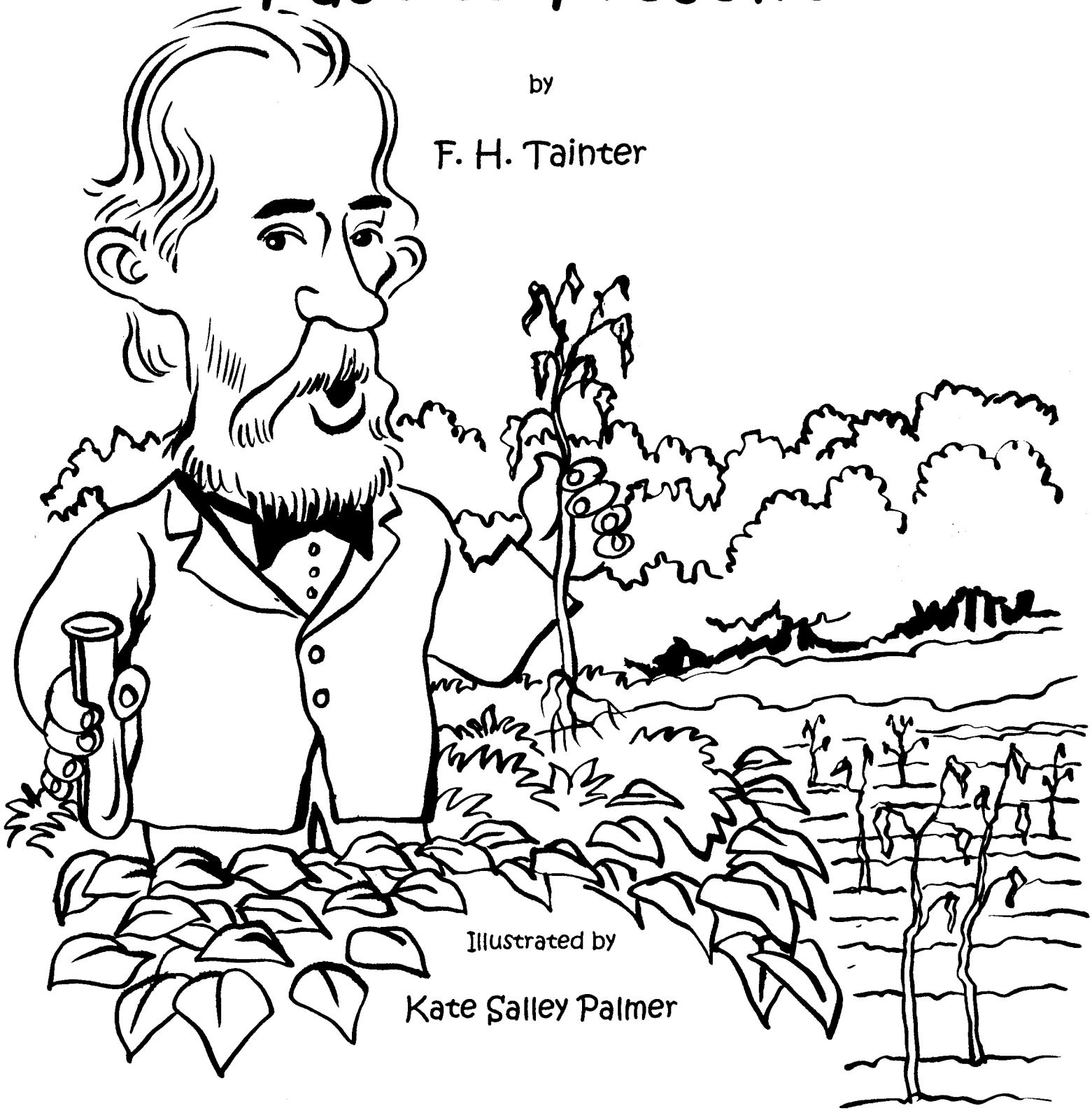
Plant Pathology: Past to Present

by

F. H. Tainter



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APS

Healthy Plants • Healthy World

The American Phytopathological Society (APS) is the premier organization dedicated to high-quality, innovative plant pathology research. APS members diagnose and search for a solution for the disease that effect plants, from crops in the field to trees in the forest. With an understanding of global plant diseases, APS and its members are able to create unique resources offering education on plant diseases and how those diseases impact society.

Hello! My name is Heinrich Anton deBary. Scientists consider me, deBary, to be the "father of plant pathology". Plant Pathology is the study of diseases affecting plants.

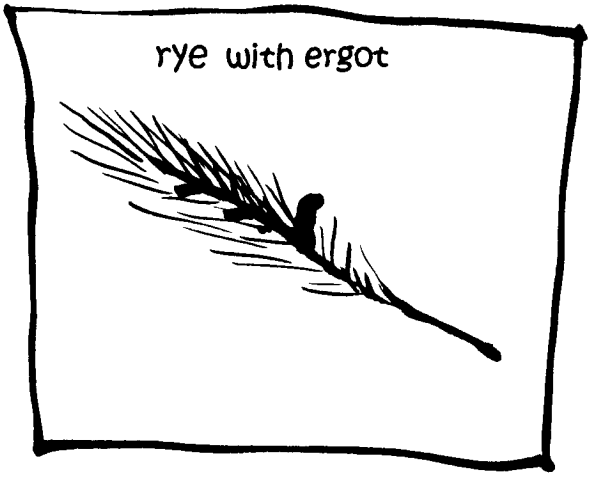
Read on, and I will show you some plant diseases, what causes them, and how plant pathologists control diseases.

