ade if complete and reliable data were available conrning the relation of the weather to any irregular or nnual variations in these tests.

The success or failure of a year's work is dependent on the amount in which the crops may be favored by the weather, and although the farmer has no means of control over this element, there may be found several ways in which it is possible to take advantage of seemingly unfavorable conditions.

For this reason any facts which may be established through the investigation of these problems will help to give us a scientific knowledge of the different relations between weather and crops, and this knowledge put in workable form will enable agricultural experimenters, students, and farmers to clear up many things which are so little understood at this time, and thereby greatly improve the present status of agricultural practice.

THE INFLUENCE OF METEOROLOGICAL PHENOMENA ON VEGETATION.

Revue Scientifique, February, 1920, pp. 115–116.

Translated by Katharine Davis.

Dr. Azzi, of the University of Rome, has studied the relations existing between the critical periods of vegetation and meteorological phenomena. His method consists of observing at the same time the biological phenomena which dominate the life of plants and the meteorological phenomena which react on them with the greatest intensity. (Treatise presented by M. G. Wery to the Academy of Agriculture.)

Vegetation presents critical periods which are controlled by meteorological phenomena, rain, humidity (moisture), frost, heat, and dryness. Each period corresponds to a particular phase in the life of the plant; thus the critical period of vegetation of wheat with respect to rain is that, of variable duration, when this cereal requires, absolutely, a minimum of water. If rain does not fall at the precise time when the grain is in this critical period with respect to water, its development is hindered and the yield will be diminished.

In the same way for fruit trees, if the heat which is necessary for them in the corresponding critical period is less than they require, the crop will be decreased. (Leaf of Information of the Minister of Agriculture.)

Knowing the critical periods, it is necessary to know what are the mean epochs of the year when these occur for each one of the cultivated plants, epochs which vary with the region. One may then draw charts to which the author has given the name phenoscopic charts.

For each cultivated plant there are as many phenoscopic charts as there are critical periods and decisive meteorological factors; thus, there are four for grains relative to humidity (moisture); germination, earing, flowering, and maturity of grains.

Dryness being recognized as the determining cause for diminished return of grain crops in a particular zone, three methods are possible to agriculturists for offsetting this condition. (1) To avoid the phase of vegetation to which the critical period corresponds by modifying the time of seeding; (2) by modifying artificially the meteorological conditions during the critical period by irrigation if that is possible; and (3) to select grain in such a way as to obtain a variety which will resist the injurious meteorological phenomenon, dryness for example.

Phenoscopic charts may, then, assist to a knowledge of climatic conditions as geological charts assist to a knowledge of the soil and consequently of fertility.

THE INFLUENCE OF COLD IN STIMULATING THE GROWTH OF PLANTS.

By Frederick V. Coville.

[Abstracted from *Journal of Agricultural Research*, vol. 20, No. 2, Oct. 15, 1920.]

It is the general belief that dormancy in winter of our native trees and shrubs is brought about by cold weather, and that warm weather is of itself sufficient to start new growth in spring. Mr. Coville shows that both of these ideas are erroneous. From a number of very interesting and instructive experiments with blueberry plants under controlled conditions, it is shown that cold weather is not necessary for the establishment of complete dormancy and that after it is established the exposure of plants to ordinary growing temperatures does not suffice to start them into growth; also that plants will not resume normal growth in spring unless they have been subjected previously to a period of chilling. Finally, a theory is advanced to explain this paradoxical effect of cold in stimulating growth. The subject is presented in a series of numbered statements, with supporting evidence in each case.

Healthy blueberry plants were put into a greenhouse at the end of summer and kept at ordinary growing temperatures, but they gradually dropped their leaves and finally went into a condition of complete dormancy. The only difference between the behavior of the indoor and outdoor specimens was a tardiness of the former in assuming dormancy, probably due to a lack of injury to the foliage by freezing temperature.

Plants that were kept continuously warm during the winter started into growth much later in spring than those that were subjected to a period of chilling, while some that had been outdoors during the winter were brought into the greenhouse in early spring. The latter burst into leaf and flower luxuriantly, while the former remained completely dormant. In some cases, plants remained dormant a whole year under heat, light, and moisture conditions favorable for luxuriant growth. As a further test of the matter, some of the branches of a plant were extended through an opening in the greenhouse in one case, and in another the plant was placed just outside with some of the branches extending into the house. When spring came the outdoor branches, in both cases, put out leaves promptly and normally, but the interior branches remained dormant.

In explanation of these phenomena, Mr. Coville points out that the stimulating effect produced on dormant plants by cold is intimately associated with the transformation of stored starch into sugar. Stated in terms of simplicity, stripped of technical phraseology, the theory advanced in explanation of the formation of sugar during the process of chilling is that the starch grains stored in the cells of the plant are at first separated by the living and active cell membranes from the enzym that would transform the starch into sugar, but when the plant is chilled the vital activity of the cell membrane is weakened so that the enzym "leaks" through it, comes in contact with the starch, and turns it into sugar.

