Transactions

of the

TEXAS ACADEMY *of* SCIENCE

MAY 29, 1929 to NOVEMBER 30, 1929

Together with the Proceedings for the same time

Volume XIV.

San Antonio, Texas, U. S. A.
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Committee on Publication

O. W. Silvey
E. S. Quillin
B. C. Tharp
Robert Runyon
W. J. McConnell
H. B. Parks

Contents

Letters of Incorporation

THE STATE OF TEXAS,
COUNTY OF BEXAR.

We, the undersigned resident citizens of the State of Texas, do hereby voluntarily associate ourselves together for the purpose of forming a private corporation for purposes herein set forth, to-wit:

1.—The name of this corporation shall be "The Texas Academy of Science."

2.—The purposes for which this corporation is formed are:—To stimulate scientific research, to promote fraternal relationship among those engaged in scientific work, especially in Texas; to diffuse among the citizens of the State a knowledge of the various departments of science; to investigate and report on any subject of science or industry when called upon by any Department of the State Government; to arrange and prepare for publication such reports of investigation and discussion as set forth in these articles; to collect, arrange and exhibit articles of scientific worth; to acquire and arrange for use a library of scientific literature; to acquire relics, mementos and articles of scientific interest; to maintain a museum in which these collections shall be available to the Academy and to the public with such restrictions as are placed on similar public institutions.

3.—The place where the principal business of this corporation is to be transacted is in San Antonio, Bexar County, Texas, or such other points as may be deemed expedient by this corporation.

4.—The term for which this corporation is to exist is fifty years.

5.—This corporation shall be managed by a board of five directors. The names and residence of those selected to serve the first year are as follows:

Clyde T. Reed, Kingsville, Texas.
C. M. Adkisson, Denton, Texas.
J. K. Strecker, Waco, Texas.
W. J. McConnell, Denton, Texas.
H. B. Parks, San Antonio, Texas.

6.—This corporation shall have no capital stock; and it owns no goods, chattels, lands, rights or credits.

IN WITNESS WHEREOF we have hereunto subscribed our names on this the 12 day of November, A. D. 1929.

CLYDE T. REED,
C. N. ADKISSON,
W. J. MCCONNELL,
J. K. STRECKER,
H. B. PARKS.

Preamble

Be it Known to All People:—That we, the undersigned, desire to aid in the advancement of the present state of knowledge, to help in the dispersion of what is now recorded and to form an association for mutual betterment, do hereby adopt the following Constitution and By-Laws.

Be it Further Knowns—That an organization, entitled the Texas Academy of Science, was organized in 1892 with these same objects in view and continued in active operation up to 1912; that we know and are aware of the life and activities of that organization, and desiring to continue their good work, we have adopted the name, Texas Academy of Science and have modified the original constitution to the present need.

Be it Further Known:—That in the personal of the present organization there are, by their own will and action, a majority of the remaining members of the original organization and that no legal obstruction exists, therefore the following articles are adopted:

Article 1.—This constitution shall take precedence over and make null and void the original constitution of the Texas Academy of Science and any and all revisions of and amendments thereto.

Article 2.—All members and fellows of the old academy shall upon meeting the provisions of this constitution be regarded as members and fellows of The Texas Academy of Science under the present constitution.

Article 3.—Further, whatever funds remained in the treasury of the old organization shall be transfered by the last secretary-treasurer to the present secretary-treasurer. Any and all property still belonging to the original organization shall become the property of the present Academy and subject to the provisions of this Constitution.

Article 4.—All publications that may be issued shall be numbered so as to continue the series already published and shall conform to this series in size, make up, and character of contents.

Constitution and By-Laws

Article I.—Object

Section 1.—Name.—This organization shall be called "The Texas Academy of Science."

Section .—Purpose.—The purpose of this Academy shall be to stimulate scientific research, to promote fraternal relationship among those engaged in scientific work, especially in Texas; to diffuse among the citizens of the State a knowledge of the various departments of science; to investigate and report on any subject of science, or industry when called upon by any department of the state government; to arrange and prepare for publication such reports of investigation and discussion as set forth in these articles.

Article II.—Membership

Section 1.—Classification. The membership of this Academy shall be composed of active members, fellows, honorary members, and patrons.

Section 2.—Eligibility.—Any person engaged in scientific work or interested in the promotion of science shall be eligible to membership.

Section 3.—Active Members.—Active members may be annual members or life members. Annual members may be elected at any meeting of the Academy. To become an active member, the candidate will fill in the application form of the Academy, which when signed by two fellows and accompanied by the entrance fee and one year's dues shall be sent to the secretary, who will enroll the applicant as an active member subject to confirmation by election at the regular meeting of the Academy. They shall sign the constitution, pay their admission fee, and their annual dues before they are declared members. Any person who shall contribute twenty-five dollars (fifty dollars after 1932) to the funds of this Academy may be elected a life member of the Academy, free from assessments.

Section 4.—Fellows.—Any member of this Academy who is actively engaged in scientific reasearch or the administration of scientific pursuit may be elected a fellow. To become a fellow, the candidate must have held membership in the Academy at least one year prior to his application for fellowship. His application must be signed by two fellows who are acquanted with the experience and achievement of the candidate. He must present to the Academy for permanent file a copy of a publication of merit of which he is the author. When these requirements are met, the

Executive Council will present the candidate to the Academy at the annual meeting. If he receives two thirds vote, pays a fellow's fee of three dollars and the annual dues he is declared a fellow. All who were fellows in the former Academy may become fellows upon election to membership in the present Academy.

At the annual meeting for 1929 the members of the Executive Council and fifteen others shall be elected as the original fellowship. This group will be required to pay the fellow's fee and file the publications. The secretary shall prepare a list of fifteen members who are eligible for this first selection.

Section 5.—Honorary Members. — Anyone who has rendered distinguished service to the Academy or to Science may be elected an honorary member. This honor carries with it neither obligations or privileges.

Secton 6.—Patrons—Any person who shall at one time contribute one hundred dollars (five hundred after 1932) to the funds of this Academy may be elected a patron, who is a life member of the Academy and free from dues.

Section 7.—Dues.—The annual dues for the Academy shall be one dollar per year payable on or before the annual meeting. An entrance fee of two dollars must accompany every application for election into the Academy. A fee of three dollars must be paid by a member at the time he is elected to a fellowship.

Article III.—Sections

Section 1.—The Academy shall be divided into sections according to the major interests of its members. The present division shall be:

Section 1.

A (Mathematics), B (Physics), C (Chemistry),
D (Astronomy), M (Engineering).

Section 2.

E (Geology and Geography), F (Zoological Sciences),
G (Botanical Sciences), N (Medical Sciences),
O (Agriculture).

Section 3.

H (Anthropology), I (Psychology), K (Social and Economic Sciences), L (Historical and Philological Sciences),
Q (Education)

(The divisions given correspond to, and are lettered the same as the divisions of the American Association for the Advancement of Scence).

Section 2.—Each section shall elect one of its members as a Vice-President of the Academy.

Section 3.—A section may elect officers to serve its own organization providing such action is done with the approval of the Executive Council of the Academy.

Section 4.—Members shall designate the section to which they belong. A member may change from one section to another, provided that he notifies the Secretary of such a change at least two weeks prior to the annual election. He may take part in the work of two or more sections but in no case shall he vote except in the section he has designated. The Executive Council is authorized to make redivisions of the sections, when this need shall arise.

Article IV.—Inter-Organizations

Section 1.—Local Chapters. — The Academy may establish through the Executive Council a local chapter on receipt of a request to do so signed by ten members of the Academy in good standing, residing in the territory within which the club is desired.

Secton 2.—Officers of Local Chapters. — Such chapters shall appoint their own officers and committees and may make any rules for their government not inconsistent with the constitution and By-Laws of the Academy.

Section 3.—Territory.—The place of headquarters and definite territory selected by each Chapter within which its membership shall reside will be subject to the approval of the Council.

Article V.—Affiliated Organizations

Section 1.—Conditions.—Any organization now existing within the state, having a membership of more than ten and an object in organization which meets the approval of the Executive Council of this Academy may become an affiliated organization upon the approval of the Executive Council.

Section 2.—Manner of Affiliation.—The organization desiring affiliation must make application to the Secretary of the Academy for a certificate of affiliation. With the application there must be, at least ten (10) applications for membership into the Academy of Science from among the members of the organization, each accompanied by the dues for one year in the Academy. On receipt of the application, membership dues and upon proper election to membership in the Academy of such applicants, the certificate will be granted. Additional members of this organization may become members of the Academy without election by presenting evidence of membership in the affiliated body in place of the usual entrance fee and the payment of the annual dues of one dollar per member. Any organization now existing within the state among whose membership are ten or more, who are members in good standing and regular standing in the Academy, may secure a certificate of affiliation by application and presenting evidence of membership in both organizations of at least ten persons. Other members of such an organization have the privilege of becoming members of the Academy without the payment of the entrance fee.

Article VI.—Executives

Section 1.—Officers.—The officers of this Academy shall be a President, a Vice-President for each section and a Secretary-Treasurer. These officers shall perform the duties usually devolving upon such officers in similar associations. All officers of the Academy must be elected from the fellowship.

Section 2.—Executive Council.—The President, the Vice-Presidents, the Secretary-Treasurer and the retiring President shall constitute the Executive Council which shall transact any necessary business of the Academy not specifically provided for in this constitution. At any meeting of the Executive Council three members are authorized to transact business provided that sufficient notice is before sent to all the members of the Executive Council.

Section 3.—Board of Directors.—In order that the Texas Academy of Science may comply with the charter granted by the State of Texas and thereby make legal the actions of this body, a board of five directors will be chosen at each annual meeting. All directors shall be ex-officio. The Board shall consist of the elected officers. The President shall be the chairman of the Board. This Board shall have authority in all the legal relations of the Academy.

Section 4.—Term of Office.—All elective or appointive officers, with the exception of the Secretary-Treasurer, shall hold office until the succeeding annual meeting. The Secretary-Treasurer shall be elected for a period of two Academy years. The Executive Council shall fill by appointment all vacancies that arise.

Article VII.—Committees

Section 1.—Program Committee.—There shall be a program committee to consist of the Secretary-Treasurer of the Academy as Chairman, and the Vice-Presidents of the sections with such other persons as may be appointed by the President. The program committee shall arrange for the meetings of the Academy, as constitutionally provided and for such other special meetings as may be called by the Executive Council.

Section 2.—Publication Committee.—This committee shall consist of the Vice-Presidents of the sections, the Secretary-Treasurer and the authors of the papers to be issued. The Secretary-Treasurer shall be the chairman. This committee shall have the power to pass on all papers offered for publication.

Section 3.—Auditing Committee.—The President shall appoint at each meeting two members of the Academy not otherwise officers who shall audit the accounts of the Treasurer and report before the adjournment of the meeting.

Section 4.—Legislative Committee. — The Executive Council may appoint a standing committee on legislation whose duties shall be to familiarize itself with proposed legislation on matters of scientific interest, and to represent the Academy in dealing with any legislative proposals of interest to the Academy.

Section 5.—Nomination Committee.—At the opening of each annual meeting the President shall appoint a committee to present nominations for all officers and fellows to be elected.

Any section, district, club, or affiliated organization may present nominations for fellowship to ths Committee.

Section 6.—Publicity Committee.—This committee shall consist of three members appointed annually by the president. It shall be the duty of this committee to place the Academy and its work before the people of Texas in the most favorable way possible and to keep the public advised of the achievements and undertakings of the Academy and its members. Also, to serve as press representatives of the Academy at all times. All official statements must be passed upon by the president or, in his absence, the Secretary-Treasurer, before releasing to the press.

Section 7.—Membership Committee. — This committee shall consist of three members, appointed annually by the President. it shall cooperate with the Secretary-Treasurer in increasing the membership of the Academy.

Section 8.—Special Committee.—The president may at any time appoint any special committees that he may deem necessary or advisable. Such committees shall not function longer, without re-appointment, than the term of the president creating them.

Article VIII.—Procedure

Section 1.—Meetings.—The annual meeting of this Academy shall be held on the Friday and Saturday following Thanksgiving each year, unless otherwise ordered by the Executive Council, and at such a place as said Council may deeme convenient or expedient. Other meetings of the Academy may be called at the discretion of the Executive Council, provided that the electoin of officers may occur only at the regular meetings.

Section 2.—Amendments.—This constitution may be altered or amended at any annual meeting of the Academy by a three-fourths majority of the attending members of at least one year's standing; provided that no such question of amendment shall be decided on the day of its presentation.

By-Laws

1.—The President shall deliver a public address at one of the sessions of the annual meeting at the expiration of his term of office.

2.—The time allotted to the presentation of a single paper shall not exceed fifteen minutes except as provided for by the program committee.

3.—The order of business of the Academy shall be:—(1)—Call to order. (2)—Statements by President. (3)—Reading of the minutes of the previous meeting. (4)—Appointment of committees as may be necessary, and hearing of any and all proposed amendments to the constitution or by-laws. (5)—Program. (6)—Reports of officers. (7)—Reports of Executive Council. (8)—Reports of standing committees. (9)—Reports of special committees. (10)—Unfinished and deferred business. (11)—New business. (12)—Announcements and miscellaneous business. (13)—Election of officers. (14)—Election of fellows. (15)—Election of members. (16)—Adjournment.

4.—Ten per cent of the membership in good standing shall constitute a quorum for transaction of business.

5.—Money received through contributions of patrons and life members shall be invested as a permanent fund, the interest on which may be used toward paying for the printing of the transactions of the Academy or for such other purposes as the Council may determine.

Officers 1929-1930

President, Prof. C. T. Reed, Kingsville.
Vice-President—Section I.—O. W. Silvey, College Station.
Vice-President—Section II.—Dr. B. C. Tharp, Austin.
Vice-President—Section III.—W. J. McConnell, Denton.
Sec'y-Treasurer—H. B. Parks, Route 1, Box 368, San Antonio.

Fellows

Adkisson, C. M., Denton.
Bantel, Dr. E. C., Austin.
Barcus, Prof. J. M., Arlington.
Benedict, Dr. H. Y., Austin.
Bilsing, Dr. S. W., College Station.
Birge, Miss W. I., Denton.
Burt, F. A., College Station.
Carter, W. T., College Station.

Conner, Director A. B., College Station.
Cory, V. L., Sonora.
Culyer, Prof. R. H., Austin.
Dodd, Dr. E. L., Austin.
Ferguson, Mr. A. M., Sherman.
Francis, Dr. Mark, College Station.
Fraps, Dr. G. S., College Station.
Geiser, Dr. S. W., Dallas.
Godbey, Prof., Georgetown.
Harris, Prof. B. B., Denton.
Harper, Dr. H. W., Austin.
Isely, F. B., Fort Worth (Dean).
Kuehue, Dr. J. M., Austin.
Lewis, Dr. I. M., Austin.
Mally, F. M., San Antonio.
Masters, Prof. W. M., Denton.
Mather, Dr. W. T., Austin.
McConnel, W. J., Denton.
Parks, H. B., Rt. 1, Box 368, San Antonio.
Patterson, Dr. J. T., Austin.
Pearce, Dr. J. E., Austin.
Plummer, Mr. F. B., Austin.
Quillin, Mrs. E. S., San Antonio.
Reed, C. T., Kingsville.
Reinhard, H. J., College Station.
Romberg, Dr. A., Austin.
Silvey, Dr. O. W., College Station.
Schoch, Dr. E. P., Austin.
Simonds, Dr. F. M., Austin.
Strecker, J. K., Waco.
Taylor, T. U., Austin.
Tharp, Dr. B. C., Austin.
Udden, J. A., Austin.
Whitney, Dr. F. L., Austin.

Members

Adams, Mr. B. T., 2172 Avenue X, Wichita Falls.
Alexander, E. R., College Station.
Armendt, Prof. B. F., Austin College, Sherman.
Baker, Mrs. H. A., Stephenville, Texas.
Baker, H. A., John Tarleton Agricultural College, Stephenville.
Bass, Prof. S. W., College of Arts and Industries, Kingsville.
Bawden, Dr. A. T. Baylor University, Belton.
Bobo, Prof. Ralph, Belton.
Brady, Prof. T. H., East Texas State Teachers College, Commerce.
Brown, Prof. L. S., University of Texas, Austin.

Brown, Prof. T. T., East Texas State Teachers, College, Commerce.
Carroll, Mr. J. J., P. O. Box 386, Houston.
Cook, Prof. R. J., College of Arts and Industries, Kingsville.
Crenshaw, Mr. G. S. P., Georgetown.
Cribbs, Prof. W. J., State College of Women, Denton.
Crimmins, Colonel M. L., Fort Sam Houston.
Cushing, Mr. A. B., 315 Halliday Ave., San Antonio.
Cushing, Mr. M. C., Menard.
Damon, Mrs. H. G., University of Texas, Austin.
Doak, Mr. C. C., College Station.
Fletcher, Dr. R. K., Texas Agricultural Experiment Station, College Station.
Godbold, Dr. E., Howard Payne College, Brownwood.
Goldsmith, Dr. G. W., University of Texas, Austin.
Gore, Mr. T. U., College Station.
Harris, Miss Fay, East Texas State Teachers College, Commerce.
Hawtof, Mr. E. M., 309 Amicable Building, Waco.
Horlacher, Dr. W. R., College Station.
Howard, Mr. C. A., 3120 Princeton Avenue, Dallas.
James, Prof. W. A., Galveston Public School, Galveston.
Jones, Prof. E. M., Baylor University, Waco.
Johnston, Mr. H. G., College Station.
Le Compte, Prof. W. H., College of Arts and Industries, Kingsville.
Little, Mr. V. A., College Station.
Loring, Porter, 206 Jefferson St., San Antonio.
Lutz, Prof. C. M., East Texas State Teachers College, Commerce.
May, H. Y., 1738 W. Gramercy, San Antonio.
Maisteller, Dr. R. P., College Station.
McAllister, Dr. F. M., University of Texas, Austin.
Morrow, Miss Marie, University of Texas, Austin.
Nierman, Dr. J. L., College of Arts and Industries, Kingsville.
O'Neill, Mrs. Mike, 1311 Bonham, Commerce.
Oliver, Mr. C. P., University of Texas, Austin.
Oppe, Miss Greta, 1609 Avenue K, Galveston.
Parks, H. B., Jr., 2501 Nueces Street, Austin.
Parsons, Prof. L. D., East Texas State Teachers College, Commerce.
Patton, Dr. L. T., Texas Tech., Lubbock.
Plummer, Mrs. F. B., 608 W. 7th Street, Austin.
Pope, Prof. M. D., San Angelo Junior College, San Angelo.
Potter, Dr. O. E., Baylor University, Waco.
Rea, Homer E., Temple.
Reid, Mrs. Bessie M., Port Arthur.

Reynolds, Mr. E. B., College Station.
Rix, Prof. R. A., Sam Houston Teachers College, Huntsville.
Sandlin, Mr. L. V., Alief, Texas.
Sinclair, Prof. J. F., Box 167, Kingsville.
Smith, Elmer, College Station.
Smyre, Prof. S. H., Caldwell.
Stenzel, Dr. H. B., College Station.
Stewart, Dr. W. A., Rice Institute, Houston.
Thomas, Dr. F. L., College Station.
Watson, Mr. E. H., East Texas State Teachers College, Commerce.
West Texas Historical and Scientific Society, Alpine.
Winebranner, Dr. E. O., Howard Payne College, Brownwood.
Whitley, Dr. S. H., East Texas State Teachers College, Commerce.

Texas Academy of Science

ANNUAL MEETING

College Station, November 29-30, 1930

Papers Presented and Read by Title

Presented

1.—"Chemical Factors of the Soil Which Influence Plant Distribution and Plant Physiological Behavior," Vernon A. Young, A. & M. College.

2.—"The Correlation Between Plant Communities and the Microflora of the Soil." With maps and charts. Miss Marie Morrow, University of Texas.

3.—"Notes on the Vegetation of San Marcos River Head Water." With maps, charts, and slides. Gustav Watkins, University of Texas.

4.—"The Hybridization of Indian Corn and Related Species." With slides. P. C. Magelsdorf, Texas Experiment Station.

5.—Report on "Some Work Being Done on Datura at Cold Spring Harbor with Special Reference to Pollen Tube Investigation." With drawings and slides. C. C. Doak, A. & M. College.

6.—"The Spread of the Various Culture Units Among the Aboriginal People of the Southwest." With colored slides. Colonel M. L. Crimmins, U. S. A. Retired, San Antonio.

7.—"Kitiness in Pigeons," W. R. Horlacher, A. & M. College.

8.—"Clay-Galls—Their Origin and Significance." With slides and specimens. Frederick A. Burt, A. & M. College.

9.—"Molluscan Animals in Relation to the Social Life or Man." J. K. Strecker, Baylor University.

10.—"Educational Work in Yellowstone National Park." Dr. E. N. Jones, Baylor University.

Lecture Open to the Public

"Poisonous Snakes of Texas and the Treatment of Their Bites." Films made by the Antivenom Institute of America, Colonel M. L. Crimmins, U. S. A. Retired, San Antonio, Texas.

Read By Title

1.—"Some Texas Liverworts," Dr. Frederick McAllister, University of Texas.

2.—"Chemical Character of Underground Waters from Eocene Formation of Southwest Texas," J. T. Londsdale, A. & M. College.

3.—"Major Structural Features of the Gulf Coast Region." H. E. Stenzel, A. & M. College.

4.—"Scientific Disposal of Dairy Waste," P. J. A. Zellner, A. & M. College.

5.—"Texas Cacti." Ellen Schulz Quillin, Witte Museum, San Antonio.

Report of Treasurer

November 29, 1928—November 30, 1929

Receipts from fees and dues.............76 members		$240.00
Expenses itemized in report of May 24	$114.10	
June 6 From Standard Printing Co.		
500—No. 10 envelopes		
1000—Letter head	10.75	
From Darley's Dup. shop		
Postage, addressing envelopes	5.65	
July 13, from Darley's Dup. shop		
1 set letters. 1 set lists (2 sheets)		
1 set ballots, stamps	8.87	

October 28, from Darley's Dup. shop Notice of annual meeting	2.75	
November 1. Expenses incured in arranging Oberholser meeting	7.50	
November 18. Stenographic help for year	4.50	
November 23. Expenses for Charter	15.00	
Total Expense	$169.12	
November 30. Cash on hand	70.88	
	$240.00	$240.00

H. B. Parks, *Treasurer.*

Report of Auditing Committee

We have examined this account and compared the items with the original statements and receipts and have found this report correct.

F. L. Thomas
A. B. Cushing
J. C. Sinclair.

NIGHT-BLOOMING CEREUS—*Acanthocereus pentagonus*

A Mexican species extending into Texas near Brownsville. One of the two native night-blooming cacti in Texas.

PROCEEDINGS OF THE TEXAS ACADEMY OF SCIENCE
VOLUME XIV

Texas Cacti

A popular and scientific account of the Cacti native of Texas

by

Ellen D. Schulz, M. S.,
(MRS. ROY W. QUILLIN)

Author, **Texas Wild Flowers**
Fellow, Texas Academy of Science
Director, Nature Study and Science
San Antonio Public Schools
Director, Witte Memorial Museum

And

Robert Runyon

Member, Texas Academy of Science
Photographer of Wild Life

TEXAS ACADEMY OF SCIENCE
PUBLISHERS
San Antonio, Texas
1930

Foreword

The purpose of assembling these notes and data was to meet the need for a handbook which would give information and make possible the easy identification of Texas Cacti. Much of the material contained was compiled from the experience and observations of others. Acknowledgements are gratefully made to the following:

1. Carnegie Institution at Washington, D. C. for the privilege of copying scientific description as given in their splendid four volume work "The Cactaceae" by Britton and Rose.

2. To Dr. John K. Small for valuable assistance in identifying species.

3. To Edwin G. Bogush, Plant Taxonomist, University of Illinois, for part of the Introduction and Key to the Opuntias

4. To Mr. E. Mortensen, formerly Assistant Entomologist, Australian Prickly Pear Investigations, Uvalde, Texas, and now in charge of the Winter Garden Substation of the Texas Agricultural Experiment Station, and by whom the articles on Diseases and Insect Enemies were written.

5. To Mr. William E. Hess, of the San Antonio Floral Company for valuable notes and proof-reading the manuscript.

6. To Miss Eleanor Onderdonk, Curator of Art, Witte Museum, San Antonio, for the cover design.

7. To Laidlaw Brothers, publishers of *Texas Wild Flowers,* who permitted the use of six plates from that volume.

8. To the following members of the Texas Academy of Science for furthering the publication of the manuscript:

Mr. Clyde T. Reed, *President.*

Mr. H. B. Parks, *Sec'y-Treas.*

Dr. B. C. Tharp, *Chairman Botanical Section.*

Ellen Schulz Quillin
Robert Runyon.

San Antonio, Texas,
February, 1930.

Table *of* Contents

Introduction

In the widespread conception a cactus is usually a plant in which the thorny feature is predominant, and with this idea there is in some way connected the thought of dry hillsides and desert country. In the greater part this is true, for with the exception of the so-called Burbank cacti and occasional specimens, practically every member of this family of plants native of North America bears a few or many spines which protect them well against the ravages of animals.

DISTRIBUTION

The cactus group represents a case of optimum adaptation to their natural environment, and the members reach their greatest expression in the semi-arid and desert regions of the world. Nevertheless, not all forms are confined to such areas of minimum rainfall, for within the borders of the United States a few of the prickly pear relatives range eastward to Massachusetts and the Atlantic Coast. Texas, however, boasts of the most varied assortment of forms found anywhere in the Southwest, and from central Texas westward to the Trans-Pecos Region they become increasingly abundant and diversified in form.

GENERAL CHARACTERISTICS

None of the cacti except a few tropical genera (*Pereskia and Pereskiopsis*) bear leaves. The broad and flattened leaf-like "joints" (cladophylls) of the common "nopal" or prickly pear are greatly modified stems that serve all the functions of the leaf. In all other forms the shape of the stem is usually cylindrical, for in this manner the plant can provide the greatest storage capacity for the water necessary for its vital activity with the least exposure of surface. Further protection is gained against evaporation by a covering of waxy material on the surface that effectually seals all but very minute microscopic openings (breathing pores or stomata) against water-loss. So perfect is this protection that the cacti can often thrive where few other plants can exist. Indeed, it has been the writer's experience to have specimens of *Echinocereus* that were left without any provision for moisture or food in the laboratory for more than a year resume their activity and grow when suitable conditions were provided. In only one genus (*Opuntia*) represented in Texas are leaves, in even a rudimentary form, to be found. These minute fleshy projections that clothe the young growing joints of the prickly pear and out of whose axils the spines grow are what remains of leaves, and with the maturing of the flattened leaf-like joints, the functionless leaves die and drop away.

GENERAL CLASSIFICATION

Those who have given more than a passing thought to our cacti soon learn to recognize several distinctive forms. The most common of these is the prickly pear just mentioned with its flattened stems, the individual joints of which vary from less than three inches in length to over a foot and produce by their irregular arrangement the tall bush-like plants prominent over much of our area.