In ancient Babylon, Smut, a disease of wheat (one of our main foods!), was recorded as early as 1900 BC.
Smut reduces yields of the edible grains used for making bread and cereal.

In 980 BC, prayers were offered in the Temple of Solomon to ward off plant diseases.

The wheat rust fungus, with its reddish-colored spores, plagued early farmers. In 715 BC, the Romans created the gods "Robigo" and "Robigus".

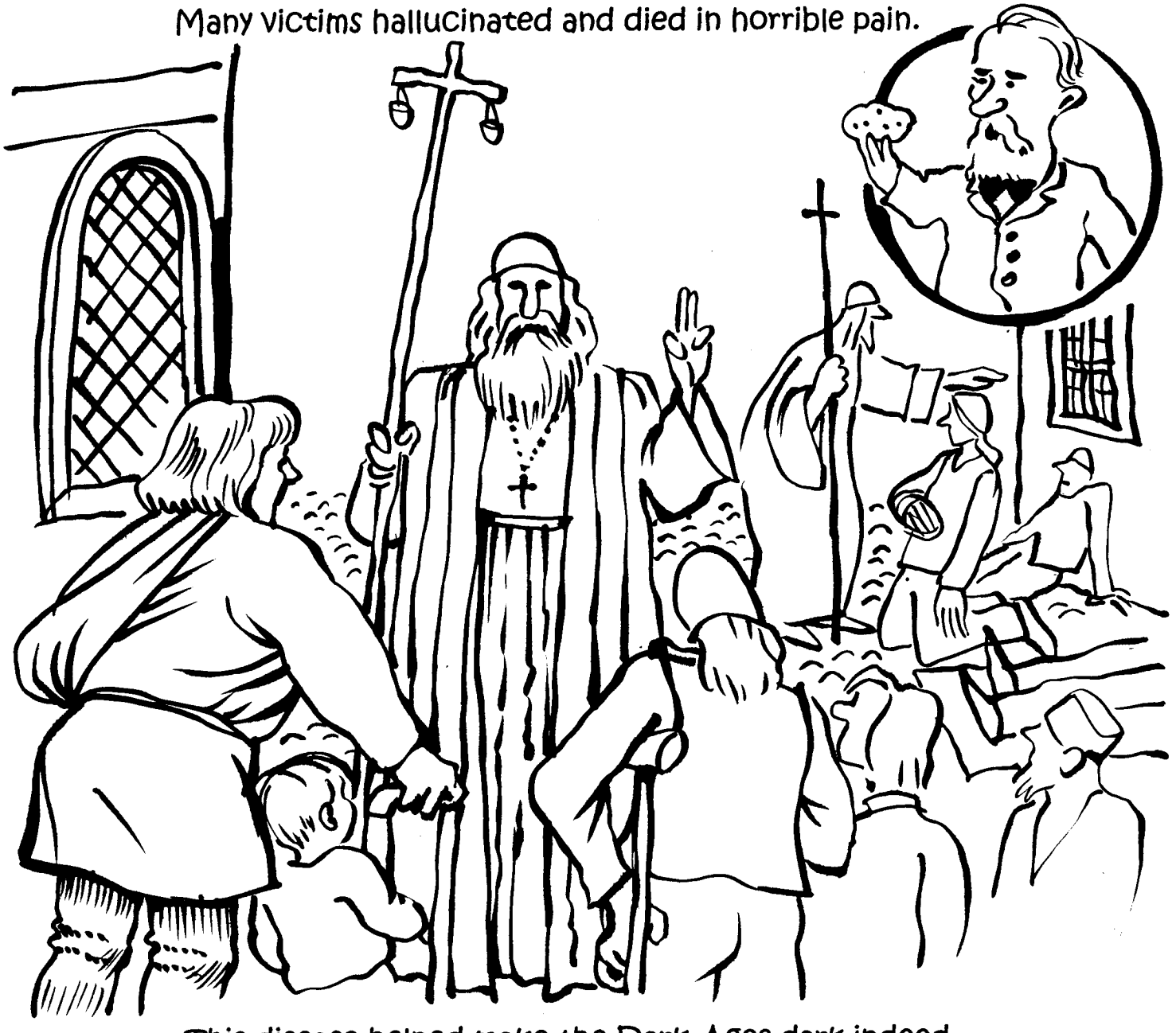
"Robigalia" was celebrated on April 25. On this day, sacrifices of reddish-colored animals were made to Robigo and Robigus to protect wheat from wheat rust.



After the decline of the Roman Empire in Europe, poor people relied on rye as their primary food source. When the weather was cool and wet, a fungus infected the developing rye grains and produced purplish-black, grain-like structures called "ergots".

The ergots were inadvertently ground with the grain, and used to make bread.

