Influence of Forest on Climate and Water Supply.

On this continent nearly all statements as to the influence of the forest on climate and waterflow are general. In Europe more extended and detailed observations have formed a basis for definite conclusions.

The discussion first began in France, when in 1789 the success of the Revolutionary party led to the removal of the restrictions on the cutting of private woodlands, and a subsequent wholesale clearing of large areas. As early as 1792 a change in the climatic conditions was observed, and shortly after that time investigations by two distinguished scientists, Becquerel and Krutsch, were begun in France and Germany. For a long time results were not satisfactory, owing to the difficulty of taking observations, but about forty years ago a system was devised of having observing stations within the forest, and similar stations at some distance from the forest, so that results might be compared. By this means the difference between the heat and the moisture in the forested country and that in the open country may be learned. Where all other conditions are equal, the difference is ascribed to the presence of the forest.

Climate is the average weather condition, and is dependent upon the distance of the locality from the equator, the elevation above sea level, the distribution of land and water, the character of the country, whether level or mountainous, whether vegetated or barren, the winds, and the moisture of the atmosphere. The factors which the forest may influence are the surface cover, moisture and wind. Upon the surface cover, which influences the heat, and upon the moisture and wind are dependent the changes in climate which are most evident to human beings.

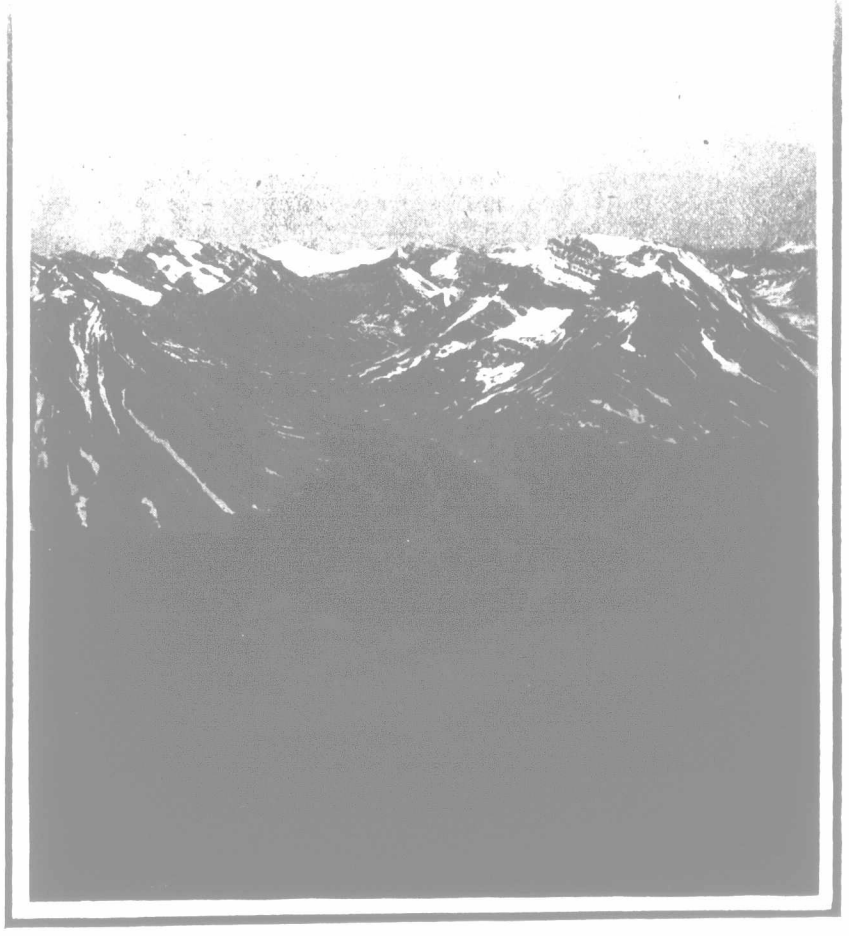
The influence of the forest on these climatic factors is evident in the following ways: The forest as it stands prevents the sunshine and rain from freely reaching the earth, is a barrier to air currents, and diminishes the radiation of heat from the earth at night. The trees and the vegetation which accompanies them produce large quantities of vegetable mould or duff, which checks and reduces extremes of waterflow in the ground.

