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Was This Tree Struck By Lightening?

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Lightning strikes a lot of trees each year and usually kills them. When several million volts of electricity charge through the air in the form of lightning, it follows the path of least resistance to the ground, often through the bark of a tree and the sap in the bark is subjected to extreme temperature…….. Whether a tree burns when struck by lightning depends on a variety of factors, such as the moisture content of the bark, foliage on the branches and which part of the tree lightning strikes.

In March/April, 2019, I (Arun) spent six weeks visiting my daughter's (Anita) family in Issaquah, a suburb of Seattle, in the state of Washington, USA (Figure 1). During those days we visited Interlake High School in Bellevue, another suburb of Seattle, (Figures 1 and 2) every Saturday to pick up Diya (Anita's daughter) who attended Gurukul, a school that teaches Indian languages to young children. Diya, eight years old studies Hindi in this school. The school is surrounded by a temperate rain forest dominated by coniferous evergreen trees. In front of the school we observed a strange looking tree; we identified it as Pacific Madrone whose botanical name is *Arbutus menziesii* Pursh of plant family Ericaceae (Figure 3). This tree is a native of the Pacific Northwest of the USA and Canada (website 1).

The description of Pacific Madrone is provided in website 2 as "a broadleaved, sclerophyllous, evergreen tree, heights range from 5 to 40 m, with diameters up to 0.6-1 m. Single or multiple curved trunks support a broad, spreading crown composed of heavy, irregularly-shaped limbs. The bark is freely exfoliating, peeling off in large, thin scales. Once the outer bark is shed, the remaining bark has a smooth, polished appearance and a distinctive reddish color. Color of young bark varies widely but darkens to a deep red with age; younger stems may range from green to chartreuse, while young trunks are frequently orange. Older portions of the bark become dark, brownish-red in color and are fissured. The glossy, leathery leaves are arranged alternately on the stem."

As we write this article in late June, 2019, the summer season has begun in the northern hemisphere of our planet. Almost every day there are news bulletins from different parts of the world about drought conditions, severe heat wave and heat related deseases and deaths, water shortages and people fighting for water and forest fires, etc. Most of these problems are partly natural and partly man-made. Unabated and irresponsible human intervention in Earth's environment leads to such catastrophic events causing serious social and political problems globally.

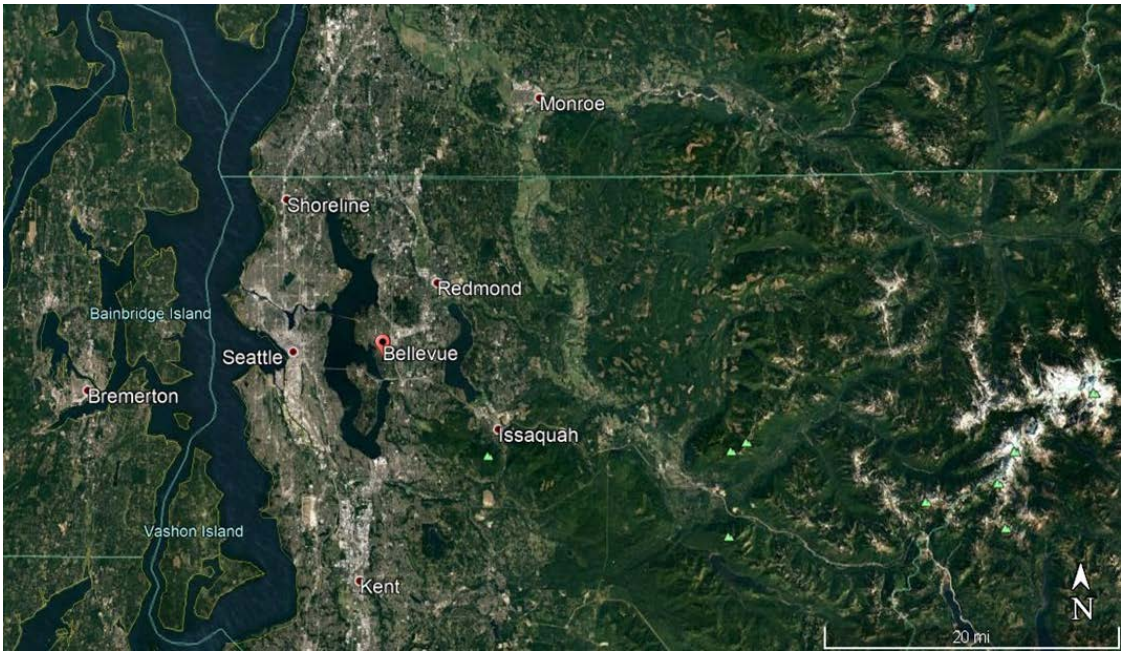

Figure 1: Topographic map of northwestern part of the Washington State, USA showing locations of Seattle, Bellevue, Issaquah and other towns of the region (Google Earth image downladed on June 20, 2019).

