

air. It has been reported² that the internal condition of the plants, due to differences in nitrogen nutrient, variety, stocks, photoperiod, shading and girdling, affected the amount of this gas used per unit leaf area in unit time.

The method employed of recording the amount of carbon dioxide in air that has been passed through a closed chamber containing plants does not measure, obviously, the amount of carbon dioxide which the plants use. For example, girdled trees have an increased respiration rate and appear to give off more carbon dioxide during the night than is taken out of the air during the day. The amount of carbon dioxide removed from the air during the day when respiration is also going on is an apparent low amount and not an actual amount. The carbon dioxide measurements do, however, show the period of its utilization during the day as well as represent the intensity of respiration during the night.

As plants do not extract carbon dioxide from the air at uniform rates during periods of illumination nor discharge it uniformly in periods of darkness, a record of the trend of carbon dioxide exchange can be secured only by determinations at different times throughout the 24 hours of the day or, it seems in some cases, only by observations during consecutive days. Three-hour readings were used in the present studies.

Observations upon 12 species other than *Malus* (6 varieties) particularly selected to represent short-day, long-day and indeterminate types³ have led to the conclusion that plants have characteristic rhythms or daily cycles of carbon dioxide utilization. It is suggested that this plant character is associated with, if not responsible for, the phenomenon of photoperiodism. The species examined to date have shown a relatively irregular respiration curve for plants in a reproductive growth condition and a more regular curve when in a purely vegetative condition. Thus, short-day plants as *Poinsettia* gave the more irregular curve when grown in a short-day environment and long-day plants as spinach had the more irregular curve in a long-day environment. Each type of plant had more regular respiration curves in the environment which produced a vegetative growth response. (That is, if curves showing carbon dioxide exchange may be referred to as respiration curves.)

This correlation of respiration type to reproductive condition appears to bear a significant relation to Wilton's⁴ deduction that plants of different photo-

periodic classes have similar anatomical characteristics, particularly in tissues of secondary origin, at the time of flower formation, although they require a different light environment in order to become fruitful.

It should be clearly noted that the present carbon dioxide studies show that the altered respiration values precede flowering and appear as a causal condition rather than an effect.

It appears that the respiration rhythm of a plant may account for the unequal responses which some plants exhibit to added illumination applied at different periods of the day.

In some plants a respiration type which has been established by a cultural treatment tends to persist for a considerable time after the environment has been altered. Tests are being made to determine if the "vernalization" effects described by Lyssenko⁵ or such phenomena as the inducing of seeding of celery by chilling in the seedling stage⁶ result from an altered and then persistent, respiration type.

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LINEAR AND DENDRITIC SINK-HOLE PATTERNS IN SOUTHEASTERN NEW MEXICO

SINK-HOLES arranged in straight lines have lately been discovered in the High Plains in the southeastern part of New Mexico. These manifestations of the dissolving action of ground-water range in size from features which are very small to others more than 1,800 feet in diameter. They are connected in places by straight "trenches" of varying depth, which are possibly also the result of solution. The basins possess different degrees of roundness, the larger ones being the more elongate. These straight alignments, extending for 10 or 15 miles, are usually arranged in a parallel series which may be seen at various places throughout a considerable region. In Lea County, in an area as large as a 15-minute quadrangle, the mode of these linear trends is north 64° west. The mean deviation from this value is only a few degrees.

There are two zones of soluble rock and an intervening insoluble layer more than 1,000 feet thick. The upper zone is a thin superficial deposit of interbedded sand and limestone known as "caliche," which is usually 200 feet or less in thickness. In places it is covered by dunes. The lower "bed-rock" zone is a complex mass, consisting of limestone and various

² Meeting of the American Society of Plant Physiologists, Boston, December 28, 1933.

³ W. W. Garner, *Plant Phys.*, 8: 347-356.

⁴ Oera C. Wilton, "The Relation of Anatomical Structure to Growth and Fruiting Condition in Plants," Doctor's thesis, University of Wisconsin, 1934.

⁵ R. O. Whyte and P. S. Hudson, "Vernalization, or Lyssenko's Method for the Pre-treatment of Seed," *Bul.* 9, Imperial Bureau, Plant Genetics, Great Britain, 1933.

⁶ H. C. Thompson, *N. Y. (Cornell) Agr. Exp. Sta. Bul.* 480, 1929.