The ergot in the bread caused severe constrictions in the blood vessels of people who ate the bread.
This caused gangrene. Hands and feet would literally fall off, producing a disease known as "holy fire" or "St. Anthony's Fire".
Many victims hallucinated and died in horrible pain.



This disease helped make the Dark Ages dark indeed.
Serious outbreaks of this disease decreased when the potato, from America, gained widespread acceptance as a staple food across Europe and Russia.

The potato was introduced into Europe about 1750 and became an important food group among poor rural people. In Ireland, it became the sole food for tenant farmers whose wheat crop paid their rent.

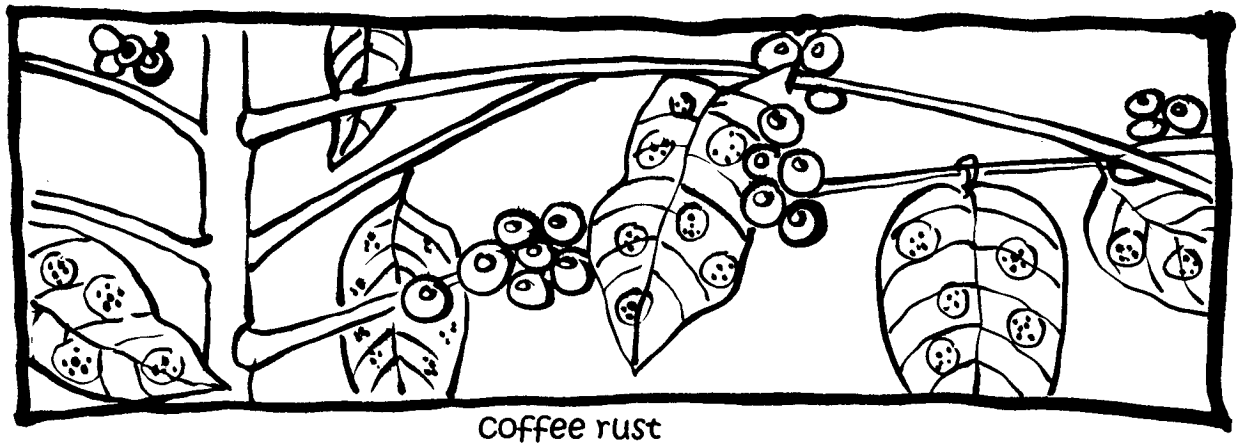
A series of wet, cool summers in the 1840's led to an epidemic of a disease called "late blight" that completely destroyed the potato crops year after year.

Thousands of Irish starved to death; 1 1/2 million emigrated to escape starvation. Many Americans of Irish descent can trace their family histories to that period.

The American Chestnut was once an important forest tree in the Eastern United States.

Chestnut blight killed the American Chestnut trees in the early 1900's. Only their stumps remain, surrounded by sprouts which soon become infected and die.

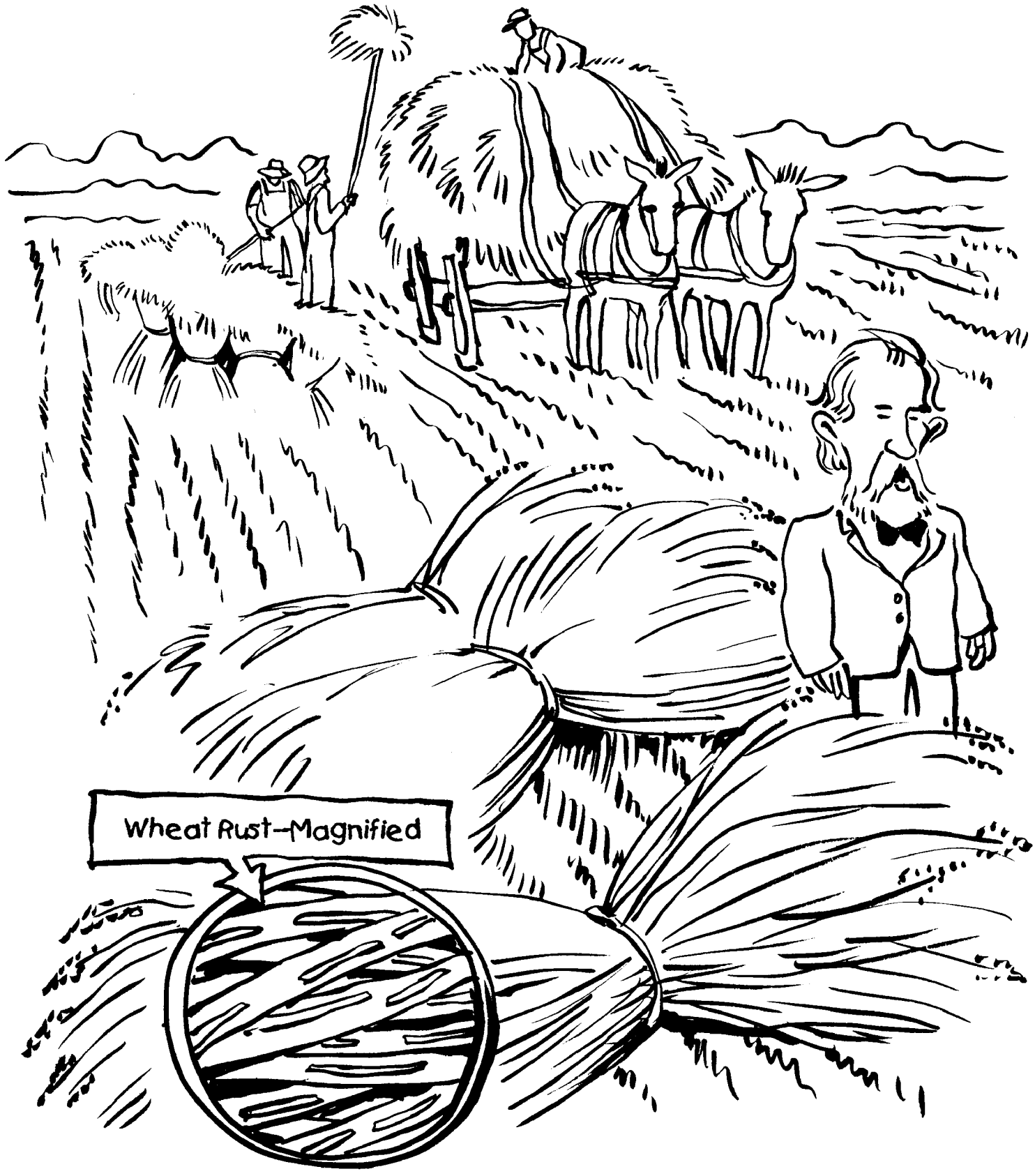
The fungus that causes blight is believed to have been imported from Asia to Europe to America.