Figure 2: The campus of Interlake High School in Bellevue, Washington. Red star shows location of the tree (Google Earth image downladed on June 20, 2019).

Among all the problems that arise during summer, forest fires are very serious and caused by natural processes and human activities. Lighting during thunderstorms are a major cause of

forest fires (Demillo, 1994). In this article we examine what happens to a tree when it is hit by lighting. The Pacific Madrone tree on the campus of Interlake School provides certain clues on this subject.

The Pacific Madrone tree near Interlake High School

This Pacific madrone tree is surrounded by Cedar trees in the area surrounding the Interlake High School in Bellevue (Figure 3). It is about 20 to 25 m high with a curved trunk of 70 to 80 cm diameter having a profusely branched crown with fewer leaves (Figures 5 C and D). We observed a few other trees of the same species around this school, but this particular tree has few peculiar features not seen on other trees. A truly remarkable feature is that one side of the trunk has no or very little dead bark; that too is only at the base. The dead bark is almost totally peeled off on one side whereas the other side of the trunk is full of the dead bark showing absolutely no sign of peeling. A straight line clearly demarcates this division (Figures 4 A, B and C). Base of the stem is damaged on the side of the peeled dead bark exposing a cambium layer of the trunk (Figure 4 D). There is a distinct patch of burnt dead bark on the stem (Figures 5 A and B) and canopy of the tree also shows burnt branches and very few leaves (Figures 3, 5 C and D). The above mentioned features need an explanation about their possible origin.

After pondering over various options we think that this tree was hit by lightning in the recent past, probably no more than a few decades back. We do not have any documentary proof about our conclusion thus our suggestion is only tentative.

What happens when lightning strikes a tree ?

Lightning strikes a lot of trees each year and usually kills them. When several million volts of electricity charge through the air in the form of lightning, it follows the path of least resistance to the ground, often through the bark of a tree and the sap in the bark is subjected to extreme temperature; this temperature is many times hotter than the surface of the Sun due to electrical resistance which causes the sap to be heated into steam which can explode. This is why some trees violently explode when struck by lightning (website 3).

During rainfall trees are soaked with water as is the case during a thunderstorm. The lightning may cause relatively little damage to a tree, because the electricity would be conducted through the outer soaked layer of the tree, rather than affecting the inner bark. Whether a tree burns when struck by lightning depends on a variety of factors, such as the moisture content of the bark, foliage on the branches and which part of the tree lightning strikes. When a tree catches fire it may burn to the ground or just remain partially damaged (website 3).

When lightning strikes a tree it can bend and bounce back, which cracks the bark and breaks branches. In the case of multiple shock waves, more splitting may be noticeable. Immense heat steams water inside the tree that busts bark from the trunk and branches and can even split a tree open. Most trees struck by lightning show damage, some die within days; others make full recovery. If they survive, these trees remain stressed and prone to problems such as pest infestations while they recover. Lightning strike interrupts a tree's water distribution process

causing its leaves to wilt. Wilting leaves are usually the first noticeable symptom of lightning damage. Sometimes the decline of a branch is gradual and leaves wilt over time without new foliage to replace them, while pests often infest the weakened branches. Sometimes lightning destroys tree roots with no obvious symptoms of lightning damage above the ground. This causes leaf wilt, which often kills the tree in just a few days. However, some trees recover from root damage as long as they are able to produce new leaves in the spring (website 4).

Figure 3: The Pacific Madrone is a deciduous tree surrounded by evergreen trees showing the damaged base of the stem caused by destruction of live bark exposing cambium layer (white) of the trunk. Notice the clear line separating no dead bark on one side (yellowish side) and undisturbed dead bark on the other side (brown side) of the stem. (Photo: The author, April, 2019).

Figure 4: Features of the stem. A. A sharp line dividing the stem with one side with dead bark intact (brown side) and other side without layer of dead bark (yellowish side). B. A close-up of the stem showing the divide. C. The brown side of the stem showing the dead bark. D. Damaged base of the stem caused by destruction of live bark exposing cambium layer (white) of the trunk. (All photos; the author April, 2019).

The descriptions about a tree struck by lightning in websites 3 and 4 are clearly visible in the Pacific Madrone tree of the Interlake High School in Bellevue; for example, removal of bark, bending of tree, wilting of leaves and branches on the canopy, damaged stems, burn marks on stem, etc. These are the reasons we suggest this tree was struck by lightning.

Figure 5: A and B. A patch of burnt dead bark on the stem. C and D. Canopy of the tree showing burnt branches and very few leaves. (All photos; the author April, 2019).

