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ARTS. CACTI IN NEW MEXICO,
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AGRICULTURAL EXPERIMENT STATION
AGRICULTURAL COLLEGE, N. M.

CACTI IN NEW MEXICO

BY
E. O. WOOTON

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INTRODUCTION.

There are two concepts more or less closely associated in the minds of a large number of people in New Mexico, both of which are in some degree inaccurate and which need correction before we can discuss the subject of this bulletin. The first is that any queer looking spiny plant found growing wild on the mesa or in the mountains is a cactus; and the second is that New Mexico is the home of the cactus. It therefore becomes necessary to state pretty definitely just what a cactus is so the reader may understand what we are talking about in the bulletin. The correction if the other idea is easier and of less relative importance to our purpose.

CHARACTERISTICS OF THE CACTI.

In the classification of plants botanists are practically agreed in the belief that similarity of flower structures indicates much closer relationship than any other kind of similarity, and since they assume that plants are genetically related and try to express that relationship in the arrangement of them in principal and subsidiary groups, it naturally follows that they associate plants having the same group of flower characters in families; and resemblances in plan of structure of flowers are accepted as having much more fundamental significance than similarities of individual organs, especially the vegetative ones (i. e. the organs concerned in the nutrition or growing of the plant). Hence it is that the botanist will assemble apparently rather diverse plants in the same family because of similarity of flower structure not readily appreciated by the ordinary observer.

The cacti of New Mexico have flowers with the following characteristics: They are mostly large for the plant, varying from about one-half an inch to fully four inches long in the different species. The calyx consists of from one to several rows of more or less fleshy or waxy sepals united at the base and attached to the top of the ovary. In the outer row the sepals are usually slightly greenish,

somewhat like sepals of other kinds of flowers, but the inner ones gradually change into the delicate waxy petals of which there are ordinarily two or sometimes more whorls, and these are united at the base with the sepals forming a more or less elongated tube. Inside the tube are the very numerous stamens, 100 or more, each with a 2-celled anther on a slender filament. The ovary is under all the other parts of the flower seeming to be imbedded in a peculiarly modified stem, at least in some of the genera. It has many ovules which become the seeds in the dry or leathery or fleshy, berry-like fruit. The styles are united into a single stout one and the stigmas are usually separate, there being from 5 to a dozen or more.

Besides the characteristics of the flower just discussed the structure of the plant body of the cacti is distinctly different from that of most plants and so peculiar as to attract attention from almost everyone. It has several characteristics which fit it especially for life in an arid region, in fact nearly all its most characteristic peculiarities are in some way connected with adaptation to arid land conditions.

The leaf surface is reduced to nothing at all in all but a few genera, but the fact that one sub-tropical genus has persistent foliar though thickened fleshy leaves, which function as all leaves do, and another genus (*Opuntia*) has rudimentary leaves that never function and soon fall off, indicates that the family has acquired the leafless habit in response to the conditions under which it has lived. Since leaves naturally furnish transpiration surface and transpiration is a process resulting in the loss of water, the reduction of leaf surface would naturally reduce the amount of water lost by the plant and therefore reduce the amount of water necessary for the plant in order that it might live.

The nearer a body approaches a spherical form the less surface does it have in proportion to its solid content or volume. When a plant has lost its leaves, transpiration must go on through its stem surface, for some transpiration must take place in all land plants. The desirable, from the standpoint of a plant living in an arid region, is that the *minimum amount* of transpiration should occur; hence the thickening of the stems is but another means of reducing transpiration surface.

Two other methods of still further reducing the loss of water

are seen in the cacti. The epidermis of the plant (the outside layer or "skin") is much thickened and hardened on the outer surface making the cells more resistant to the loss of water from the succulent tissues within; and the sap is not watery as in many plants but is mucilaginous, thus tending to hold the water, as well as quickly sealing any accidental break in the epidermis.

The thickened stem is advantageous in another way, since it offers a relatively large storage capacity for moisture when the plant is able to get water.

Attention has been called to the fact that desert plants usually have relatively large root systems spreading either deep into the ground where the water table is only a few feet down, or spreading widely just below the surface where the ground water is entirely out of reach. The cacti belong in the latter category and their roots are long and slender (sometimes tuberous thickened) and cover relatively large areas about the plants. In this way they are able to collect water from a large area (for desert plants do not stand thickly over the ground as do plants of the moist regions) and a very small amount of rainfall is sufficient to give such plants a refreshing drink. This arrangement also makes possible the rapid absorption of moisture when there is plenty, a factor of great importance in the arid region where the precipitation is mostly torrential in character. That animals eat plants goes without saying, and that such succulent plants as cacti would be especially palatable to a thirsty animal is self-evident; hence the spiny defence that is so efficient.

