

killing frosts as at the time of its appearance practically all crops had either been gathered or were fully matured. Over much of the district killing frosts were from one to two weeks later than usual, thus extending the growing season to that extent, which was very beneficial. Killing frost occurred at one station in Pennsylvania as early as the 4th and at several stations in that State and in Ohio on the 8th and light frosts at quite a few stations in various parts of the district on scattered dates during the first and second decades. As a rule, however, the killing frosts of the period 23d to 25th were the first frosts of the season. Large flocks of wild geese were flying southward at the end of the month.

PRECIPITATION.

Precipitation was unusually large in amount and frequent in occurrence for October in nearly all parts of the Ohio Valley. Over considerable of the district, particularly the eastern half and in southeastern Indiana, it averaged nearly double the normal amount for the month, while at many stations in this area considerably more than double the usual amount was received, and at some stations the amounts were the largest of any October of local record. About the only part of the district where precipitation was deficient over any extensive area was in the lower Ohio Valley proper; that is, in southern Illinois and western Kentucky. In this area the amount was generally less than 2 inches, and at a few stations less than 1 inch. The greatest monthly precipitation, ranging from 5 to 9 inches, occurred over a large area extending from southeastern Indiana southeastward over eastern Kentucky, southern West Virginia, and into southwestern Virginia; over a smaller, although considerable area, comprising the Allegheny River watershed in western Pennsylvania and the Mahoning River watershed in northeastern Ohio; over considerable of central Ohio; and over a relatively small area in east-central Tennessee. Over the remainder of the district the monthly rainfall ranged between 2.5 and 5 inches.

The distribution of precipitation through the month was in five general periods: 1st-4th, 7th-11th, 15th-18th, 22d-23d, and 30th-31st. During the first three of these periods there were some very heavy rains over large areas of the district, but during the last two, while there were moderately heavy rains in some localities, the precipitation as a rule was light. Snow flurries occurred in several of the northern States of the district on one or two days. The first snow of the season occurred on the 21st in the Wabash Valley of Illinois.

Heavy rains at the beginning of the month, following so closely the unusually large rainfall of September, caused damaging floods in some of the upper tributaries of the Ohio River and in many of the smaller streams of the central and eastern portions of the watershed. Floods in the Allegheny and Mahoning River basins caused a property loss in western Pennsylvania and northeastern Ohio of nearly a million and a half dollars, besides several lives. The damage was especially large in the Beaver River section of western Pennsylvania. Timely flood warnings were widely distributed by the local office of the Weather Bureau at Pittsburgh, Pa., and resulted in the saving of considerable property which would otherwise have been lost. There was also a great deal of damage by floods during this same period in the rivers and small streams in portions of Illinois and Indiana, and in eastern Kentucky, the damage being especially great in the Licking and upper Kentucky River basins of Kentucky,

and over the East Fork of White River and the extreme southeastern counties of Indiana. Besides general property loss in these sections, growing crops suffered much damage.

MISCELLANEOUS.

Thunderstorms attended by severe wind squalls caused considerable damage in various localities in the district on the 3d, the wind reaching a velocity of 50 miles per hour at Pittsburgh, Pa. Several large tobacco and stock barns were destroyed and stock killed in the north-central counties of Kentucky. On the 6th and 7th, considerable damage resulted from thunderstorms, wind squalls, and heavy rains in the central counties of Ohio. In the period 14th to 15th, sections of Illinois, Indiana, and Kentucky were visited by local thunderstorms attended by destructive lightning, wind squalls, and hail. Numerous barns were destroyed and considerable stock was killed in those States. The most destructive storm of the month crossed central Indiana on the 14th, of which the section director at Indianapolis furnishes the following detailed account:

SEVERE WINDSTORM CROSSES THE STATE OF INDIANA.

[By VERNE H. CHURCH, Section Director.]