coffee rust

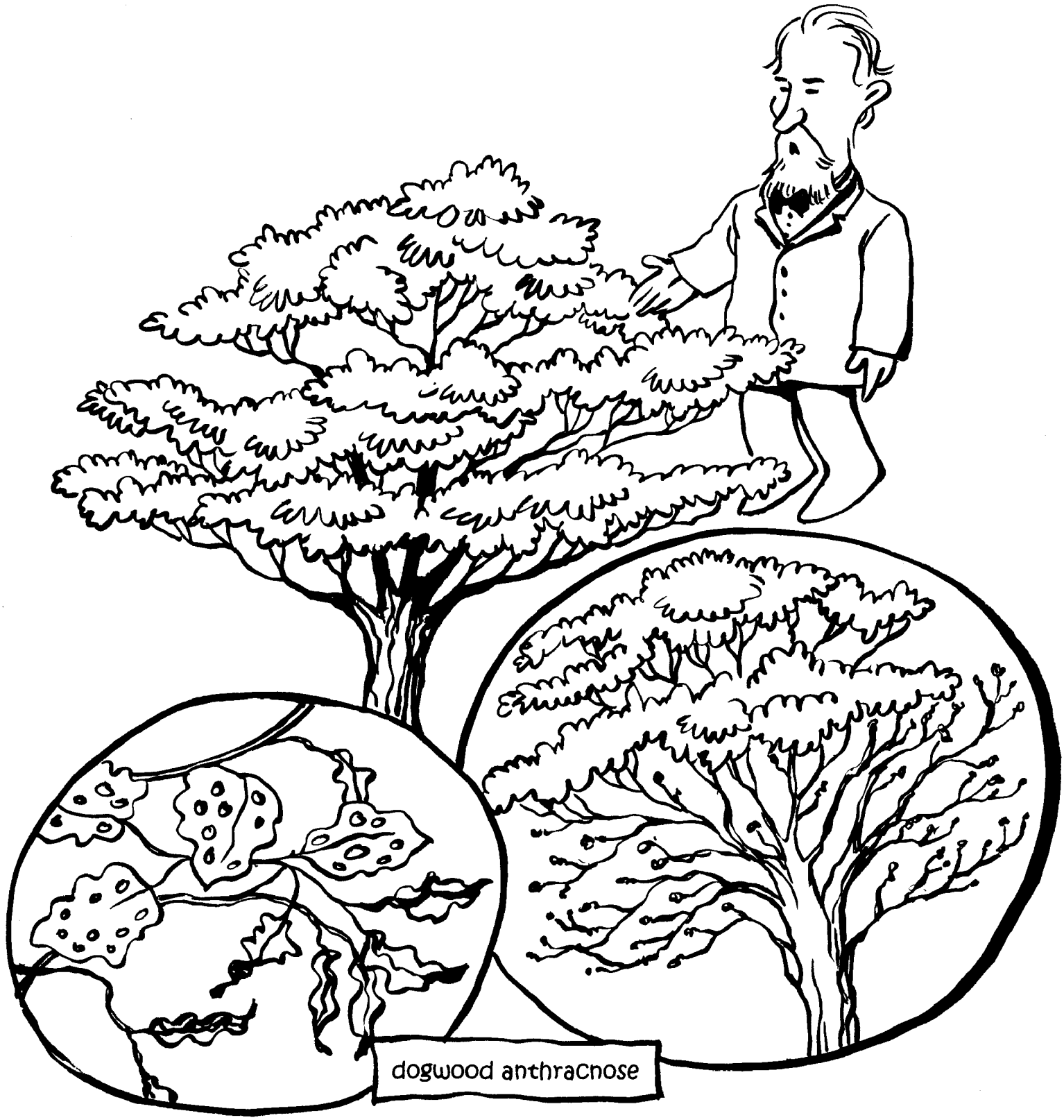
Coffee has been a popular beverage in Europe since the 1600's. In the 1800's, the fungal disease "coffee rust" devastated the British coffee plantations in Ceylon. Because of this, the British switched to growing and drinking tea.