Thus we see the cacti are abundantly fitted to collect water rapidly when there is abundance; make the most of a small supply; and utilize most effectively whatever they get by being practically immune to the effects of the most rigorous drought, and at the same time be amply protected from the attacks of hungry and thirsty animals.

Plants that are able to grow rapidly bloom profusely, and mature seed in a short "rainy season" and that can endure a "dry season" are sometimes called tropophytes, and most of the tropical plants are to some extent of this character. Plants able to endure extremely dry conditions are known as xerophytes and the cacti are certainly of this kind. But considered as a family, they are also somewhat tropophytic. The New Mexican species have adapted themselves to the endurance of great daily and annual

range of temperature, another very unfavorable climatic condition.

GEOGRAPHICAL DISTRIBUTION.

Attention has been called, in another place,* to the climatic requirements of the cacti, and it has been shown that they are adapted to a region where the temperature is moderately high but not excessive; where the minimum temperature is not very low (many species will endure continued and severe freezing, but by far the greater number will not); and where the rainfall is periodic and moderate in amount with long periods of drought between. The region of the Western Hemisphere having climatic conditions such as these is the one occupied by the CACTACEAE or cactus family. A similar region in Africa is occupied by an entirely different family of plants (the Spurges) which has developed a structure of plant body similar to that of the cacti, but whose flower characters are very different.

As is intimated by the above, the cactus family is native on the American continents, the species now growing in the old world having been introduced from this hemisphere. Its extreme limits of distribution are those of the land in the Western hemisphere, there being at least some representatives, mostly more than one, all the way from Alaska to Patagonia. The genus most widely distributed and apparently most able to adapt itself to varying climatic conditions is *Opuntia*.

The latest treatment of the CACTACEAE† (a German book) divides the family into 21 genera and lists about 700 species that it was possible to recognize from the literature and the specimens available to the author for study. There are apparently two centers of distribution, one in each of the American continents. The greater number of species and individual plants are found in North America with the center of this distribution area in the State of San Luis Potosi, Mexico. From this region the number of genera, and individuals if not species, diminishes as one travels northward, so that by the time New Mexico is reached these plants have become a relatively subordinate part of the vegetation, and attract attention not so much by their abundance as by their strik-

*Bull. 60, New Mexico Experiment Station, page 29.

†Schumann. Gesamtbeschreibung der Kakteen.

ing differences from other and much more common plants that possesses characteristics we are accustomed to. As considered in this paper there are five genera of cacti represented in New Mexico, and sixty-three species are here listed. Of three of these species the author has not seen material from New Mexico. One of the three is common at El Paso and we have material from there growing in the cactus garden. The other two are reported from New Mexico in the original descriptions and one is described from plants collected in New Mexico. Of the 63 species mentioned we have 48 under cultivation in the cactus garden and are acquainted with several of the others as they grow in the field. In the preparation of this paper the author has had access to the preserved material in the U. S. National Herbarium which is particularly rich in cactus specimens, since Dr. Rose has been collecting material in this family for a number of years. The author has been studying, collecting, and growing them since 1904.

CLIMATIC CONDITIONS.

In a general way the climatic conditions of New Mexico are not favorable to the cacti. It is either too cold or too dry or both for most of the species. At the lower levels, where the weather is hot enough to make them grow well during the summer season, the minimum temperature in the winter is too low for many species and the amount of water which falls is entirely inadequate for the requirements of even more species, notwithstanding the current opinion that cacti will grow "on the top of the stove or on one's office desk."

The author once collected two plants in the early spring and threw them on the floor behind the stove to dry out, expecting to use them as herbarium specimens. Over a month later both specimens bloomed. But this does not mean that the plants do not require water to grow. It simply means that they are able to retain the water they get for a long time and use it most economically in the production of flowers and seeds. The species found growing in New Mexico are those which either can live on a very small amount of water (and, therefore, grow very slowly and attain only a relatively small size), or can endure severe winter temperatures.

To give some definite idea of climatic conditions which the plants must endure in New Mexico it is only necessary to say that the *minimum* temperature (which is the most important temperature