Another form is typified by the slender branched *tasajillo,* also an *Opuntia,* whose habit is that of a low shrub, growing often in masses and forming one of the features of the chaparral country. The term chaparral is a misleading word applied indiscriminately to any aggregation of thorny shrubs. The yellow flowers, often less than ½ inch in diameter, usually pass unnoticed, but anyone so fortunate as to see them will forget the strong spines that render the plant objectionable and will admire the delicate petals and the daintiness of the flower. The fruit that follows is a red berry-like organ about the size of the last joint of the small finger on one's hand.

There is a third general group that passes locally under several different names, each applied to certain species. They are often called "devil's pin cushions" and "pancake cacti." There are three common genera represented in this group and some less closely related genera confined to western Texas and beyond. The tallest of these seldom grow more than a few inches high.

The first of these is the little *Echinocereus,* characterized by its grayish white appearance due to the dense covering of radially disposed spines. These spines are borne in regular rows down the side of the stem and are set close together. The ridges on which the spines are borne are either straight or twist to the right or the left according to the species examined. The total height of these plants found within our range is seldom over six or eight inches and usually much less, while the diameter is usually below a maximum of three and a half inches. In early spring, the plants are conspicuous because of their delicate rose-colored flowers, lasting seldom more than a day each. As in all cacti except those of the tropics, those of the same species usually bloom simultaneously, and on gravel slopes where plants of *Echinocereus reichenbachii* occur, the scene will suddenly become resplendent with delicate pink color; and at such times the bees find a harvest of nectar they cannot well refuse.

The genus of *Echinocactus* is somewhat more varied in size, although those in our area are comparatively small forms usually growing flush with the surface of the ground or rising but a few inches above it. Again, these plants have clear-cut similarities in that the body of the plant is divided into prominent vertical ridges on which the spines are borne. The spines are usually much coarser and stronger than in the preceding genus, and may be arranged with or without a central spine, which in a few forms may be decidedly recurved to give the plant the name of "fish-hook cactus." The giant barrel cactus of the desert country of Arizona and beyond, whose ample water storage capacity has often saved the lives of weary and thirsting travelers, is a member of this genus.

The third one of these low flattened cacti is the genus *Mammillaria,* very easily recognized because the ridges are replaced by small conical tubercles, at the summit of which is borne a slender group of white or reddish spines arranged radially like the spokes of a wheel. With hardly an exception these plants grow flush with the surface of the ground. A few larger ones are conical and thus rise somewhat above it, and were it not for the bright red fruits many would pass unnoticed. The fruits of practically all members of the genus are edible, with a varying amount of acidity, giving the fruit of some species a decided strawberry flavor. A few of the species grow in masses, but the majority are solitary.

In the Trans-Pecos region of Texas one encounters now and then smooth forms in which the tubercles are very much flattened. These species have recently been taken out of the genus *Mammillaria.* One is the so-called living rock cactus or the Texas star cactus (*Ariocarpus fissuratus*) and the other the "dry whiskey" or peyote (*Lophophora williamsii*), much sought after by certain tribes of Indians who still use this cactus in their ceremonial rites.

The most conspicuous of the cacti of western Texas and on the western edge of the Staked Plains is the tree cactus or cane cactus (*Opuntia arborescens*), whose latter name is derived from the use the Mexicans make of the long slender joints. The softer parts are allowed to decay, leaving the woody skeleton behind. This resembles very much a skilfully plaited fiber cylinder but is really very stout and polishes beautifully to produce the canes and walking sticks sometimes offered to tourists who cross into Mexico.

In a few isolated parts of the Rio Grande Valley just below the Big Bend country another slender stem cactus (*Wilcoxia poselgeri*) is found. The stems are scarcely larger than the *tasajillo,* but they are clothed with small soft spines. It can be found occasionally in the protecting shade of mesquite bushes and other small shrubs. On the higher mountains of Trans-Pecos Texas are other forms whose relationships are less clearly defined, including low forms of *Opuntia* that often look like members of *Echinocactus.*

EARLY HISTORY

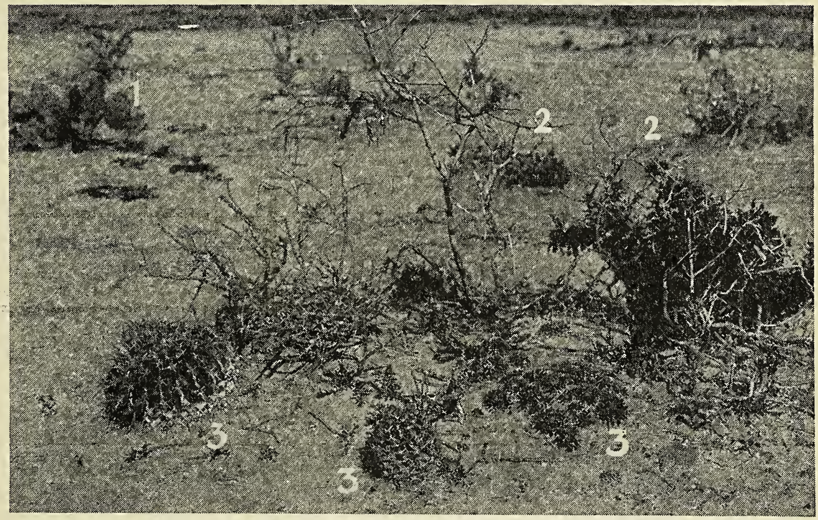
Many accounts of cacti are found in the earliest published reports of the introduced and cultivated plants of European gardens. These plants were carried back to Europe by English, Dutch, and Spanish traders on their return trips from the West Indies, Mexico, and South and Central America. In 1753, when Linnaeus published his *Species Plantarum,* twenty-two species were listed and recognized. All these were included under the Genus *Cactus.* The common name was "thistles" doubtless in reference to the spiny character of the plants. They were further dividend into the "melon thistles" and the "torch and candle thistles." The "Melon thistles" were the more or less globose forms, and the "torch thistles" the taller forms.

Since that time importations into Europe have increased, and many new forms were described by Salm-Dyck, Link and Otto, Haworth, P. DeCandolle, Lemaire, Pheiffer, Schumann and others. A little later, but contemporaneous with the latter named botanists of Europe, America contributed her part in research and in naming this great and interesting family. Chief among these workers are Engelmann, Lindheimer, Griffiths, Rose, Britton, Standley, and Small.

GEOGRAPHICAL DISTRIBUTION AND RELATION TO SOIL AND CLIMATE

The Cactaceae (cacti) are almost entirely confined to America, the only exception being a few species of the Genus *Rhipsalis*. Cacti of this genus are epiphytes with semi-transparent glutinous berries, many of them resembling mistletoe more than cactus.

It is common to regard cacti as tropical or sub-tropical plants, but there are a number which withstand the more severe winters



While some cacti limit themselves to one hillside in distribution, others are more sociable as shown here. Neomammillaria hemisphaerica, Homalocephala texensis, Hamatocactus setispinus, Ferocactus hamatacanthus, Opuntia leptocaulis, and Opuntia lindheimeri are all growing within a few feet of each other on a clay dune. Note the three general types as described: the broad flat jointed forms (1); the slender branching more or less upright form (2); the globular types (3).

or northern climates. Several Opuntias extend in range as far as British Columbia in the Northern Hemisphere, and as far as Chile, Argentina, and Uruguay in the Southern Hemisphere. Again several species of *Echinocereus* and *Mammillarias* are to be found native to Colorado. Others are found on islands and along the seashore.

Individual species of cacti are often of very limited distribution.

Every hillside may yield a different form, or contrarily certain areas will support only one definite species. Opposed to this habit are several species such as *Opuntia leptocaulis* and *Opuntia lindheimeri,* which have a state wide distribution. The Opuntias are rarely found in acid soils along the Texas Coast. As a whole cacti are essentially children of the sun.

RELATION TO RAINFALL

With continuous data for fifty years on the rainfall of the State available, it is definitely known that the average rainfall in the far eastern part of the state is as much as fifty inches, and that it drops off roughly one inch to a degree as one travels westward toward El Paso. The cacti (except some Opuntias) being semi-desert plants by preference become more numerous westward.

GENERAL STRUCTURE

The Cacti have a more or less pronounced woody axis usually surrounded by pulpy cellular tissue in which water is stored. The transpiring surface is much reduced and the stomata (breathing pores) are usually situated in depressions or grooves in the wax-covered leathery cuticle of the stem. As an additional means of checking transpiration, the plant tissue is nearly always mucilaginous, and in some genera there are latex ducts filled with a milky or gummy fluid.

LEAVES AND AREOLES

Some cacti have leaves. In most species these are rudimentary and so small that they cannot be seen with the naked eye. In others of the genus *Pereskia,* they are large and perfectly developed, often with petioles and broad blades. In the genus *Opuntia* they are awl-shaped and drop off early.

In the axils of the leaves are areoles. These are little cushions clothed with down or felt-like wool from which the spines issue, and in some species the flowers also. In the genus *Opuntia* and *Pereskiopsis,* in addition to the spines, they usually bear a tuft of small short barbed bristles, called *glochidia.*

SPINES

The spines are not connected with the woody axis of the stem or branches, but emerge from the areoles. Most cacti bear two types, namely central and radial spines. The radial spines are usually small and weak. The central spines are generally erect or projecting, and either straight and rigid or curved.

In some species the spines are straight, bristle-like, and awl-shaped, or short and conical. In others they are bent at their tips like fishhooks, or curved and hornlike, often with transverse ribs. Sometimes they are minutely pubescent or hairy, and sometimes even plumose or feathery. They may be grouped in star-like clusters, with straight or curved rays spreading from a common center, or in pectinate fasciles with the radial spines arranged comb-shaped in two rows on each side of a longitudinal axis.

USES OF SPINES

Fishhooks were reported by Dr. Edward Palmer as being used by the Mohave Indians of the Colorado River. Quoting William Edwin Safford, in "Cactaceae of Mexico," Annual Report of the Smithsonian Institution, 1908, we have the following interesting information. "Fishhooks with straight shanks of bone and barbs of cactus spines were dug up by the writer from prehistoric graves at Africa, on the Coast of Chile, in 1887. They were associated with other articles made of cactus spines, such as needles and combs. In December, 1891, the writer assisted at the opening of several other graves at Iquique, on the same coast, in which not only hooks and needles of the same description were found, but interesting examples of the application of cactus spines to the mending of slits in seal-skins which had been used for covering the graves. In these the spines were stuck like awls through both margins and allowed to remain with the ends projecting. Around the ends thread had been passed in a zigzag manner and drawn tight, thus closing the slits tightly and effectively."

FLOWERS

*In most genera the flowers issue from the upper part of the areoles. But in some species of *Mammillaria* and allied genera they grow from between the mammillae, or from near their base at the end of a groove extending backward from the areole. The flowers are usually solitary and sessile but in the genus *Pereskia* they are peduncled and clustered.

*—Taken for the most part from Cactaceae of Mexico—Safford.

In nearly all genera they are conspicuously colored in tints of rose, crimson, purple, yellow, orange or copper, and sometimes scarlet. Often they are pure white, gradually becoming rose tinted in age. Some are large, and when wide open are as many as five to ten inches across, and some are small and inconspicuous as the greenish blossoms of the *Tasajillo.* Some are nocturnal as the *Echinopsis* and *Cereus,* but most of them are diurnal. Some open at sunrise and close at night or when the sky is clouded; others open at a certain hour and close at a certain hour of the day or night; some, like *Echinocereus triglochidiatus* last for several days, some for a day, and some for only a few hours.

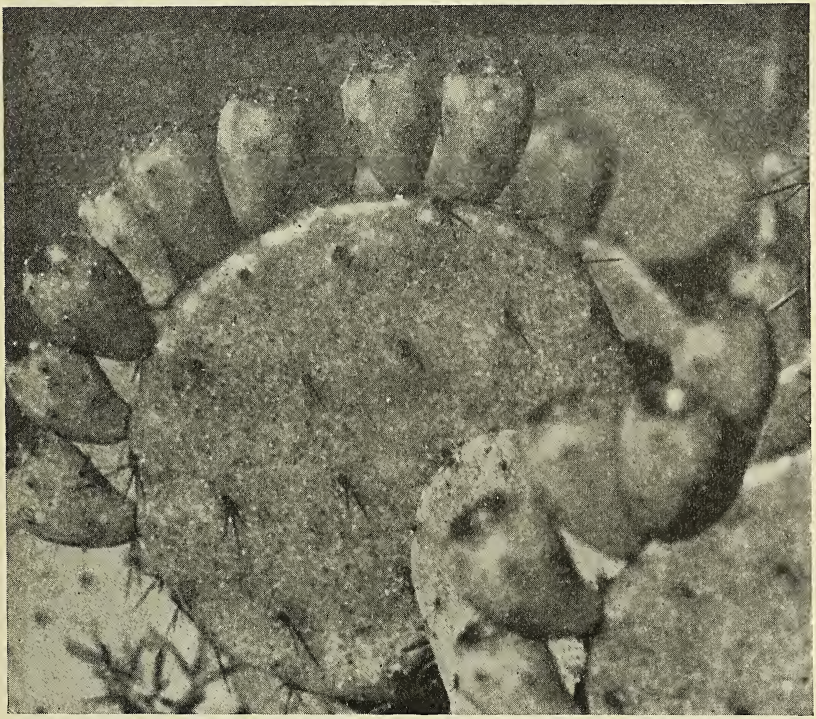
The flowers do not possess a well-defined calyx and corolla, although the outer floral leaves are often quite sepal-like and the inner ones true petals. The floral leaves are not arranged in definite series, but form a spiral in which the scale-like lower bracts gradually assume a sepal-like appearance and at length become broad and petaloid. In all cases the perianth crowns the ovary, and often after withering it persists as a crown to the fruit. The stamens are numerous and are inserted on the petals or perianth tube. The style is robust and longer than the filaments. It usually expands at the summit and bears a stigma divided into five to ten rays. Sometimes the stigma is brightly colored and looks like a star issuing from the dense cluster of anthers.

The ovary, though formed of several carpels, is always one-celled. The placentae are parietal and bear an indefinite number of anatropous ovules. In some genera (the *Opuntia* and its allies) the funiculi, or ovule stalks, become thick and fleshy.

FRUITS

Many species of Texas cacti bear edible fruit. In Texas and Northern Mexico several long-spined *"alicoches"* are known as "strawberry cactus" from the flavor of the fruits. They vary in size from those as large as figs to the small currant-like berries called *"garambullas"* in Mexico.

The fruits of many species of cacti are very refreshing, nourishing, and agreeable to the taste. This is especially true of many species of the *Opuntias* and a few species of *Lemaireocereus* and *Echinocereus.* In certain part of Mexico the *tunas* form an important part of the diet of the poor natives. In other parts, the *Opuntias* are cultivated, and the *tunas* sold on the market among all classes. *Tunas* are imported to the United States regularly and sold in city markets. The outer part is peeled like one pares an apple. The inner pulp is eaten. *Tunas* usually possess a pleasant flavor and have the added quality of giving the consumer the impression that it is cool even in the hottest weather. *Chilitos* is the other common edible fruit, these being the smaller club-shaped crimson fruits of a number of *Mammillarias*.



Tunas studding the joints of the prickly pear in **Opuntia lindheimeri.** The coyote is particularly fond of these tunas which are covered with spine clusters. He brushes the spines off with his tail, removes the **tunas** with his foot; then eats the **tunas** in comfort.

*The fruits of the prickly year vary in size, shape, and color, depending upon the specias and conditions under which they are grown. They are from one to three inches in diameter and are usually pear or fig-shaped, but in some species they are nearly spherical. They will weigh from an ounce to a half pound or more, and vary when ripe from a yellowish-green to a dark purple color.

*From Bulletin No. 64, April, 1927, New Mexico College of Agriculture and Mechanic Arts.

All varieties of prickly pear have minute spicules arranged in bunches over their surface, there being about one bunch to every square inch of surface in the best varieties, but in most species they are more numerous than this. The fruits of nearly all of the species have large spines also, which correspond to those of the plant body, but they are much more delicate and usually drop off before tht fruits are thoroughly ripe. A cross section through the fruit shows it to be covered with a thin skin or epidermis, underneath which there is a rind varying in thickness from one-eighth to one-half inch. This includes the pulp or edible portion in which there are found inbedded from one-hundred to two hundred seeds. In some fruits we have counted as many as four hundred."

SPINELESS CACTUS

Among all pad-cacti are individuals which drop their spines just as other plants drop leaves. Thus, the finding of a plant without spines is often announced as a new spineless cactus, but much to the disgust of the discoveror the next spring a fine crop of spines shows the plant to be the common species.

There does occur, but widely scattered in location and time, plants of Pad-cacti that never develop spines and which have poorly developed areoles. These true spineless cacti are lethal mutations of the species common where they are found. These plants seldom make fruit and most of that which is developed does not contain viable seed. The only way of perpetuation is by cuttings and as the pads are dainty morsels to rabbits, rats, deer, and other animals, the plant is hard to grow. Bereft of its protecting thorns and power to produce seed the plants soon disappear. Several years ago the spineless cactus was heralded as the coming crop for semi-arid sections, but for the reasons given proved a failure.

Spineless cactus has been cultivated in southern Europe for many years and was early reported from Mexico. There are two common forms cultivated in Texas, one with oval and the other with round pads. Plant folk-lore says that oval pads come from Mexico and the round pad from a location just west of the city of El Paso. A form with large oval pads is sometimes met with under the name of Burbank's cactus. In locations where cactus fruits form an important item of food, the growers have, by many years of pad selection, produced varieties having large sized fruits, especially valuable as they are seedless.

Cactus Culture

PROPAGATION FROM SEEDS

Most cacti yield seeds abundantly. Few of the seeds, however, germinate and develop into mature plants because of unfavorable environment. When planted under proper conditions a large percentage will germinate and with a little care develop into healthy plants.

The best soil for growing cacti from seed is a thoroughly decomposed sod mixed with an equal amount of clean sand. When these have been thoroughly mixed, run the material through a sieve of about one fourth inch mesh. This will remove all large particles and any superfluous root fibers. Screening also forms a loose soil which drains very readily. The soil need not be rich in humus. Avoid manured soils because of their undue tendency to hold moisture.

Next, secure a shallow wooden box of convenient size, something about 18 by 24 inches and four inches deep. Or, use a large flower pot saucer. Fill it to within one inch of the top with the prepared dirt. Sow the cactus seeds and cover with very fine soil. Then spread a layer of fine gravel to the depth of about one-fourth of an inch.

This layer of gravel is important. As the box is later watered with a fine spray, it prevents the surface of the soil from washing and consequently keeps the seeds from being disarranged. It also promotes the free passage of moist air through the spaces between the bits of gravel, which together with the shading by the gravel, prevents the surface of the soil from becoming dry and baked.

Next, cover the top of the box with fine mesh screen wire and fasten the ends with tacks to keep the wire from sagging. This gives protection to the seed during hard rains and when sprinkling, and protects the young plants from birds and large insects. The wire also helps to shade the delicate young plants.

For the first few months of their existence, cactus seedlings are small, globular or cylindrical bodies, composed of very thin-walled cells filled to turdigity with water. They are so tender and delicate that they readily "damp off" if subjected to a sudden change from a high to a low temperature. The death rate of seedlings from this cause has been greatly minimized by the use of the gravel over the surface of the soil. This layer, with its intervening spaces, acts as a protection from sudden changes in temperature. The little seedlings have exceedingly fine and delicate roots, which spread out near the surface of the soil. If this surface is allowed to dry out these delicate rootlets are destroyed and the seedlings are either damaged or killed. The temperature should be kept about 70°F.

Never allow the soil to become water-logged. While the young plants require moisture, they cannot stand too much water at one time. Always remember that cacti are desert plants and when full grown, they live for many months without water, and that the young seedlings that do survive are those that are fortunate enough to have been seeded near a tree trunk, or a large rock, or other protection. These hold moisture and protect the little seedlings. Millions of young plants perish each year in the desert for lack of moisture at the right time.

When sprinkling, use a fine spray and do not throw the water on in large gushes. Water the plants every day. After the plants are crowding each other and are of fair size, transplant them to pots that are filled with the same kind of soil as above mentioned. Continue to keep them slightly moist but lesson the amount of water as the plants grow older and larger.

PROPAGATION BY CUTTINGS

Many cacti produce offsets in abundance at the sides or the base of the plant. These may be separated from the mother plant and placed on earth to form new individual plants.

In some species where offsets are not produced, individual tubercles may be cut out. These should be exposed to the sun for a short time in order to form a callous over the cut section. The callous will prevent disease bacteria from entering. When placed on soil a good percentage of these cuttings should take root.

The easiest of all cacti to propagate are the *Opuntias*. In this genus, any joint may be separated from the parent plant. Care should be taken to callous the ends. This is done by exposing to the sun for several days. Place the joints flat on the surface of the ground. Roots soon develop from the under side of the pads.

GRAFTING

Grafting is principally done to preserve species of cacti that are susceptible to rotting from contact with moist earth, to produce a quicker growth, and to improve the blossoms. Also, by selecting a hardy stock, the more delicate species can be lifted from the ground, and in that way can be seen and enjoyed. It again comes into use in producing "freak and ornamental" effects. For this purpose, certain stems of the upright stiff-stemmed *Cerei* and *Pereskias* produce the best stock.

Grafting cacti is a simple process. For slender varieties wedge, cleft or saddle grafting is the best method. This method gives a good surface for further union of the tissues. Cut back stock to the height wanted, then split stock at the top (cut end), cut scion to a wedge-shape and insert in the split stock. Hold in place by running a cactus spine through in one or two places. To hold cut edges even more firmly together, put on a split stick like a clothes pin. Be careful to put it on tight enough to hold the graft from opening and still not so tight as to hurt the plant. Wax is not required. Leave splint on from five to ten days. A perfect union should take place in that time.

Remove any growths that may arise on the stock later so that full strength may be given to the newly grafted scion.

Where a globular species is to be grafted, select a stout-stemmed *Cereus* for the stock. Cut top of stock into cone-shape and fit carefully into a hole in the scion that is cut to fit the cone of the stock. Fasten by running two or three spines through the edges. If not firm, use twine to hold the scion more securely.

DRAINAGE

Good drainage is all important. Few species of cacti live in places of poor drainage. Do not let plants remain dry any length of time as the fine roots will be injured. Keep moist, but do not let superfluous water stand about base of plant or around roots. Failures in the growing of cacti are due more often to neglect of good drainage than from all other causes combined.

In out-of-door planting select a situation where the ground slopes sufficiently to insure perfect drainage, or use elevated beds.

LIGHT

Good light is quite as essential as good drainage. The best rule to follow is to know where your plants grow naturally. Many cacti grow in the hottest regions of the desert. Most of them grow out in the open in full sunlight. Plant such species where they are in the full sun. Part shading will not be objectionable to most cacti.

Where plants grow naturally at the base of shrubs or small trees where they get some shade, or in the open but where the tall grasses shade them in mid-summer, reproduce these shade conditions. Otherwise you will lose them from sun-scald. A lattice over them in July and August is very useful, but hard to provide. Palm leaves have sometimes been substituted for a lattice. A covering of weeds during the hottest months is not attractive but saves the cacti.

SOIL

In outdoor beds where one mixture is desired to do for all cacti, the following mixture has proven successful:

One third to one half finely screened black dirt, the other about equal portions of fine sand and coarse sand (or very fine gravel). The percentage of sand and gravel will vary with the soil used. Sandy loam would require less sand, while black waxy soil would require more. The essential and most important thing is to produce a soil which will drain freely.

Ernest Braunton in his article "Best Soil for Cactus" in the August 1929 number of the *Journal of the Cactus and Succulent Society of America* gives this mixture. One-half sharp sand, one-fourth good peat, one-fourth good black loam; to this should be added one-twentieth as much pulverized charcoal.

For all cacti, known to be or listed as growing in limestone areas, including such species as *Echinocereus reichenbachii*, mix a small percentage of powered limestone rock or slacked lime in the soil before planting. Some *Mammillarias* do best in a mixture of about one-half course sand and one-half light loam.

WATERING

With the exception of drainage, nothing is of greater importance in the successful cultivation of cacti than the watering. Too much watering or too little may bring about the destruction of the plant. More cacti suffer during the hottest weather for want of water than from being planted in the wrong type of soil. A few suggestions to the amateur grower may prove helpful.

Use clean water. Some cactus fanciers even suggest the use of rain water only. Do not water over the plants in winter. This is especially true for indoor watering, and where the water is liable to settle in the crown of the plant. In summer, it is considered beneficial by many to water over the plants.

Choose time of watering according to season. In the summer it is probably best to water in the evening, in the spring and fall the morning is suggested, and in the cold of winter mid-day is most beneficial to the plant.

Water every evening during the continued hot weather of the summer months. Similarly withhold watering or water mildly on cloudy days and when the atmosphere is moist. Water plants sparingly in winter.

REPOTTING

Select size of pot to match cactus. Put in an inch or so of small rocks, wood or coal-ash cinders, or broken pieces of flower pots. Then add soil as outlined above, leaving a cone-shaped hollow in the center. Trim roots back to a reasonable length. Then set your cactus and fill in around the roots. Water sparingly.

In repotting older plants disturb the roots as little as possible. Remove the plant by inverting the pot and gently tapping its rim on the edge of a bench or solid structure. Usually the roots and dirt will come out in a lump. Remove any surface soil if it bears evidence of fungus growth or algae. Put ball of dirt and roots into new pot and pack fresh soil around it. Leave sufficient space at the top to receive water.

TRANSPLANTING

To transplant cacti properly from their native location reproduce their original environment. Imitate as nearly as possible the conditions in which the plants grew before you took them up. Get as near Nature's way as you can. In digging the plant, break as few roots as possible. Then wrap each plant separately so that it will not be injured by "spine pricks," in transportation.

TRANSPLANTING "SHIPPED PLANTS"

When receiving a box of cacti, unpack and place plants in lukewarm water for half an hour. Cut the roots short, and plant out in very sandy loam or a soil specially provided for them as suggested under "Soils." Provide good drainage. Place a handful of propagating sand around the roots of the plants. Give little water. New roots form quickly if water is given sparingly. When transplanting to the open in July and August weather, make an exception to this rule. Water every day.

Insect Enemies

Over 250 species of insects have been collected from cactus in Texas. Fifty species are more or less destructive. The Australian government during the past eight years has collected, studied and shipped large numbers of the more destructive of these species from Texas and the Southwest to Australia for the purpose of destroying the prickly pear in that country.

