Wisconsin School of the Air
Afield with Ranger Mac
October 16, 1939

HOW LEAVES CHANGE COLOR

Hello Boys and Girls;

This is your day-

So, up and away!

The old Indians had an explanation for most every miracle or wonder in nature... such as the change of seasons, Northern Lights, thunder and lightning, the color in flowers, the source of winds. These explanations make up an Indian lore that is interesting reading. In Hiawatha, Longfellow gives us an explanation of the Four Winds. You know that Longfellow visited the Chippewa Indians living in the land south of Gitche Gumee, and there gathered material for the poem Hiawatha. Well, as the story goes, Mud-je-kee-wis was given dominion over the winds of the heavens. For himself he kept the West Wind.

"Gave the others to his children,
Unto Wabun gave the East Wind,
Gave the South to Sha-won-da-see
And the North Wind, wild and cruel,
To the fierce Kab-i-be-nok-ka.

and about Kabibonokka he wrote;

"But the fierce Kabibonokka
Had his dwelling among the icebergs
In the everlasting snow-drifts
In the kingdom of Wabasso
In the land of White Rabbit.
He it was whose hand in autumn
Painted all the trees with scarlet
Stained the leaves with red and yellow- "

And that brings us to the trail we take to-day-- a trail all trimmed with leaves of red and yellow, the autumn trail, painted by the hand of Kabibonokka, according to the Indian legend, because this his hand and will brought the frosts. Most people believe that frost causes the coloring in leaves. This is not so. Frosts may help some; frost hastens the falling of the leaves, but we always have the most beautiful leaf coloring when frosts hold off in the fall. Frosts that come too early spoil autumn's leaf decoration entirely. Dry weather and the declining sun cause the green coloring matter in the leaf - the chlorophyll to break up and disappear. After this has taken place, the other coloring matter, the other pigments that are always present

in the leaf, show up and we have the colorful scene that is a good bye to summer.

We are going to learn about leaves on our trip afield this morning. The leaves are the food manufacturing part of the tree, and of every plant. The leaves are the tree's kitchen, that feeds the rest of the tree. All through spring and summer these leaves work. They drink in the sun's vital rays, send this life-giving vitality to the roots and to every part of the tree. I like to think of a tree as sunlight made solid. Let's see what happens in the leaf.

During the growing season the water that is taken in by the roots is forced up through the cells of the wood to the leaves. Then, on the underside of the leaf are thousands of little openings called stomata. You can remember the name because it sounds like stomach. The singular form is stoma, which means mouth. There are many 100s of 1000s of them on the underside of an oak leaf of ordinary size. These little openings can be seen plainly with the aid of a microscope. Through these openings a gas passes, the gas we give off when we breathe; or the gas given off when wood burns, or when things decompose. It is called carbon dioxide; CO_2 gas, the boys call it in Chemistry. It is a waste gas from our bodies, but it is food for trees and all vegetation. If nature had not made this provision or some other provision to use up this gas, the earth would soon be covered with it, and we could not live. If you sleep with your windows closed tight at night, this gas from your breathing renders the air impure and in the morning your head feels thick, and you cannot solve your arithmetic problems very well, nor follow Ranger Mac on his trips afield. This CO_2 gas enters the leaf through the stomata and there it is changed by chlorophyll to a starch and other carbon compounds; and oxygen is given off by the leaf into the air. In this way the plant uses what we discard and gives off as a waste product what we need in order to live. The word chlorophyll sounds hard, but it isn't. This is the way to spell it C H L O R O P H Y L L. Let's all say it together. Ready - chlorophyll. When you learn that <u>chloro</u> in Greek means <u>green</u>; <u>phyll</u> means <u>leaf</u>; then you are sure not to forget it. That word is so important in our life that we should know it as well as bread or cake. It gives the green coloring matter to the leaf. But it must have the sun to keep it green and at work. Did you ever remove a board that had been

lying in grass for sometime a nd notice how yellowish the grass was? The chlorophyll was fast breaking up. In a little while the grass would die. If you have a broad leaf plant in your school room, have your teacher paste a small piece of cloth somewhere on one of the leaves. Then place in the sunshine and after a couple of days remove the patch and what do you think you will find beneath? That's right - a white or yellowish patch just where the cloth covered. If you could analyze that patch, you would find that there is little or no starch there. The chlorophyll catches the light from the sun and in some way, that even our smartest man can't solve, changes the CO_2 gas into a starch which later is changed to sugar and is carried back by the water that comes up thru the sapwood from the roots, through the veins of the leaf, thru the stem of the leaf, into the tree, down the inner bark of the tree and furnishes the food for the growth of the tree. It is really a two way traffic. In early summer the leaves work especially hard, and build up the tree so fast that we get a spongy ring in the trunks all full of little holes, called summer wood. All boys and girls know about the rings in the trunk of a tree and how the age of a tree can be told by counting these rings of summer wood.

Are you following Ranger Mac? Don't lag behind because we are just part way on our journey.