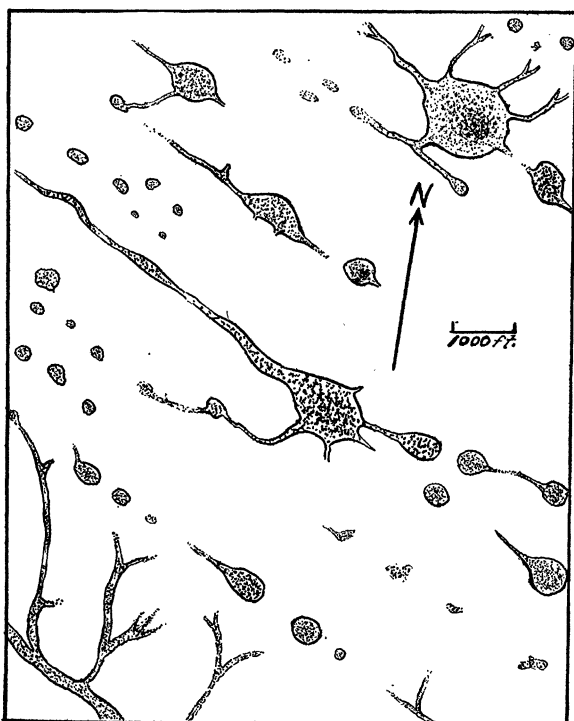


FIG. 1. Sketch made from an aerial photograph illustrating the alinement of sink-holes in southeastern New Mexico. The shaded areas represent surfaces of dark soil.

products formed by the evaporation of marine waters. There follows a list of formations near the southeastern corner of the state:

Tertiary and Quaternary:

"Caliche," sand and gravel..... 200 feet \pm

Triassic and Permian:

Red shale and sandstone..... 1,200 to 2,000 feet

Permian:

Salt and anhydrite 1,000 to 1,500 feet

Limestone and anhydrite 500 to 1,500 feet

The large basins doubtless owe their alinement directly to a system of parallel fractures in the underlying bed-rock. Faults and joints with somewhat similar trend are prominent features in the Yates oil district and at other localities to the southeastward. Some of the smaller sink-holes likewise may be due to the presence of joints in the bed-rock, though in this case there is probably only an indirect connection. For example, straight ravines may have been eroded along these fractures in the Triassic strata before their burial by the Tertiary caliche deposits. Removal of limestone by underground drainage through the hypothetical valleys may thus have formed many small depressions as well as the elongate "trenches" in the present surface. Since the caliche is seldom found to be jointed with an intensity similar to that of the underlying terrane it does not seem probable

that planes of fracture in this superficial formation could have been responsible for such an alinement.

In addition to this linear arrangement, a branching pattern is manifested in some places by groups of connected basins having an average diameter of less than 200 feet. This pattern has doubtless developed through the work of ground-water within the caliche, either as it integrated separate drainage channels into

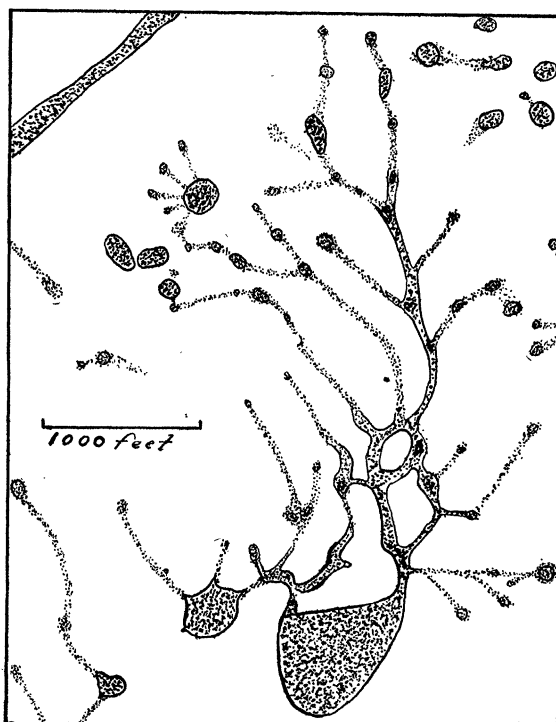


FIG. 2. Sketch made from an aerial photograph illustrating a branching arrangement of sink-holes in southeastern New Mexico. The shaded areas represent surfaces of dark soil.

a connected system, or as it flowed along branching valleys buried beneath the porous Tertiary beds. The available facts are inadequate to test these two alternatives. The writer has seen similar branching patterns in Florida; linear patterns formed by a series of parallel lines, however, are rare in that state as well as in the Mammoth Cave district of Kentucky.

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