could, or could not, include a queen. Because of the time these bees would be without food during transit, it was thought that they would have time to flush any disease from their systems, and because no diseased comb or brood accompanied them, package bees were considered one of the best ways to increase the number of bees in an apiary without introducing disease, such as American foul brood.[570] Because the package bees arrived without food stores and extremely hungry, it was necessary to immediately begin feeding them upon arrival. In 1929 Farrar claimed a three pound package of bees cost $4.75, which is $68 today, and the bees needed ten pounds of sugar, even if the orchardist was only interested in the bees as pollinators and did not intend to save the bees for honey production or for use as pollinators the next year.[571] It seems clear that many orchardists used these package bees similarly to how we use live ladybugs today, as an expendable ecological tool to achieve a human goal.

In 1926 package bees had become a major beekeeping product, so important that the USDA began an extended study published in 1932 and titled, *The Development of Package-Bee Colonies*,

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[569] C.W. Tucker, "Caring for Package Bees and Nuclei," in *The First Annual Report of the Division of Apiculture to the Governor of Washington*, ed. A.L. Melander (Olympia: Frank M. Lamborn, Public Printer, 1921), 62.
[570] Tucker, 32.
[571] C.L. Farrar, *Bees and Apple Pollination* Special Circular No. 7, ed. the Massachusetts Agricultural College Department of Entomology (Amherst: Massachusetts Agricultural College, 1929), 9.
Farrar went on to say that the uncertainty of when the bees would arrive was one reason package bees were not good for orchard pollination.

written by W.J. Nolan, Apiculturist for the Division of Bee Culture Investigations, Bureau of Entomology. This report claimed that Alabama had become the center for the package bee and queen bee industries. An indication of the rapid growth in package bee sales is the increase between 1924 and 1926 in Alabama, with 18,000 packages of bees sold in 1924 and 40,000 packages of bees sold in 1926.[572] This study found that most package bees were sold to beekeepers desiring to increase the size of their apiary or to strengthen colonies that had weakened over the winter. However, a new market opening up was to sell package bees to beekeepers who needed more hives for pollination rentals. This study found that package bees in good condition "will gather pollen within a few hours after being installed. This fact makes possible the use of the original bees in the package as pollenizers [sic] without the necessity of having them build up into colonies."[573]

6.11 Beekeepers welcomed (?) into orchards

> Are there any Wasco county fruit growers who would like to lease hives of bees, guaranteed to have well-oiled stingers, and to be tireless honey chasers…He is willing to rent hives of Italian bees to anarchists for use in pollenizing [sic] fruit blossoms – excerpt from the *Hood River Glacier*, May 11, 1922

J. Skovbo, based in Hermiston, was one of the largest beekeepers in Oregon at the time of this article. He wrote a letter to The Dalles, Oregon, Chamber of Commerce asking if anyone in their county was interested in renting hives of bees for pollination. This newspaper rendition of that request is a good indication of the relationship between beekeepers and orchardists in Hood River, Oregon early in the twentieth century and of the general feeling about paying for pollination.[574] Nine years after the

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572 W.J. Nolan, *The Development of Package-Bee Colonies*, ed. the Bureau of Entomology United States Department of Agriculture (Washington, D.C.: USDA, 1932), 2.
573 Nolan, 42.
574 "Clipped Here and There," *The Hood River Glacier* (Hood River, OR) May 11, 1922, 10.

publication of this article, 1931, H.A. Scullen claimed that only 14% of Oregon commercial beekeepers had rented bees for pollination purposes.[575] However, he expected even this small percentage to decrease because of the presence of bee diseases in orchard districts and the fact that many beekeepers who had rented in these areas in 1931 had lost bees, time, and money on the venture.[576] It was a brave few Oregon beekeepers who were willing to venture into the new business of pollination rentals.