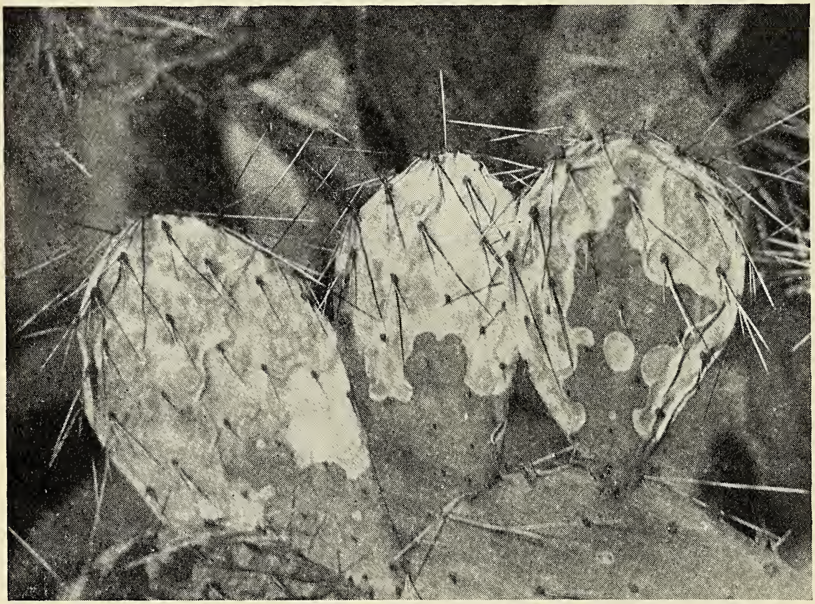
One of the most widespread of these in Texas is the seed-midge, *Asphondylia opuntiae,* which prevents seeds from developing in the cactus fruit and causes it to send out little joints instead of producing seed. The larvae within these fruits are very minute orange-colored maggots which pupate and emerge in March causing the infested fruit to drop off. Many species of fly maggots enter the cactus and cause it to rot when it has been injured by other insects.

The cactus "stink bugs" are very widespread in Texas. Some species of these, *Chelinidea spp.,* leave yellow spots on the sides of the joints where they suck the juices, and whitish blotches when they are feeding heavily. Other species, *Narvia spp.* suck the juices from the fruits but are seldom destructive. These bugs probably aid in the dissemination of diseases on cactus.

Cactus weevils, *Gerstaekeria spp.,* are found practically all over the State. They destroy little areas in the joints sometimes giving a "shot hole" effect. A half dozen species of large black beetles, *Moneilema spp.,* are found in the Eastern part of Texas, particularly west of the Colorado River. They lay eggs near the surface of the ground and the grubs that hatch from them attack the heavy stems and roots of the plants. The beetles themselves can usually be found only at dusk or dawn on the plants as they do not like sunshine and hide during the day.

The caterpillars (worm stage) of quite a number of species of moths are probably the most destructive insects attacking cactus in Texas. Some attack the fruits. These are largely species of *Ozomia, Noctuelia,* and *Olyca.* Others attack the older joints and stems, *Melitara spp.,* and one attacks the young shoots as they appear, *Mimorista flavidissimalis. Ozamia* has a greenish tinge; *Noctuelia* worms have red bands; *Olyca* worms are banded with either brown or blue; *Melitaras* has a deep blue color; and, *Mimorista* worms are all light yellow in color. The adults of these are moths and are seldom seen unless reared or trapped at night with a light.

Grasshoppers are commonly found on the prickly pear of the Southwest but they are relatively harmless to the plants.



Prickly pear showing a well advanced stage of Shot-hole Disease, **Gloesporium lunatum.** The areas are first black, later turning gray.

No description of cactus insects is complete without mentioning the cochineal insect, *Dactylopius spp.* This insect is found mostly on Opuntias but will through lack of this species attack many other cacti. It is known by the tufts of white cottony material which covers a group of females. The insect when mashed shows the cochineal color. This insect often becomes a pest in collections as also does its close relatives, the *Diaspii,* a small smooth light-colored scale. The cure for all scale trouble is soapy water put on with plenty of force.

Diseases

In Texas, diseases destroy more cacti annually than insects. The most noticeable of these is the cactus anthracnose, *Gloesporium lunatum,* which is particularly active on cactus during the more humid months of January, February and March. It is first a brownish area. Later this turns gray with black spores on it. This disease also destroys much of the young cactus growth in the spring of the year.

Another common disease is "sun scald," *Hendersonia opuntiae.* This forms light brown patches or scabs on the surface of the cactus joints and sometimes "chokes" the plant.

A third disease occurs only in the more humid areas, *Perisporium wrightii.* It is characterized by patches of black sooty spores on the surface of the cactus joint.

PREVENTING DECAY

Decay at the roots or stem is the only disease cacti in the home garden are easily subject to. Cut off diseased part, then sprinkle or cut the part of the plant with fully pulverized charcoal, sulphur, or lime. Keep plant very dry for several weeks afterwards, or let dry in the sun for a week, or until dried out. Replant by placing propagating soil next to the plant.

The plant body is always a good medium for the development of "Rot" as it is so completely saturated with water. Rot will attack any part where the bacteria have opportunity to reach the interior of the plant.

Cut and bruised places are the most favorable points for infection. Water dripping on a plant for even a short time may produce a good place for infection. Most plants become infected with rot through their bases and roots, the rot gradually working upward.

E. O. Orpet of Santa Barbara, California, makes the following recommendation in the September, 1929 number of the "Journal of the Cactus and Succulent Society of America."

"No mention seems to be made of "Semesan" as an active agent in preventing decay. This is the greatest styptic found after fifty years of search. We keep a large pan of beach sand and Semesan on tap all the time, and plunge the base of all cuttings in this till they root. It is invaluable also to check decay in bad spots, and if we plant a Cereus cutting out before rooting, some of the above mixture is placed at the base of the cutting. There is no risk, and we find the reaction is that of a stimulant to growth. The regular propagating beds are watered with Semesan in solution if we suspect any fungus present. Directions are sent with each can."

The Opuntias

The genus was first described in 1754. It enjoys an exceptionally wide distribution for a cactus genus and grows from Massachusetts to southwestern United States, south in Mexico and continues through South America to the Strait of Magellan. It includes a large number of species, numbering more than 900 names. Of these but 250 are considered as valid, the others either being reduced to synonymy or are of such uncertain affinity as to be practically valueless. Texas has 33 recorded as occuring within its limits, and of these half are sufficiently rare to escape detection by any but the most searching botanist. The average person recognizes about five different kinds, and even the average botanist with more training is content with knowing two or three of the flat-jointed species and a like number of the cylindrical forms. Nevertheless, the different species when seen in both flower and fruit offer so many differences that one cannot help but see the genus fall into definite groups, namely the species herein described.

The habit of growth is a good criterion in some cases, while in others it is practically valueless. For example, the common prickly pear (*Opuntia lindheimeri*) is typically a low spreading or slightly arborescent bush at its type locality, New Braunfels. Farther toward the Mexican border, however, it often assumes tree-like forms with a decidedly rounded trunk. Likewise, the number of spines, their color, and their distribution in some cases are constant; in others they vary. A plant normally spiny may become spineless in cultivation. Fruit and flower characters are the only constant ones, for it is on these characters that the species are separated.

The key has been made as much as possible on stem structures and spine characteristics. In several cases, however, reference to the flower is the only sure way. In using this key, the reader is cautioned to read both species descriptions when in doubt, for in many cases, the material at hand may be typical or differ in the characters demanded by the key.

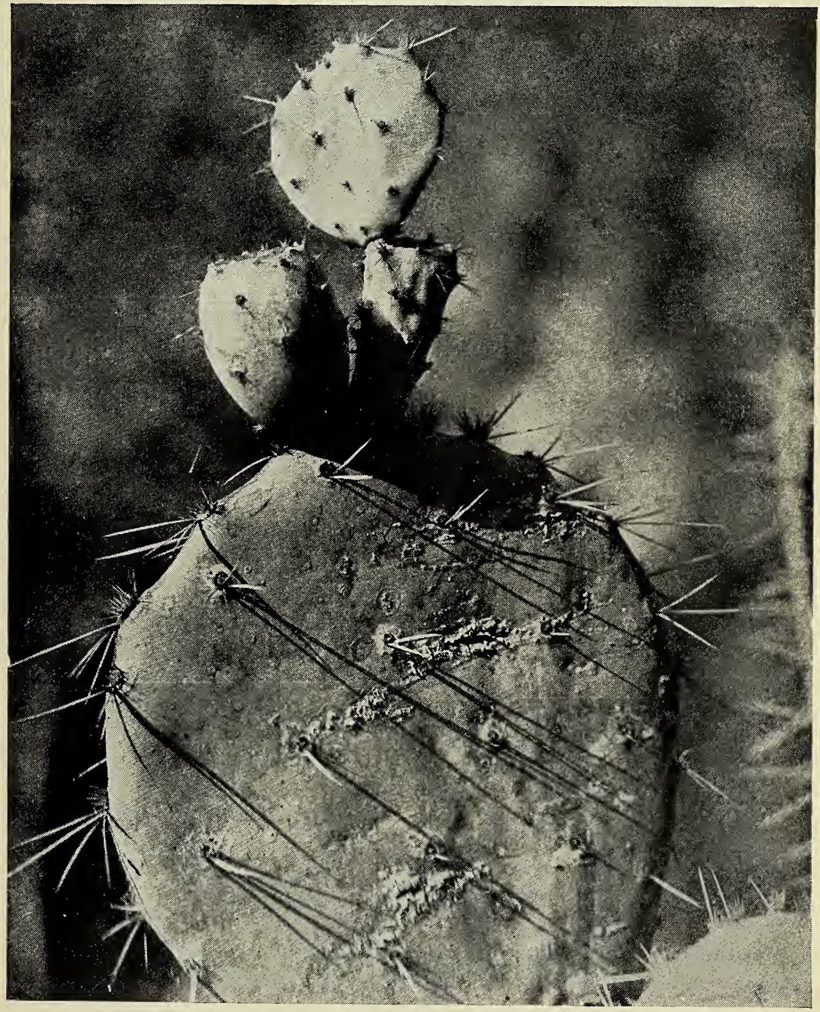
The economic uses of the species of this genus are varied and usually local. They vary from ornament to food. In the Southwest, the "pear leaves" have often served as stock food after the spines were burned off. This is usually done with a gasoline torch, or the "pear leaves" are burned individually by holding them over an open fire with a pitch fork. In Mexico and also in parts of South America, the "tunas" are the ripe fruits of certain species They are used as food by the natives. Their taste is somewhat sickening to the uninitiated, for the glutinous material found in the stem is also present to a lesser degree in the fruits. One species (*O. soehrensii*), native to Bolivia and northern Argentina, found value in the past because of the coloring matter adhering to its dried seeds. They were used to give jellies and wines their deep red color. Little use is made of them at present. The so-called cactus candy of the border of Texas and Mexico is commonly made from prickly pear, and in some parts the young joints have the epidermis removed and are fried like squash. In South America and parts of Mexico they are boiled like spinach. Excellent jellies, it is reported, can be made from the mature fruits of *O. lindheimeri.*

Although Opuntias are New World plants as are the rest of the cacti, many species have naturalized themselves in Europe, especially along the Mediterranean. Some were introduced for ornament, and others planted for stock food. *O. ficus-indica,* a somewhat spineless form, has naturalized itself along the northern Mediterranean Sea. The so-called pest pear of Australia and southern India that was introduced and then spread until now in many parts it is a menace is *O. dillenii,* a native of the Gulf Coast of the United States, Mexico, and South America. Another species, *O. vulgaris,* has been reported from every state of Australia but unlike the other (*Opuntia dillenii*) is not proving itself a pest.

Of late years a great deal of credit has been given to Burbank because of his spineless forms. In the United States this found immediate acceptance. As a matter of fact, there are numerous species that are normally and quite typically spineless, while others become so upon cultivation. Thus *O. ficus-indica, O. amyclaea, O. tomentosa,* and *O. inamoena* are usually typically spineless. *O. dillenii* and others when grown in the shade lose their spines in greater part.

As has been mentioned the genus ranges from the northern United States to the tip of South America. It is also found represented on the cold heights of the Andes Mountains of southern Peru by *O. floccosa.* The average reader usually associates prickly pear with arid climates. It is true that the culmination of development is reached in this habitat, but not to the exclusion of good development in other and colder climates.

The propagation of species of this genus with but one or two exceptions is chiefly by vegetative means. Almost any joint will



Opuntia lindheimeri

Showing normal and proliferous fruit. The structure with the new joints becomes so heavy that the ovary breaks off at its base and the entire mass falls to the earth to take root and grow. Proliferation is also very common in the fruits of "Tasajillo."

strike root if placed in suitable contact with the soil. Indeed, in such species as *O. leptocaulis,* this seems to be the chief method of reproduction. As a consequence, the result of this method of reproduction seems to be tending to terminate the usefulness of the seed. Some species have never been known to grow from seed naturally and only with great difficulty artificially. In many, proliferations of the ovary produce new vegetative structures, sometimes with incidental sterility of the ovules. The structure with the new joints becomes so heavy that the ovary breaks off at its base and the entire mass falls to the earth to strike root and grow. This condition exists in *O. lindheimeri* and related species. In many cases the ovary tissues themselves are capable of producing both root and leaf when in contact with the soil.

OPUNTIA (Tournefort) Miller

Cacti, sometimes with definite trunks, or more often much branched from the base, the branches often spreading, reclining, or prostrate, sometimes clambering but never climbing (one species known with annual stems); roots fibrous or rarely tuberous and large and fleshy; ultimate branches (joints or pads) cylindric to globose or flattened, usually very fleshy, sometimes woody; areoles axillary, bearing spines, barbed bristles (glochids), hairs, flowers, and sometimes glands; leaves usually small, terete, mostly early deciduous; spines solitary or in clusters, terete of flattened, naked or sheathed, variously colored; glochids usually numerous, borne above the spines; flowers usually one at an areole; ovary inferior, one-celled, many ovuled, bearing leaves, the areoles often with spines and glochids; sepals green or more or less colored, usually grading into the petals; petals usually of various shades and combinations of green, yellow, and red (rarely white), widely spreading; stamens much shorter than the petals, sensitive; style single, thick; stigma-lobes short; fruit a berry, dry or juicy, often edible, spiny or naked, globular, ovoid or ellipsoid; seed covered by a hard, bony aril, white, flattened; embryc curved; cotyledons 2, large.

KEY TO THE SPECIES OPUNTIA

Joints all terete, sometimes cylindric to globose.
  Spines furnished with papery sheaths.
    Spines usually solitary but sometimes several, acicular; last formed branches rarely more than 1 cm. thick.
      Terminal joints not over 3.5 cm. long and usually at right angles to main branches, from 4 to 7 mm. thick............**O. leptocaulis**
      Terminal joints over 3.5 cm. long and usually at an acute angle to main branches, from 8 to 15 mm. thick............**O. kleiniae**
    Spines always more than 1: last formed branches over 1 cm. thick.
      Terminal joints not over 2 cm. thick............**O. davisii**
      Terminal joints over 2 cm. thick............**O. imbricata**
  Spines not furnished with papery sheaths.
    Spines usually flattened............**O. schottii**
    Spines usually terete, the central ones sometimes flattened............**O. grahamii**
Joints, at least some, flattened.
  Fruit a juicy berry.
    Joints very readily detached; plants low or small jointed............**O. nemoralis**
    Joints not readily detached, persistent.
      Areoles small, 1 to 2 mm. in diameter, not elevated, mostly close together............**O. rufida**
      Areoles larger, mostly distant.
        Prostrate or spreading species, the joints relatively small.
          Spines none or only 1 or 2 at an areole.
            Joints bluish green, at least when young, flowers 6-7 cm. across............**O. allairei**
            Joints dark green; flowers 11-12.5 cm. across............**O. grondiflora**
          Spines mostly 2 or more at an areole.
            Ovary obconic, 2-4 cm. long.
              Joints typically over 8 cm. long.
                Spines yellow or brown............**O. macrorhiza**
                Spines white or light brown............**O. tortispina**
              Joints typically 8 cm. or less long............**O. fuscoatra**
            Ovary narrowly subcylindric, 5-6 cm. long............**O. macateei**
        Bushy, depressed or tall species.
          Spines when present brown or yellow.
            Fruit less than 2 cm. across............**O. strigil**
            Fruit over 2 cm. across ....(except sometimes in **O. ballii**)
              Spines acicular.
                Fruit 2 cm. or less............**O. ballii**
                Fruit 2.5 to 6 cm. long.
                  Flowers red to purple; plants low and spreading, 3 dm. high or less............**O. pottsii**
                  Flowers yellow.
                    Joints usually orbicular; seeds 5 to 6 mm. broad............**O. mackensenii**

Joints obovate; seeds 4 mm. broad or less .... **O. tenuispina**

Spines subulate.

Joints thin; spines, when present, very long and confined to the upper and middle areoles.

Plant pale green to purplish; Spines up to 12 cm. long .... **O. macrocentra**

Plant dull dark green; spines 6 cm. long or less .... **O. tardospina**

Joints thick; spines not confined to the upper and middle areoles.

Joints relatively small, seldom over 15 cm. broad; plants relatively low.

Plant light green .... **O. atrispina**

Plant bluish green or grayish green .... **O. phaeacantha**

Joints relatively large, mostly over 15 cm. broad; plants relatively tall .... **O. engelmannii**

Spines, if any, yellow, at least partially.

Joints spineless, or with only 1 or 2 spines at some of the areoles, or spines very short .... **O. stricta**

Joints usually manifestly spiny; spines mostly 2 or more at the areoles.

Joints elongated-lanceolate or oblong, several times longer than wide .... **O. linguiformis**

Joints obovate to suborbicular.

Spines brown at base .... **O. aciculata**

Spines yellow or white.

Spines 4 cm. long or longer .... **O. lindheimeri**

Spines not over 2 or 3 cm, long .... **O. anahuacensis**

Fruit dry, not juicy.

Joints turgid.

Joints readily detached .... **O. fragilis**

Joints not readily detached .... **O. arenaria**

Joints not turgid, usually thinner and flat.

Spines or some of them very long, flexible, and bristle-like .... **O. trichophora**

Spines stiff, acicular or subulate; areoles distant .... **O. polycantha**

OPUNTIA LEPTOCAULIS—Slender Stem Cactus—"Tasajillo"

"Tasajillo" has the largest distribution of any known cactus in the Southwest. Its range is Texas, New Mexico, Arizona, California, and the whole northern half of Mexico. It grows singly or in dense thickets, in all kinds of well-drained soil but it reaches perfection in high sandy loams.

The stems are terete, usually much branched or bushy, and covered with spines which give protection to the plant. The spines which are sheathed in most instances make very annoying and painful wounds in the flesh. When extracted, the sheath remains, causing the wound to fester and become very sore. In fact, the spines are the most wicked of the Opuntia group. The species name *"leptocaulis"* means slender-stemmed. The branches are slender, from one-four to one-half inch in diameter, composed of joints of different lengths, some not over an inch long, others a foot or more long.

The fruit is globose or oblong. It is often proliferous, bearing pieces of green stems, which detach and take root under favorable conditions. It grows quickly from cuttings. The scarlet fruits are very showy making the plant very attractive in the fall and winter. A yellow-berried form is often seen in the vicinity of Somerset, Texas. The plant at a distance resembles a shrub covered with tiny lemons.

This cactus furnishes protection to many other cacti, birds and small animals. It is generally known by the old Indian name, *Tasajillo.* This name is probably as old as the plant itself. *"Garambullo"* is another name given on account of its succulent fruit.

Tasajillo blooms in the summer. The flowers are small, inconspicuous, and yellowish-green. They open in bright sunlight and close at night for about two consecutive days. The blossoming period is mid-summer, principally July and August.

The great variation in the lengths of the spines and the character of the spine sheaths has led to the description of many varieties. A short-spined species is often mentioned as *Opuntia leptocaulis* var. *brevispina.* Britton and Rose give their opinion as follows:—These all seem to us to merge into the one species as above indicated. Further study confirms the same observations made by local botanists. The old growth of the plant is usually spineless or nearly so. The new growth is usually well covered with spines. In a rainy season, the new growth has few spines. In a dry year where plants grow slowly the new growth is generally a mass of long spines.

Opuntia leptocaulis is sometimes confused with *Opuntia kleiniae* which has stouter stems and larger yellowish fruits. The flowers are also larger, about one and one-half inches in diameter, and of a dull purple hue with greenish streaks. With the exception of a

"Tasajillo"—*Opuntia leptocaulis*

The upper parts of the plant are an intricate maze of short joints, the diameter of a pencil, and brilliant scarlet, rarely lemon-yellow fruits.

few yellow-berried sports, *Opuntia leptocaulis* has brilliant scarlet fruits.

An interesting feature is that the fruits of this closely allied species are commonly proliferous, that is branches grow from the areoles of the cuticle covering the fruit itself.

Description:—Usually bushy, often compact, 2 to 20 dm. high, but sometimes with a short, definite trunk 5 to 8 cm. in diameter, dull green with darker blotches below the areoles, with slender, cylindric, ascending, hardly tuberculate branches; branches, especially the fruiting ones, thickly set with short, usually spineless joints spreading nearly at right angles to the main branches, very easily detached; leaves green, awl-shaped, 12 mm. long or less, acute;

spines usually solitary at young areoles, very slender, white, at areoles of old branches 2 or 3 together, 2 to 5 cm. long or less; sheaths of spines closely fitting or loose and papery, yellowish brown to whitish; areoles with very short white wool; flowers greenish or yellowish, 1.5 to 2 cm. long including the ovary; sepals broadly ovate, acute, or cuspidate; ovary obconic, bearing numerous small woolly brown areoles subtended by small leaves, its glochids brown; fruit small, globular to obovate or even clavate, often proliferous, red or rarely yellow, 10 to 18 mm. long, turgid, slightly fleshy; seeds compressed, 3 to 4 mm. broad, with narrow, often acute margins.

TASAJILLO—*Opuntia leptocaulis*

The flowers are small, inconspicuous, and yellowish green in color, while the fruits are usually numerous forming scarlet cactus sprays throughout the winter. These sprays make an interesting and effective Christmas decoration. They are easily handled at the hard black base of the stems where the noxious spines have practically all fallen off.

Type locality:—In Mexico.

Distribution:—Southwestern United States and Mexico. Unusually wide distribution for an Opuntia. Wichita Falls to southern Mexico and east as far as the Brazos.

Synonymy:—Opuntia leptocaulis De Candolle, Mem. Mus. Hist. Nat., Paris, 17:118. 1828.

Opuntia ramulifera Salm-Dyck, Hort. Dyck. 360. 1834.

Opuntia gracilis Pfeiffer, Enum. Cact. 172. 1837.

Opuntia fragilis frutescens Engelmann, Bost. Journ. Nat. Hist. 5:245. 1845.

Opuntia virgata Link and Otto in Förster, Handb. Cact. 506. 1846.

Opuntia vaginata Engelmann in Wizlizenus, Mem. Tour North Mex. 100. 1848.

Opuntia frutescens Engelmann, Bost. Journ. Nat. Hist. 6:208. 1850.

Opuntia frutescens brevispina Engelmann, Proc. Amer. Acad. 3:309. 1856.

Opuntia frutescens longispina Engelmann, Proc. Amer. Acad. 3:309. 1856.

Opuntia leptocaulis brevispina S. Watson, Bibl. Index 1:407. 1878.

Opuntia leptocaulis vaginata S. Watson, Bibl. Index 1:407. 1878.

Opuntia leptocaulis stipata Coulter, Contr. U. S. Nat. Herb. 3:456. 1896.

Opuntia leptocaulis longispina Berger, Bot. Jahrb. Engler 36: 450. 1905.

OPUNTIA KLEINIAE

Opuntia kleiniae is a "cane-stemmed" *Opuntia* intermediate between the slender-stemmed *Opuntia leptocaulis* and the more stocky *Opuntia imbricata.*

The stems may grow sparcely and reach a height of three to five feet, or they may form regular thickets. In diameter they are always larger than "Tasajillo" (*Opuntia leptocaulis*) and smaller than the cholla cactus (*Opuntia imbricata.*)

Opuntia kleiniae has long been in cultivation and is represented in most desert garden collections. *Opuntia kleiniae cristata* is a garden form.

Description:—Stems pale, glaucous, sometimes 2.5 meters tall, woody at base; tubercles long; areoles large, a little longer than wide, filled with white wool from the very first; spines usually 1, but sometimes more, from the base of the areole, covered with yellow sheaths, on old joints accompanied by several bristle-like spines from the lower margin of the areole; glochids yellow to brown; leaves linear, 15 cm. long, acute; flowers 3 cm. long, purplish; petals broad, rounded at apex; fruit red, 2 to 2.5 cm. long, long persisting; seeds 4 to 5 mm. broad.

Type locality:—In Mexico.

Distributions—Texas to Central Mexico, particularly the Big Bend District.

Synonymy:—Opuntia kleiniae De Candolle, Mem. Mus. Hist. Nat. Paris 17:118. 1828.

Opuntia wrightii Engelmann, Proc. Amer. Acad. 3:308. 1856.
Opuntia caerulescens Griffiths, Rep. Mo. Bot. Gard. 20:86. 1909.

OPUNTIA DAVISII

This cactus was named in honor of Jefferson Davis, Secretary of War and under whom the Pacific Railroad surveys were made. Davis was also Secretary of War when Whipple's report was made.

CHOLLA CACTUS—*Opuntia imbricata*

Before the introduction of coal tar dyes into Mexico an extract from the tunas was used to dissolve and set cochineal dye.

Opuntia davisii is now believed to be rather limited in its range. It was first reported from near Colorado, Texas. An interesting feature of this cactus is that it has only one scientific name. It evidently stands out as a clearly defined species even though it was named as long ago as 1856.

The plants grow very low but their dense covering of pinkish to straw-colored spines makes them conspicuous in the landscape.

The joints differ from the foreging Opuntias in that they are slender and only two to four inches long.

Like *Tasajillo* the flowers are olive-green to yellow in color and inconspicuous. In the field their low-growing habit makes identification almost positive.

Description:—Plants low., 3 to 5 dm. high, much branched, their dense covering of straw-colored spines making them conspicious objects in the landscape; terminal joints slender, 6 to 8 cm. long, about 1 cm. in diameter, strongly tuberculate; spines 6 to 12, unequal, the longest ones 4 to 5 cm. long, acicular, covered with thin sheaths; glochids numerous, yellow; flowers, including ovary, 3.5 cm. long; petals olive-green to yellow, broad, with rounded mucronate tips; ovary with large areoles bearing a few spines each; fruit 3 cm. long, somewhat tuberculate, naked; seeds not known.

Type locality:—Upper Canadian, about Tucumcari Hills, near the Llano Estacado.

Distribution:—Western Texas and eastern New Mexico, particularly the Plains and Big Bend in Texas.

Synonymy:—Opuntia davisii Engelmann and Bigelow, Proc. Amer. Acad. 3:305. 1856.

OPUNTIA IMBRICATA—Candelabrum Cactus
Cholla, Tree Cactus, Cane Cactus, Velas de Coyote

This is the common cane-stemmed *Opuntia* native to mesas and the foot hills of mountains of western Texas. It particularly favors lava-capped hills. Individual plants are frequently found growing in Mexican door yards of central and southeastern Texas. This is the most formidable of all Texas cacti. Anna Botsford Comstock aptly describes it as "So prickly that even words shy off at the thought of it." The spines are the most lacerating and difficult to remove from flesh of any of the cacti, even more so than the spines of the dreaded *Tasajillo, Opuntia leptocaulis*. *Tasajillo* spines have one deflexed barb while cholla spines are barbed their entire length.

