

Tracking a Potato Killer: Using Latitude & Longitude to Map the United States spread of *P. infestans*

Objective/Problem: In this activity, you will use the scientific method in reading primary sources, as well as latitude and longitude coordinates to track the migration of *P. infestans* the pathogen that causes potato late blight. This pandemic resulted in the Great Famine of Ireland and massive potato crop failures in America in the mid to late 1840s. Using the map and data from the US Patent Reports, you will infer its route of transmission across time and space, 1843-1850.

THE POTATO DISEASE.

Boston Recorder (1830-1849); Oct 17, 1844; 29, 42; APS Online pg. 168

THE POTATO DISEASE.—An article in the Amherst, (Mass.) Express, supposed to be from the pen of Dr. Hitchcock, expresses the opinion that the failure of the potato crop this year, is the effect of disease. To prove this, he states that the tops failed first, and appeared as if they had endured a hard frost. And as it is in the leaves and stalks that the juices and other principles that nourish the roots and tubers, are prepared, if these fail, the potatoes must be stopped in their growth. They do not ripen, and are of course, liable to decay. He expresses doubt in regard to the cause of the disease, but thinks it must be something derived from the atmosphere, since it is so wide spread. He finds that in dry land they have suffered less than in moist or wet ground, and is confident that the season has been too wet for this crop. He also supposes it possible that the electric state of the atmosphere may have had something to do with the matter. With regard to the supposed poisonous quality of potatoes affected by this disease, he expresses the opinion that there is no peculiar virus in them that need excite a panic. There is no danger in eating them, provided they are well cooked, and those that are water-soaked are rejected.—Chr. Secretary.

Observations: Read the following passages from primary sources. As you read, record your observations from the articles. The first article appeared in the *Boston Recorder* on October 17, 1844 and the second article from the *New England Farmer* on September 21, 1844.

What were the symptoms of the “late blight?” Why did they think that this was a “new disease?” How did they think it spread? What evidence is given from the passage? In what geographic locations was late blight appearing? How do you think that is related to the outbreaks from Europe?

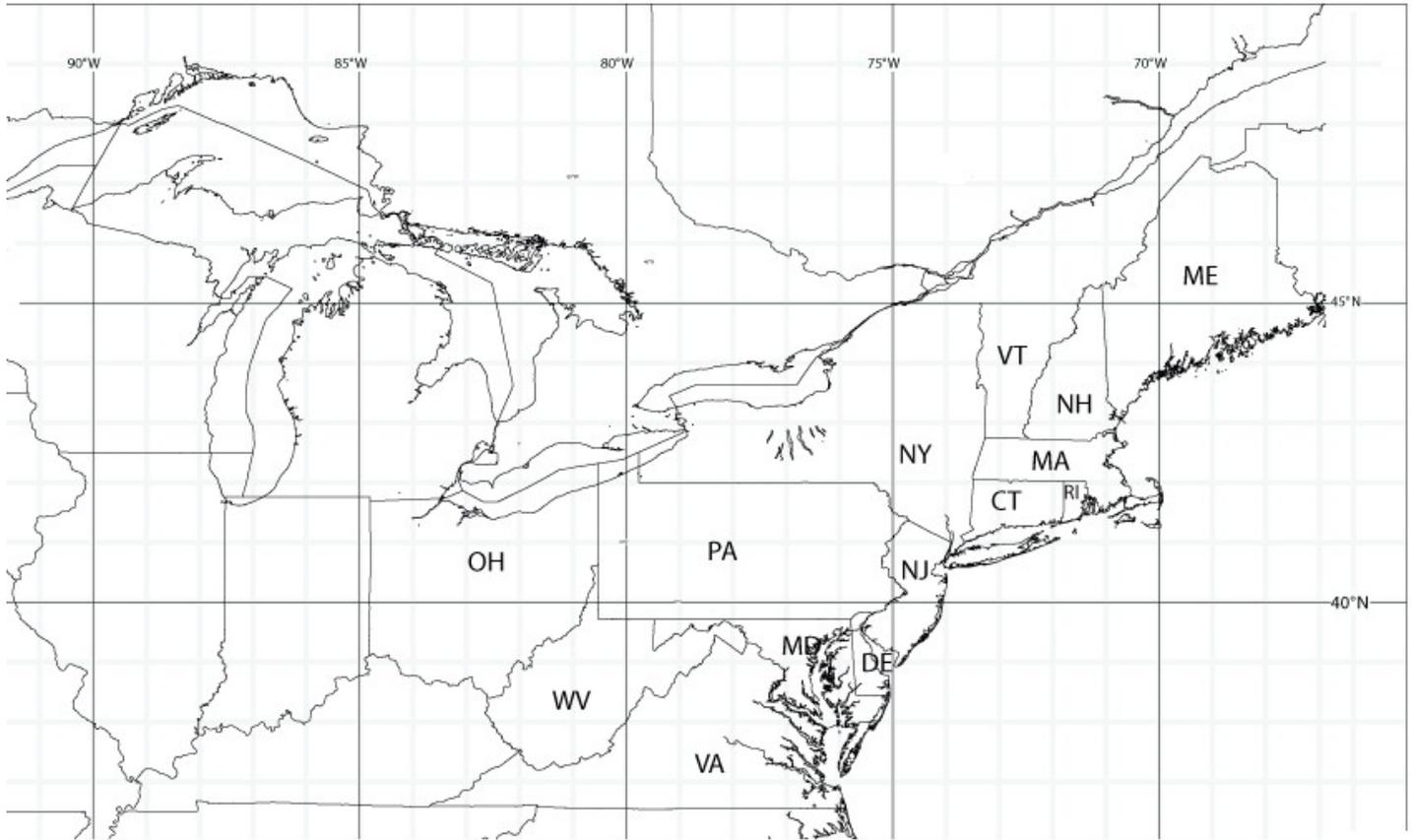
Hypothesis: Create a hypothesis about the type of disease and migration that caused the pathogen to spread across potato crops in the United States. Put your response in an “if...then” format.

