

# Proceedings of the Iowa Academy of Science

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Volume 23 | Annual Issue

Article 51

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1916

## How a Tree Grows

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### Recommended Citation

Berninghausen, Fred (1916) "How a Tree Grows," *Proceedings of the Iowa Academy of Science*, 23(1), 315-316.

Available at: <https://scholarworks.uni.edu/pias/vol23/iss1/51>

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## HOW A TREE GROWS.

FRED BERNINGHAUSEN.

Professor Ebermeier of Munich, Germany says: "When the leaves take carbonic acid from the air they break it up and force its carbon into new chemical compounds which are then stored away as new material in the tree. The forest is the most highly organized portion of the vegetable kingdom."

No man can really know the forest without feeling the gentle influence of one of the kindest and strongest parts of nature. It is the most helpful friend of man.

There is no other natural agent which has done so much for the human race. Its influence upon streams alone makes farming possible. It supplies fuel, one of the first necessities of life, and lumber, the raw material without which railroads and all the great achievements of material progress would have either been long delayed or wholly impossible.

The forest is as beautiful as it is useful. A tree is a woody plant growing up from the ground. It consists of three parts: First, the roots which take up water from the soil and some mineral substance which the tree needs in its growth; second, the trunk, stem or bole which supports the crown itself with its network of branches, buds, and leaves, in which all the food taken up by the tree from the soil and air is worked over and made ready to assist in the growth of the whole tree. The crown has more to do with the life of the tree than any other part. The most important process is the reproduction of the tree and the digestion of the food, which takes place in the crown. The material upon which the tree feeds is derived from the soil and the air. The minute root hairs take up water from the ground and with it substances which it holds in solution. These are the earthy contents of the tree which appear in the form of ashes when any part is burned. The water which contains these materials goes straight from the roots to the leaves, in which the most important process in the feeding of the tree takes place. This process is assimilation or taking up and breaking up by the leaves of carbonic gas from the air. It goes on only in the presence of light and heat and through the action of chlorophyl, a substance through which the leaves and the bark get their green color. Plants or trees containing chlorophyl are the chief means by which the mineral materials are changed into food so that nearly all plant and animal life

depends upon them. Plant cells which contain chlorophyl break up the carbonic acid gas with which they come in contact, retaining the carbon, one of its elements, and sending back the oxygen into the air. Under the influence of sunlight they combine the carbon with the oxygen and hydrogen of the water from the roots into the new chemical compounds; in which nitrogen and the earthy constituents mentioned above, that is to say the food material which reaches the tree through the roots and leaves, are first digested in the body and are then sent to all living parts of the roots, stem and crown. Some of this food is stored away until the proper moment arrives. Wood is made up chiefly of carbon, oxygen and hydrogen. When perfectly dry about half its weight is carbon and half oxygen and hydrogen in almost the same proportion as water. It contains about one part in a hundred by weight of earthy constituents. The nitrogen and water taken up by the roots were originally in the air before they reached the ground. It is true therefore that when wood is burned those parts which came from the air go back into it in the form of gas, while those which came from the soil remain behind in the form of ashes. Besides giving out oxygen through the leaves to the air they breathe through the minute openings in the bark. This breathing goes on day and night and consequently more carbonic acid gas is taken into the tree than is given out and the surplus carbon is used in growing. The addition of new material or the foundation of growth is deposited in a thin coat over the whole tree between the wood and the bark. There are two layers of this coat separated by a third one of tender tissues, and the outer or cambium layer forms new bark. Wood is chiefly made up of very small tubes or cells of various kinds which have special use in the life of a tree. Some conduct water from the roots to the crown, some store away digested food, and others merely strengthen the structure of the wood and hold it together; but in each case some of the cells have thick walls and small openings and others wide openings and thin walls. Consequently at first the tree makes thin walls itself and wide openings through which water can rise rapidly to the ends of the branches; later on when the demand of water is not so great and there is plenty of digested food to supply building material the cells formed are narrow and thick walled. Thus the summer growth in wood is heavier, stronger, darker in color than spring wood.