Cholla is tree-like in form, with a few to many erect stems growing to a height of three to eight feet. The stems are cylindrical, tuberculated, about an inch in diameter, and conspicuosly spiny. The spines are covered with loose-fitting, glossy white or greenish to brownish-tipped sheaths. The spines are always short and numerous. The flowers are bright purple, two and one-half to three inches across. The fruits are tuberculate, dry and yellow when ripe. Many of them are proliferous, and fall off in winter thus making new plants.

The stems are used in the manufacture of canes, the reticulated part giving them a peculiar appearance. Occasionally the spines are removed by burning, and the stems cut into sections and fed to stock. The cut sections are too tough to be palatable.

In Australia it is called the Devil's Rope. It is now growing wild in that country much to the distress of the inhabitants. It is said to have originated in the garden of the parsonage of Sofala, New South Wales. In 1911, it was reported as growing on ridges in that town. It then spread along the river and escaped into the brush around the township.

Before the introduction of coal tar dyes into Mexico this fruit had an important place in the Arts. The tunas were gathered, chopped into small pieces, and boiled, the fiber and seed being filtered out and the extract used to dissolve and set cochineal dye. It is still used in this way to a limited extent. Its mordanting property is doubtless due to the large amount of acids and salts of organic acids present.

The fruit is not eaten by man or beast. It is very high in acid, and because of this and so much plant mucilage and the absence of sugar it is not at all palatable.

The remarks of Britton and Rose in The Cactaceae, Vol. 1 are of interest in explaining the synonymy of this interesting genus. "We have followed Schumann and Weber in uniting *Opuntia arborescens* and *Opuntia imbricata.* As thus treated, the species has a wide geographic distribution, and in our view consists of many slightly differing races. In its northern limits it is much smaller than in its southern range."

The species name *imbricata* means "covered with gutter tiles" and refers to the ridges covering the joints.

Opuntia imbricata differs from *Opuntia leptocaulis* and *Opuntia kleiniae* in the thicker cylindrical stems and the yellow tuberculate fruits.

Other common names are *cardenche, tuna juell, goconoxtie,* coyote prickly pear, *Xoconochtli, xoconostle, joconoxtle, joconostle, tasajo, coyonostle, coyonoxtle, coyonostli, tuna joconctla, tuna huell, "velas de coyote," entrana.*

Description:—Tree-like, often 3 meters high or higher, with a more or less definite woody trunk 2.5 cm. in diameter; ultimate joints 2 to 3 cm. in diameter; strongly tuberculate; leaves 8 to 24 mm. long, terete; tubercles 2 to 2.5 cm. long, flattened laterally; spines 8 to 30, 2 to 3 cm. long, brown, covered with papery sheaths; flowers borne at ends of branches, 4 to 6 cm. long, sometimes 8 to 9 cm. broad, purple; ovary tuberculate, bearing a few bristles from some of the upper areoles; fruit naked, yellow, 2:5 to 3 cm. long, strongly tuberculate or, when long persistent, smooth; seeds 2.5 to 3:5 mm. in diameter.

Type locality:—Unknown; introduced into England by Loddiges in 1830.

Distribution:—Central Colorado to Texas, New Mexico, and central Mexico.

Synonymy: — Opuntia imbricata (Haworth) De Candolle, Prodr. 3:471. 1828.

Cereus imbricatus Haworth, Rev. Pl. Succ. 70. 1821.

Cactus cylindricus James, Cat. 182. 1825. Not Lamarck. 1783.

Cactus bleo Torrey, Ann. Lyc. N. Y. 2:202. 1828. Not Humboldt, Bonpland, and Kunth. 1823.

Opuntia rosea De Candolle, Propr. 3:471. 1828.

Opuntia desipiens De Candolle, Mem. Mus. Hist. Nat. Paris 17:118. 1828.

Opuntia exuviata De Candolle, Mem. Mus. Hist. Nat. Paris 17:118. 1828.

Opuntia exuviata augustior De Candolle, Mem. Mus. Hist. Nat. Paris, 17:118. 1828.

Opuntia exuviata spinosior De Candolle, Mem. Mus. Hist. Nat. Paris, 17:118. Opuntia exuviata stellata Lamaire, Cact. Gen. Nov. Sp. 67, 1839.

Opuntia exuviata viridior Salm-Dyck, Cact. Hort. Dyck. 1844. 48. 1845.

Opuntia arborescens Engelmann in Wislizenus, Mem. Tour North Mexico, 90.. 1848.

Opuntia imbricata crassior Salm-Dyck, Cact. Hort. Dyck. 1849. 249. 1850.

Opuntia imbricata ramosior Salm-Dyck, Cact. Hort. Dyck. 1849. 73. 1850.

Opuntia imbricata tenuior Salm-Dyck. Cact. Hort. Dyck. 1849. 73. 1850.

Opuntia vexaus Griffiths, Rep. Mo. Bot. Gard. 22:28. 1912.

Opuntia magna Griffiths, Proc. Biol. Soc. Washington 27:23. 1914.

Opuntia spinotecta Griffiths, Proc. Biol. Soc. Washington 27: 24. 1914.

DEVIL CACTUS—"Clavellina"—Opuntia schotti

A prostrate form of Opuntia occurring along the Rio Grande from Hidalgo County to the Pecos River in West Texas. It is very abundant near Rio Grande City, Texas and on the Mexican side as far east as Reynosa.

It forms dense masses, ten to fifty feet square. These masses are absolutely impenetrable, and therefore a great pest to grazing stock.

The spines are long and very dangerous. The joints are easily broken off and when the spine touches an animal's foot or body, the joint detaches and the piece is carried to another place by the passing animal. Here they take root and form new plants.

The flowers are yellow, blooming in the spring, opening in bright daylight, and closing at night. They bloom one or two consecutive days. The plants do not produce flowers in abundance as other species of *Opuntia* do, but depend on the scattering of the broken stems for propagation.

Quoting Robert Runyon: "In the Cemetery at Reynosa, I noticed the graves covered with the devilish *Clavellina,* and asked a Mexican who was cleaning up the Cemetery, why he did not remove the Clavellina. His answer was, 'We don't wanty the dead to leave.' Clavellina is a word that Mexicans apply to plants that have large nail-like spines.

Description: — Prostrate, rooting from the areoles, forming dense clusters sometimes 2 or 3 meters in diameter; joints clavate, curved, ascending, easily breaking off, 6 to 7 cm. long, 2 cm. in diameter at thickest part, strongly tuberculate; leaves subulate, bronze-colored, 6 to 8 mm. long, acuminate; areoles 1 to 1.5 cm. apart; spines white and sheathed when young, soon brown, the larger ones sometimes as many as 12, very slender, sometimes 6 cm. long, somewhat flattened; wool white when young, turning brown; glochids white when young, turning brown, 4 mm. long or less; flowers yellow, 4 cm. long including ovary; sepals narrow, acuminate; petals acuminate; fruit yellow, narrowly oblong in outline, a little narrowed at base, 4 cm. long, closely set with areoles bearing numerous short spines, bristles, and white wool, the unbilicus depressed; seeds yellow, flattened, 4 mm. in diameter, notched at base.

Type locality:—Arid soil near the mouth of the San Pedro and Pecos, western Texas.

Distribution: — Southern and western Texas and northern

Mexico. Very common in the Big Bend country and the Trans-Pecos.

Synonymy:—Opuntia schottii Engelmann, Proc. Amer. Acad. 3:304. 1856.

OPUNTIA GRAHAMII

This species was named in honor of James Duncan Graham, Colonel, Corps of Engineers, United States Army, and who died December 28, 1865, at Boston, Massachusetts. Colonel Graham was for a time chief of the scientific corps of the United States

Opuntia grahamii

A low-growing west Texas species similar to O. Schottii but having smaller joints.

and Mexican Boundary Commission, and sent the type specimens of this plant to Dr. George Engelmann.

Opuntia grahamii grows in patches like *Opuntia schottii* but both the plant and joints are smaller. The plant is also an extreme western Texas cactus.

Description:—Roots at first thick and fleshy, becoming woody, 2 cm. thick or more; plant low, much branched, spreading, forming low mounds often half buried in the sand, sometimes giving off roots at the areoles; terminal joints erect, clavate, bright green, 3 to 5 cm. long, with large oblongtu bercles; leaves thick, bronze-colored, ovate, acute, 3 to 4 mm. long; areoles about 3 mm. broad; wool white; spines 8 to 15, slender, slightly scabrous, terete or some of the larger ones slightly compressed, white when young, soon reddish, the longest 3.5 to 6 cm. long; glochids numerous, slender, 4 mm. long or less, white, turning brown, persistent on the old stems; flowers yellow, 5 cm. broad; sepals ovate, acute, about 5 mm. long; fruit oblong to ovoid, 3 to 4.5 cm. long, its numerous areoles bearing white glochids and some slender spines; seeds beakless, 5 to 5.5 mm. in diameter, the commissure indistinct, linear.

Type locality:—Near El Paso, Texas.

Distribution:—Western Texas, New Mexico, and adjacent parts of Mexico. Common in the Big Bend District of Texas.

Synonymy:—Opuntia grahamii Engelmann, Proc. Amer. Acad. 3:304. 1856.

OPUNTIA NEMORALIS

This species strongly resembles *Opuntia tortispina* in its habit, joints, and spines. Britton and Rose base their classification of it as a distinct species on the fact that the joints are easily detached.

Description:—Plants low, usually prostrate, forming clumps 1 meter in diameter, sometimes 3 dm. high; joints ovate to obovate, thick, 7 to 9 cm. long, green, but often with purple blotches about the areoles; spines 1 or 2, only from the upper areoles, 2 to 2.5 cm. long, mostly erect; glochids yellow; flowers yellow; fruit obovoid to pyriform, small, 3 cm. long, light red, truncate.

Type locality:—Longview, Texas.

Distribution:—Pine woods and fields about Longview, Texas.

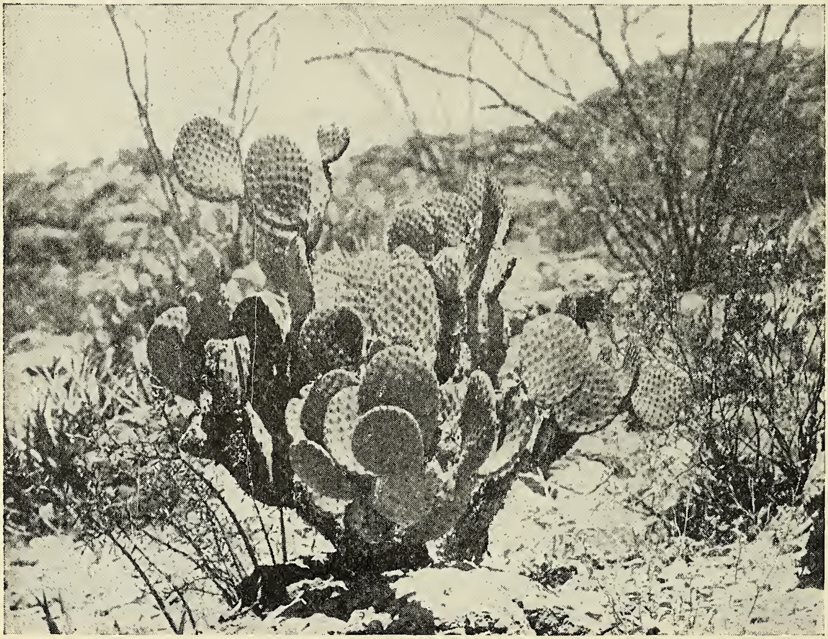
Synonymy:—Opuntia nemoralis Griffiths, Monatsschr. Kakteenk. 23. 133. 1913.

OPUNTIA RUFIDA—Blind Pear

This is the blind pear of the Big Bend District. It is a spineless *Opuntia* of upright growth, and of a good size. The joints are orbicular, thickish, velvety tomentose, and dull grayish or bluish green. The leaves are green with reddish tips and fall off early. The flowers are yellow to orange, the petals obovate. The filaments are short and greenish white. The style is thick and bulbous just above the base.

Many of the plants grow in the crevices of rocks. The following note is added by Mr. William Hess of San Antonio,—"This species with its close relative *microdasys* are probable the prettiest of the flat jointed types of cacti. The former with its areoles covered with short dark red velvety bristles against the deep or blue green delicate appearing joints is hardly less attractive than the *O. microdasys*. The light green joints of this species are studded with many yellow pearl-like tufts of bristles, which cause it to be admired even by those people who see nothing in cacti in general."

Description:—More or less erect, 2 to 15 dm. high, with a somewhat definite trunk; joints nearly orbicular, 6 to 25 cm. in diameter, thickish, velvety-tomentose, dull grayish green; leaves



OPUNTIA RUFIDA
The Blind Pear of the Big Bend District.

subulate, caducous, 4 to 6 cm. long, green with reddish tips; areoles large, filled with numerous brown glochids; flowers yellow to orange, 4 to 5 cm. long including the ovary; petals obovate, 2 to 2.5 cm. long; filaments greenish white, short, 1 cm. long; style 1.5 cm. long, thick, bulbous just above the base; stigma-lobes 5, deep green; ovary globular, 1.5 cm. in diameter, umbilicate, with large areoles; fruit, according to field observation of Dr. Griffiths, bright red.

Type locality:—About Presidio del Norte, on the Rio Grande.

Distribution:—Texas and northern Mexico. Particularly in the Big Bend District in Texas.

Synonymy:—Opuntia rufida Engelmann, Proc. Amer. Acad. 3:298. 1856.

Opuntia microdasys rufida Schumann, Gesamtb. Kakteen 706. 1898.

OPUNTIA ALLAIREI

Description: — A low, spreading, tuberous-rooted, prostrate plant, with some of the joints ascending; joints bluish green, obovate, usually 10 to 15 cm. long, originally described as even longer, with or without spines; spines, if present, 1 to 3, yellowish brown, 2.5 cm. long or less, slender but a little flattened; glochids numerous, especially abundant at very old areoles, yellow; leaves 6 to 8 mm. long; flowers 6 to 7 cm. broad, yellow with a red center; fruit 4 to 5 cm. long, dark red.

Type locality:—Mouth of Trinity River, Texas.

Distribution:—Southern Texas and western Louisiana.

Synonymy:—Opuntia allairei Griffiths, Rep. Mo. Bot. Gard. 20:83. 1909.

LARGE-FLOWERED OPUNTIA—Opuntia grandiflora

This species was first described by Dr. George Engelmann as *Opuntia rafinesquei grandiflora,* and a good drawing of it was published in the Pacific Railroad Report, Vol. 4, 1856. Its range of distribution in Texas is from central Texas eastward. It is not generally well known among Cactus Collectors. It is by far the largest and most handsome flowered species in Texas. The flowers are large, yellow with a red center, and very showy. The stems are low and prostrate to ascending.

It will undoubtedly stand a moderate freeze and can be recommended as a good species for outdoor planting where the temperature does not fall below 15°F.

Description:—Low, with somewhat ascending branches; joints 12.5 to 15 cm. long; areoles 2.5 cm. apart; spines usually wanting; flowers very large, 11 to 12.5 cm. broad, yellow with a red center; petals broad; fruit elongated, 6 cm. long.

Type locality:—On the Brazos, Texas.

Distribution:—Eastern Texas.

Synonymy: — Opuntia grandiflora Engelmann, Proc. Amer. Acad. 3:295. 1856.

Opuntia rafinesquei grandiflora Engelmann, Pac. R. Rep. 4:55. 1856.

Opuntia mesacantha grandiflora Coulter, Contr. U. S. Nat. Herb. 3:429. 1896.

OPUNTIA MACRORHIZA

This is one of the low, nearly prostrate *Opuntias* that grows from tuberous roots. The clumps vary in size from a foot to as much as three feet across. The joints are orbicular to obovate, dull green, and two to four inches long. In comparison with the common prickly pear, *Opuntia lindheimeri,* the joints are very small. The spines are frequently few or none at all. When present, they vary from one to four, and are about one inch long. The flowers are yellow with a reddish center. Compared with *Opuntia lindheimeri* the fruits are slender, somewhat obovoid, one to one and one-half inches long, and not edible.

This species is easily distinguished from the majority of Texas species of *Opuntia* by the small joints, prostrate habit, and tuberous roots.

Description:—Plant low, usually nearly prostrate, forming a clump 1 meter in diameter, from a cluster of tuber-like roots, these sometimes 5 to 7.5 cm. in diameter; joints orbicular to obovate, dull green, 5 to 16 cm. long, about 1 cm. thick; leaves subulate, 4 to 10 cm. long; areoles rather large, the lower ones and sometimes all of them spineless; glochids numerous, yellow or brown; spines, when present, 1 to 4, unequal, yellow to brown, the longest 2.5 cm. long; flower yellow, with a reddish or purplish center, 7 to 8 cm. broad; fruit narrowly obovoid, 3.5 cm. long, purple or red, with a depressed umbilicus, not edible; seeds 5 mm. in diameter, with broad margins.

Type locality:—Rocky places on the Upper Guadalupe, Texas.

Distribution: — Missouri and Kansas to Texas. Particularly central Texas.

Synonymy: — Opuntia macrorhiza Engelmann, Bost. Journ. Nat. Hist. 6:206. 1850.

Opuntia fusiformis Engelmann and Bifelow, Proc. Amer. Acad. 3:297. 1856.

Opuntia rafinesquei fusiformis Engelmann, Pac. R. Rep. 4:43. 1856.

Opuntia mesacantha macrorhiza Coulter, Contr. U. S. Nat. Herb. 3:430. 1896.

Opuntia xanthoglochia Griffith, Rep. Mo. Bot. Gard. 21:166. 1910.

Opuntia roseana Mackensen, Bull. Torr. Club 38:142. 1911.

OPUNTIA TORTISPINA

A prostrate and creeping species. The joints are ascending, orbicular or obovate, and six to eight inches long. There are always several spines at each areole, usually six to eight. The upper and longer spines are often one to two inches long. The color varies from white to yellowish and brown. The flowers are sulphur yellow and two and one-half to three inches across. The fruit is rather large and fleshy, being one and one-half to two inches long and three-fourths to one and one-fourth inches broad.

Compared with the foregoing species, *Opuntia macrorhiza* it is a more erect species, with larger joints, more spines, sulphur yellow flowers *without* the red center, and larger and heavier fruits.

Its range is exceptionally wide in that it may be found all the way from Texas to Canada. Its hardy qualities make it a desirable *Opuntia* for northern desert gardens.

Description:—Prostrate and creeping; joints ascending, orbicular to obovate, 15 to 20 cm. long; areoles 1.5 to 3 cm. apart; spines several, often 6 to 8, the upper and longer ones 3 to 6 cm. long, either white, yellowish, or brown; on the upper areoles one spine erect, the others spreading or with the lowermost ones deflexed; flowers sulphur-yellow, 6 to 7.5 cm. broad; fruit rather large, 4 to 5 cm. long, 2 to 3 cm. broad; seeds 4 to 6 mm. broad, thick, regular, with a slight indentation at the hilum.

Type locality:—On the Camanchica Plains near the Canadian River.

Distribution: — Wisconsin to South Dakota, Texas, Kansas, Colorado, and New Mexico.

Synonymy:—Opuntia tortispina Engelmann, Proc. Amer. Acad. 3:293. 1856.

Opuntia tortisperma Engelmann, Pac. R. Rep. 4:pl. 23,f 1 to 5. 1856.

Opuntia cymochila Engelmann, Proc. Amer. Acad. 3:295. 1856.

Opuntia rafinesquei cymochila montana Engelmann and Bigelow, Pac. R. Rep. 4:42. 1856.

Opuntia rafinesquei cymochila Engelmann, Proc. Amer. Acad. 3:295. 1856.

Opuntia mesacantha cymochila Coulter, Contr. U. S. Nat. Herb. 3:430. 1896.

Opuntia mesacantha greenei Coulter, Contr. U. S. Nat. Herb. 3:431. 1896.

Opuntia mesacantha oplocarpa Coulter, Contr. U. S. Nat. Herb. 3:431. 1896.

Opuntia greenei Engelmann in Britton and Rose, Smiths. Misc. Coll. 50:523. 1908.

(?) Opuntia sanginocula Griffiths, Proc. Biol. Soc. Washington. 27:26. 1914.

OPUNTIA FUSCOATRA

This is an *Opuntia* with prostrate branching habits. The joints are orbicular to obovate, somewhat tuberculate, two to three and one-half inches long. The spines are two to three in number, one being rather stout, one to one and one-fourth inches long, often a little flattened. They vary in color from yellow to dark brown or nearly black. The flowers are all yellow, fully three inches across. The petals are very broad. The fruit varies from one and one-half to two inches in length.

Compared with *Opuntia tortispina,* the joints are only about half as large, the spines fewer in number, and the flowers paler but approximately the same size. It is also a distinctly East Texas species. Singularly its distinguishing characteristics are so well defined and constant that it has only been given one scientific name.

Description:—Diffuse prostrate plants; joints orbicular to obovate, somewhat tuberculate, 5 to 8 cm. long, areoles 12 to 20 mm. apart, very large for the group; spines single or in twos or threes, one rather stout, sometimes a little flattened, 2.5 to 3 cm. long, yellow to dark brown or even nearly black; usually from the lower areoles; glochids numerous, brown; flowers 7.5 cm. broad, yellow; petals very broad; stigma-lobes 5; ovary 2.5 cm. long, slender; fruit 4 to 5 cm. long, red; seeds 4 mm. broad.

Type locality:—Sterile places of prairies west of Houston, Tex.

Distribution:—Eastern Texas.

Synonymy:—Opuntia fuscoatra Engelmann, Proc. Amer. Acad. 3:297. 1856.

OPUNTIA MACATEEI

This species is strictly Texas in distribution. It was first collected by Mr. W. L. MacAtee near Rockport, Texas, in December, 1910, and first described by Britton and Rose in *The Cactaceae,* Volume 1, 1919.

The stems are usually prostrate with small joints that bear only 1 to 3 brownish spines from each areole. The flower is yellow with a red center.

It can be identified by its small slender joints and the elongated, leafy ovaries.

Description:—Small prostrate plant; joints 2.5 to 6 cm. long, orbicular to obovate, glabrous, dull green, in age somewhat tuberculate; leaves linear, 10 mm. long or less, green; spines 1 to 3, brownish, the longer ones up to 2.5 cm. long; flowers, including the ovary, 8 to 10 cm. long, 7 to 10 cm. broad, yellow with a red center; fruit subcylindric, 5 to 6 cm. long, bearing conspicuous leaves, sometimes 12 mm. long.

Type locality:—Rockport, Texas.

Distribution:—Southeast Texas.

Synonymy:—Opuntia macateei Britton and Rose, Cactaceae, Volume 1, Page 221. 1919.

OPUNTIA STRIGIL

Opuntia strigil is somewhat erect. The joints are orbicular to obovate, four to five inches long. The areoles are close together and rather prominent. The spines vary from five to eight in number and are about an inch long. Most of them are spreading. Many of them are appressed to the plant and some are deflexed. They vary from red to reddish-brown in color with lighter tips. The flowers as yet are unknown; the fruits are small, nearly globular, and about one-half inch across.

Opuntia strigil is mostly a West Texas species. It differs from most of the *Opuntias* in the small round fruits and the spreading appressed spines.

Description:—Suberet, 6 dm. high; joints orbicular to obovate, 10 to 12.5 cm. long; areoles close together, prominent; spines 5 to 8, spreading, many of them appressed to the joint and deflexed, red to reddish brown with lighter tips, the longer ones 2.5 cm. long; glochids numerous; flowers unknown; fruits small, nearly globular, 12 mm. in diameter, truncate, red; areoles on fruit very small; seeds 3 mm. broad.

Type locality:—In crevices of limestone rock, between the Pecos River and El Paso, Texas.

Distribution:—Texas.

Synonymy:—Opuntia strigil Engelmann, Proc. Amer. Acad. 3:290. 1856.

OPUNTIA BALLII

Opuntia ballii was named in honor of Mr. C. R. Ball, who first collected it in Reeves County, Texas.

This species grows low, and is more or less procumbent. The branches lie on the ground, spread more or less, and take root wherever the joints touch the ground. It is generally a small plant. The joints are obovate, two and one-half to four inches long, pale green, glaucous, and thickish. The spines are slender, two to four in number, one and one-half to two and three-fourths inches long. The flowers are unknown. The fruit is small, slender, club-shaped, spineless, and less than an inch long. The plant as far as known is a distinctly West Texas species.

Britton and Rose in "The Cactaceae" give the following interesting note: "Wooton and Standley in their Flora of New Mexico refer this species to *Opuntia filipendula,* but *Opuntia ballii* grows in a different habitat, has smaller fruit, stouter and erect spines, and different areoles; it grows on the dry mesa beyond Pecos, Texas."

Description:—Plants low, spreading; joints obovate, 6 to 10 cm. long, thickish, pale green, glaucous; spines 2 to 4, brownish, a little flattened, usually ascending or erect, the larger ones 4 to 7 cm. long; glochids conspicuous; fruit small, about 2 cm. long, clavate, glaucous, spineless; seeds thick, 3.5 mm. broad.

Type locality:—Pecos, Reeves County, Texas.

Distribution:—Western Texas.

Synonymy:—Opuntia ballii Rose, Contr. U. S. Nat. Herb. 13: 309. 1911.

OPUNTIA POTTSII

This is a Mexican species which extends into southwestern Texas and southern New Mexico and is abundant in that region. It is easily identified by its peculiar, thick, tuberous roots and the fact that the spines are mostly confined to the upper areoles or margins of the pads. The very large purple flowers are also characteristic.

This Opuntia was named in honor of Mr. John Potts, who was manager of the mint at Chihuahua and who sent cacti to Mr. F. Scheer at Kew Gardens, London, between 1842 and 1850. The species name was given by Prince Salm-Dyck in 1850.

It has long been listed under the name *Opuntia filipendula,* but Britton and Rose made a very careful study of it and they now use Prince Salm-Dyck's name *Opuntia pottsii,* which in our opinion is correct.

Description:—Low, spreading plant, 3 dm. high or less, from thickened tuberous roots 2 to 3 cm. in diameter, these sometimes moniliform; joints broadly obovate, 3.5 to 12 cm. long, pale green to bluish; spines few, either small or large, confined to the upper and marginal areoles, 1 or 2, slender, 2 to 4 cm. long, usually white, but sometimes purplish: glochids yellow, usually few but sometimes abundant; flowers large, 6 to 7 cm. broad, deep purple; ovary slender, 3 to 3.5 cm. long, with only a few scattered areoles; fruit spineless.

Type locality:—Near Chihuahua City, Mexico.

Distribution:—Central Chihuahua, Mexico to Texas and New Mexico.

Synonymy: — Opuntia pottsii Salm-Dyck, Cact. Hort. Dyck. 1849. 236. 1850.