Before summer merges into autumn something is starting to happen. Right where the stem of the leaf is attached to the twig a thin layer of what is really dry cork begins to grow on all sides of the leaf stalk. By the time the first frost comes, that layer has grown completely across the place where the leaf is attached to the twig. The leaf is now cut off from the tree it nourished. Only a few dried up strings hold it on. These strings were the tubes or ducts that carried the water to the leaf and the food which the leaf manufactured back to the tree. The attachment is not strong, except in some oaks, and the first gust of wind may sever the connection and the leaf falls. In the case of some of the oaks these ducts form rather strong attachments and the leaves stay on into the spring when new growth pushes them off.

This is a wonderful operation Nature performs. You can see that she heals the wound before the operation is performed. The scar that is left is very interesting.

It is called a leaf scar. Some of them look like horseshoes, some like shields that men carried in older days when they fought with spears; some like faces, some like monkey-faces. Each kind of tree has its own peculiar leaf scar, so that any interested boy or girl can learn to tell an oak, or poplar, or elm or maple by its leaf scar. Do you know what would be a fine thing to do? Bring to school five or six twigs from as many different trees and draw enlarged leaf scars in your scrap book and then name them. The prominent marks or spots you find on each scar are the places where the tubes or ducts were that extend into the leaf. Most people don't know that these scars exist, but you do; and now you know how they come to be, and how thoughtfully nature healed the wound before she performed the operation of casting off the leaf. While you are collecting the twigs, why not select the most beautiful leaf you can find for your scrap book?

But our journey is not complete until we learn what takes place in the leaf to give it color. I saw a picture that explains it one way. In this picture a little elf sat on a twig painting a leaf. Maybe there are lots of elves helping him out, otherwise he would have a task greater than that of Santa Claus; and I thought Santa's job was the biggest and best in the world. You can accept this explanation if you choose. But the real elfin is that corky layer that shuts off the action of the leaf. It is in reality the little elfin. It closes up that little food factory; but the leaf is loyal to the end, and most of the foods that it contains ebb back into the tree, until the leaf gives back all that is worth saving before it closes up shop completely. It is something like a man who just before dying passes what he has left to his children.

Experiments conducted by scientists show this is true about the leaf. When a leaf about to turn yellow is taken from a tree and put in a moist place, it remains green until it decomposes while a companion leaf left on the tree turns yellow! Then these scientists analyzed the two leaves and found that the leaf on the tree had given up nitrogen, potassium, and other food elements of value to the tree.

You have noticed that the leaf has a great structure running all through it, just like the blood vessels in our own bodies. It is a pretty object...this mesh work without the fleshy part of the leaf. Worms sometime cast out the fleshy part and

leave just the network. Well, these scientists took a leaf while still green and severed a vein connecting a corner. That corner stayed green, while the rest of the leaf turned yellow. What I want you to see is that the leaf even in dying given up food values. Then the chlorophyll breaks up and the remaining carbon compounds with some minerals mixed in start to decay and we have that glorious spectable which no hand can reproduce and poets write about.

When the goldenrod has faded
When the maple's leaves are red
When the empty nest is clinging
To the branches overhead;
In the silence and the shadow
Of the hurrying later fall
Come the crisp days, the colorful days;
Days we love the best of all.

It isn't known, for sure, where the robins and other birds get the coloring for their eggs, but it quite well known where the coloring of the leaves in the fall comes from. Each kind of tree has different pigments for its leaves; pigment is nothing else than coloring matter; the same kind that makes the flower yellow or purple. In the growing season the green coloring matter, the chlorophyll, increases under the influence of the sun so that the green is the conspicuous color and hides all other colors. But when the sun's rays grow less intense and the leaf ceases in its activity, the chlorophyll breaks down and the other pigments show up. If the yellow pigment is most prominent than we get the bright yellow as in the walnut, aspens, birch and poplars. If the red pigment is strongest, then red is the outstanding color as in the red, white and pin oaks. And so we get orange shades in the red and sugar maples, the horn bean and scrub oaks; and brown in the elm and ashes.

And that is the way nature makes her annual art display in the autumn wood, and so the millions of leaves that the wind scatter about have done their work for another year. They have added height and diameter to the tree, they have helped free the air from much carbon dioxide, they have given millions of gallons of moisture to the air; they have formed a canopy under which man and

beasts have found shelter from sun and rain, and they have been a hiding place for birds and their nests. But even in death they have a part to play. Rains, snow and sun will slowly reduce them to a rich leaf mold, that will become a part of the soil, and furnish food for other plants. Oh! how important leaves are!

Now, our little journey for today is almost ended. The clock keeps ticking on and tick by tick the spring of the year turns to the summer and summer to fall; and tick by tick babyhood into childhood, childhood into boyhood and girlhood, then to manhood and womanhood, followed by old age when the hair turns white and time leaves its trace upon the face. And so it goes generation after generation; and so it will go with you, my trailhitter - the passing of time is a compulsion of life. But if you see the beauty and purpose and learn a little about the whole of nature's scheme and how she performs, time will add theme upon theme, beauty upon beauty, riches upon riches, and each passing year will be fuller than the last. So today we learned that trees grow because of their leaves; and after these leaves have accomplished their work how they sing their florious song of farewell, like the Vikkings of old, who when they were ready to die set sail in their flaming ships - glorious to the very end.