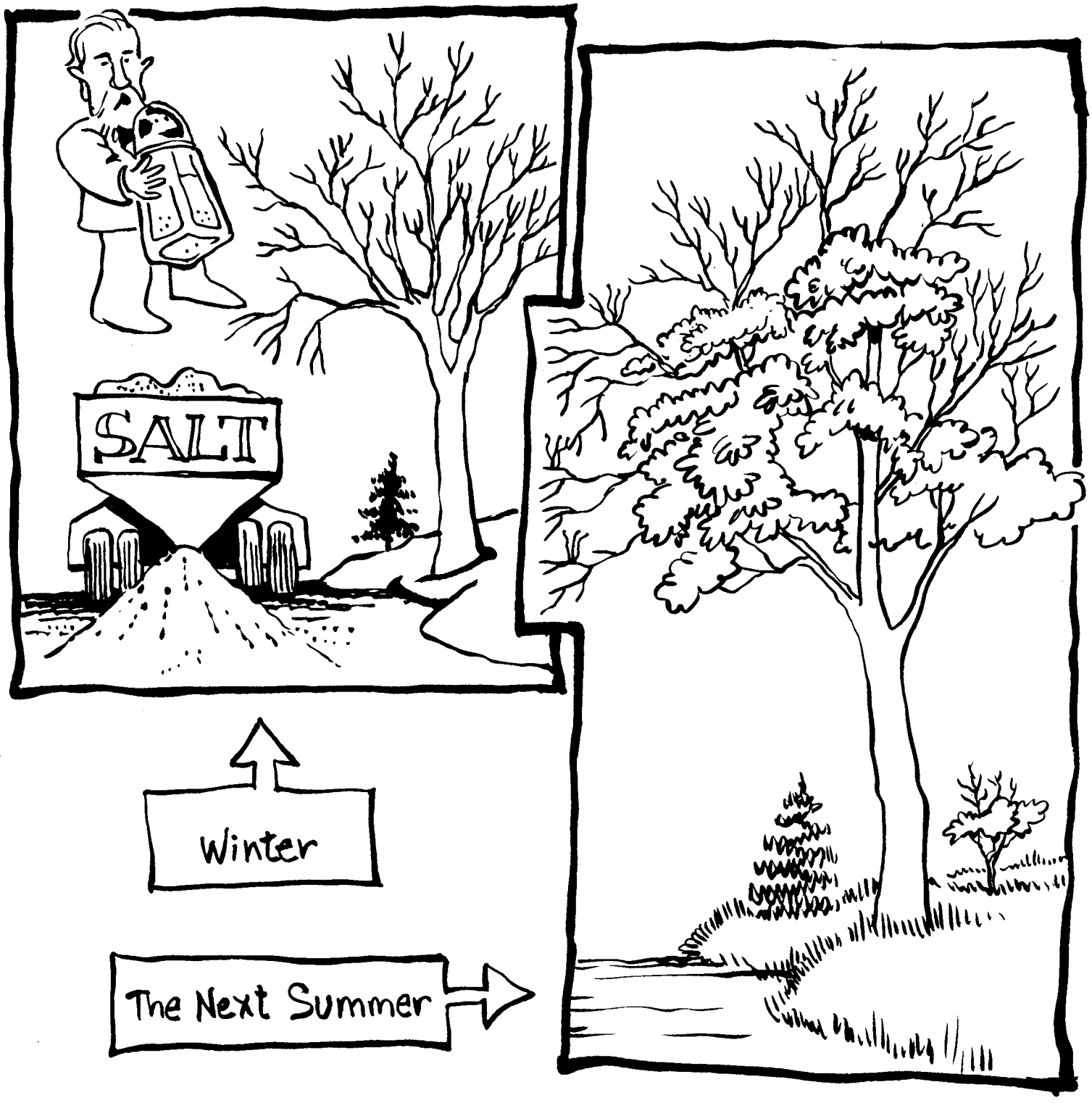
Known since Roman times, wheat rust continued to plague farmers even into the 20th century. During the 1920's, this rust nearly destroyed the entire wheat crop in the United states and Canada.



In 1970, a relatively unimportant disease called "southern corn leaf blight" suddenly became prevalent and completely destroyed the corn crop on many farms in the United States.