These forest influences extend more or less to the temperature of the air, the evaporation and transpiration of water from the earth, the rainfall and the disposal of rain water after it has reached the earth.

Many scientists will not admit that the temperature is affected by the presence of forest growth. Such observations as have been made go to show that it is only affected to a few degrees, and only by the presence of so much vegetable matter as is contained in the forest. The trunks, branches and leaves of a tree contain a large proportion of water, the leaves being 50% to 70% water. Water requires more heat to raise its temperature one degree than almost any other substance, pound for pound. Thus, while bare soil or rock would be heated under the influence of the sun, the leaves and trees, largely water, would absorb the heat without showing much change in temperature; consequently, while the hot soil or rock is radiating and heating the air, the forest cover is still absorbing heat and keeping the air beneath it cool. Further, the leaves of the trees and all vegetation give off large quantities of water by transpiration. The evaporation of this water requires heat which is absorbed from the air.

The air thus cooled in the forest sinks to the ground and a rising current of warm air takes its place. The cool air flows off along the surface of the ground into the country, and thus local breezes are formed, and the influence of the forest felt at some distance. At night the currents are reversed, the forest checks the radiation of the earth's heat, and the air in the forest becomes warmer than that in the open. The colder air then flows from the open country to the forest; thus the forest checks extremes of temperature both at night and day. When this cooling of the air has been measured it has been found greatest in summer and of more effect in the mountains than on the level plains.

Results of investigation in Bavaria show that the lowest daily temperature for a year was 2° higher in the forest than in the open country, while the highest daily temperature was on an average lower by 4°. The same observations showed that the hottest day in summer was 7½° cooler in a forested country, and that the coldest day in winter was 3° warmer.



Effects of Erosion.

Where there is no timber on the mountains, there is nothing to protect the soil or hold the water.

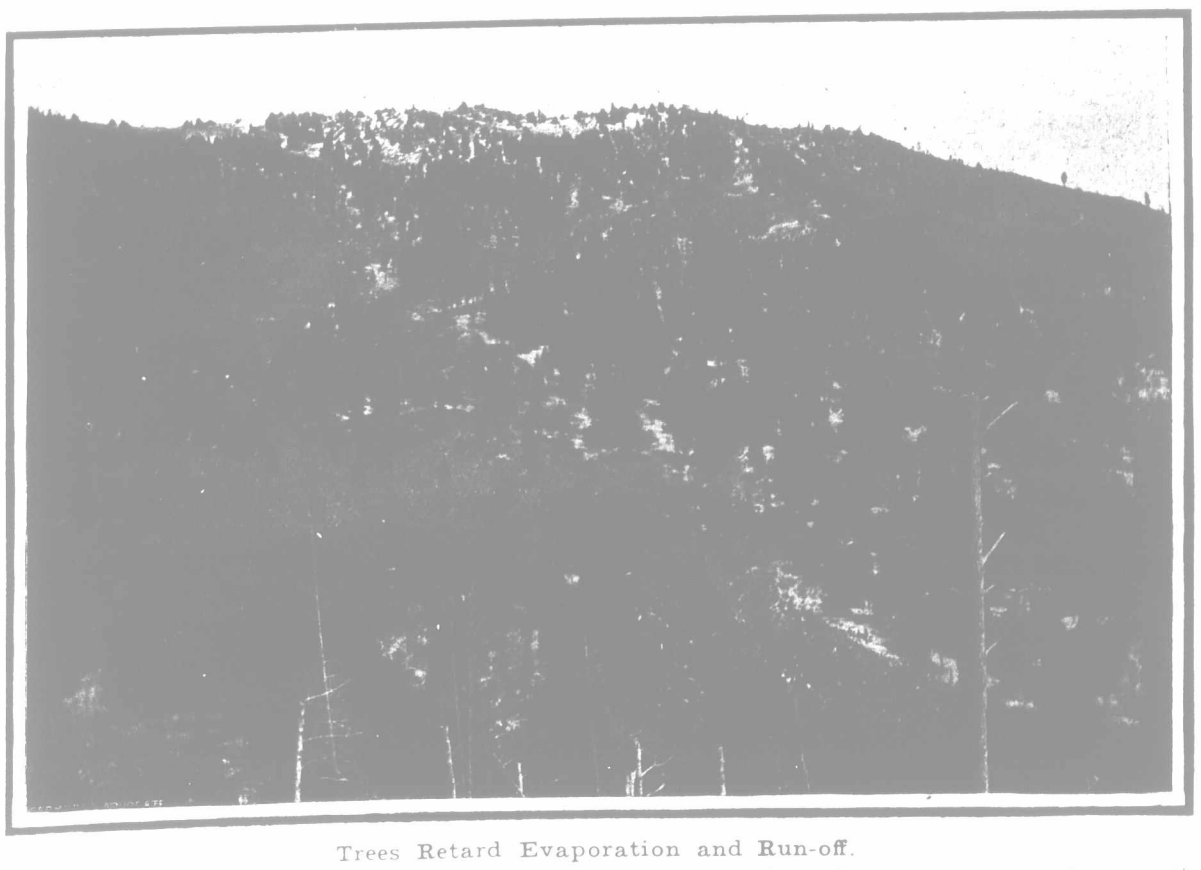
These figures are for Central Europe; there are none for America, but the same principles govern on both continents, and as we are in a country of greater extremes and more rapid changes of climate, we may expect to find that the forest has even more influence here in Canada than where the question has been studied in Europe.