Opuntia filipendula Engelmann, Proc. Amer. Acad. 3:294. 1856.

OPUNTIA MACKENSENII

With so many botanists working central Texas in the early development of the State, it is singular that an *Opuntia* of such marked characters should have been overlooked until 1911. The species is named by Dr. Rose in honor of Mr. Bernard Mackensen of San Antonio and author of *Native Trees and Shrubs of San Antonio and Vicinity.*

This *Opuntia* is a low growing plant, with spreading branches, the lower edge of the joints usually resting on ground. A few branches are often erect. The joints are orbicular to obovate, four to eight inches long, rarely broader than long. They are pale and covered with a bloom when young, but deep green when older. The lower areoles are usually without spines, the upper ones with one to four. The spines vary from white to brown, many of them being brown at the base and white above. Most of them are slender, somewhat flattened, and twisted, and one to two inches long. The flowers are about three inches across, yellow with a reddish brown center. The stigma lobes are white, and vary from seven to nine. The fruit is spineless, one and one-half to two and one-half inches long, rose-purple when ripe.

In general appearance, habit of growth, type of root and flower it strongly resembles *Opuntia macrorhiza.* Mr. E. Mortensen formerly connected with the Prickly Pear Investigations of the Australian government, at Uvalde, gives his opinion that *Opuntia mackensenii* is a large form of *Opuntia macrorhiza.*

Description:—Plants low, with thick, tuberous roots, spreading, usually resting on the edges of the joints, but some of the branches often erect; joints orbicular to obovate, 10 to 20 cm. long, rarely broader than long, pale and glaucous when young, deep green when older; areoles small, the lower ones without spines, the upper ones with 1 to 4 spines; spines white or brown, or brown at the base and white above, somewhat flattened and twisted, slender, 5 cm. long or less; glochids brown; flowers of medium size, 7 to 8 cm. broad, yellow with a reddish brown center; stigma-lobes 7 to 9, white; fruit spineless, 4 to 6 cm. long, truncate or nearly so at apex, rose-purple; seeds suborbicular, 5 to 6 mm. broad, acute on the margin.

Type locality:—Near Kerrville, Texas.

Distribution:—Kerr County, Texas.

Synonymy:—Opuntia mackensenii Rose, Contr. U. S. Nat. Herb. 13:310. 1911.

OPUNTIA TENUISPINA

The species name *tenuispina* means thin or slender-spined. The plant is prostrate in habit. The joints are obovate, three to seven inches long, three to four inches wide, light green in color. The pads are usually densely covered with slender white spines, one to three at each areole, each one to two inches long. The flowers are yellow, two and one-half to three inches across. The fruit is rather small, oblong to ellipsoidal in shape, one to one and one-half inches long, red with greenish pulp and medium-sized seeds.

Quoting Britton and Rose in "The Cactaceae" we have the following comparison with *Opuntia pheacantha.*

"Engelmann says that this plant grows with *Opuntia phaeacantha,* but is readily distinguished from the latter by its spines and fruit. Cultivated plants and herbarium specimens closely resemble *Opuntia phaeacantha.*"

The type locality "sand hills near El Paso" is also of good assistance to the amateur in identification. Mr. E. Mortensen reports it as "common in the Davis Mountains."

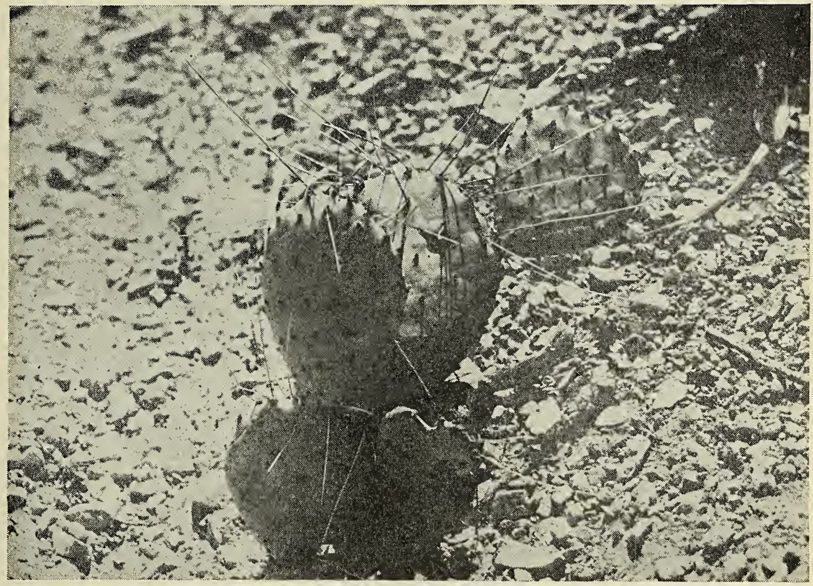
Description:—Low and spreading, but becoming 3 dm. high; joints obovate, attenuate at base, 7 to 15 cm. long, light green; leaves very slender, 4 mm. long or less; spines 1 to 3 from an areole, slender, usually white but sometimes brownish, 3 to 5 cm. long, the upper spines erect or spreading; glochids brown; flowers yellow, 6 to 7.5 cm. broad; ovary with numerous areoles filled with brown wool and brown glochids; fruit oblong, 2.5 to 4 cm. long, with a deep umbilicus; seeds 4 mm. broad or less, very irregular.

Type locality:—Sand hills near El Paso, Texas.

Distribution: — Southwestern Texas and adjacent parts of Mexico and New Mexico, apparently extending to Arizona.

Synonymy:—Opuntia tenuispina Engelmann, Proc. Amer. Acad. 3:294. 1856.

Opuntia minor C. Mueller in Walpers, Ann. Bot. 5:50. 1858.



Opuntia macrocentra
The common long-spined opuntia of western Texas.

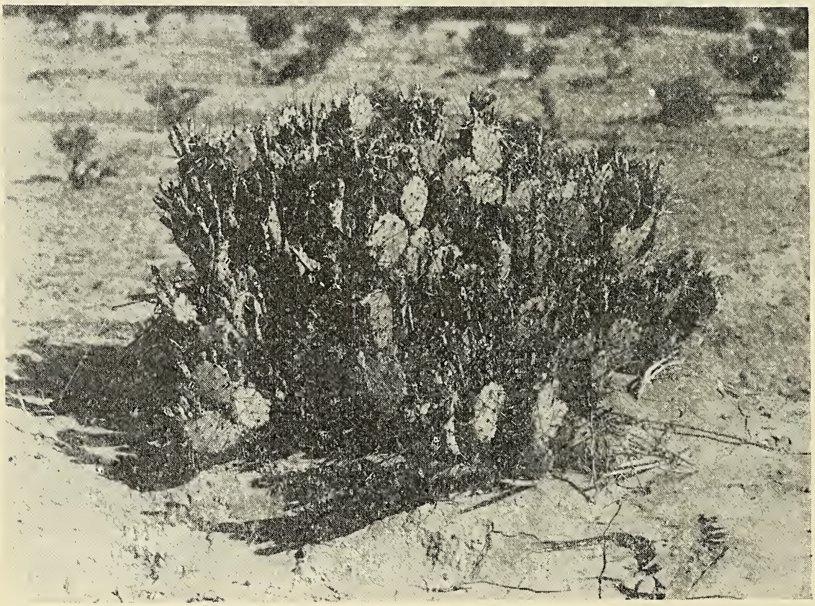
OPUNTIA MACROCENTRA

Opuntia macrocentra is one of the most attractive and at the same time most common of the *Opuntias* on the mesas of West Texas. It is easily the most striking and most abundant *Opuntia* in the Big Bend Country. One distinguishes it at once from other *Opuntias* by the reddish or purplish tinged joints and the very long central dark-colored spines.

The plant is rarely over two and one-half feet high. It is mostly erect with an inclination to spreading, but joints rarely lie on the ground.

The joints are circular to oblong in outline, four to eight inches long. The reddish-blue to purplish hue is a distinct characteristic of the majority of the plants. The spines are one to two in number, rarely three, usually brownish or black in color, sometimes paler at the tips, and two to five inches long. The flowers are yellow, two to three inches across, often drying red. The fruit is purple and varies from one to two inches in length.

E. Mortensen records it as growing common with the cresote bush, and as a common species growing with *Opuntia engelmannia* in the vicinity of Fort Stockton. H. T. Fletcher reports it as



Opuntia macrocentra

Known for its very long spines and purplish tinged "joints."

common in the Davis Mountains and adds that the "joints are thin and reddish."

The brilliant purple hue throughout the winter season should make it a good decorative species.

The species name *macrocentra* means large centrals in reference to the unusually long central spines.

Description:—Somewhat bushy, with ascending branches, 6 to 9 dm. high; joints orbicular to oblong, or sometimes broader than long, 10 to 20 cm. long, often bluish or purplish, sometimes spineless but usually bearing spines at the uppermost areoles; spines 1 or 2, rarely 3 together, usually brownish or black but sometimes white above, slender, erect or porrect, 4 to 7 cm. long; flowers yellow, often drying red, 7.5 cm. broad; sepals ovate, acuminate; ovary with few areoles, these bearing brown glochids; filaments very short; fruit 3 to 6 cm. long, purple; seeds 4 to 4.5 mm. broad.

Type locality:—Sand hills on the Rio Grande near El Paso, Texas.

Distribution:—Western Texas to eastern Arizona and Chihuahua, Mexico.

Synonymy: — Opuntia macrocentra Engelmann, Proc. Amer. Acad. 3:292. 1856.

OPUNTIA TARDOSPINA

Opuntia tardospina is an abundant species in the section between Del Rio and the Devil's River. Mr. E. Mortensen also reports it as common in the vicinity of Uvalde, Sanderson, and San Angelo. He further reports it so common in the Fort Worth section and southwest of Fort Worth as to be a pest. It has also been recorded from Gillespie, Burnet, Lampasas, and Blanco counties. The type locality is Lampasas.

Opuntia tardospina has fibrous roots. It is a low spreading plant with the joints usually resting on the ground. The joints are orbicular to obovate, six to twelve inches long. The spines are usually wanting except on the upper margins and sections of the pods. They are usually single, one to two inches long, dark brown or black in color, paler at the tips. The fruit is red, and two to two and one-half inches long.

Description:—Roots fibrous; low, spreading plant, the joints usually resting on the ground; joints orbicular to obovate, 16 to 24 cm. long; areoles large, usually distant, often 4 cm. apart; spines usually wanting except from the upper areoles and along the upper margin, usually single, sometimes 2 from an areole, 4 to 5 cm. long, brown, but lighter towards the apex; glochids numerous, brown, peristent; fruit red, 6 cm. long; seeds 5 mm. broad, acute on the margin.

Type locality:—Near Lampasas, Texas.

Distribution:—Eastern and central Texas.

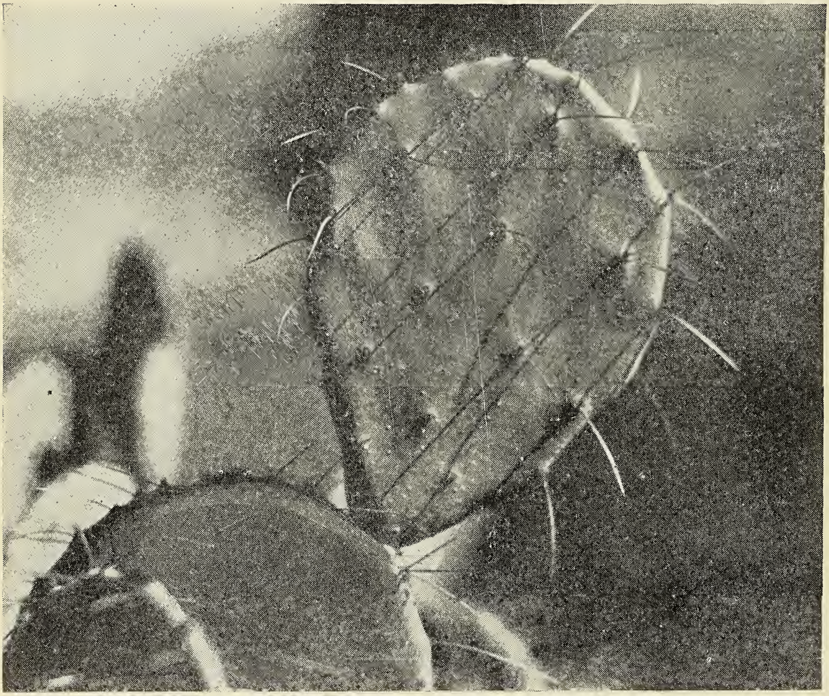
Synonymy: — Opuntia tardospina Griffiths, Rep. Mo. Bot. Gard. 22:34. 1912.

OPUNTIA ATRISPINA

This *Opuntia* was first described by David Griffiths in the Report of the Missouri Botanical Gardens, Vol. 21, 1910. The type species was collected near the Devil's River, July 20th, 1928.

A good picture of it in its natural habitat was published in the above mentioned Report (plate 26).

The stems are low, ascending, and usually lying on their edges. The secondary stems are mostly erect. The spines are described as jet black at the base, changing to orange toward the tip. The flowers are yellow changing to orange, greenish within, and 4 to 5 cm. across when fully open. The filaments are yellowish above



Opuntia atrispina

and greenish below; the style white; the stigma yellowish, small, and 7-parted. The fruit is small and pyriform.

It is either a rare species or it has not been collected extensively. It is probably a Mexican species entering our territory along the Devil's River.

Description:—Usually low and spreading, sometimes 2 meters in diameter, but sometimes the central branches nearly erect and 6 dm. high; joints rather small, nearly orbicular, 10 to 15 cm. in diameter, light green, sometimes a little glaucous; lower areoles spineless; spines from the upper areoles 2 to 4, the principal ones spreading, flattened, dark brown, almost black at base, much lighter above; glochids at first yellow or yellowish, but soon changing to brown; flowers described as yellow, changing to orange; fruit reddish purple.

Type locality:—Near Devil's River, Texas.

Distribution:—Type locality and vicinity.

Synonymy:—Opuntia atrispina Griffiths, Rep. Mo. Bot. Gard. 21:172. 1910.

OPUNTIA PHEACANTHA

The following remarks of Britton and Rose in "The Cactaceae" Vol 1, indicate that *Opuntia pheacantha* is a broad species and somewhat troublesome.

"We have referred to *Opuntia phaeacantha* the common, low, bushy Opuntia with small joints, brown spines, and yellow flowers of the Southwest; we formerly regarded it as composed of several species, and others have followed our lead; but we are unable to draw any distinct lines after a study of much additional herbarium and greenhouse material. Dr. Rose has collected a large series of specimens from the Southwest, especially from the type localities, but his specimens seem to bridge over differences which before seemed tangible; cited differences appear to be racial rather than specific."

The plant grows low, with mostly prostrate branches and only a few ascending ones. The joints are usually longer than broad. The spines are from one to four in number, those on the sides of the joints being stout, more or less reflexed, somewhat flattened, one to two and one-half inches long, brown, sometimes nearly white throughout.

The flowers are yellow, about two inches across, with a short ovary. The fruit varies from one to one and one-half inches in length, and is decidedly contracted at the base. The species name *pheacantha* means brown-spined.

Description:—Low, usually prostrate, with some branches ascending; joints usually longer than broad, 10 to 15 cm. long; areoles rather remote, the lower ones often spineless; spines 1 to 4, those on the sides of the joints more or less reflexed, somewhat flattened, usually rather stout, brown, sometimes darker at base, or often nearly white throughout, the longer ones 5 to 6 cm. long; glochids numerous, yellow to brown; flowers 5 cm. broad, yellow; ovary short; fruit 30 to 35 mm. long, much contracted at base.

Type locality:—About Santa Fé and on the Rio Grande, New Mexico.

Distribution:—Texas to Arizona and Chihuahua.

Synonymy:—Opuntia pheacantha Engelmann in Gray, Mem. Amer. Acad. 4:52. 1849.

Opuntia pheacantha brunnea Engelmann, Proc. Amer. Acad. 3:293. 1856.

Opuntia pheacantha major Engelmann, Proc. Amer. Acad. 3:293. 1856.

Opuntia pheacantha nigricans Engelmann, Proc. Amer. Acad. 3:293. 1856.

Opuntia camanchica Engelmann and Bigelow, Proc. Amer. Acad. 3:293. 1856.

Opuntia chihuahuensis Rose, Contr. U. S. Nat. Herb. 12:291. 1909.

Opuntia toumeyi Rose, Contr. U. S. Nat. Herb. 12:402. 1909.

Opuntia blakeana Rose, Contr. U. S. Nat. Herb. 12:402. 1909.

Opuntia zuniensis Griffits, Bull, Torr. Club, 43:86. 1916. (From the description.)

OPUNTIA ENGELMANNII—Engelmann's Cactus

This species was first described in 1850 from the region between El Paso and Chihuahua, Mexico. It ranges from Mexico to Arizona, New Mexico, and over most of western Texas. It is the common prickly pear of the southwest and has often been confused in literature with *Opuntia lindheimeri.* It differs from that species by the stout spines that have dark brown or black bases and tips. As far as we know, it never assumes the tree-like habit that the former takes in certain parts of the state. The overlapping range of the two species accounts for the confusion existing in regard to the identity.

This cactus is named in honor of Dr. George Engelmann of St. Louis, who studied the cacti extensively and named most of the species of the southwestern states.

It is probably the commonest large-jointed erect *Opuntia* growing in the Southwest. The joints are large, circular to obovate, eight inches to a foot long, rather yellowish-green, and usually well covered with spines. The spines vary from two to five in each cluster, are one to two inches long, white to whitish in color. The spines on the edge of the joints are usually four to five in number. The flowers are large and bright yellow when they first open. The fruit is large, dark purple on the outside and inside.

Both rind and pulp are deep purple in color. The market name "tuna negra" refers to the fact that over-ripe fruits turn a deep purple to almost black.

In some localities the fruit is prepared into an attractive and palatable syrup. The juice is expressed in a fruit press. It is then boiled to one fourth its original volume after the addition of one sixth its weight of cane sugar. The finished product is not only palatable, but attractve in appearance as boiling does not destroy the color in the least.

The following excerpt from *The Cactaceae,* Vol. I. is confusing to the amateur but will throw some light to the specialist who may not possess the above volume since it is out of print and almost impossible to get.

"*Opuntia engelmannii* has been more confused than any other species of *Opuntia.* Salm-Dyck, who first studied the species, doubtless had but a single specimen before him, and this or a duplicate is now in the herbarium of the Missouri Botanical Garden. This type specimen came from near Chihuahua City, from which place Dr. Rose has collected identical material. Dr. Engelmann, who published Salm-Dyck's name, described the plant as erect and five to six feet high, giving its range from Chihuahua City to Texas. These remarks of his were doubtless based on notes of Dr. Wislizenus, who collected the type, and must have included more than one species; as Engelmann says it is both cultivated and wild, the cultivated plants doubtless referring to some of the many forms grown about towns and ranches. In 1852 Engelmann extends the distribution of the species westward to the Pacific Ocean, referring especially to a San Diego specimen. In 1856 he refers here to his previously described species *Opuntia lindheimeri,* and extends the range eastward to the mouth of the Rio Grande and to lower Mexico. Coulter brought all this material together under *Opuntia lindheimeri* and four varieties.

An examination of herbarium and greenhouse specimens shows that at least half a dozen species have been passing under the name of *Opuntia engelmannii.* While certain varieties and specimens are evidently to be excluded from the species, we are still uncertain as to its specific limits. It is quite common about Chihuahua City and extends to Monterey and Saltillo or is represented there by a near ally, while Mr. E. O. Wooton would refer here plants of southern New Mexico, and we are including large, bushy *Opuntias* from Arizona.

Dr. Rose was inclined at one time to separate the Tucson plant, which seems to have some just claims for specific recognition, but there is a mass of herbarium material which seems to connect this with the true *Opuntia engelmannii.*"

Description:—Originally described as erect and up to 2 meters high, but more properly a widely spreading bush, usually without a definite trunk; joints oblong to orbicular, 2 to 3 dm. long, thick, pale green; areoles distant, becoming large and bulging; spines usually more or less white, with dark red or brownish bases and sometimes with black tips, usually 3 or 4, sometimes only 1, or entirely wanting from the lower areoles, but on old joints 10 or more, usually somewhat porrect or a little spreading, but never reflexed, the larger ones much flattened, the longest one 5 cm. long; leaves subulate, about 15 mm. long; glochids numerous, brown with yellowish tips flowers large, yellow; fruit 3.5 to 4 cm. long, red; seeds small, 3 to 4 mm. broad.

Type locality:—From El Paso to Chihuahua.

Distribution: — Chihuahua, Durango, Sonora, Arizona, New Mexico, and Texas.

Synonymy:—Opuntia engelmannii Salm-Dyck in Engelmann, Bost. Journ. Nat. Hist. 6:207. 1850.

Opuntia engelmannii cyclodes Engelmann, Proc. Amer. Acad. 3:291. 1856.

Opuntia lindheimeri cyclodes Coulter, Contr. U. S. Nat. Herb. 3:422. 1896.

Opuntia dillei Griffiths, Rep. Mo. Bot. Gard. 20:82. 1909.

Opuntia arizonica Griffiths, Rep. Mo. Bot. Gard. 20:93. 1909.

Opuntia wootonii Griffiths, Rep Mo. Bot. Gard. 21:17. 1910.

Opuntia cyclodes Rose, Contr. U. S. Nat. Herb. 13:309. 1911.

Opuntia gregoriana Griffiths, Rep. Mo. Bot. Gard. 22:26. 1912.

Opuntia valida Griffiths, Proc. Biol. Soc. Washington 27:24. 1914.

Opuntia confusa Griffiths, Proc .Biol. Soc. Washington 27:28. 1914.

Opuntia magnarenensis Griffiths, Proc. Biol. Soc. Washington 29:9. 1916.

Opuntia expansa Griffiths, Proc. Biol. Soc. Washington 29:14. 1916.

OPUNTIA STRICTA

Opuntia stricta is a Texas Coast species.

It should be noted that while Britton and Rose give *Opuntia* *stricta* and *Opuntia inermis* as synonyms, the reports published by the Australian government give them as separate species. The plant called *Opuntia inermis* by them is so common as to be considered a pest in the vicinity of Freeport, Texas.

This species is one of the "pest years" of Australia. It has run over thousands of acres of the best agricultural and grazing

OPUNTIA LINGUIFORMIS

Commonly called Cow-tongue cactus. Pads two to three feet long and only three to four inches wide are not uncommon. Note O. lindheimeri at right.

lands in the interior of that country. Photographs seen by the author show it as growing thick and high in woodland as well as out in the open. In the effort to check its rapid advance, which is reported as being several thousand acres per year, the Australian government has sent scientific expeditions to the United States and other countries to find insects or a disease that might be introduced to destroy the plants naturally. One of these stations for investigation and study is located in Uvalde, Texas.

To emphasize its spread in Australia we quote J. H. Maiden. "The growth of this *Opuntia* is one of the wonders of the world, and the spread of few plants in any country can be compared with it."

A further remark in The Cactaceae, Vol. I. is of interest. "This species if often cultivated on the west coast of South America. It was there given the name *Opuntia airampo* by Dr. Phillippi, who supposed it to be the *airampo* of the *Peruvians,* a native species, quite different from this one."

Description:—Bushy, low, spreading plants, sometimes forming large clumps, seldom over 8 dm. high; joints obovate to oblong, usually 8 to 15 cm. long, but sometimes much elongated and then 30 cm. long or more, green or bluish green, glabrous, often spineless especially in greenhouse specimens, sometimes but a spine or two in joint, at other times spines more abundant; leaves stout, subulate, 3 to 4 mm. long; areoles distant, the wool brownish, the glochids short; spines, when present, usually 1 or 2 from an areole, stiff, terete, yellow, 1 to 4 cm. long;f lowers 6 to 7 cm. long; petals yellow, broad, obtuse, apiculate; filaments yellow to greenish; style usually white; stigma-lobes usually white but sometimes greenish; fruit purple, usually broadest at top, tapering to a slender base, 4 to 6 cm. long, with a more or less depressed umbilicus.

Type locality:—Not given.

Distribution:—Western Cuba; Florida to southern Texas.

Synonymy:—Opuntia stricta Haworth, Syn. Pl. Succ. 191. 1812.

Cactus opuntia inermis De Candolle, Pl. Succ. Hist. 2:pl. 138 (C). 1799.

Cactus strictus Haworth, Misc. Nat. 188. 1803.

Opuntia inermis De Candolle, Prodr. 3:473. 1828.

Opuntian airampo Philippi, Anal. Univ. Chile 85:492. 1894.

Opuntia parva Berger, Hort. Mortol. 411. 1912 .

Opuntia bentonii Griffiths, Rep. Mo. Bot. Gard. 22:25. 1912.

Opuntia longiclada Griffiths, Bull. Torr. Club 43:525. 1916 (according to description and illustration).

OPUNTIA LINGUIFORMIS—Cow-Tongue Cactus

This rare cactus was first described by David Griffiths in the nineteenth Annual Report of the Missouri Botanical Garden 1908. Mr. Griffiths found it growing in a very limited amount in about three places in the vicinity of San Antonio. It does not occur elsewhere as far as is known. It is called Cow-tongue Cactus or *Lengua de Vaca,* because the stems are elongated or taper off like a cow's tongue. It is undoubtedly of south Texas origin and a very rare species. It does well in cultivation and will stand cold weather. The flowers which appear in the spring are large, yellow or goldish in color, similar to *Opuntia lindheimeri.*

In its natural habitat it is affected by a black fungus which seems to hold it in complete check. Due to its limited distribution and the way cactus collectors are digging it up, it will probably last only a few years in its natural habitat.

The following observations made by Mr. H. B. Parks, who lives within three miles of the type locality are of interest.

To the genus Opuntia belong several species that are valuable as honey plants. During years when low temperatures and high humidity prolong the time of blooming, *O. lindheimeri* gives the bees an abundant supply of nectar. *O. leptocaulis* and *O. macrorhiza* are well known as minor honey plants.

In making a distribution study of *O. lindheimeri* it was found that certain variations occur, the most striking of which is one with triangular or parallel-sided pads. This form seems to be of much more rapid growth than the type and for ease of record was designated as *O. lindheimeri* var. brava. The first peculiarity noticed was that it seldom bloomed. In case of bloom, the flower cannot be distinguished from that of *O. lindheimeri* blooming in the immediate vicinity. If fruits are set, they do not develop seeds. This variety is therefore dependent upon pad distribution for its perpetuation. The long padded form is more brittle and susceptible to disease than the round padded form. The habitat of this form seems to be the "hog wallows" of the mesquite thickets. These wallows are low places where storm water gathers and where through a long lapse of time a very peculiar soil has been developed through the decay of washed-in vegetation. The larger of these basins have given rise to small water courses made necessary to carry off the excess of water. From such locations many pads, separated from the parents by accident of weather, animals, or by the simple vegetable division which occurs where an unfertilized fruit gives rise to pads, have been carried and planted at some distance by water. Two localities are known where roads were built through growth of this cacti and the long padded form has been scattered from two to three miles on each side of the original location by grading machinery.

