

SURVEY OF THE VEGETATION IN THE VICINITY OF CEMENT MILLS.

C. L. PORTER, Purdue University.

Modern industry has contributed much to agriculture. On the other hand, it has been responsible for many new problems in agriculture. Pioneer farming was attempted for the most part on virgin soil supplied with all of the nutrients necessary to plant growth. The plants grew surrounded by an atmosphere free from impurities. Insect and fungous parasites did not cause much trouble. Today continuous cropping has destroyed much of the fertility of the soil. Increase in population and rapid means of communication have introduced into our midst parasites from all quarters of the globe. The atmosphere is no longer free from contaminations. These contaminations consist of the products of combustion of innumerable chimneys, domestic and factory, and from the various machines that line our railways and highways. Poisonous gases are poured forth into the air from many places of specialized and wasteful manufacture. Dust is also created and expelled into the air from many industries including those that manufacture cement. The enormous volumes of road dust which arise from our crowded highways must hinder to some extent the normal functioning of the plant life of our country sides.

The problem of atmospheric pollution has been one of sufficient importance to attract the attention of a number of investigators. Clevenger¹ conducted a survey in the vicinity of Pittsburg in which he determined the effect of soot on the surrounding vegetation. This survey was supplemented with laboratory investigations. He concludes that soot has a deleterious effect on vegetation on account of the clogging of the stomata. Bakke² conducted a similar survey in the vicinity of Des Moines in which he demonstrated that there were certain recognizable and definite belts of vegetation about a factory district. In zones immediately about such a district certain forms of plant life would not grow. Bakke believed that the damage to the vegetation was partially due to mechanical stoppage as well as to the chemical effects of certain poisonous gases present in the smoke. The effects of dusts settling from cement mills have been studied by several investigators. Anderson³ determined that such dust prevented the setting of fruit. This injury he thought took place because the reaction on the stigmatic surfaces was changed inhibiting pollen germination. Peirce⁴

¹ Clevenger, J. F. The Effect of the Soot in Smoke on Vegetation. Mellon Inst. Bull. 7. 1913.

² Bakke, A. L. The Effect of City Smoke on Vegetation. Iowa Agr. Exp. Sta. Bul. 145. 1913.

³ Anderson, P. J. The Effect of Dust from Cement Mills on the Setting of Fruit. Plant World 17: 57-68. 1914.

⁴ Pierce, G. L. The Effect of Cement Dust on Orange Trees. Plant World. 13: 283-288. 1910.

demonstrated the effect of cement dust on the leaves of citrus trees in California by showing that five times as many starch grains were formed on the halves of leaves from which he had removed cement encrustations in contrast to the halves still encrusted. Parish⁵ estimated that the lemon crop in the vicinity of cement mills was decreased one-fourth because of the interference of the cement encrustations with photosynthesis.

The survey which forms the subject of this paper was made in the vicinity of Oglesby, Illinois. Oglesby is situated in LaSalle County in the north central portion of the state. The city is located on the Vermillion River and is immediately opposite the famous "Deer Park" region. The principal industry at Oglesby is the manufacture of cement. Two large mills, the Marquette and the Lehigh are located at Oglesby. The Marquette is the larger of the two and both mills when operating at capacity do an immense business. The Marquette company mine their rock while the Lehigh company removes the overburden of dirt and then takes the rock from the surface. The latter company grinds the rock, mixes it with gypsum and clay and stores it in great bins. This mixture is taken from the bottom of the bins by gravity onto carriers and is transferred to the kilns where under forced draft the mixture is burned into a finished cement. It is during the latter process that most of the dust so evident over the surrounding territory is liberated. At the time of this survey the Lehigh company was having its kiln chimneys equipped with condensers which caught most of the dust from the stacks and returned it eventually to the kilns. These condensers should effect a saving to the company and protect the surrounding country from disfigurement. Three of the four kilns were so equipped and the fourth was in process of installation. The condensers that were in operation seemed to be quite efficient and the quantity of dust produced by this mill with the exception of the one stack was little. The Marquette Company did not have their kilns so equipped and great clouds of dust arose from the stacks of this plant.

The presence of the cement mills gives to the surrounding countryside an atmosphere that is unique. When one is several miles away the cement dust is visible as a cloud hanging over the city. As one comes into the region the dust becomes more evident; the dust clouds being of such volume as to partially obscure the light from the sun. It has an irritating effect upon the membranes of the eyes and nose. Clothes and shoes are quickly covered with a fine gray dust. I was told by one of the men in charge of the Lehigh mill that the grade about the mill had been raised two feet by dust accumulations since the mill had been in operation. Previous to my survey the season had been very wet and a heavy rain had fallen within the previous 48 hours. Nevertheless, within the zone affected by dust the characteristic gray coating was to be seen everywhere on the sides of buildings, roofs, telephone poles, trunks of trees, and upon the leaves of vegetation. I was informed that rain had little effect in removing accumulations from permanent structures. On these a hard cement coating is formed by

⁵ Parish, S. B. The Effect of Cement Dust on Citrus Trees. *Plant World* 13: 288-291. 1910.

the union of the dust and rain water which is practically indestructible by the ordinary atmospheric agencies.

The purpose of the survey was: 1, to determine if plants were injured by such dust accumulations; 2, if injury was apparent, to determine whether some plants were more resistant than others to it; 3, to lay a basis for laboratory studies upon various phases of the problem.