The humidity of the air in the forest is greater than that of the air outside. The actual weight of water vapor in a cubic foot of forest air is the same as that of a cubic foot of air in the open country under similar conditions—but as the forest air is cooler, its capacity to contain moisture is less. Swiss experiments show that the relative humidity of forest air is 3% to 10% greater than outside air. This is the reason that dew is more frequent near timber than at a distance.

The presence of forest has but little influence on the quantity of rainfall in a district. The chief causes of rainfall are the great currents of warm and cold water in the ocean, the presence or absence of large bodies of water and mountain ranges, and the direction of the prevailing winds. Forests are cooler than the surrounding country and obstruct the winds, and, consequently, may influence local showers. European and Indian observations encourage the belief that forests in this manner increase the annual rainfall by about 10 per cent.

The forest has a greater effect in preventing the evaporation of water than in increasing the rainfall. The air of the forest being cooler cannot absorb moisture as quickly as the warmer air of the open country. The forest also retards air currents and obstructs winds, which, when blowing quickly, dry the plains and open fields. In this respect, the forest is of far more influence than the wind-breaks commonly planted. Bavarian experiments show that the evaporation from an open surface of water in a forest is only 40% of that from the same body of water in the open. The influence of the forest to prevent evaporation increases with the elevation of the country above sea level. This furnishes justification or reason for the Government reserving the forests at the headwaters of streams in mountain regions. In the Rockies a large proportion of the water evaporates before it reaches the streams; especially is this the case when the snow is going off in the summer. Large snowbanks evaporate without wetting the ground around them. Experiments by the United States Geological Survey have proven that when exposed to the sun the snow evaporates at least four times faster than water. Where water is important for irrigation this is a serious consideration.

The chief influence of the forest is in modifying the run-off of the water after it has fallen. From 10% to 25% of the rain falling in a forested country is held by the branches and the leaves of the trees. This is later evaporated, and tends to keep the air moist. The water which reaches the ground is absorbed by the decayed vegetable matter and soft permeable soil, as it would be by a sponge two inches to two feet thick spread over the whole surface of the land. Such a soil will hold a five-inch rainfall before it becomes saturated. The water thus held slowly soaks into the subsoil, is held as a reservoir to support vegetation, or seeps away to feed springs and streams. None of it is wasted or lost. When rain falls upon a bare slope, the result is different; it does not sink into the ground half so readily, but immediately runs off the surface in rivulets and creates floods. Investigations by the United States Forest Service



Trees Retard Evaporation and Run-off.

Where there are no trees, the snow has melted and evaporated. Where there is a shelter of trees, the snow banks still remain. Crow's Nest Valley, Alberta.