Beekeepers and apple growers struggled to find a way to marry their two interests – honey production and pollination – in a way that was profitable for both parties. By the 1920s, some Northwest beekeepers began receiving payments for their bees' pollination service, $5 per hive.[577] By 1929 the price for pollination service in the U.S. ranged between $5 and $10 ($71.57 - $143.15 in 2017)[578] per hive depending on the number of bees present in each hive (the colony strength). It did not

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[575] In California "less than 16 percent of the beekeepers that answered a questionnaire reported renting bees for pollination. This seems to indicate that this phase of the industry is relatively unimportant in most parts of California. It is most prevalent in the Sacramento-San Joaquin belt, where about 55 percent of the state's deciduous-fruit acreage, having a pollination problem, is located."
Edwin C. Voorhies, Frank E. Todd, and J.K. Galbraith, *Economic Aspects of the Bee Industry* Bulletin 555 (Berkeley: University of California Experiment Station, 1933), 104.

[576] H.A. Scullen, *Oregon Beekeepers' News Letter*, no. 41 (December 20, 1932), 4.
"Spray poison, buckeye (which is poisonous to bees) in some areas, and bee disease in others have done much to discourage beekeeping by fruit growers. Many beekeepers refuse to rent bees for pollination in areas where there are possibilities of poisoning or disease, because it does not pay to take the risk involved for a small rental fee."
Voorhies, *et al.,* 104.

[577] "According to the *Western Honey Bee*, fruit growers in Yakima Valley are renting bees to pollinize their orchards. As many as 40 stands have been contracted for by one cherry grower, to be placed in blossoming time in an orchard of six and one half acres. The owner receives $5.00 per hive for the blossoming season."
"Untitled," *American Fruit Grower,* no.3 (1920): 52.
$5 in 1920 is equivalent to $61.20 in 2017
"Inflation Calculator," U.S. Official Inflation Data, Alioth Finance, http://www.in2013dollars.com/1905-dollars-in-2017?amount=500.

[578] "Inflation Calculator."
C.L. Farrar, *Bees and Apple Pollination* Special Circular No. 7, ed. the Massachusetts Agricultural College Department of Entomology (Amherst: Massachusetts Agricultural College, 1929), 8.

take long before the beekeepers realized that in most cases when they rented their bees for pollination, the only money they made was the rental fee minus expenses.[579] As late as 1980 S.E. McGregor, a USDA apiculturist, stated that "most of the bee rentals, however, are personal arrangements between growers and local beekeepers."[580] Modern beekeepers have several factors that impact their decision whether or not to rent their bees for pollination. A major consideration is the fact that honey bees will never produce the amount of honey they could have produced if the beekeeper had not rented them for pollination purposes. Additionally, there are risks to renting bees for pollination: pesticide exposure, damage to the bees or equipment during transit, and an increased chance of disease because of exposure to other bees in the pollination contract area; and there is always a chance that the pollination fee will be difficult, or impossible, to collect. Beekeepers have to decide if these concerns are worth the pollination service fee.[581]

As early as 1939, Burrier and his colleagues had claimed that "the renting of bees for pollination has not been highly developed, but since poisonous spray residues tend to destroy the natural pollinating insects, the importance of bees for this purpose is likely to be greatly increased as time goes on."[582] Burrier and his colleagues were correct. Pollination service has become an important part of Oregon agriculture and beekeeping. Michael Burgett, emeritus professor of entomology at Oregon State

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[579] Edwin C. Voorhies, Frank E. Todd, and J.K. Galbraith, *Economic Aspects of the Bee Industry* Bulletin 555 (Berkeley: University of California Experiment Station, 1933).
[580] S.E. McGregor, "Pollination of Crops," in *Beekeeping in the United States Agricultural Handbook Number 335*, ed. E.C. Martin, E. Oertel, N.P. Nye, and others (Washington D.C.: Government Printing Office, 1980), 112.
[581] McGregor, 113.
[582] A.S. Burrier, Frank E. Todd, H.A. Scullen and William W. Gorton, *Costs and Practices in Producing Honey in Oregon*, Station Bulletin 362, ed. the Oregon Agricultural College Experiment Station and the USDA Bureau of Entomology and Plant Quarantine (Washington, D.C.: USDA and Oregon Agricultural College, 1939), 34.