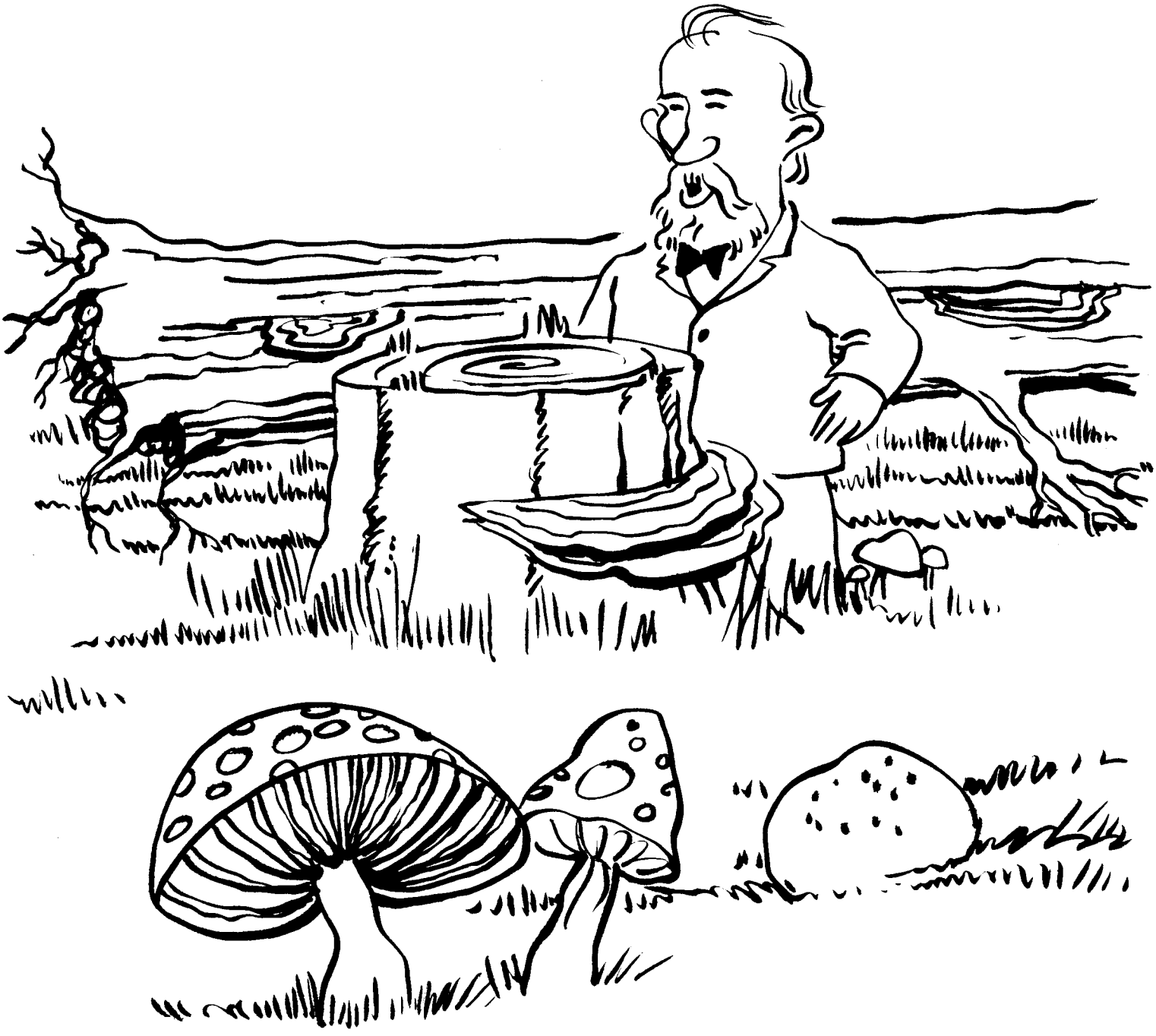
In the 1980's, a new disease called "dogwood anthracnose" quickly spread southward along the Appalachian mountains. At higher elevations, in some locations, almost every dogwood has been killed.