It should be first noted that smoke injury is a minor factor in this region. The community is essentially rural. Oglesby has a population of 4,000 people living in scattered dwellings. The only smoke producers of consequence being the two mills situated a half a mile apart and the two railroads which pass through the center of the town. Little soot was detected in the dust accumulations and there was none of the characteristic tarry deposits found on the leaves such as may be found when smoke is abundant in the atmosphere.

Gardens in which all the usual garden vegetables were grown were found in the near vicinities of the mills. In fact one garden was found within the wire enclosure belonging to the Lehigh company. All gardens within the first two blocks of the mills showed a very evident lack of thriftiness on the part of nearly all of the plants. The plants were stunted, with many yellow leaves and some plants were positively deformed. A quarter of a mile east of the Lehigh plant, gardens again appeared to be normal although dust accumulations were plainly evident to a distance of a half a mile east of the mill. One gardener whose patch was one-fourth mile away from the source of the dust told me that he believed the cement dust to be an excellent fertilizer. Deleterious effects were much more evident upon both fruit and shade trees than they were upon other kinds of vegetation. Among the fruit trees, cherries, apples and pears were to be found within the quarter of a mile zone of the mills. Many of these fruit trees were entirely dead. Those that were alive apparently were having a difficult struggle for existence. Yellow leaves were common. Much dead wood was noted and there had been a dropping of leaves although it was early in the season. Many of the cherry trees were barren and those that were in fruit had but scanty crops. As a rule there was a better set of fruit on the side of the tree away from the mill. Cherry fruits were gnarled and imperfect. Outside of the zone of dust influence there was a uniformly even set of cherries on all trees and the imperfections noted within the zone were absent outside. Pear trees were more normal in their vegetative aspect but all were barren. Whether barrenness in this instance was caused by the dust can not be definitely stated as many trees outside of the zone were also barren. Apple trees were in fruit and as nearly as could be determined the fruit was set as well on one side as another. Peach trees within the quarter mile zone were barren and for the most part dead. Near the Lehigh mill the street trees consisted of Carolina poplar, boxelder, and catalpa. Of these trees the poplar appeared to be in healthiest condition, in fact showed no visible ill effects of its environment at all. Two blocks east of the Lehigh mill was found the first elm tree in this district. It was small. The leaves were yellow and curling. Elms were also found along the street

which connected the two mills but for the most part they were much less vigorous and thrifty than the three street trees previously mentioned. At the eastern edge of the quarter mile zone was found two small groves of white and black oaks. In one of these groves 16 per cent of the trees were entirely dead while in the other, 50 per cent of the trees were dead. The western sides of the trunks of these trees were coated with cement dust. One-half mile east of the Lehigh mill another grove of oaks and shellbark hickories were found. In this grove there were no dead trees but much dead wood was present among the branches. Plants appeared to be normal beyond the half mile zone in this direction.

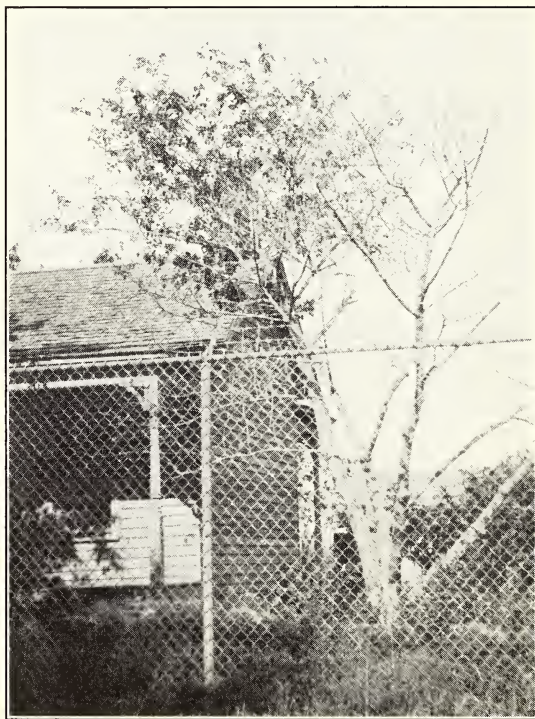


Fig. 1. Characteristic appearance of fruit trees near cement mills. Cement company's fence seen in foreground.

Conifers as a rule are considered to be more sensitive to atmospheric contaminations than are the broad leaved trees. At the gates to the entrance of the Lehigh company's ground were found two small decorative hemlocks. They appeared to be normal. These were the only conifers of any sort that were found within the affected zone with the exception of a small juniper that was entirely dead.

The affected zone did not extend so far to the west. Vegetation appeared to be normal in every respect one-fourth mile west of the

Lehigh plant. It is rather significant that the better homes are located on this side. A number of white pines in excellent condition were found in a dooryard six-tenths of a mile west of the mill.

Vegetation seems to be more affected in the vicinity of the Marquette mill. The space within the Marquette enclosure is almost a barren waste. Here and there a dead tree may be seen lifting up its barren branches over a landscape consisting of scattered patches of coarse grasses and weeds.

SUMMARY.

1. Many plants are seriously injured in the presence of large atmospheric loads of cement dust.

2. The zone of noticeable injury is comparatively small. The effect being greatest nearest the source of the dust.

3. The zone of injury extends farther to the east than to the west showing the influence of the prevailing winds.

4. Plants differ with regard to their tolerance toward this form of injury.