University and apicultural specialist, states that as of 2010, commercial beekeepers who provide pollination service in the Pacific Northwest pollinate more than five crops “in about seven different counties” each year. These beekeepers make about sixty percent of their income from pollination service fees, “whereas semi-commercial beekeepers make about 60 percent of their income from selling honey.”[583] Pollination service, like honey production and apple growing, comes in all scales of commercial endeavor, from having a few colonies of bees for your own small orchard to having thousands of colonies of bees that spend their lives being moved from crop to crop by semi-trucks.

Most beekeepers, apple growers and experiment station scientists now agree that having bees in the orchard will result in hybrid vigor produced by the transfer of pollen between the various varieties of apple trees present in modern orchards, and that hybrid vigor “promotes fruit sets and ultimately fruit quality and uniformity.”[584] Randal R. Rucker and his research team did an extensive study on *Honey Bee Pollination Markets and the Internationalization of Reciprocal Benefits*, published in 2012. They concluded that "markets must coordinate the joint production of pollination and honey against a backdrop of continually evolving scientific views of the efficacy of honey bee pollination."[585] Despite this, the United States is the largest user of migratory pollination services.[586]

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[583] Michael Burgett, Stan Daberkow, Randal Rucker, and Walter Thurman, "U.S. Pollination Markets: Recent Changes and Historical Perspective," *American Bee Journal,* no.1 (2010), 40.
[584] Randal R. Rucker, Walter N. Thurman and Michael Burgett, "Honey Bee Pollination Markets and the Internationalization of Reciprocal Benefits," *American Journal of Agricultural Economics,* no.4 (2012): 958.
[585] Rucker*, et al*., 958.
[586] Rucker, *et al*., 957.

6.12 Conclusion

Pollination service became a viable beekeeping practice due to a complex set of circumstances and this chapter identifies four central themes. First, developments in technology and infrastructure made it physically possible to transport large numbers of hives to various locations, both within Oregon and out-of-state. Second, established, successful beekeepers, such as Langstroth and M.G. Dadant, experimented early with migratory and outapiary beekeeping models, providing feedback and encouragement to other beekeepers contemplating adding this revenue stream to their beekeeping operations. Thirdly, USDA and experiment station scientists were advocating the need for honey bee pollination in orchards. And, finally, intensive spray regimes and mono-cropping diminished wild pollinators' ability to both sustain their populations and to provide pollination within a sea of apple blossoms.

In this chapter I also touched on the development of road systems and trucks which could carry large numbers of hives or package bees quickly to distant locations. Additionally, small rail systems were developed, such as the PE&E in Oregon, connecting rural residents and their products with more urban marketing centers, creating a network of connections between agriculturists that the beekeepers could use to follow the nectar-flow. Without more extensive road and rail systems, and larger and more reliable trucks the commercial pollination service we are familiar with today would not have been possible.

Throughout this dissertation I've discussed the importance of recommendations from beekeepers and apple growers with first-hand experience. The two most prominent names in beekeeping that I focused on in this chapter are L.L. Langstroth and M.G. Dadant. Both combined several beekeeping activities within their beekeeping businesses. Langstroth was a clergyman, teacher, inventor of the moveable frame hive, and author of *The Hive and the Honey Bee*, however he suffered from illness throughout his adult life and spent years in a patent-battle both of which left him with little money at the end of his life. However, beekeepers within the U.S. and England held him in such high regard that they created a fund for his support to supplement his income toward the end of his life.[587] Langstroth is also known as the "father of American beekeeping" because of his role in transitioning beekeeping from a small, ancillary income activity to a profession. His very early support for outapiaries was one example of Langstroth's influence in creating the possibility for future migratory pollination service. The Dadant family is well-known in beekeeping circles and M.G. Dadant was the grandson of Charles Dadant, the first of the family to emigrate from France to the United States and begin beekeeping. M.G. became business manager for the *American Bee Journal* after his family's purchase of the journal and his graduation from college.[588] The fact that someone from the Dadant family would publish a book promoting outapiaries, *Outapiaries and Their Management* (1919), was very influential. Additionally, M.G.'s book is filled with practical advice, including a chapter on cars and trucks, and vignettes of beekeepers who had been successful using outapiaries. Both Langstroth and Dadant were frequent contributors to the *American Bee Journal* and were well-known and respected within beekeeping circles. I believe that it was these, and other beekeepers who published articles and books highlighting experiences with outapiaries, not the government scientists, which made migratory, and later pollination service, imaginable. Neither beekeepers nor government agricultural scientists were able to change the behavior of apple growers in any significant way when it came to providing a safe space for honey bee pollination, despite attempts to legislate a solution. However, the beekeeping

[587] Thomas William Cowan, "Rev. L.L. Langstroth," *Gleanings In Bee Culture,* no.24 (1895).
[588] "History," *American Bee Journal*, http://americanbeejournal.com/.

community, by continually making adjustments to the pollination service process based on their first-hand, hard-won experiences, were able to forge a path that others could follow.