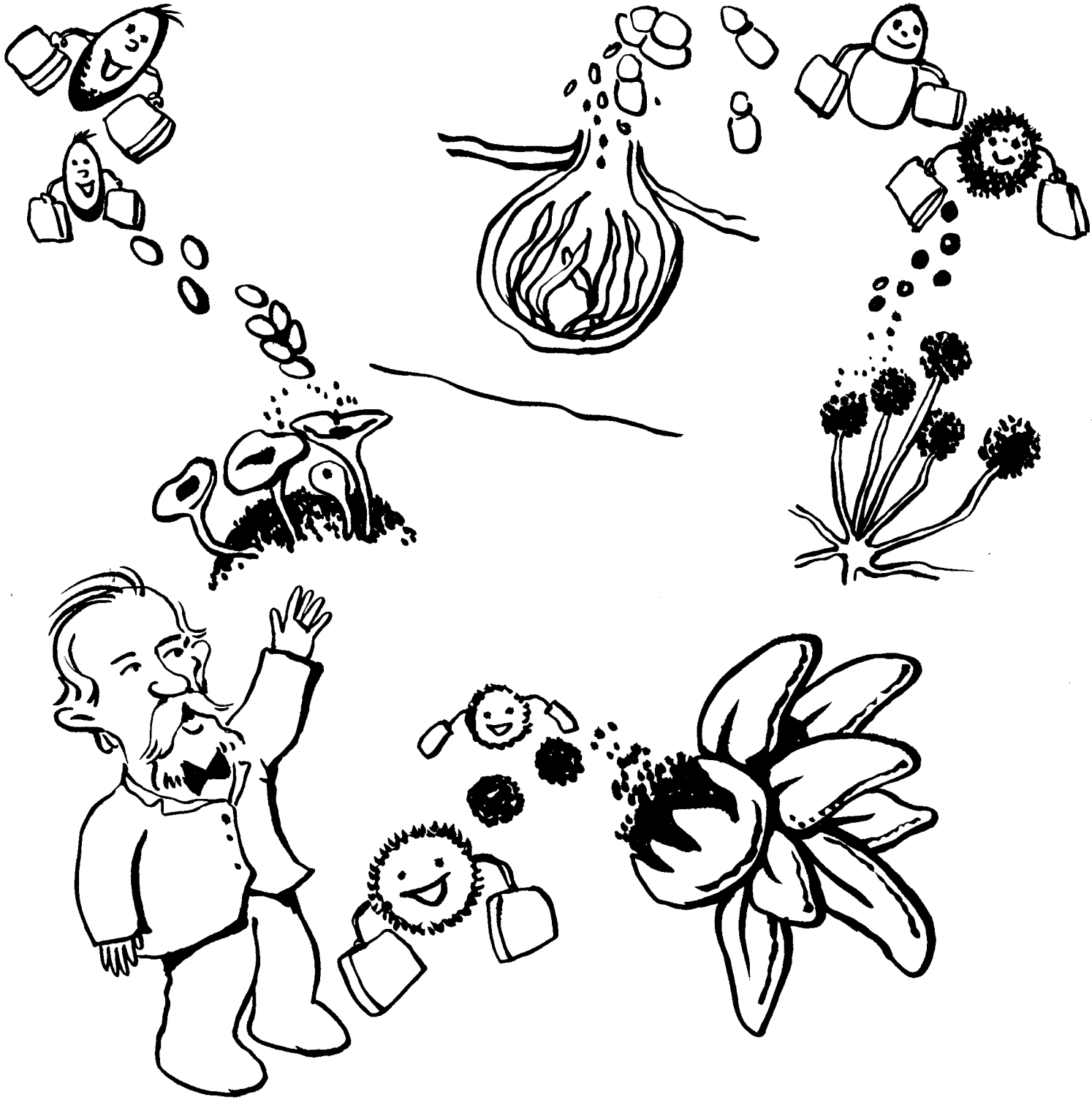


Plants and trees can be injured by many nonliving factors, such as severe weather, chemical spills, fire, or air pollution. The use of salt along roadsides in winter to control ice buildup may kill or injure nearby plants.

Most plant diseases are caused by fungi. Fungi can grow on dead, dying, or living plants.
Fungi have long, thread-like structures called hyphae; are usually microscopic in size; and reproduce by means of spores.



Large numbers of spores are produced.
Fungal spores are released and spread in many unique and specialized ways.



Fungi produce a wide variety of enzymes which can break down almost any organic substance and use it as food.

Bacteria are small, single-celled organisms some of which can cause plant diseases. Plant pathogenic bacteria do not produce spores. Bacteria may leak out of diseased plants in a sticky ooze. They are spread by splashing water and insects.

The Moko disease of banana is caused by bacteria.

Fireblight is a bacterial disease of apple and pear. The foliage appears as though scorched by fire, hence, the name. Fireblight prevents the culture of pears and apples in many areas.

Phytoplasmas are smaller than bacteria and don't have a protective cell wall. They are all obligate parasites and cause "yellows" symptoms or "witches' brooms" in some plant hosts. Lethal Yellowing of palms is a phytoplasma-caused disease which has killed most palms in southern Florida.

Plant diseases can also be caused by viruses. Viruses cause interesting color patterns and deformations on plants, including mosaics, ringspots, and crinkles.
Viral diseases lead to stunting and reduced productivity.
Plant viruses are very simple, consisting only of ribonucleic acid (the genetic information), surrounded by a protein coat for protection.

Many solanaceous plants such as tomato, potato, and pepper are common hosts for viruses.

In the late 1500's, tulips became very popular in western Europe. The most valuable flowers were those with streaks of contrasting colors. In some cases, these streaks resulted from infection with a virus, causing a disease known today as "tulip break".

Small, worm-like animals called "nematodes" can infect plants and cause disease. Stunting, wilting, yellowing, and lowered productivity are symptoms of nematode infections on roots.

Here a gardener is examining a tomato plant with a severe disease caused by the "root-knot nematode".

Parasitic flowering plants parasitize other plants, particularly trees. The leafy mistletoe was worshipped by ancient Europeans because it kept its green leaves in the winter.

The use of chemical control originated thousands of years ago.
In 2000 BC, grain farmers, having observed that emissions from nearby volcanoes protected their crops from diseases, applied sulfur as one of the earliest disease controls.
Sulfur is still used today against some diseases.

The development of reliable chemical controls for plant diseases began in the late 1800's with the discovery of Bordeaux mixture and its activity against downy mildew on grapevines.

In the days of wooden ships, rock salt was packed in the bilge to protect the wood from fungal decay.