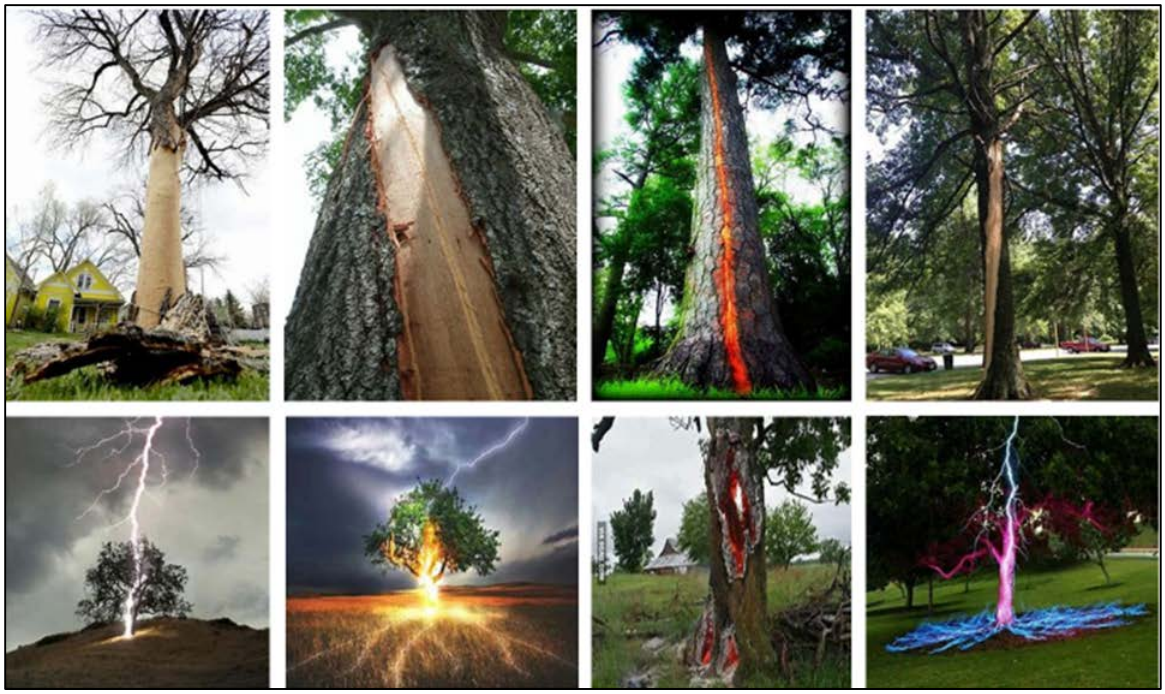

Figure 6: Photographs showing impact of lightening on trees, mainly on stem bark. (https://www.bing.com/images/search?q=lightning+strikes+on+trees&qpvt=lightning+strikes+on+trees&FORM=IGRE)

Forest fires caused by lightening

"Lightning is an extremely large electrical static discharge that raises the local temperature to around 54,000 degrees F (30,000 degrees C). This is hot enough to fuse sand into glass, let alone ignite ordinary flammable fuels such as trees and houses made of wood. A single "dry lightning" storm could start several hundred fires, most of which naturally burn themselves out quietly" (website 5). Fulgurite is a unique mineral formed by impact of lightning on sand or sandstone (Kumar, 2012).

According to website 6 *"It has been estimated that lightning strikes the earth about 100 times in a second, and is responsible for causing almost 12% of the total forest fires in the United States. Forest fires are usually caused by dry lightning or lightning not accompanied by rain."* Further *"Forest fires damage trees and affect climate and weather by increasing the level of greenhouse gases (water vapor, carbon dioxide, methane, nitrous oxide, ozone, and chlorofluorocarbons) thus increasing pollution and global warming."* (website 6).

Based on the description of the Pacific Madrone tree on the campus of Interlake High School in Bellevue and our current knowledge of the impact of lightning on trees, we suggest that this tree was hit by lighting not long ago. However, we do not have any documentary evidence to prove it.

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Website 1: Native Trees of the Pacific Northwest: A Geographic Guide https://www.arcgis.com/apps/MapJournal/index.html?appid=d3295191730a49f691379d7962b20bb0
Website 2: https://www.fs.fed.us/database/feis/plants/tree/arbmen/all.html
Website 3: https://www.scienceabc.com/nature/tree-struck-by-lightning.html
Website 4: https://homeguides.sfgate.com/tree-damage-lightning-strike-71409.html
Website 5. https://www.answers.com/Q/How_does_lightning_cause_forest_fires
Website 6. https://sciencestruck.com/what-causes-forest-fires

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Ms. Anita Maisuria is a Software Development Manager at Dell EMC. She was born in Sheffield, U.K. and did her schooling in Lucknow, Dehradun and Ottawa. She earned her B.Sc. (Electrical Engineering) from the University of Toronto. An engineer by profession, she also has keen interest in life and environmental sciences, a passion she inherited from her father, Dr. Arun Kumar. Anita lives with her husband Paresh and two kids, Diya and Kavi, in Seattle, Washington, USA. Living in Seattle she gets ample opportunities to explore and enjoy the natural beauty of the Pacific Northwest.