Mr. Coville recognizes that the hypothesis of transformation of starch into sugar by the weakening of cell membrane and the consequent leakage of starch-transforming enzyms into the starch chambers may very properly be challenged. In the Tropics there is no chilling weather, yet some trees and shrubs alternate from a state of dormancy to active growth, much as in cold climates. As a probable explanation of this, Mr. Coville points out that injury, such as pruning or girdling, to a long-dormant plant will often start it into growth, possibly caused by enzym being brought into contact with the starch as a direct result of the breaking and straining of the cells. Sugar is then formed and growth begins. This phase of the question is discussed in considerable detail, with the conclusion that the awakening from dormancy to growth in tropical plants may result from cell injury caused by the long dormant period.

The twigs of trees and shrubs, after their winter chilling and the transformation of their starch into sugar, are regarded as mechanisms for the development of higher osmotic pressures which start the plant into growth. Finally, the importance of the establishment of a dormant condition before the advent of freezing weather, and the continuation of this dormancy through warm periods in late fall and early winter, as a protective adaptation to the native trees and shrubs, is pointed out. If plants were so constituted as to start into growth as readily in the warm periods of late fall as they do during similar periods in early spring, the result might frequently be disastrous.—*J. B. K.*

RELATION OF WEATHER TO FRUITFULNESS IN THE PLUM.

By M. J. DORSEY.

[Review-summary of paper No. 162, Journal Series, Minnesota Agricultural Experiment Station.[1]]

Owing to the fact that fruit buds usually appear in the plum in sufficient abundance to produce a full crop of fruit with favorable development, and the further fact that the intervening period between the beginning of blossoming and the setting of fruit is of short duration, the question can be approached with confidence of success in an attempt to isolate definitely the weather factors influencing the setting of fruit.

The study is based on meterological and fruiting data collected during a period of 7 years, 1912 to 1918, inclusive. The data are presented in graphic form by means of diagrams showing the influence of wind, temperature, sunshine, and rainfall during the blooming period on the setting of fruit, and are presented for each blooming period and for 10 days thereafter.

In some experiments cited, it was found that no fruit set from wind-carried pollen when insects were excluded. Therefore, wind may be regarded as having a more indirect than direct bearing on the setting of fruit, in that its influence upon bee flight may be serious at certain times, bees being the chief polinizer of the plum.

Temperature is considered of primary importance from three standpoints: Its effect upon pollen or pistil, its influence upon pollen-tube growth, and its interference with bee flight. In some experiments pollen was not destroyed by exposure to freezing temperature. With an exposure to a temperature of 29.3° F., 56 per cent of plum pollen germinated, compared with 62 per cent when exposed to temperatures above freezing. On the other hand, 21 plum pistils exposed to similar low temperatures for six hours were all killed, except two. Also the time required for germination was considerably increased as a result of low temperature. The action of low temperature in retarding pollen-tube growth is considered as one of the principal causes of the failure of fruit to set, as it was shown that plum pollen does not germinate at temperatures below 40° F. and even at 51° F. there is slow pollen-tube growth. It is pointed out that individual bees can control muscular movement only with temperatures 45° F. or higher, and that, in general, they will not leave the hive when the temperature is below 60° F.

Investigations were cited to show that while sunshine has a direct influence on the fertilization of the tomato, it apparently has none on the plum. Judging from these experiments, sunshine appears to have the chief bearing in this connection on such factors as insect flight and general plant activity, particularly nectar secretion.

On account of the nature of the processes taking place at blooming time, rainfall was found to have a more direct effect than any of the other weather elements. The fact that the period of pollination in the plum is so limited makes it possible for rain to delay normal functioning to an injurious extent. A study of the bloom in the orchard during a heavy and prolonged rain showed that the stamens were drawn together and held in a cluster about the pistil by a large drop of water, especially in the absence of wind. In order to study another action more in detail at the time of rain, a limb which had been in bloom for three days was cut from the tree during a heavy rain and brought into the laboratory, the temperature of which was about 68° F. All anthers were closed when first brought in, but some opened completely in 10 minutes, but when again placed in water they closed in two or three minutes.

The conditions which close anthers frequently prevent insect flight, but even if insects were working, pollination could not take place for the reason that pollen is not available. It appears, therefore, that too much emphasis has been placed upon the action of rain in washing the pollen away, because anthers largely close quickly enough to prevent it. In addition to the above, the effect of water on other organs of the plum flower and their functioning process is discussed in considerable detail.

In summarizing, it is pointed out that unfavorable weather at blooming time may completely prevent the setting of fruit, even though there be a full bloom, and that rain and low temperatures are the most important factors, although strong wind when prolonged is harmful. Wind has its influence indirectly by interfering with insect action, but is seldom strong enough to cause direct mechanical injury. Frosts during bloom injure the pistil more than the pollen, but the greatest damage from low temperature is in the retarding of pollen-tube growth. Cloudiness has no injurious effect in the setting of fruit, but rain prevents pollen dissemination by closing the anthers or preventing them from opening. In one season, rain during bloom may be the limiting factor and in another low temperatures during the period of tube growth.—*J. B. K.*

[1] Shorter abstract published in MONTHLY WEATHER REVIEW, May, 1920, 48: 285.