One of the most destructive windstorms of many years in Indiana crossed that State during the late afternoon of October 14, 1911. It made its first appearance in the vicinity of Veedersburg, Fountain County, then traveled eastward to Hillsboro, Waynetown, Crawfordsville, thence southeastward to Danville, and nearly east from there to Indianapolis. The last damage of consequence occurred at Ben Davis, a small village 4 miles west of the western limits of the city of Indianapolis. The wind at Indianapolis was not of unusual velocity, and no damage occurred there or at points to the eastward, although a marked disturbance in the atmospheric pressure took place at Richmond, as registered by the barograph of Prof. B. W. Kelly, of the high school in that city. Large fluctuations in barometer occurred also at Indianapolis and at La Fayette. The record at La Fayette was furnished by William J. Jones, jr., of Purdue University. The storm traveled an approximate distance of 140 miles at an average rate of 45 or 50 miles an hour, judging from the barograph records.

The miraculous feature of the storm was the fact that, although many buildings were completely demolished, no persons were killed at any of the places visited, and but few injured, and these not seriously.

The estimated property loss from the storm is \$50,000, divided as follows: Veedersburg, \$5,000; Hillsboro, \$25,000; Danville, \$500; Ben Davis, \$40,000; scattered points in rural districts of region traversed, \$9,500.

At Veedersburg the storm approached from the northwest, and was said to have been accompanied by a funnel-shaped cloud. The trees and poles blown down fell toward the southeast over the entire path of destruction, which was but 50 feet in width.

At Hillsboro the damage to property ranged over a territory 1 mile in width. The storm approached from the southwest, and a cloud of funnel shape was observed about 4.05 p. m. Trees on the north side of the path fell toward the north; on the south side, toward the east; and in the center, nearly east.

The damage at Danville was not extensive. The path covered was about 50 yards in width, and the funnel-shaped cloud was observed. The trees on the north side of the path fell toward the south; on the south side, toward the north; and in the center, toward the east. This plainly indicates that a rotary motion took place at this point.

The greatest damage occurred at Ben Davis, which the storm reached about 5.30 p. m. The wind blew from the southwest, and trees, telephone poles, and the walls of buildings fell toward the northeast over the path of the storm in that vicinity, which was nearly one-half mile in width, although the principal destruction was confined to less than one-eighth mile in width and about the same distance in length. The writer visited the scene of the disaster at Ben Davis and made a thorough examination of the debris, but was unable to find any evidence of a rotary movement of the storm or any explosive effects produced by the sudden expansion of the air within the buildings destroyed, so characteristic of tornadoes in general. A church, concrete factory, and about one dozen houses and barns were completely demolished, and many other houses and barns were damaged. Many large trees were uprooted or broken off, and telephone and electric-light poles were leveled throughout the village.

The storm was almost immediately followed by a heavy fall of rain and hail at Indianapolis, which lasted only a short time, however,

and rain had also fallen earlier in the afternoon. Heavy black clouds were observed in the west for some time before the storm, and a dull roar immediately preceded it. Thunder was heard at intervals during the afternoon and was loudest immediately after the occurrence of the maximum wind velocity.

ENGINEERING NOTES.

Lock and Dam No. 21 on the Cumberland River, situated about 20 miles below Burnside, Ky., was completed and formally opened to operation on the 20th of October. The completion of this lock gives navigable water between Burnside, Ky., and Nashville, Tenn., every week in the year, whereas heretofore navigation could only be had, with the boats plying on that river, about six months in the year. The upper Cumberland

penetrates a region that is rich in natural resources, and a number of counties in that section are entirely dependent on river transportation, as they are without railroads. While the region can not hope to attain its fullest development until railroads shall find their way to its fertile valleys and treasure-filled hills, yet dependable river transportation will help tremendously. The depth of the Cumberland River between Burnside and the new lock has been increased to about 12 feet. Plans have been started for the construction of Lock No. 20, which should be completed within the next five years. This proposed lock will tap even a richer territory than Lock No. 21 and make navigable 30 miles more of the Cumberland River.