USDA and experiment station scientists were encouraging beekeepers to include some degree of migratory practice in their beekeeping programs, and, probably more significant, these government agricultural scientists were lobbying fruit growers to allow beekeepers in their orchards. At the same time they were advocating intensive insecticide eradication programs in the orchards. By recommending both the inclusion of bees in orchards and an intensive spray program, agricultural scientists were forcing orchardists to prioritize one practice over the other and, as this dissertation has shown, orchardists chose intensive spray regimes over nurturing bees in their orchards. In response beekeepers turned to policy creation for a solution, helping to establish spray laws within several states. However, beekeepers also turned once again to science and agricultural scientists for a solution to the problem that had been caused by the scientists' advocating an intensive orchard spray schedule. Agricultural scientists began searching for a bee repellent, a possible solution that would make spraying of insecticides if not benign, at least less harmful, for honey bees. While agricultural scientists' struggle to convince apple growers that honey bees were a benefit in the orchard appears to have been successful, this success compounded the problem caused by the scientists' simultaneous recommendation for intensive arsenic-based insecticidal spraying of orchards. In this case science failed beekeepers spectacularly, to the point that both A. Burr Black and H.A. Scullen lauded the arrival of DDT as the possible savior of honey bees, with Scullen stating in a 1945 letter to Black, "it is evident that DDT may not be as serious a problem as we had feared. It might serve to be a blessing in disguise if it replaces some of the arsenic."[589]

[589] H.A. Scullen, letter to A. Burr Black, July 12, 1945.

These intensive spray regimes, coupled with increasing specialization in agriculture, which created large areas with only one plant available to wild pollinators for food and shelter, caused a pollination crisis as we approached the mid-twentieth century. The decreasing wild pollinator population and many wild pollinators' inability to live within large, mono-cropped areas made orchardists more receptive to agricultural scientists' recommendations to use honey bees as pollinators. This chapter describes some of the issues encountered as beekeepers and orchardists began redefining their relationship, from one of beekeeper as supplicant to one where beekeeper and orchardist were partners within the orchard. These partnerships needed to be economically beneficial for both parties despite their very different goals. I believe this chapter illustrates how difficult this transition was for all parties as both apple growers and beekeepers kept turning to agricultural scientists to validate their concerns and mitigate the pressures impacting their ability to compromise.

Black, in December of that same year, 1945, told a beekeeper, "Nearly all reports so far from over the state would indicate that DDT is not nearly so dangerous to bees as expected. In fact, from present indication, it is far less harmful to bees than the arsenical sprays and dusts."
A. Burr Black, letter to C.L. Gibson, December 13, 1945.

7 General Conclusion

The transition to commercial pollination service was the result of many parallel decisions that were being made by beekeepers and fruit growers. Despite the complex relationship between seemingly disparate decision-making instances, I found five main themes present to some extent within all chapters – globalization, expertise, the mixing of vocation and avocation by scientists and government officials, the role of legislation, and the role of personal economics. Often the individual decisions being made were in response to immediate issues, to achieve one short-term goal, or to take advantage of some new opportunity, as when the Lee brothers used the PE&E railroad to expand into mobile pollination service. Each chapter provided an examination of the goals of those involved in providing and evaluating information used to make decisions, as well as an examination of the changes in technology and infrastructure that helped push decisions in a certain direction.