Similar shaped pad cactus but with differing areoles is common among ornamental cacti. Among those seen, judging from color and arrangement of spines, two probably originated from *O. tortispina* and from *O. macrorhiza.*

The common characteristic of all these varieties is the long tongue-shaped pad which bears few or no flowers. A close study of the morphology of these plants gives the following: In the common or recognized species, the pads are round or orbicular in shape. They have no definite growing point. When the pad starts to grow, its size and shape seem to be predetermined as the growth expansion takes place all over the pad and at the same time the outside edge is always smooth and complete. In the variety the new pad has a growing point from which the pad continues to elongate and to broaden, whenever, and as long as growing conditions continue. If the growing period is short the pad will be triangular. If the growing continues the pad elongates and the sides become parallel. Pads three to four feet long and only three to four inches wide are quite common. Such pads are produced during wet seasons when the growing period is from May until September. On many of these pads the scalloped edge gives the record of alternate dry and wet conditions of the weather. The coming of cold weather puts an end to the growing of the pad but does not do away with the growing point.

The study which has been made of these long padded forms thus far indicates that they are lethal mutations. This mutation carries with it a rapidity of growth which is greater than that of the parent plant. Should this be true and the food value be similar, these mutations have possibilities as forage plants. The form named *O. lindheimeri* var. *brava* was named *O. linguiformis* by Dr. Griffiths, but as there is little doubt that it is a lethal mutation and cannot perpetuate itself, it is doubtful if it should receive specific standing.

Description: — A bushy plant, 1 meter high or more; joints elongated, oblong to ovate-oblong or lanceolate, 2 to 5 dm. long or even more, often several times longer than wide, pale green and slightly glaucous; leaves 6 mm. long, terete; spines yellow, very slender, terete or nearly so; areoles filled with brown wool; flowers yellow, 7 to 8 cm. broad; petals broad; filaments white or greenish at base: stigma-lobes 9, green; ovary bearing numerous long glochids at the upper areoles; fruit reddish purple; seeds 3 or 4 mm. broad, acute on the back.

Type locality:—Near San Antonio, Texas.

Distribution:—Southern Texas, in the vicinity of San Antonio.

Synonymy:—Opuntia linguiformis Griffiths, Rep. Mo. Bot. Gard. 19:270. 1908.

OPUNTIA ACICULATA

This species as reported, has a closely circumscribed area as its natural habitat. Britton and Rose add in their notes in *The Cactaceae,* Vol. I that it is not very common about Laredo, but grows in small colonies to the exclusion of all other plants. It is usually restricted to dry hills.

Opuntia aciculata is a bushy plant. It has both horizontal and erect branches. The joints are obovate, five to eight inches long, dull dark green, sometimes glaucous, bearing large closely set, almost spineless areoles. The spines are slender, several in a cluster, one to two inches long, often reflexed, apparently deciduous. The flowers are large, golden yellow, often with a greenish center. The petals are broad. The fruit is purple and constricted at the base.

Description:—Low, bushy plant, 1 meter high or more, often 3 meters broad or more, the lower branches decumbent and sending up erect branches; joints obovate, 12 to 20 cm. long, rounded at apex, dull dark green, somewhat glaucous, bearing large, closely set areoles, these often spineless; leaves subulate, 7 mm. long; spines several in a cluster, acicular, slender, 3 to 5.5 cm. long, often reflexed, brownish at base, with yellow tips, seemingly deciduous; glochids numerous, from all parts of the areoles, long, persisting for several years; flower golden yellow, sometimes with a greenish center, large, 8 to 10 cm. broad; petals broad, rounded or retuse; filaments yellowish; style dull yellowish green; stigma-lobes 8 to 10 green; fruit pyriform, purple.

Type locality:—Near Laredo, Texas.

Distribution:—On high gravelly ground at type locality and vicinity.

Synonymy: — Opuntia aciculata Griffiths, Proc. Biol. Soc. Washington 29:10. 1916.

OPUNTIA LINDHEIMERI—"Nopal" Prickly Pear

This cactus has a very wide range of distribution, Louisiana to New Mexico and all the northeastern part of Mexico. Mr. E. Mortensen gives it as "the common *Opuntia* in Wilson and De Witte counties, but that it does not occur in the areas of Taylor, Jones and Fisher counties." In the lower Rio Grande Valley, where conditions are very favorable, it reaches a height of twelve to fifteen feet. It is of great economic importance and has saved the lives of thousands of animals and people by furnishing them

Opuntia lindheimeri in fruit. The blossoms and fruit form on the edge of the leaf-like stems. During periods of drought enormous quantities of this plant are fed to livestock, particularly cattle, after the thorns have been burned off by torches or "pear burners" especially made for that purpose. To the cattlemen it is one of the most valuable of our native plants.

food during long dry spells when every spring of grass was parched.

Opuntia lindheimeri is a very heavy, erect growing *Opuntia.* It is very variable in form and habit of growth, even to its spines and the shape of the pads. It produces beautiful flowers of many colors, from lemon yellow to orange and scarlet red. Usually each plant produces only one shade of flowers.

While the fruit is not relished by man generally it was formerly used in great quantities by the Indians. Very little present day use is made of the fruit by man. Government analyses show that it is has comparatively little merit as a food. Occasionally a family is found which makes a sort of preserve of the peeled fruits. A few dry them, and a few are eaten in the raw state. During July when it is ripe, the wild animals and the birds also have a real "fiesta." The Mexicans tell that the Coyotes whip the small spines from the fruit with their tails and then eat the fruit.

This cactus gives protection to many other weak cacti and desert plants as well as birds and small animals.

It is also utilized as a stock feed, the spines and bristles being singed off with a gasoline torch. Some varieties have had the spines bred off, and where not too cold thrive under vegetation.

The fruits are called *Tunas*. The tender shoots are cooked and relished by the Mexicans during Lent, a time when there are few other vegetables and their religious faith prohibits them from eating meat. The young tender shoots are called *"Nopalitos."*

Quoting H. T. Fletcher of Alpine, Texas in his *Report of the Flora of Green Valley* we have the following interesting note:

"The fruits are eaten by the Mexicans and Indians, being a staple diet of the latter when the first Americans visited Texas. The joints, when young and tender are cooked and served with dressing and pepper. They are also used for making candy, the flavor suggesting watermelon. Good syrup is made by boiling ripe fruit and straining to remove the seeds which are stony and annoying. *Queso de tuna* (Tuna cheese) is made by making a pulp of seed fruit and after evaporation, making it into small masses resembling cheeses. A tea made from the fruit is said to be a cure for gall stones. Commercial alcohol has been made from the sap. The fruit is also host to the fuzzy insects from which cochineal dye is made."

The remarks of Britton and Rose in *The Cactaceae,* Vol. I may be of interest in clearing up doubtful identifications:

"Opuntia lindheimeri is an extremely variable species, composed of many races, differing in armament, color of flowers, size and shape of joints and of fruit. Certain forms have been described which in cultivation we have been able to recognize as possibly distinct; but in the field they seem to intergrade with other forms, indicating that they are at most only races of a very variable

species. In the delta of the Rio Grande this is especially true, and from this region a number of species has been described. In fact, all the plants described as species which are cited above in the synonymy grow within a relatively small distributional area. Dr. Rose has examined all this region and is of the opinion that only one species of this series exists there, and this we believe is to be referred to *Opuntia lindheimeri.* It is very common about Brownsville and Corpus Christi, where it forms thickets covering thousands of acres of land. It is very variable in habit, being either low and wide spreading or becoming tall and three-like sometimes three meters high, with a definite cylindric trunk. Plants from these two extremes, if studied apart from the field, might be considered as different species, but in the field one sees innumerable intergrading forms. The low, prostrate forms gradually pass into others with more or less erect or ascending branches, while the large tree-like forms often bear large lateral branches which lie prostrate on the ground, indicating that they have developed from the prostrate ones. Decided differences in the flower colors have been pointed out in the original descriptions, and we have observed them in greenhouse specimens, but they do not correlate with other characters.

"*Opuntia ellisiana* Griffiths, is quite different from the *Ficus-indicae* series, which it much resembles, and is quite hardy in southern Texas. It may be a spineless race of the common *Opuntia lindheimeri* of this region."

Description:—Usually erect, 2 to 4 meters high, with a more or less definite trunk, but at times much lower and spreading; joints green or bluish green, somewhat glaucous, orbicular to obovate, up to 25 dm. long; leaves subulate, 3 to 4 mm. long, somewhat flattened, pointed; areoles distant, often 6 cm. apart; spines usually 1 to 6, often only 2, one porrect and 4 cm. long or more, the others somewhat shorter and only slightly spreading, pale yellow to nearly white, sometimes brownish or blackish at base, or some plants spineless; glochids yellow or sometimes brownish, usually prominent; petals yellow to dark red; stigma-lobes usually green; fruit purple, pyriform to oblong, 3.5 to 5.5 cm. long.

Type locality:—About New Braunfels, Texas.

Distribution: — Southwestern Louisiana, southeastern Texas, and Tamaulipas, Mexico.

Synonymy: — Opuntia lindheimeri Engelmann, Bost. Journ. Nat. Hist. 6:207. 1850.

Opuntia dulcis Engelmann, Proc. Amer. Acad. 3:291. 1856.

Opuntia lindheimeri dulcis Coulter, Contr. U. S. Nat. Herb. 3:421. 1896.

Opuntian engelmannii dulces Schumann, Gsamtb. Kakteen 725. 1898.

Opuntia cacanapa Griffiths and Hare, N. Mex. Agr. Exp. Sta. Bull. 60:47. 1906.

Opuntia ferruginispina Griffiths, Rep. Mo. Bot. Gard. 19: 267. 1908.

Opuntian tricolor Griffiths, Rep. Mo. Bot. Gard. 20:85. 1909.

Opuntia texana Griffiths, Rep. Mo. Bot. Gard. 20:92. 1909.

Opuntia subarmata Griffiths, Rep. Mo. Bot. Gard. 20:94. 1909.

Opuntia alta Griffiths, Rep. Mo. Bot. Gard. 21:165. 1910.

Opuntia gomei Griffiths, Rep. Mo. Bot. Gard. 21:167. 1910.

Opuntia sinclairii Griffiths, Rep. Mo. Bot. Gard. 21:173. 1910.

Opuntia cyanella Griffiths, Rep. Mo. Bot. Gard. 22:30. 1912.

Opuntia gilvoalba Griffiths, Rep. Mo. Bot. Gard. 22:35. 1912.

Opuntia convexa Mackensen, Bull. Torr. Club 39:290. 1912.

Opuntia griffithsiana Mackensen, Bull. Torr. Club 39:291fl 1912.

Opuntia reflexa Mackensen, Bull. Torr. Club 39:292. 1912.

Opuntia deltica Griffiths, Bull. Torr. Club 43:84. 1916.

Opuntia laxiflora Griffiths, Bull. Torr. Club 43:85. 1916.

Opuntia floexospina Griffiths, Bull. Torr. Club 43:87. 1916.

Opuntia squarrosa Griffiths, Bull. Torr. Club 43:91. 1916.

OPUNTIA ANACHUACENSIS

This species was named for its type locality, Anahuac.

The plant is low, with reclining or prostrate stems. The joints are obovate, yellowish green, and glossy. The spines are one to two in number, about an inch long, flattened and twisted. The flowers are yellow. The fruit is dark purplish red, unusually long (about two and one-half inches), and narrowed at the base.

Description:—A low, reclining or prostrate plant, up to 5 dm. high, 1.5 meters broad; joints obovate, glossy, yellowish green, 27 cm. long, 13 cm. broad; spines yellow or becoming white, 1 or 2, porrect, flattened, twisted, 2 or 3 cm. long; flowers yellow; style white; stigma-lobes 6, white; fruit dark purplish red, pyriform, 7 cm. long.

Type locality:—Anahuac, Texas.

Distribution:—Known only from the type locality, at the mouth of Trinity River, eastern Texas.

Synonymy:—Opuntia anahuacensis Griffiths, Bull. Torr. Club 43:92. 1916.

OPUNTIA FRAGILIS

Opuntian fragilis is included here because of its probable occurrence in the Pan Handle. It is generally considered a northern Opuntia. The remarks of Britton and Rose in *The Cactaceae* Vol. 1 are both graphic and interesting.

"This species is of wide distribution and is especially common on the Plains. It usually grows low, often being hidden by the grass. In the grazing country it is a most troublesome weed, for the joints easily break off and become attached by their spines to passing objects, thus greatly annoying and pestering all animals on the range, even frightening horses. The wide distribution of the species is doubtless due to the fact that the joints are so easily scattered.

The plant is of special interest as the most northern in distribution of the *Opuntias*."

Description:—Usually low and spreading, small and inconspicuous, but sometimes forming mounds 2 dm. high in the center and 4 dm. in diameter, with hundreds of joints; joints fragile (the terminal ones especially breaking off at the slightest touch), often nearly globular but sometimes decidedly flattened, usually dark green, 1 to 4 cm. long; areoles closely set, small, filled with white wool; spines 5 to 7, brown or only with brown tips and lighter below, 1 to 3 cm. long; glochids yellowish; flowers pale yellow, about 5 cm. broad; fruit dry, spiny, 1.5 to 2 cm. long, with a truncate or slightly depressed umbilicus; seeds large, 5 to 7 mm. broad.

Type locality: -- "From the Mandans to the mountains, in sterile but moist situations."

Distribution:—Wisconsin to central Kansas and northwestern Texas, westward to Arizona, Oregon, Washington, and British Columbia.

Synonymy:—Opuntia fragilis (Nuttall) Haworth, Suppl. Pl. Succ. 82. 1819.

Cactus fragilis Nuttall, Gen. Pl. 1:296. 1818.

Opuntia brachyartha Engelmann and Bigelow, Proc. Amer. Acad. 3:302. 1856.

Opuntia fragilis brachyarthra Coulter, Contr. U. S. Nat. Herb. 3:440. 1896.

Opuntia fragilis caespitosa and tuberiformis Hortus, Stand. Cycl. Hort. Bailey 4:2363. 1916.

(?) Opuntia columbiana Griffiths, Bull. Torr. Club 43:523. 1916.

OPUNTIA ARENARIA

Opuntia arenaria is a distinctly west Texas species. It is also of limited distribution as indicated by the remarks of Britton and Rose in *The Cactaceae,* Vol. I.

"This species is very rare and has been reported only a few times. Dr. Rose, who has repeatedly collected at El Paso, was never able to find it until October 1913, and then but a single plant about eight miles from El Paso on the New Mexican side of the Rio Grande. It grows in nearly pure sand not far above the level of the river."

It is much branched plant with prostrate stems. The roots are spindle-form, somewhat fleshy, and in clusters of ten to fifteen. The joints are small, two to three inches long, are somewhat turgid in the growing season, later becoming much thinner. The areoles are large, numerous, and filled with brown wool, glochids, and five to eight spines.

The spines are unequal in length. The flowers are large, red, about two and one-half inches across. The fruit is both dry and spiny.

Description:—Roots in clusters of 10 to 15, spindle-form, somewhat fleshy; stems prostrate, 2 to 3 dm. long, much branched; joints during growing season quite turgid, afterwards much thinner, 4 to 8 cm. long, half as broad as long; areoles large, numerous, filled with brown wool, glochids, and spines; spines 5 to 8 from an areole 2 to 3 much longer than the others, sometimes 4 cm. long; flowers red, 7 cm. broad; fruit dry, spiny, 3 cm. long; seeds large, 7 cm. broad.

Type locality: — Sandy bottoms of the Rio Grande near El Paso.

Distribution:—Texas and southern New Mexico.

Synonymy:—Opuntia arenaria Engelmann, Proc. Amer Acad. 3:301. 1856.

OPUNTIA TRICHOPHORA

This is a Texas species which laps over the border into New Mexico and Oklahoma. It is very closely related to *Opuntia polycantha* and sometimes mistaken for it. It can be identified by the closely set areoles, numerous slender unequal spines, and yellow flowers with red tinged sepals. The ovary is covered with numerous areoles that bear pale bristles.

It is a low spreading plant and sometimes forms clumps of fair size. It is fairly abundant throughout northern Texas and eastern New Mexico.

This species is closely related to *Opuntia polycantha.* Britton and Rose base their classiffication as a separate species chiefly on the long weak spines.

Description: — A low, spreading plant, often forming small clumps 5 to 10 dm. diameter; joints orbicular to obovate,6 to 10 cm. in diameter; areoles closely set; spines numerous, very unequal, the longest one 4 cm. long or so, acicular, pale, often white, but on old joints developing into long, weak hair-like bristles; flowers yellow, the sepals tinged with red; ovary with numerous areoles these bearing weak pale bristles; fruit unknown.
Type locality:—Mountains near Albuquerque, New Mexico.
Distribution:—New Mexico, Texas, and Oklahoma.

Synonymy: — Opuntia trichophora (Engelmann) Britton and Rose, Smiths. Misc. Coll. 50:535. 1908.
Opuntia missouriensis trichophora Engelmann, Proc. Amer. Acad. 3:300. 1856.
Opuntia polycantha trichophora Coulter, Contr. U. S. Nat. Herb. 3:437. 1896.

OPUNTIA POLYACANTHA

This is the *Opuntia missouriensis* of the older books. It is one of the first of our western species to be collected and described. It was first collected by Thomas Nuttall. As indicated by its fourteen synonyms the species has been a source of much observation and argument.

In Texas it is confined to the Panhandle and Plains. The general distribution ranges from the Panhandle north to the Dakotas, Washington and Alberta, Canada, and west to Utah. Notes on this plant in *The Cactaceae,* Vol. I by Britton and Rose give a good description of the habits and habitat of this prolific and interesting plant.

"This species has a wide distribution laterally and altitudinally. It is properly a plains' species but is found in mountain valleys and on dry hills, usually in the open but sometimes in sparse pine woods. In a species of such wide distribution, and growing under such diverse conditions a wide range of forms is to be expected and a number of varieties have been proposed for the various races, some of which may perhaps have red flowers. The plant is hardy at New York, flowering freely in June."

Opuntia pheacantha is a small-jointed, nearly prostrate plant. The clumps are usually small. The joints are mostly obovate or circular, thin, generally light green. The spines are numerous in each cluster, often as many as nine. Those on the sides of the joints are usually short and appressed. Often they are highly colored. The fruit is small, less than an inch long, dry, covered with small white spines. The seeds are white.

Wooton gives it as "the common plant in the piñon and cedar covered areas and on the high mesas in the northern part of New Mexico where it forms large irregular beds mainly on sandy soils."

Description:—Low, spreading plants, with fibrous roots, usually forming small clumps; joints not very thick, orbicular, usually less than 10 cm. in diameter, generally light green; areoles small, closely set, usually less than 1 cm. apart, all spiny; spines numerous, often 9, those from the sides mostly short, appressed, and white, but often 1 or 2 of these elongated and like those from the upper and marginal areoles, dark brown, with lighter tips and about 3 cm. long; glochids yellow; flowers small, 4 to 5 cm. long, including the ovary; sepals tinged with red; petals lemon-yellow; stigma-lobes green; fruit dry, oblong, 2 cm. long, bearing small clusters of white, acicular spines at the areoles; seeds white, 6 mm. long, acute on the margin.

Type locality:—Arid situations on the plains of the Missouri.

Distribution:—North Dakota to Nebraska, Texas, and Arizona to Utah, Washington, and Alberta. Confined to Panhandle and Plains in Texas.

Synonymy: — Opuntia polycantha Haworth, Suppl. Pl. Succ. 82. 1819.

Cactus ferox Nuttall, Gen. Pl. 1:296. 1818. Not Willdenow. 1813.

Opuntia media Haworth, Suppl. Pl. Succ. 82. 1819.

Opuntia missouriensis De Candolle, Prodr. 3:472. 1828.

Opuntia splendens Pfeiffer, Enum. Cact. 159. 1837.

Opuntia missouriensis albispina Engelmann and Bigelow, Proc. Amer. Acad. 3:300. 1856.

Opuntia missouriensis microsperma Engelmann and Bigelow, Proc. Amer. Acad. 3:300. 1856. Not O. rafinesquei microsperma Engelmann, Proc. Amer. Acad. 3:295. 1856.

Opuntia missouriensis platycarpa Engelmann, Proc. Amer. 3:300. 1856.

Opuntia missouriensis rufispina Engelmann and Bigelow, Proc. Amer. Acad. 3:300. 1856.

Opuntia missouriensis subinermis Engelmann, Proc. Amer. Acad. 3:300. 1856.

Opuntia polycantha albispina Coulter, Contr. U. S. Nat. Herb. 3:437. 1896.

Opuntia polycantha borealis Coulter, Contr. U. S. Nat. Herb. 3:436. 1896.

Opuntia polycantha platycarpa Coulter, Contr. U. S. Nat. Herb. 3:436. 1896.

Opuntia polycantha watsonii Coulter, Contr. U. S. Nat. Herb. 3:437. 1896.

Opuntia schweriniana Schumann, Monatsschr. Kakteenk. 9:148. 1899.

LEAD PENCIL CACTUS—Dahlia cactus—Sacasil

The Lead Pencil Cactus is one of the few cacti having its type locality in Texas. It is a rare and extremely interesting desert plant. The Mexicans have long called it *Sacasil.* The tuberous roots are used by them as a remedy.

The plant was formerly known as *Cereus tuberosa* and *Echinocereus tuberosus.* In 1909 it was given generic rank by Britton and Rose. It was classified with the *Cereii* and *Echinocerii* so long because the flowers, fruit and seed strongly resemble these genera. It differs noticeably in its slender, erect or reclining stems, and the dahlia-like roots.

It grows on gravel or sandy hillsides, and sandy flats. Its range is from Hidalgo County up the Rio Grande to Laredo or probably farther west, and in adjacent Mexico. It is difficult to find in its natural habitat when not in blossom, because it grows hidden in clumps of *Chaparral, Nopal* and *Tasajillo.* The protection afforded by these plants has undoubtedly saved it from extermination.

The stems are erect, simple or branched, about the size of a lead pencil, and woody or dry at the base. Some stems are enlarged and fleshy upward. The 8 to 10 inconspicuous ribs are covered with delicate soft, grayish or brownish, interlaced, mostly radial spines.

The flowers are showy, rose to pinkish purple in color, near the tip of the branches, 1½ to 2 inches across, and large for the size of the plant. They open at midday and close at about five o'clock, The period of blossoming is from March to May. The styles are green, and the stamens yellow.

Plate 38 in Blühende Kakteen, Vol. 1 is a splendid reproduction in color.

The roots are black, tuberous, in dahlia-like clusters, and only two to four inches below the surface of the ground. The plants reach perfection in dry sandy loam soil.

Wilcoxia is a rare and interesting plant. In greenhouse cultivation it gradually loses its vitality. Plants have however persisted ten years in cultivation. When grafted on *Selenicereus pteranthus,* very vigorous plants that will blossom each year can be developed.

Lead Pencil Cactus—*Dahlia cactus*—*Wilcoxia poselgeri*

The stems are about the size of a lead pencil, very graceful, and covered with a lacy network of delicate spines. The flowers are deep rose to pinkish purple in color.

Wilcoxia was named in honor of General Timothy E. Wilcox, U. S. A., who for many years was an enthusiastic student of plant life.

Description:—Roots tuberous, black, several, near the surface of the ground; stems 60 cm. high or less, 6 to 10 mm. thick, with 8 to 10 inconspicuous ribs, the lower and older parts naked, spiny above, the spines almost hiding the ribs; radial spines 9 to 12, appressed, 3 to 5 mm. long, delicate, puberulent; central one ascending, black tipped, about 1 cm. long, stouter than the radials; flowers purple or pink, 5 cm. long; spines of ovary and flower-tube intermixed with white hairs; perianth-segments linear, acuminate, about 2.5 cm. long, widely spreading or strongly recurved; style pale green; stigma-lobes slender, green; seeds pitted or rugose, 8 mm. long.

Synonymy:—Wilcoxia poselgeri (Lemaire) Britton and Rose, Contr. U. S. Nat. Herb. 12:434. 1909.

Cereus tuberosus Poselger, Allg. Gartenz. 21:135. 1853. Not Pfeiffer, 1837.

Echinocereus poselgeri, Lemaire, Cact. 57. 1868.

Echinocereus tuberosus Rumpler in Forster, Handb. Cact. ed. 2:783. 1885.

Cereus poselgeri Coulter, Contr. U. S. Nat. Herb. 3:398. 1896.

DEER HORN CACTUS—Chaparral Cactus—Penicereus greggii

Penicereus greggii is remarkable for its enormous fleshy root. These are often a foot thick, and as much as a foot and a half long.

It is often known as the "Night Blooming Cereus of the Texas desert" as the flowers are white and open at night. The plant grows erect, has one or more stems at the base, and branches sparingly above. The stems are more or less slender, about half an inch thick, 4 or 5 ribbed. The color is a dark gray or dull green, the skin of a peculiar velvety texture.

The flowers are nocturnal, fragrant, large for the size of the plant, white with the outer perianth segments tinged with red. The floral tube is long and slender. The majority of the flowers appear on the same night and being extremely fragrant make excellent guides to collectors searching for the plant. In Tucson, Arizona, the approximate flowering date is given as June fifteenth.

The fruit is bright scarlet, fleshy, edible, and through its habit of tipping the branches is an easy second guide for the collector in the location of plants.

The plants invariably grow nestled at the base of a small clump of desert shrubs, the slender stems growing through the branches of these shrubs. This habit has given it the name, Chaparral Cactus.

This cactus is unique in that it is a monotypic genus, native to the Southwestern United States and Northern Mexico. The plants slowly lose their vitality in greenhouse cultivation and finally die. Outdoor cultivation in their native climate does not injure them. Botanically they are extremely rare and interesting.

The generic name, *Penicereus,* is of Greek origin, signifying thread-cereus.

It is easily distinguished from the Lead Pencil Cactus by the stouter stems, the 4 to 5 angled ribs bearing short spines with the space between the ribs naked, the heavy turnip-shaped root, and the nocturnal blossoming of its large white flowers.

Description:—Roots often very large, sometimes 6 dm. in diameter, weighing 60 to 125 pounds, usually 15 to 20 cm. long by 5 to 8 cm. in diameter; stems 3 dm. to 3 meters high, 2 to 2½ cm. in diameter, theyoung parts pubescent; spines small, blackish; radials 6 to 9, centrals usually 1, sometimes 2; flowers 15 to 20 cm. long, the tube slender and terminating in a short funnelform throat, covered with stamens; inner perianth-segment lanceolate, acute, 4 cm. long, spreading, or the outer ones reflexed; filaments erect, exerted; style slender, the stigma-lobes about 1 cm. long; fruit tuberculate, 12 to 15 cm. long, including the elongated beak.

Type locality:—Near Chihuahua, Mexico.

Distribution: — Western Texas, southern New Mexico and Arizona to Sonora, Chihuahua, and Zacatecas.