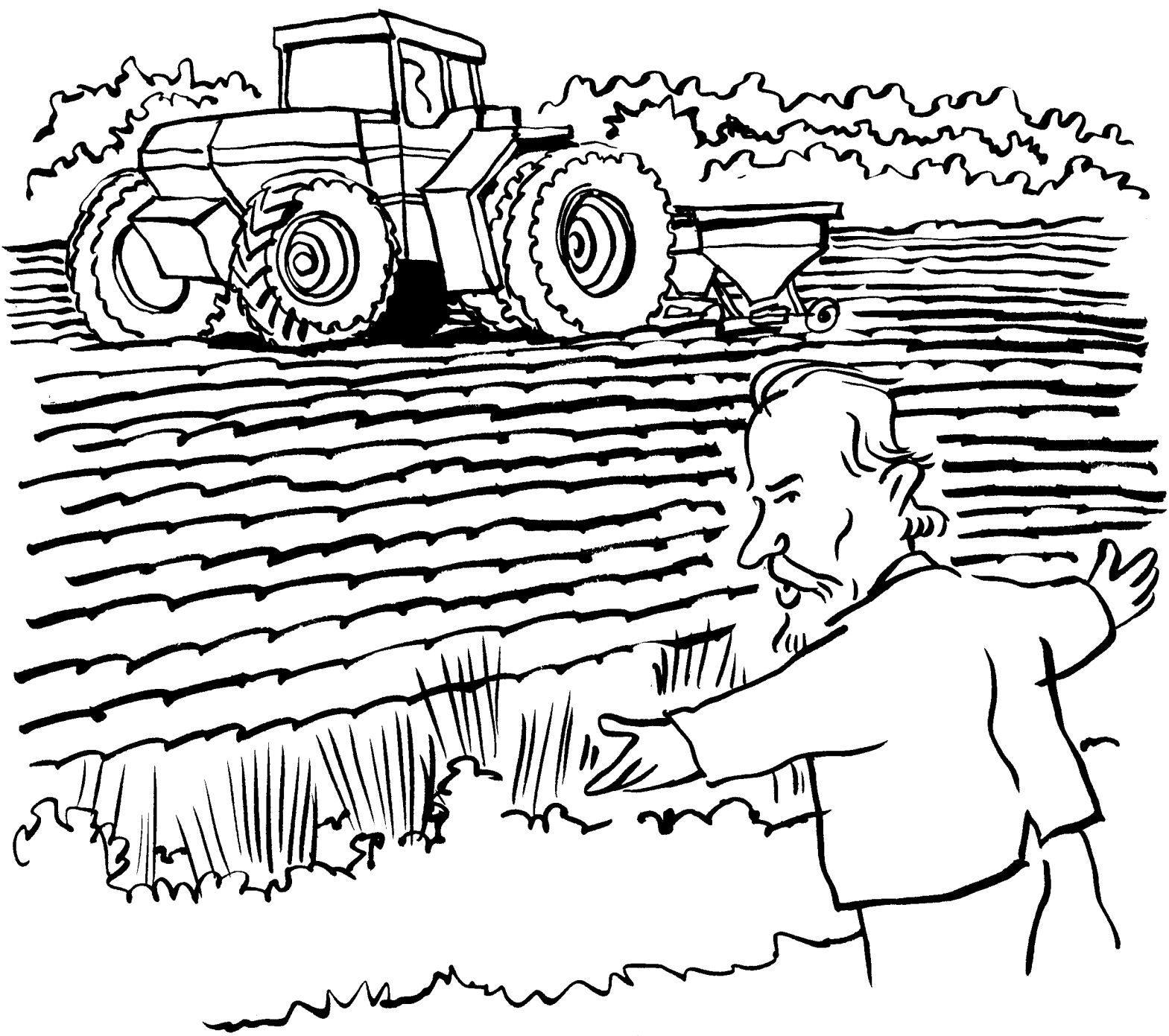
Eradication or elimination of the pathogen is a form of disease control.

In 1760, George Washington directed that wheat seed be soaked in hot water to eliminate wheat smut spores from the infected kernels.

Eradication also attempted unsuccessfully to control white pine blister rust. Currants and gooseberries (alternate hosts for the rust), were either dug out or killed with herbicides. Here a crew is digging out currant bushes and disposing of them.

Exclusion is another form of disease control. Exotic disease pests are excluded from new regions or countries. USDA quarantine officials and trained dogs check all incoming travelers and baggage for agricultural crops that might harbor plant pathogens.

Farmers control plant diseases by rotation of different crops that are susceptible to different diseases. Crop rotation lowers the risk of both plant infections and widespread epidemics.



Plant disease control is achieved for most major crops by developing genetic resistance. Here, plant breeders are artificially crossing corn plants which have desirable traits such as disease resistance.

Plant diseases can be controlled with biotechnology. Using molecular techniques to improve plants, a single gene can be removed from a microbe (such as a virus) and inserted into a host plant (such as cucumber) and the plant is rendered resistant to the virus.

Integrated pest management is the preferred method of controlling plant diseases. Not only does it optimize the use of chemical controls, it attempts to create cultural and growth conditions that hinder development of the disease.