Before going any further I want to mention some issues that deserve more research in the future. To my regret (as an anthropologist in my first career), there are few voices from outside the public realm in this dissertation as it relies mainly on published sources, whether books, professional journals, or government agricultural bulletins. Archival items, such as letters, are present if either the recipient or writer was well-known or had a position of importance within their profession or government. Local newspapers were my best source of information about anyone who was not present in these other documents and they are where I found the two Hood River, Oregon beekeepers. I was only able to include small beekeepers and small orchardists as reflections of the impression they left on those who would talk about them within publications or letters. Because their apple growing or beekeeping operations were a tiny portion of what they did with their lives, the linking of these activities to their names has mainly been lost. I believe they are present somewhere, despite finding very little evidence of them myself. This belief is based in personal experience, having found the ledger my great-grandmother kept of her egg production and sales a few years ago. It was a sideline that added to the household income and, when I found the ledger and talked to family about her egg sales they had very vague memories that, "Oh yeah. She did sell a few eggs didn't she?" The ledger tells me it was a more significant part of the family income than they know. Additionally, there were many cultures present in Oregon at the turn of the twentieth century who were involved in beekeeping or apple growing and their voices are also mainly absent. The area now recognized as Oregon has been the home of Native American groups for thousands of years and they can be found in the names of places included in this dissertation, in settler diaries, and in the orchard photos. Japanese and other Asian immigrants worked to create infrastructure, businesses, and orchards, while creating a place for themselves within Oregon. There are stories that still need to be told.

For this dissertation, the first issue I want to reflect on is globalization. This is a term we are all familiar with and most of us believe we understand what it encapsulates. In the first chapters I focused on the fact that even frontier areas, like Oregon, and frontier activities taking place in these areas, like beekeeping and apple growing, were impacted by international science, politics, and economics from the last half of the nineteenth- through the first half of the twentieth- centuries. Both honey bees and apples were as much immigrants to Oregon as the people who inserted themselves into territory belonging to Native American populations, and both were dependent on the resources coming from the east, whether it was the eastern United States or other homelands left behind.

Science pertaining to beekeeping often came to Oregon from England or continental Europe. Professional journals not only translated and correlated information on topics, such as arsenicals or foul brood, but most also included international sections with correspondents from numerous countries who would tell American beekeepers the current issues they were facing and how they were dealing with them. Private beekeepers, like L.L. Langstroth, would maintain relationships with beekeepers from other countries which included exchanges of information and bees. This international system of beekeepers was nurtured by the federal government, an example being Frank Benton's mandate to find bee races not present in the U.S. and to send them and information about them to American beekeepers. However, economic entomology seems to be a product of the U.S., coming out of the progressive era's belief in science to solve problems, centralization of authority, efficiency, and the conflation of agricultural productivity and growth of the nation as a world power.

While the politics of English colonization and two world wars impacted both beekeepers and apple growers in Oregon, the economic impact of globalization was greatest for the Hood River, Oregon apple growers who made the decision early on to focus on distant apple markets. As I discussed, this was not a new concept for Oregon apple growers, but Hood River made it the core of their agricultural enterprise. All of the decisions made by Hood River apple growers came from their need to cater to the international fruit market. The problem encountered by Hood River apple growers when England, and later some other European countries, decided to put a maximum on pesticide residue levels for fruit coming from the United States are discussed in the codling moth chapter. Many American fruit growers at the time speculated the pesticide residue mandate had more to do with England's desire to encourage apple growing in her current and former colonies than any true health concern. Despite this and other hurdles, Hood River apple growers remained steadfast in their pursuit of international fruit markets, fully supported in that effort by federal, state, and professional organizations. As Laurie Carlson tells her readers, the USDA justified its budget by pointing to export agriculture, to which I would add the USDA also used export production as a way to solidify their position as a scientific authority at home and abroad.[590]

The foulbrood chapter is an excellent example of incipient international professionalization and specialization in science. The boundaries between people within this chapter had as much to do with scientists' need to buffer their authority and define themselves as experts in newly defined sciences, such as microscopists and bacteriologists, as it did scientists' need to separate themselves from lay beekeepers and apple growers. In some of the other chapters we see these boundaries can be very porous, with beekeepers and apple growers' knowledge valued and sought by agricultural scientists. Indeed, in the apples in Oregon chapter I discussed the training provided to apple growers by experiment station scientists on record-keeping as a way for apple growers to truly know what their revenue was and for government scientists to collect data on Oregon agriculture through essential field, hands-on experiences.