Synonymy: — Peniocereus greggii (Engelmann) Britton and Rose, Contr. U. S. Nat. Herb. 12:428. 1909.

Cereus greggii Engelmann in Wislizenus, Men. Tour, North Mexico. 102. 1848.

Cereus bottsii Salm-Dyck, Cact. Hort. Dyck. 1849. 208. 1850.

Cereus greggii transmantanus Engelmann, Proc. Amer Acad. 3:287. 1856.

Cereus greggii roseiflorus Kuntze, Monatsschr. Kakteenk, 20:-172. 1910.

TRIANGLE CACTUS—Night-blooming cereus—"Organo"—"Pitahaya"
Acanthocereus pentagonus

Acanthocereus is one of the two night-blooming cacti growing native in Texas. The stems are 3 to 6-angled, erect or reclining. The plant is of a spreading habit, and older plants form in large clumps as illustrated in the photograph. The young stems are at first upright, but when attaining four or more feet in length, arch over, the tips taking root in the soil.

The flowers are large, white, open at night, and are known for their fragance. The floral tubes are especially long and covered with a number of soft spines. The inner perianth segments are white, the outer green. The buds begin to expand about four o'clock in the afternoon and are wide open by ten o'clock at night. The flowers close at daylight the following morning, and do not open again.

The fruits are oval, spiny, bright scarlet, with thick black seeds and a luscious red pulp. The Mexican name for this fruit is *Pitahaya.*

The distribution of this cactus in Texas is very limited. As far as is known, it is confined to Cameron, Willacy, and probably Kenedy counties, except a few scattered patches along the Gulf Coast.

It is called Triangle cactus or Night-blooming Cereus by the American people and *Organo* by the Mexicans. The name "organo" in Mexico is also applied to *Pachycereus marginatus,* a cactus which resembles a pipe organ in its manner of growth.

Our Texas-Mexico species is the type of the genus. It was first described by Linnaeus in his "Species Plantarum," under the name *Cactus pentagonus.* The generic name *Acanthocereus* is taken from the Greek word "akonthos," meaning a spine. The species name *pentagonus* means five-angled, in reference to the angled stems.

There are eight species of this tropical cactus, with only one extending into Texas and Mexico. It has a very wide distribution in low altitudes.

Acanthocereus pentagonus varies greatly in the relative thickness of the stems, in the number of angles of the stem, in its armament, and in the size of the flowers. The following notes were contributed by Mr. William Hess:

"On account of its vigorous growth this is one of the best species to graft upon. If a specific name should apply to certain characters of the plant this species ought to be *variabilis* Engelmann. This describes it perfectly, while *pentagonus* does not. It has been a question for years whether or not Linnacus really had this species in mind when giving his name."

Description:—Stems clambering, usually 2 to 3, sometimes 7 meters high, but when growing in the open more or less arched and rooting at the tips, then making other arches and thus forming large colonies; old trunk becoming nearly round, 5 cm. in diameter or more, covered with a thick mucilaginous, spineless cortex and a hard wood axis with only a small pithy cavity; joints 3 to 8 cm. broad, 3 to 5-angled, low-crenate; juvenile growth nearly terete, with 6 to 8 low ribs, approximate areoles and numerous short acicular spines; areoles on normal branches 3 to 5 cm. apart; spines gray, acicular to subulate, various; radials at first 6 or 7, 1 to 4 cm. long; central spine often solitary, longer than the radials; spines of old areoles of as many as 12, of which several are centrals; flowers 14 to 20 cm. long; tube and ovary bearing conspicuous areoles with brown felt and several subulate spines; outer perianth-segments green, inner perianth-segments white, acuminate; fruit oblong, red, edible; cotyledons broadly ovate, 5 to 8 mm. long, thick, united at base, gradually passing below into the spindle-shaped hypocotyl.

Type locality:—America, but no definite locality cited.

Distribution:—Coast of Texas, south along the east coast of Mexico to Guatemala and Panama; the coast of Columbia and Venezuela and Guadeloupe. Introduced on St. Thomas and St. Croix. Recorded from Cuba.

Synonymy: — Acanthocereus pentagonus (Linnaeus) Britton and Rose Contr. U. S. Nat. Herb. 12:432. 1909.

Cactus pentagonus Linnaeus Sp. Pl. 467. 1753.

Cactus pitajaya Jacquin, Enum. Pl. Carib. 23, 1761.

Cereus pentagonus Haworth, Syn. Pl. Succ. 180. 1813.

Cactus prismaticus Willdenow, Enum. Pl. Suppl. 32. 1813.

Cereus prismaticus Haworth, Suppl. Pl. Succ. 77. 1819.

Cereus pitajaya De Candolle, Prodr. 3:466. 1828.

Cereus undulosus De Candolle, Prodr. 3:467. 1828.

Cactus undulosus Kosteletzky, Allg. Med. Pharm. Fl. 4:1393. 1835.

Cereus cognatus Pfeiffer, Enum. Cact. 106, 1837 as synonym.

Cereus acutangulus Otto in Pfeiffer, Enum. Cact. 107. 1837.

Cereus priceps Pfeiffer, Enum. Cact. 108. 1837.

Cereus ramosus Karwinsky inPfeiffer, Enum. Cact. 108. 1837.

Cereus baxaniensis Karwinsky in Pfeiffer, Enum. Cact. 109. 1837.

Cereus variabilis Engelmann, Bost. Journ. Nat. Hist. 5:205. 1845. Not Pfeiffer 1837.

Cereus nitidus Salm-Dyck, Cact. Hort. Dyck, 1949. 211. 1850.

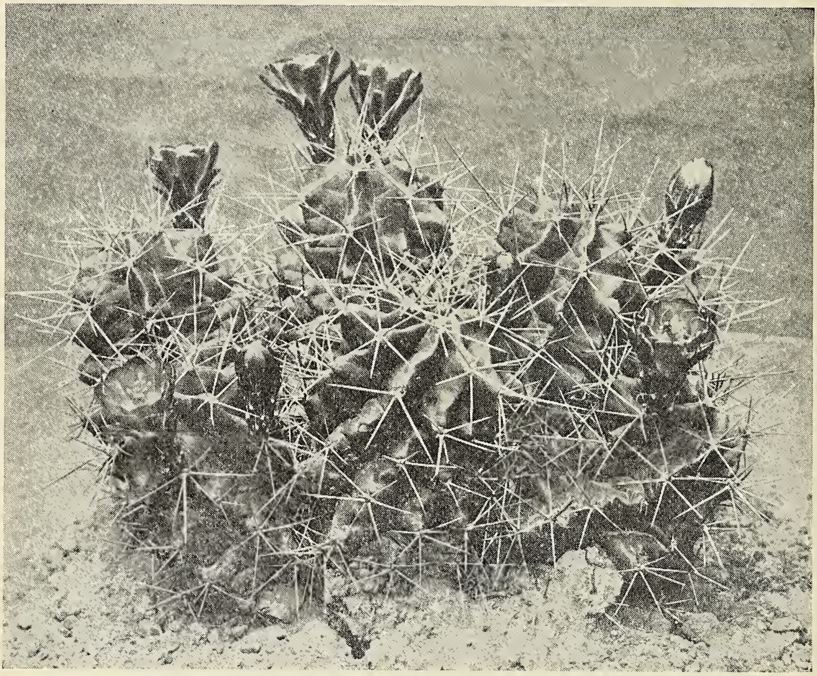
Cereus dussii Schumann, Gesamtb. Kakteen 89, 1899.

Cereus sirul Weber in Gossenlin. Bull. Mus. Hist. Nat, Paris. 10:384. 1904.

Cereus vasmeri Young, Fl. Texas 276. 1873.

CLARET CUP CACTUS—Pitaya
Echinocereus triglochidiatus

This is the well known *Echinocereus paucispinus* of cactus collectors and fanciers. It extends from New Mexico as far east as Sabinal, Texas. It has also been collected by Mr. William Hess in Medina county and at Somerset in Atascosa county.



Claret Cup—*Echinocereus triglochidiatus*

One of the earliest of cacti to blossom. The scarlet goblet-shaped blossoms remind one of a plant studded with claret cups. The flowers do not close at night as do most cacti, but remain open in good condition several days.

The plants are cespitose, consisting of one to many stems, usually many, and forming large clumps. The stems forming these clumps are thick and heavy, shaped like bananas, and bunch into a heavy rosette. Each stem bears five to eight ribs. The ribs are tuberculate, with spines on the top of each tubercle. The radial spines vary from six to more in number. A cental spine is often missing.

The flowers are small in comparison with other plants of this genus. They are brick-red to dark red in color, open about noon and remain open night and day for several consecutive days. The flowers do not open wide and look as if made of colored wax. The blossoms appear about the middle of March.

This species is easily distinguished from *Echinocereus enneacanthus* and other closely related species by the stouter and heavier stems, the small brick-red flowers which remain open all night as well, and the earlier blossoming period. Both species resemble each other strongly in their manner of growth and the rosette formation of the stems of the older plants. *Echinocereus triglochidiatus* seldom has a central spine as is common in other similar species. It should be remembered however that *E. triglochidiatus* is very variable in its growth and number of spines. For colored plate see Schumann and Gurke, Plate 124, Vol. 3, Blühende Kakteen.

There are about sixty recognized species of the genus *Echinocereus*. About one third of these are indigenous to Texas. *Echinocereus fendleri* is the State Flower of New Mexico.

Description: — Always cespitose, with few or many simple stems, these 2 to 6 dm. long, 5 to 8 cm. in diameter, deep green, erect or spreading, 5 to 8 ribbed; spines 3 to 8, various, nearly terete to strongly angled, when young reddish to yellow, but gray in age, usually spreading, often all radial, 3 cm. long or less; flowers scarlet, 5 to 7 cm. long; perianth-segments oblong, obtuse, 3 cm. long; areoles on the flower-tube and ovary few, white-felted, the subtending scales small and red; spines on ovary and flower-tube few, red and white; fruit at first spiny, but in age smooth, bright red, 3 cm. in diameter; seeds 1.6 mm. in diameter or less.

Type locality:—Wolf Creek, New Mexico.

Distribution:—Western Texas, New Mexico and Colorado.

Synonymy:—Echinocereus triglochidiatus Engelmann in Wislizenus, Mem. Tour. North. Mexico. 93. 1848.

Cereus triglochidiatus Engelmann in Gray, Pl. Fendl. 50. 1849.

Cereus gonacanthus Engelmann and Bigelow, Proc. Amer Acad. 3:283. 1856.

Cereus paucispinus Engelmann, Proc. Amer. Acad. 3:285. 1856.

Cereus hexaedrus Engelmann and Bigelow, Prop. Amer. Acad. 3:285. 1856.

Echinocereus paucispinus Rümpler in Forster, Handb. Cact. ed. 2:794. 1885.

Echinocereus gonacanthus Rümpler in Forster, Handb. Cact. ed. 2:806. 1885.

Echinocereus hexaedrus Rümpler in Forster, Handb. Cact. 2:807. 1885.

Echinocereus paucispinus triglochidiatus Schumann, Gesamtb. Kakteen 281. 1889.

Echinocereus paucispinus gonacanthus Schumann, Gesamtb. Kakteen 281. 1898.

Echinocereus paucispinus hexaedrus Schumann, Gesamtb. Kakteen 281. 1898.

ECHINOCEREUS OCTACANTHUS

As Engelmann always contended this cactus is undoubtedly a variety of *Echinocereus enneacanthus*.

Description:—Cespitose, with many simple joints; joints ovoid, yellowish green, 7 to 10 cm. long, 5 to 7 cm. in diameter; ribs 7 to 9, obtuse, somewhat tubercled; areoles when young white-woolly, in age naked, 8 to 16 mm. apart; spines rigid, grayish brown; radial spines 7 or 8, 10 to 24 mm. long; central spine solitary, stouter than the radials, porrect, 2 to 3 cm. long; flowers red, 5 cm. long, remaining open for several days; fruit unknown.

Type locality:—Northern Texas.

Distribution: — Known to Britton and Rose definitely only from northwestern Texas, but reported by Coulter from New Mexico and Utah.

Synonymy:—Echinocereus octacanthus (Muhlenpfordt). Britton and Rose.

Echinopsis octacantha Muhlenpfordt, Allg. Gartenz. 16:19. 1848.

Cereus roemeri Engelmann in Gray, Pl. Fendl. 50. 1849. Not Muhlenpfordt, 1848.

Echinocereus roemeri Rumpler in Forster, Handb. Cact. ed. 2:792. 1885.

Cereus octacanthus Coulter, Contr. U. S. Nat. Herb. 3:395. 1896.

ECHINOCEREUS CONOIDEUS

This is a western Texas and New Mexico species. It is very closely related to *Echinocereus coccineus* and is very common throughout its range of distribution. The stems are cespitose, rather stout, and well covered with stiff, strong spines. The flowers are scarlet and open in bright sunlight for two to three consecutive days. Britton and Rose in "The Cactaceae" make this statement:

"The species is closely related to *Echinocereus coccineus,* perhaps not specifically distinct from it."

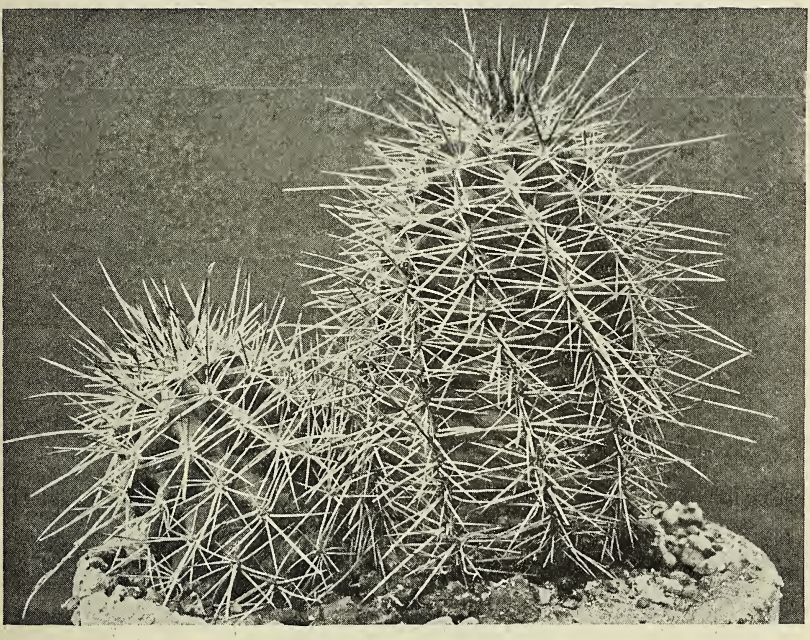
Type locality:—On the upper Pecos, New Mexico

Distribution:—Southeastern New Mexico and western Texas

Synonymy: — Echinocereus conoideus (Engelmann and Bigelow) Rümpler in Forster, Handb. Cact. ed. 2:807. 1885.

Cereus conoideus Engelmann and Bigelow, Proc. Amer Acad. 3:284. 1856.

Echinocereus phoeniceus conoideus Schumann, Gesamtb, Kakteen 283. 1898.



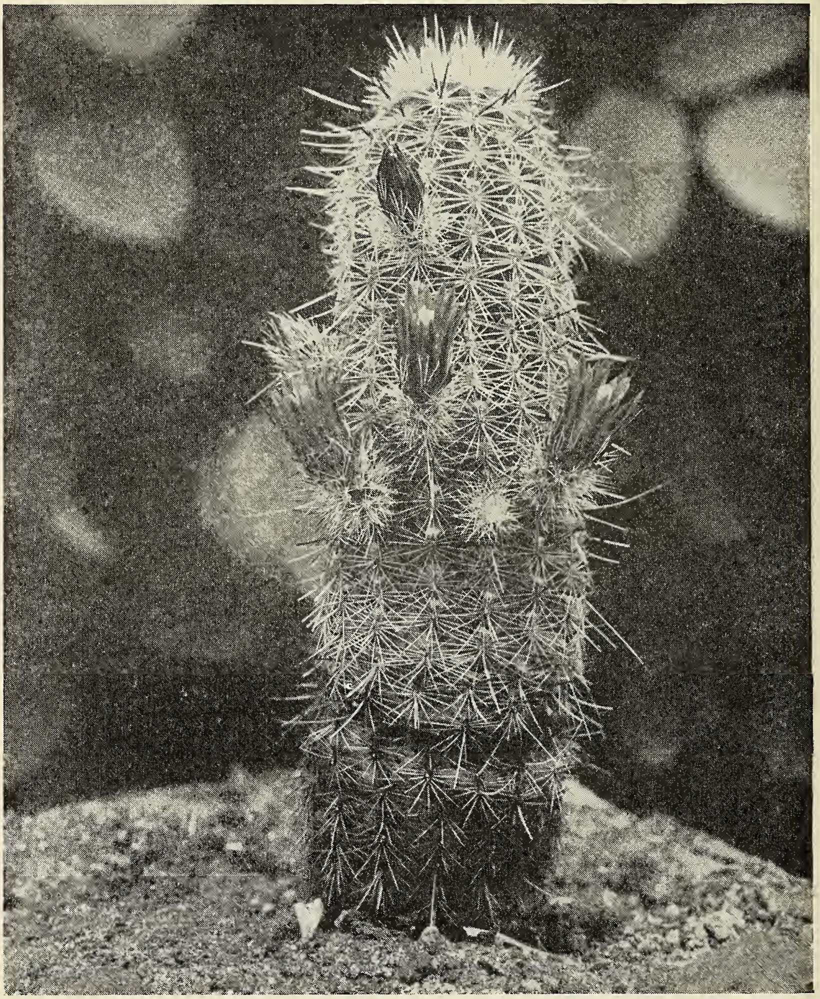
ECHINOCEREUS CONOIDEUS

A western Texas species distinguished from other species by the rather stout stems and stiff strong spines. The flowers are scarlet.

ECHINOCEREUS ROSEI

Echinocereus rosei is generally identified as *Echinocereus polyacanthus* Engelmann, a Mexican species. It is easily distinguished through characters pointed out by Dr. Paul C. Standley.—"*Echinocereus polyacanthus* is amply separated by the presence of long white wool in the areoles of the ovary and fruit."

Description:—Cespitose, forming small compact clumps, the stems 1 to 2 dm. long, 5 to 8 cm. in diameter, sometimes as many as 40; ribs 8 to 11, obtuse; areoles rather closely set; spines pinkish to brownish grey; radial spines about 10, spreading; centrals 4, 4 to 6 cm. long; flowers 4 to 6 cm. long, scarlet; inner perianth-



Brown-Flowered Pitaya—*Echinocereus chloranthus*

A west Texas species. A unique feature of the plant is the appearance of the small greenish-yellow, sometimes greenish-brown blossoms near the middle of the plant.

segments broad, obtuse; spines on ovary and flower-tube brownish or yellowish, intermixed with short hairs; fruit spiny.

Type locality:—Agricultural College, New Mexico.

Distribution:—In mountains and dry hills and sometimes on the mesas of southern New Mexico, western Texas, and adjacent parts of northern Mexico.

Synonymy:—Echinocereus rosei Wooton and Standley, Contr. U. S. Nat. Herb. 19:457. 1915.

BROWN-FLOWERED PITAYA—Rainbow-cactus
Echinocereus chloranthus

This cylindric, simple-stemmed cactus resembles the better known *Echinocereus reichenbachii,* and like this cactus, the low ribs are generally hidden by the dense covering of spines.

The plant is unique in that the buds open well down near the middle of the plant. The greenish-yellow color of the small blossoms is likewise a surprise in one's first introduction to the species. The flowers do not open wide as is characteristic of many species of this genus.

The species is somewhat similar to *Echinocereus viridiflorus* in having similar small greenish-yellow flowers. It differs generally in being more elongated, having longer central spines, and the flowers appearing lower down on the plant, usually below the middle.

This is the Rainbow Cactus of the Big Bend. It is the most common of the cylindric lower forms of that region. The majority of the plants have reddish-tinged spines.

Description:—Cylindric, usually simple, 8 to 15 cm. long, 5 to 7 cm. in diameter; ribs about 13, often nearly hidden by the densely set spines; areoles nearly circular; radial spines several, spreading; centrals 3 or 4, not angled, in a vertical row, one much more elongated than the others, 2 to 3 cm. long; flowers yellowish green, 2 cm. long; fruit small, nearly globular, 5 to 10 cm. long, dark purplish red, covered with small bristly spines; seeds black, dull, pitted, the hilum nearly basal, round.

Type locality:—About El Paso, Texas.

Distribution:—Western Texas, southeastern New Mexico, and northern Mexico.

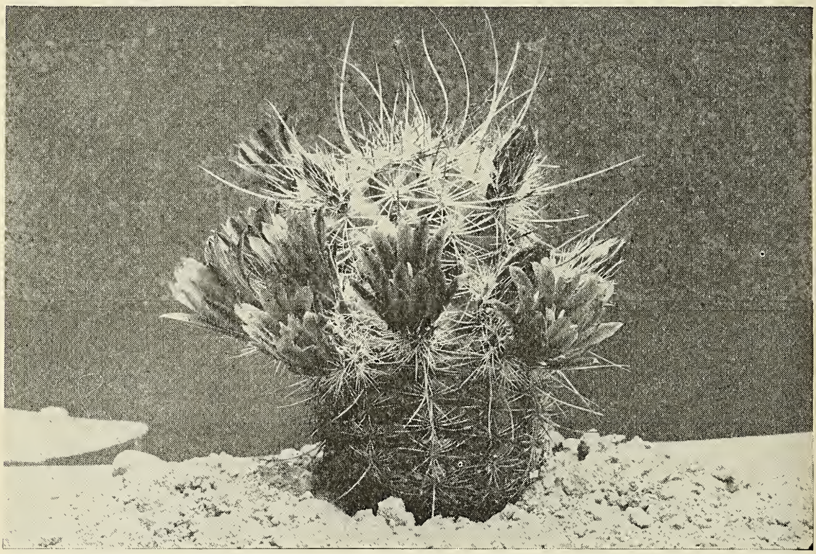
Synonymy:—Echinocereus chloranthus (Engelmann) Rümpler in Forster, Handb. Cact. ed. 2:814. 1885.

Cereus chloranthus Engelmann, Proc. Amer Acad. 3:278. 1856.

ECHINOCEREUS VIRIDIFLORUS

As the name signifies, this is the Green-flowered Pitaya. It is a very common cactus on the Plains of the West, but not generally known as abundant as many of the plants are hidden by grass.

The stems are single or branched, 4 to 8 inches in height, globose to cylindric. The spines are often variegated from dark



GREEN-FLOWERED PITAYA—*Echinocereus viridiflorus*

The most northern species of the genus. Of wide distribution, but short-lived in cultivation. The spines are often "rainbow" colored.

red to orange, yellow and white. Often these run in bands of color. The flowers are somewhat unique in that they blossom midway and nearly always on one side of the stem. The blossoms are yellowish-green to brownish green, about ¾ inch across, and 1 inch long. The stamens are green, the anthers yellow. The pistil is pale green and the ten-rayed stigma extends high above the anthers.

The plant holds an unusual scientific record in that it has been described only under one species name. It was originally named and described by Dr. George Engelmann, a co-worker with Dr. Ferdinand Lindheimer. Both men figured prominently in the early history of Texas in finding and describing new plants from the State.

It is frequently introduced into greenhouse collections, but lasts only a few years. In range it extends farther north than any other species of the genus.

Description: — Plants small, nearly globular, but sometimes cylindric and 20 cm. high, simple, or more or less cespitose; ribs 14, low; areoles elongated; spines white, dark brown or variegated, usually arranged in circular bands of light and dark about the plant; radial spines about 16, appressed; centrals, when present, 2 or 3, arranged in a perpendicular row, often elongated and then 2 cm. long; flowers greenish, 2 to 2.5 cm. long; perianth-segments obtuse; fruit 10 to 12 mm. long; seeds 1 to 1.2 mm. long.

Type locality:—Prairies about Wolf Creek, New Mexico.

Distribution: — Southern Wyoming to eastern New Mexico, western Kansas, western Texas, and south Dakota.

Synonymy: — Echinocereus viridiflorus Engelmann in Wislizenus, Mem. Tour. North. Mex. 91. 1848.

Cereus viridiflorus Engelmann in Gray, Pl. Fendl. 50. 1849.

Cereus viridiflorus cylindricus Engelmann, Proc. Amer. Acad. 3:278. 1856.

Echinocactus viridiflorus Pritzel, Icon. Bot. Index 2:113. 1866.

Echinocereus viridiflorus cylindricus Rümpler in Forster, Handb. Cact. ed. 2:812. 1885.

Echinocereus strausianus Haage Jr. in Quehl, Montasschr. Kakteen 10:70. 1890.

Cereus viridiflorus tubulosus Coulter, Contr. U. S. Nat Herb. 3:383. 1896.

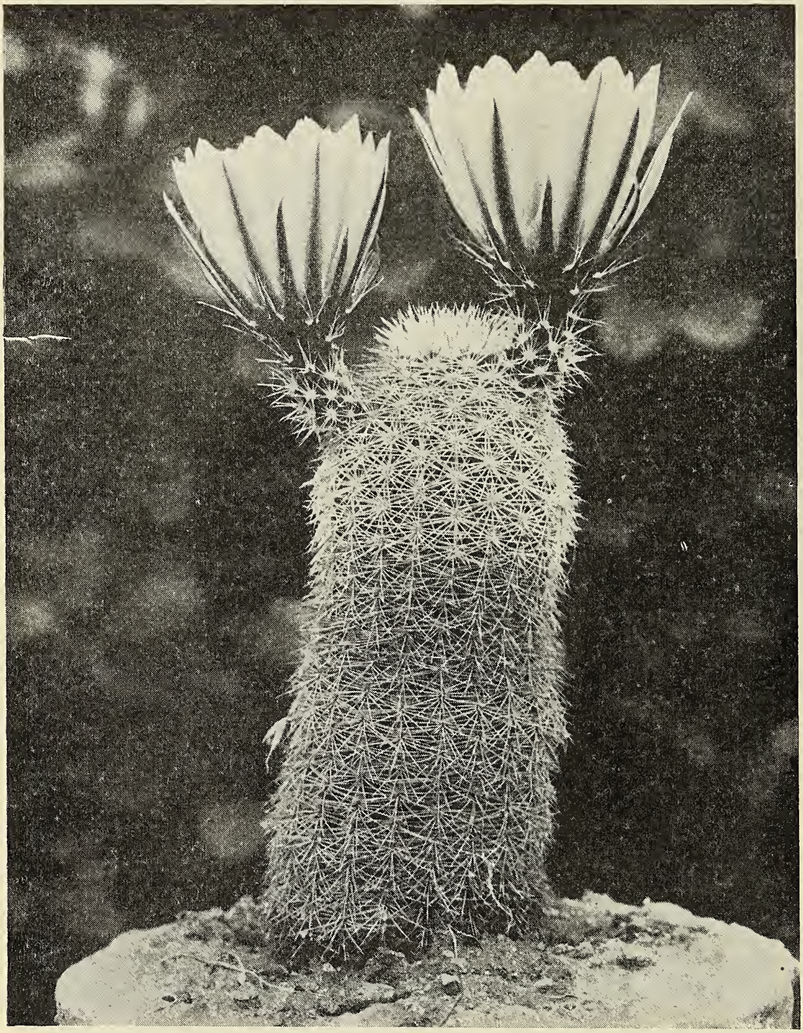
Echinocereus viridiflorus tubulosus Heller, Cat. N. Amer. Pl. ed. 2:8. 1900.