Materials: Seven different colored pencils, Lab Sheet with US map, analysis and conclusion questions.

From the *New England Farmer*, Oct. 21
THE ROT IN POTATOES.
Mr. BRECK—In your paper of the 18th inst. you have a line saying “The rot in potatoes is again noticed in New York.” I am sorry to say the same misfortune has befallen the potato crop in all this section of the country. It is but a week or ten days since it was discovered; and some farmers immediately commenced digging and storing them in their cellars; but decomposition was apparently much more rapid after they were taken from the ground, attended with a most offensive smell, and they have been taken from the cellars and buried in the ground. It is said in some instances where they have been fed to cattle and hogs, it has caused their death. It is now generally thought best to let them remain in the ground till the weather shall have become colder.
There are, of course, many conjectures and guesses about the cause of the rot. Many suppose it is in consequence of the dry and unusually warm weather, we have had for several weeks past. But why should they have rotted so badly in western New York last year and this, and we suffered none last year? Probably this disease is one of those mysterious operations of nature that are continually at work, in some form or other, in the animal and vegetable creation, and it presents to man one of those hidden mysteries that he cannot unravel. Some years, the wheat in large sections

is

Data: Use the data points shown in the table below, plot the spread of potato blight over the period of 1843 to 1850. Create a Chloropleth map, using colored pencils in the order of Red, Orange, Yellow, Green, Blue, Indigo and Violet.