A recurring theme was the role of first-hand experience in the creation of expertise. In this dissertation an early example was that of the Oregon State Board of Horticulture (OSBH), whose members were also fruit growers and could speak from experience about horticulture practices. Additionally, these men were not willing to unconditionally accept recommendations from agricultural scientists, insisting on testing them on their own orchards before sharing scientific recommendations with their members. It is clear these men saw themselves as the experts in fruit growing in their individual regions.

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[590] Laurie Carlson, "Forging His Own Path: William Jasper Spillman and Progressive Era Breeding and Genetics," *Agricultural History,* no.1 (2005): 61.

Another phenomenon throughout this dissertation are the many government agricultural scientists who saw the value of having expertise derived from personal experience, adding their own fruit growing or beekeeping experience to their scientifically-based recommendations. This was a very successful strategy for increasing their perceived level of expertise, but there were two possible down-sides. First, there were times when a possible conflict of interest made this mixing of vocation and avocation troubling. An example could be Frank Benton's selling of queens for new bee varieties he was importing to the U.S., at the expense of the federal government. In this way he was able to reap the highest prices for these queens, because he was the first private beekeeper to own any of them. Secondly, my contention is that when government agricultural scientists added a commercial enterprise to their scientific expertise, and then used that first-hand experience as a second support for their claim to expertise, it made it appear that scientific and personal, first-hand experience were equivalent. There were many beekeepers and apple growers who had first-hand experience, sometimes of many years, and professional journals and newspapers included many of their individual experiences in their publications. This publication was a validation of the importance of the personal experience and created a situation similar to the issue Alan I. Marcus brought up in 1985 on the devaluation of agricultural information based on personal experience because it led to numerous, often conflicting experiences of the same phenomena.[591]

Alvin I. Goldman has discussed the concept of a person's knowledge, meaning the extent of what they know, as one validation for expertise. Within this dissertation I have found that the volume of one's knowledge, not only theoretical, but also applied, first-hand, knowledge was used by beekeepers,

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[591] Alan I. Marcus, *Agricultural Science and the Quest for Legitimacy Farmers, Agricultural Colleges, and Experiment Stations, 1870-1890* (Ames: Iowa State University Press, 1985).

apple growers and government agricultural scientists as a way to increase their claims to authority through expertise. One example is Moses Quinby's claim to expertise on foulbrood based not only on his own first-hand experience, but also on the volume of experiences he gathered from other beekeepers. A second example is the USDA's claim to expertise on American and European foulbrood not only because of their science-based knowledge, but because of the vast amount of data on first-hand experience with the disease they had gathered from beekeepers across the nation.

For the issues I examined in this dissertation, beekeepers and apple growers always preferred to use science to solve or manage an agricultural problem. However, there were times when science was unable to provide a solution, or when a solution caused a new problem. In these cases both beekeepers and apple growers turned to legislation as a way to effect change. A prominent example is the legislation put in place to mitigate the spread of bee diseases, including American foulbrood. Legislation was also used by government agricultural scientists to increase their perceived expertise in cases where science was not providing a solution to an agricultural problem or when other considerations had more influence on decision-making by beekeepers and apple growers.

Finally, as Steven Yearly identified in 1992, other mutually held goals may have higher priority than scientific knowledge and this may affect the decision-making process.[592] One such goal I found throughout this dissertation was the need for beekeepers and apple growers to make a yearly profit. Both these agricultural groups were practicing a specialized, intensive agriculture, which mainly focused on one product, making them more vulnerable to market and environmental changes. They were dependent on the profit produced by their agricultural products each year to feed their families, entirely

[592] Steven Yearley, "Skills, Deals, and Impartiality: The Sale of Environmental Consultancy Skills and Public Perceptions of Scientific Neutrality," *Social Studies of Science,* no.3 (1992).

or partially. This may seem too simplistic, but that does not change the truth of this observation. Even for beekeepers or apple growers who used their agricultural activities to supplement their income, a reduction in that income could cause them financial hardship or to search for a more reliable income producing activity. Decisions made by agriculturists always include a concern for profitability in the near future.

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