Year	Notes from the US Patent Reports	Confirmed Cases: Coordinates
1843 (Red)	First Mention of potato disease is reported mainly in the New York and Pennsylvania.	39.5°N 75.5°W, 40.5°N 74°W, 42°N 78°W, 42°N 75°W, 42°N 80°W, 43°N 72°W, 41°N 75°W, 40°N 76°W
1844 (Orange)	Failures continue and spread. Has extended no more than 45°N to 37°N. New York state and Massachusetts are devastated as well as most of New England. Some states seem to escape the potato rot namely Maine, Indiana, Illinois, Michigan and Wisconsin.	45°N 73°W, 42°N 73°W, 43°N 72°W, 43°N 79°W, 43°N 75°W, 43°N 76°W, 42°N 79°W, 41°N 74°W, 44°N 73°W, 41°N 81°W, 41°N 77°W, 40°N 80°W
1845 (Yellow)	Western New York reports more potato crop failures and is now reported in new areas such as Ohio, Indiana and Michigan.	44°N 69°W, 45°N 67°W, 42°N 73°W, 41.5°N 71°W, 42°N 74°W, 41°N 74°W, 40°N 76°W, 40°N 75°W, 41°N 75°W, 39°N 83°W, 41°N 88°W, 42°N 86°W, 42°N 87°W
1846 (None)	According to Patent Reports, a massive drought caused a crop failure, but is not contributed to the potato disease.	<i>No data for this year.</i>
1847 (Green)	Maine has found to be a total loss as is NY, NH, OH, and VT. In MD, NJ and PA the rot has moved into new areas as well as moved to new states: Iowa and Virginia.	42°N 76°W, 42°N 77°W, 39°N 75°W, 42°N 91°W, 42°N 85°W, 42°N 88°W, 37°N 76°W, 41°N 81°W, 39°N 83°W, 42°N 83°W, 43°N 71°W
1848 (Blue)	The Northwest and Central states report more rot than before (OH, MI, WI, IA, ID, and IL) whereas in NJ, MA and CT report fewer cases. Rot has spread west in NY.	40°N 82°W, 42°N 83°W, 42°N 88°W, 41°N 90°W, 41°N 87°W, 43°N 77°W, 43°N 79°W
1849 (Indigo)	Maine has rebounded since last year and in NH the rot is lessening. MA and VT report no rot for this year. However, cases have been spotted in RI near the sea and in IL.	41°N 88°W, 41°N 89°W, 41.5°N 71.5°W, 41°N 75°W, 40°N 75°W,
1850 (Violet)	PA reports the largest case of the rot since 1846 with outbreaks in NH, MA and all over RI. It has abated in Maine and continues to plague New York State.	44°N 72°W, 42°N 84°W, 42°N 73°W, 42°N 77°W, 41°N 74°W, 42°N 73°W, 42°N 71°W, 40°N 75°W, 40°N 74°W, 42°N 70°W, 43°N 71°W,

Note: Some data points may appear twice and use the information with the data points to determine your answers.

Analysis & Conclusions: Using your data, please answer the following questions.

1. Based upon your data, where was the point of origin for the potato blight? What about this particular area would have made this area the epicenter for this plant epidemic?

2. What type of migration pattern does this pathogen display? (Is it hierarchical, contagious, or migrant diffusion?) How do you think that this type of pathogen spread across space and time in the United States?

HINT: Could it have followed more than one type of diffusion pattern?

POTATOES.—The Tabular View shows, that in quite a number of States the amount of potatoes raised is very great. New York, Maine, Pennsylvania, Vermont, New Hampshire, Ohio, Massachusetts, and Connecticut, are the great potato-growing States; more than two-thirds of the whole crop are raised by these States. Two kinds, the common Irish and the sweet potato, as they are called, with the numerous varieties, are embraced in our Agricultural Statistics. When it is recollected that this product of our soil forms a principal article of vegetable food among so large a class of our population, its value will at once be seen. The best common or Irish potatoes, as an article of food for the table, are produced in the higher northern latitudes of our country, as they seem to require a colder and moister soil than corn and the grains generally. It is on their peculiar adaptation in this respect, that Ireland, Nova Scotia, and parts of Canada, are so peculiarly successful in the raising and perfecting of the common or Irish potatoes. It is estimated that, in Great Britain, an acre of potatoes will feed more than double the number of individuals than can be fed from an acre of wheat. It is also asserted that, whenever the laboring class is mainly dependent on potatoes, wages will be reduced to a minimum. If this be true, the advantage of our laboring classes over those of Great Britain, in this respect, is very great. The failure of a crop of potatoes, too, where it is so much the main dependence, must produce great distress and starvation. Such is now the case in Ireland and parts of England and Scotland. Another disadvantage of relying on this crop as

3. Was your hypothesis supported or rejected? Why or why not?

4. Based upon what you know about the disease, what effects do farmer practices have on disease spread?

5. This is a passage from the 1841 US Patent Reports (page 72). Based upon what

you have read here and your map, what relationship(s) can you determine between the growing conditions for potatoes and the geographic effects of the spread of a fungus-like pathogen? (E.g. How has this additional information helped you to understand disease spread?)