YELLOW-FLOWERED PITAYA—Echinocereus dasyacanthus

This plant is easily distinguished from other species of this genus by the unusually large yellow blossoms. These likewise please the cactus grower in that they stay open several days and do not close fully at night. The centers are usually light green.

The plants are usually simple, cylindric, and very spiny. When old they form clusters of 4 to 8 stems, 10 to 16 inches high. The spines are usually grey but often run into the rainbow type. In color they vary from dark brown to almost white.

Echinoceeus dasyacanthus resembles *Echinocereus chloranthus* and *Echinocereus viridiflorus* except in color of the spines, the constant length of the spines, and the large yellow flowers. *Echinocereus reichenbachii,* another widespread member of the genus,



Yellow-Flowered Pitaya—*Echinocereus dasyacanthus*

Popular with both the collector and layman for its large yellow blooms.

and of the same general stem structure, has large shell pink blossoms.

A good colored illustration may be found on Plate 81, in Vol. 2, Kakteen Kunde by Schumann.

Description:—Plants usually simple, cylindric, 1 to 3 dm. high, very spiny; ribs 15 to 21, low, 2 to 3 cm. high; areoles approximate, 3 to 5 mm. apart, short-elliptic; radial spines 16 to 24, more or less spreading, 1.5 cm. long or less, at first pinkish but gray in age; central spines 3 to 8, a little stouter than the radials,

ECHINOCEREUS DASYACANTHUS
The rainbow cactus of the Big Bend District.

never in a single row; flowers from near the apex, often very large, often 10 cm. long, yellowish, or drying reddish; outer perianth-segments linear-oblong, 4 to 5 cm. long, acute; inner perianth-segments oblong, 5 cm. long; ovary very spiny; fruit nearly globular, 2.5 to 3.5 cm. in diameter, purplish, edible.

Type locality:—El Paso, Texas.

Distribution: — Western Texas, southern New Mexico, and northern Chihuahua. It has been reported from Arizona, but doubtless wrongly. Common in the Big Bend District of Texas.

Synonymy:—Echinocereus dasyacanthus Engelmann in Wislizenus Mem. Tour. North. Mex. 100. 1848.

Cereus dasyacanthus Engelmann in Gray, Pl. Fendl. 50. 1849.

Cereus dasyacanthus neo-mexicanus Coulter, Contr. U. S. Nat. Herb. 3:84. 1896.

Echinocereus spinosissimus Walton, Cact. Journ. 2:162. 1899.
Echinocereus rubescens Dams, Monatsschr. Kakteenk. 15:92. 1905.

ECHINOCEREUS CTENOIDES

This is a cylindrical *Echinocereus*. It is very closely related to *Echinocereus dasyacanthus* and may not be specifically distinct. Mr. William Hess considers it "a type of *Echinocereus dasyacanthus*."

It differs in its spines and seems to have a more southern range than *Echinocereus dasyacanthus*. It is probably a Mexican species extending from Northern Mexico into our territory.

It has been collected about Eagle Pass, Texas and seems to be quite common in that region. Its range of distribution is southwest Texas and adjacent parts of Mexico.

The flowers are a reddish yellow and very large for the size of the plant. The filaments are yellow; the style white. The ovary and fruit are very spiny.

Description:—So far as known simple, cylindric, elongated, 10 to 40 cm. long, 8 to 10 cm. in diameter, decidedly banded with pink and gray as in the rainbow cactus; ribs 15 to 17, low; areoles crowded together, short-elliptic; radial spines often as many as 20, not spreading but standing out at an angle to the ribs; central spines 8 to 10, arranged in a single row or sometimes a little irregular; flowers up to 10 cm. long, about as wide as long when fully expanded, bright to reddish yellow; filaments yellow; style white; ovary and fruit very spiny.
Type locality:—Eagle Pass, Texas.
Distribution:—Southern Texas and Chihuahua.

Synonymy:—Echinocereus ctenoides (Engelmann) Rümpler in Forster, Handb. Cact. ed. 2:819. 1885.
Cereus ctenoides Engelmann, Proc. Amer. Acad. 3:279. 1856.

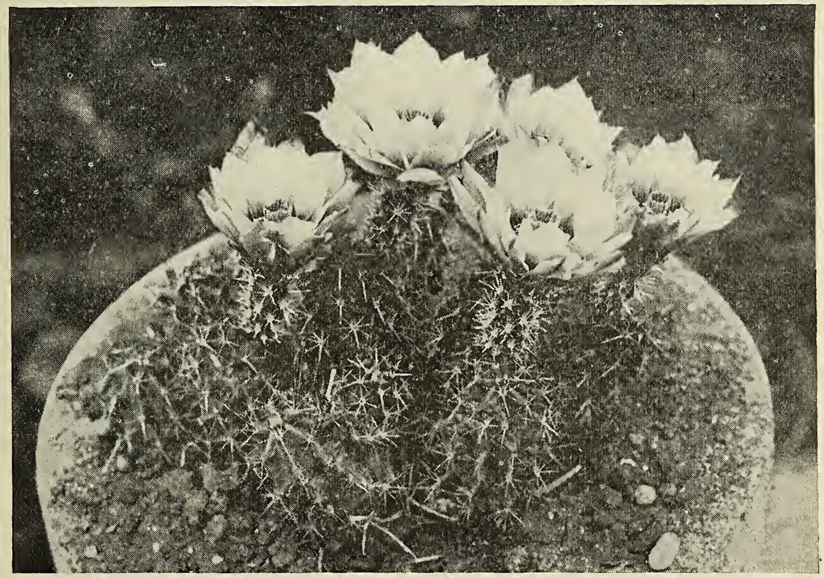
YELLOW-FLOWERED ALICOCHE—Echinocereus papillosus

A very attractive species. The stems are green, 4 to 8 inches high, about 1¼ inches in diameter, branched at the base, often forming a dozen or more heads. The ribs are six to ten in number, usually eight, tuberculate. The spines vary from white to brownish in color. The radial spines vary from 7 to 8. The central spine varies from ½ to 1 inch in length.

The blossoms are yellow with a reddish center, about 3½ inches long, 2½ inches across, with nearly three rows of petals. The anthers are yellow, and the pistil green. The base of the flower on the outside is covered with white spine clusters.

The following remarks of Britton and Rose in *The Cactaceae,* Vol. III. are of interest:

"Although this species is supposed to come from the vicinity of San Antonio, Texas, no specimens are known to us from that place but we have an herbarium specimen collected by Miss Mary



Yellow-Flowered Alicoche—*Echinocereus papillosus*

The blossoms are yellow with reddish centers. The amateur will call this a small **enneacanthus** as it has the habit and somewhat the appearance of this species when not in bloom.

B. Croft at San Diego, Texas. It is one of the few species in the genus with yellow flowers and ought easily to be distinguished from other Texan species."

Description:—More or less cespitose, rather dark green, decumbent or ascending, 5 to 30 cm. long, 2 to 4 cm. in diameter; ribs 6 to 10, prominent, strongly tubercled; radial spines acicular, spreading, about 7, white to yellowish, 1 cm. long or less; central spine solitary, acicular, porrect, 12 mm. long or more; flowers large, 10 to 12 cm. broad, yellow with a reddish center, with rather few perianth-segments 4 to 6 cm. long, oblong-spatulate, acuminate, more or less serrate; scales on ovary red, spreading; fruit not known.

Type locality:—Not cited.

Distibution:—Western Texas. Also collected near San Diego, Duval County, Texas.

Synonymy:—Echinocereus papillosus Linke in Forster, Handb. Cact. ed. 2:783. 1885.

Echinocereus texensis Rünge, Monatsschr. Kakteenk. 4:61. 1894. Not Jacobi, 1856.

Echinocereus ruengei Schumann, Monatsschr. Kakteenk. 5:124. 1895.

Cereus papillosus Berger, Rep. Mo. Bot. Gard. 16:80. 1905.

ECHINOCEREUS BLANCKII

Echinocereus blanckii was first discovered near Camargo, Tamps., Mexico. It appears that it was never critically described and for that reason it has been confused with *Echinocereus berlandieri* and other species of *Echinocereus*. It occurs along the Rio Grande River in Hidalgo and Starr Counties, Texas, and extends as far south as Victoria, Tamps., Mexico.

The stems are erect or ascending, but prostrate when elongated. The stems become terete and brownish at the base with age. They sprout from underground stems, thus forming fair sized clumps or colonies. They are flabby but brittle, and will grow from cuttings.

The stems are dark green in color, vary from 6 to 12 inches in length, and are about 1½ inches in diameter. The ribs are 6 to 8 or probably more in number, tuberculate, with spines at the top of each tubercle. The spines vary from six to eight in number. There are usually six radial spines, the upper two brown, the lower ones yellowish, each about one half inch long.

The flowers are reddish to dark reddish-purple in color, 2 to 3 inches across, darker in the center. The anthers are yellow; the filaments dark red. The pistil is green. The flowers open about noon and close near 5 o'clock for two or three consecutive days. They blossom the last of March or first of April, but nearly always the first week in April. The fruit is greenish, globose, and covered with small spines.

The stems are much larger than those of *Echinocereus berlandieri*. The plant also has a more southern range, and the flowers appear at least one month earlier. It does well in cultivation and will stand a slight freeze without injury.

Description:—Procumbent; joints slender, 3 to 15 cm. long, 2 to 2.5 cm. in diameter; ribs 5 to 7, strongly tuberculate, or when turgid scarcely tubercled; areoles 1 to 1.5 cm. apart; radial spines 6 to 8, 8 to 10 mm. long, white; central spine solitary, 10 to 50

ECHINOCEREUS BLANCKII
A cactus of extreme southern range. The flowers are a very dark red to rich purple in color with darker centers.

mm. long, brownish to black; flowers purple, 5 to 8 cm. long; perianth-segments narrow, oblanceolate, acute.

Type locality:—Near Camargo, state of Tamaulipas, Mexico.

Distribution:—Northeastern Mexico and southern Texas.

Synonymy: — Echinocereus blanckii (Poselger) Palmer, Rev. Hort. 36:92. 1865.

Cereus blanckii Poselger, Allg. Gartenz, 21:134. 1853.

Cereus berlandieri Engelmann, Proc. Amer. Acad. 3:286. 1856.

Echinocereus poselgerianus Linke, Allg. Gartenz. 25:239. 1857.

Echinocereus berlandieri Rümpler in Forster, Handb. Cact. ed. 2:776. 1885.

Echinocereus leonensis Mathson, Monatsschr. Kakteenk. 1:66. 1891.

Cereus leonensis Orcutt, West Amer. Sci. 13:27. 1902.

Cereus poselgerianus Berger, Rep. Mo. Bot. Gard. 16:80. 1905.

ECHINOCEREUS BERLANDIERI

This cactus was first discovered by Dr. J. L. Berlandier along the lower part of the Nueces River. Britton and Rose in "The Cactaceae," place it as a synonym of *Echinocereus blanckii.* Later in 1927 Dr. Rose had the opportunity to examine it in the field.

BERLANDIER'S ALICOCHE—*Echinocereus berlandieri*
A south Texas species with underground stems and rich reddish-purple blossoms.

He then gave his opinion that the plant was a good species. Mr. C. R. Orcutt in Cactography, a small pamphlet issued by him in February, 1926 called it *Echinocereus runyonii,* but this seems to be unnecessary.

The stems are procumbent, erect or ascending, contracted at the base, straight or spiral, flabby or soft, about six inches high or slightly higher. The ribs are about six in number, containing numerous tubercles with spines at the apex of each tubercle. The spines are grayish or brownish. There are about 6 radials, each one half inch long, and one central spine about one inch long.

The flowers are about two iches long, one and one half inches across, pink to reddish-purple in color. They open about 11 A. M. and close near 5 P. M. for two or three consecutive days. The stamens are yellow, the pistil green. The petals are pointed at the apex. The plant blossoms from April to May.

It occurs scattered to fairly abundant in high, well-drained, sandy, clay or black soil, from the Nueces River along the Gulf Coast to the Lower Rio Grande Valley, and in adjacent Mexico.

After two or three years the plant dies back to the ground and sprouts from the underground stems again. This is probably caused by fungi. It does well in cultivation, and will stand freezing to 26° F. for two or three days at a time. It differs from other Echinocereus species by its well developed underground stems from which it branches in profusion.

It is often confused with *Echinocereus blanckii* which is larger, has stouter stems, and blossoms earlier. *Echinocereus blanckii* is a more Mexican species than Texas; *Echinocereus berlandieri* is a more southern Texas species. Both have underground stems. The color of the flowers is about the same.

ALICOCHE—Lady finger cactus—Echinocereus pentalophus

Echinocereus pentalophus is a near relative of *Echinocereus berlandieri,* and is its associate in their natural habitat. It is a very variable species having many varieties, which seem to run into each other. The stems may be 4, 5 or 6-angled, growing separately or in a large clump. The spines may be short or long. Because of this, it has been described under several names. *Echinocereus procumbens* is the most common name used by cactus fanciers. Britton and Rose only recognize one species after several years of field work and careful observation.

The stems are prostrate, erect or ascending, 4 to 12 inches long, one half to one inch in diameter, green, flabby or somewhat soft, but brittle. It has 4 to 5 ribs, with inconspicuous tubercles. These tubercles bear the spines. The spines are brownish or grayish. The radials are ¼ to 1 inch long and the central spine is ½ to 2 inches long.

The flowers are large for the size of the plant, delicate pink to reddish-purple in color, paler towards the center. The flowers are about 3 inches long and 4 inches across when wide open. The petals curve downward from the center when the flower is wide open. The flowers open about noon and close near five o'clock for two or three consecutive days. They bloom the last week in

March, except a few late plants, which put forth one or more flowers during the first week of April.

The plants are scattered throughout the Lower Rio Grande Valley, in well drained sandy or black soil. Near the Gulf Coast, they are found on clay dunes.

It is called Lady's finger cactus by the English speaking people and Alicoche by the Mexicans. The name Lady's finger bears

Lady's Finger—*Echinocereus pentalophus*

A low growing species with 4, 5 or 6-angled stems, and large pink to purplish flowers with a paler center.

reference to its slender stems.

It does well in cultivation and will grow from cuttings. It will stand a slight freeze without injury.

The following note by Mr. William Hess of San Antonio is of interest. "The three fore-named species are so similar in growth and bloom that when grown together for several years at one place they cannot be distinguished as separate species."

Description: — Procumbent, with ascending branches, deep green; ribs 4 to 6, somewhat undulate, bearing low tubercles; radial spines 4 or 5, very short, white with brown tips; central spine 1, rarely wanting; flowers reddish violet, large, 7 to 12 cm.

long; perianth-segments broad, rounded at apex; stamens borne on the lower half of throat for a distance of about 12 mm.; tube proper not much broader than the style, purple within, 8 mm. long; filaments short; style a little longer than the filaments; scales on the ovary and flower-tube bearing long cobwebby hairs and brownish spines; style stiff, 3.5 cm. long.

Type locality:—Mexico.

Distribution: — Eastern Mexico and southern Texas. From Bexar county south to the Rio Grande.

Synonymy: — Echinocereus pentalophus (De Candolle) Rümpler in Forster, Handb. Cact. ed. 2:774. 1885.

Cereus pentalophus De Candolle, Mem. Mus. Hist. Nat. Paris 17:117. 1828.

Cereus pentalophus simplex De Candolle, Mem. Mus. Hist. Nat. Paris 17:117. 1828.

Cereus pentalophus subarticulatus De Candolle, Mem. Mus. Hist. Nat. Paris 17:117. 1828.

Cereus pentalophus radicans De Candolle, Mem. Mus. Hist. Nat. Paris 17:117. 1828.

Cereus propinquus De Candolle in Salm-Dyck, Allg. Gartenz. 1:366. 1833.

Cereus procumbens Engelmann in Gray, Pl. Fendl. 50. 1849.

Cereus pentalophus leptacauthus Salm-Dyck, Cact. Hort. Dyck. 1849. 42. 1850.

Echinocereus procumbens Römpler in Forster, Handb. Cact. ed. 2. 781. 1885.

Echinocereus leptacanthus Schumann, Gesamtb. Kakteen 260. 1898.

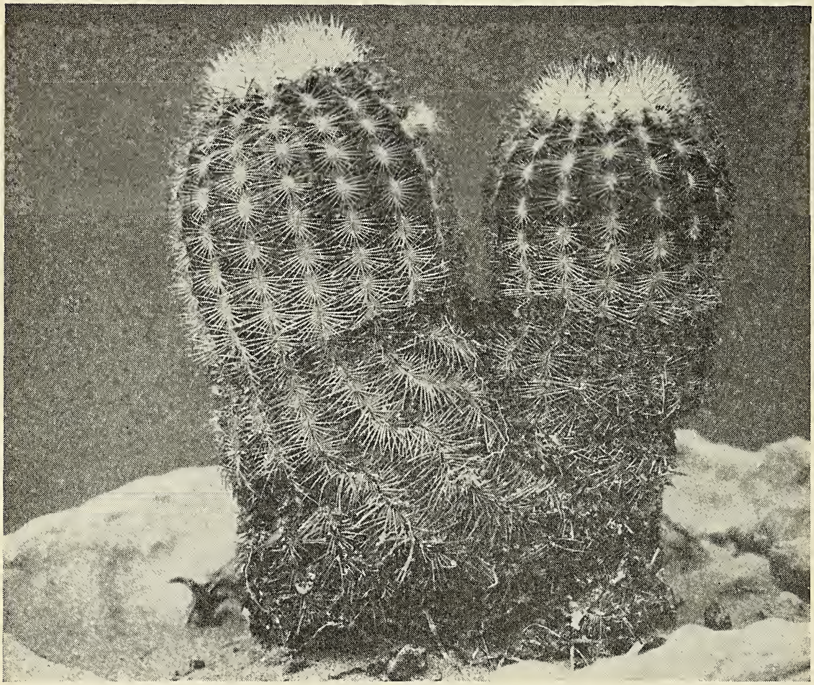
ECHINOCEREUS PERBELLUS

Mr. William Hess considers this species a southern type of *Echinocereus reichenbachii*. It was discovered in Texas in 1910 by Standley and Rose and is described as a distinct species by Britton and Rose in "The Cactaceae" published by the Carnegie Institution of Washington.

Description:—Stem either simple or clustered, 5 to 10 cm. high; ribs 15, low and broad; distance between the areoles about equal to the length of the areoles themselves; areoles elongated; spines all radials, 12 to 15, spreading but not widely, 5 to 7 mm. long, pale brown to reddish or nearly white below; flowers purple, 4 to 6 cm. long; perianth-segments broad, oblong to oblanceolate, acuminate, nearly 4 cm. long; areoles on flower-tube very woolly as well as spiny.

Type locality:—Big Springs, Texas.

Synonymy:—Echinocereus perbellus Britton and Rose.



ECHINOCEREUS PERBELLUS

A beautiful cactus similar to **Echinocereus reichenbachii** in form, spine clusters, and blossoms but more delicate in structure. A choice cactus for the rock garden. It can be handled with the bare hands, and blossoms abundantly in cultivation.

LACE CACTUS—Classen's cactus
Echinocereus reichenbachii

A very ornamental and popular cactus. It is easy to handle and the shell-pink blossoms are particularly large and beautiful. The size of the flowers borne on these small plants can best be illustrated by the name "Merry Widow" given them by Don Manuel Fraile. The "Merry Widow" was a large spreading ladies' hat at one time in vogue in the United States.

The cactus is cylindrical in shape, solitary or growing in clusters of two to several stems. The stems vary from 2 to 3 inches in diameter, and one to ten inches in height depending on age. The ribs are 10 to 15 in number, the crest of each so closely covered with spines that the cactus bears a scaly appearance.

The flowers are shell to deep pink in color, 2½ to 3 inches across, opening and closing with the sun, and lasting several days. The blossoms appear singly or a few at a time at the top of the stems. The stamens are numerous, yellow, in several rows, and circle a ten-rayed stigma. The blossoming period is March and April.

The Lace Cactus is one of the most widespread small cacti in Texas. It is a common plant of the limestone hills of the Edward's Plateau and likes well-drained gravel or rocky hillsides. Plants from red granite areas and sandy regions often have reddish spines. "Rainbow" types also appear sporadically in limestone areas.

The Lace Cactus is a popular rock garden plant. Older plants are not easily transplanted. Young plants one to two inches high do better. A good soil is one third sand, one third gravel, one third earth mold (humus). Good drainage is all important.

A species similar in form, spines and blossoms is *Echinocereus perbellus*. The flowers of this species are somewhat smaller, a deeper pink or rose in color, the spines even more delicate, and the stems noticeably smaller in diameter.

Description:—More or less cespitose; stems simple, globose to short-cylindric, 2.5 to 20 cm. long, 5 to 9 cm. in diameter; ribs 12 to 19; areoles approximate, elliptic; spines 20 to 30, white to brown, but usually those of each individual plant of one color, pectinate, interlocking, 5 to 8 mm. long, spreading, more or less recurved; centrals 1 to 2, like the radials, or often wanting; flowers fragrant, rather variable as to size, often 6 to 7 cm. long and fully as broad, opening during the day always closing at night and sometimes opening the second day, light purple, often reflexed; perianth-segments narrow, the margin more or less erose; filaments pinkish; fruit ovoid, about 1 cm. long; seeds black, nearly globose, 1.2 to 1.4 in diameter.

Type locality:—Mexico.

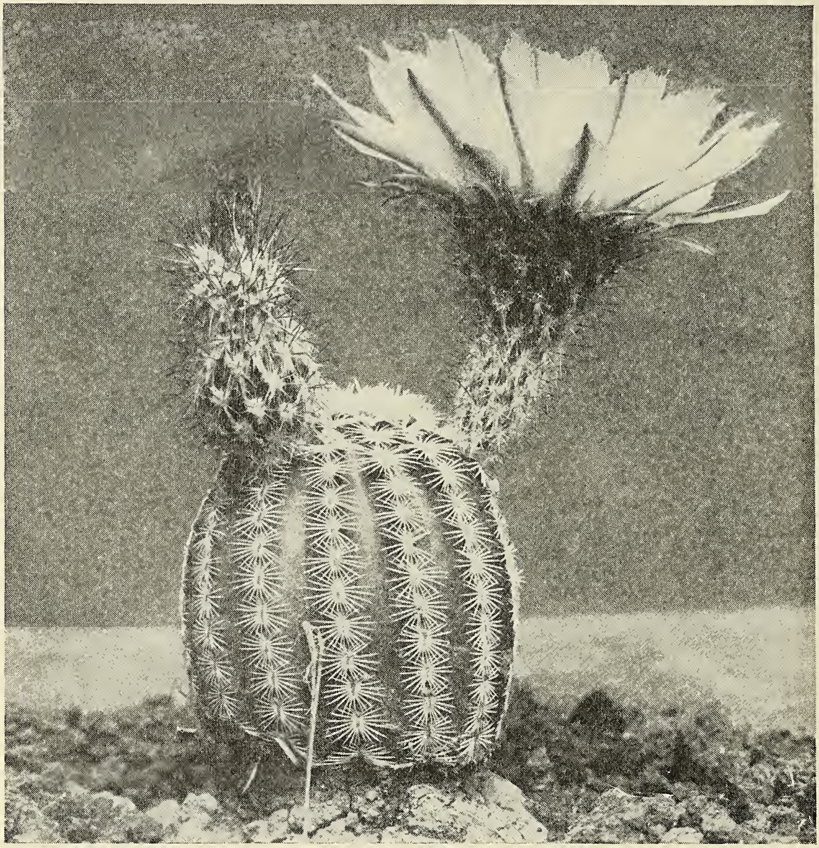
Distribution: — Texas and northern Mexico; recorded from western Kansas.

Synonymy: — Echinocereus reichenbachii (Terscheck) Haage Jr., Index Kewensis 2:813. 1893.

Echinocactus reichenbachii Terscheck in Walpers. Report Bot. 2:320. 1843.

Cereus caespitosus Engelmann, Bost. Journ. Nat. Hist. 5:247. 1845.

Echinopsis pectinata reinchenbachiana Salm-Dyck, Cact. Hort. Dyck. 1844. 26. 1845.



Echinocereus reichenbachii

Called Lace Cactus in reference to the lacy appearance of its spines. The shell to deep pink blossoms are unusually large for the size of the plants. The spine rows are far apart due to inflation by water from recent rains.

Echinocereus caespitosus Engelmann in Wislizenus, Mem. Tour North Mex. 110. 1848.

Cereus caespitosus castaneus Engelmann. Bos. Journ. Nat. Hist. 6:203. 1850.

Cereus reinchenbachianus castaneus Labouret, Monogr. Cact. 318. 1853.

Cereus caespitosus minor Engelmann, Proc. Amer. Acad. 3:280. 1856.

Cereus caespitosus major Engelmann, Proc. Amer. Acad. 3:280. 1856.

Echinocereus texensis Jacobi, Allg. Gartenz. 24:110. 1856.

Mammillaria caespitosa A. Gray, First Lessons in Botany 96. 1857.

Echinocereus rotatus Linke, Wochenschr. Gartn. Pflanz. 1:85. 1858.

Echinocereus caespitosus castaneus Rümpler in Forster, Handb. Cact. ed. 2:811. 1885.

Echinocereus caespitosus major Rümpler in Forster, Handb. Cact. ed. 2:811. 1885.

Echinocereus pectinatus caespitosus Schumann, Gesamtb. Kakteen 272. 1898.

ECHINOCEREUS FITCHII

This is a new species named by Dr. J. N. Rose in honor of Mr. William R. Fitch who accompanied him on collecting trips to western Texas and to the West Indies in 1913. Living plants were collected by Dr. Rose near Laredo in 1913. These flowered in the New York Botanical Garden, April 10, 1914. The scientific description was made from this group of plants. (No. 18037.)

Description: — Plant short-cylindric or somewhat narrowed above, 8 to 10 cm. long, 4 to 5 cm. in diameter; ribs 10 to 12, low, rounded; areoles 4 to 6 mm. long; central spines 4 to 6, slightly spreading, 12 mm. long or less, acicular, brownish, but sometimes white at base; flowers 6 to 7 cm. long, pink; perianth-segments, oblanceolate, widely spreading, acute, serrate on the margin; ovary 2.5 cm. long, bearing numerous areoles, these spiny and with cobweeby hairs.

Type locality:—Near Laredo, Texas.

Synonymy:—Echinocereus fitchii Britton and Rose.

ECHINOCEREUS ROETTERI

A southwest Texas species. It is named in honor of Paulus Roetter, the artist, who made the cactus drawings for the Mexican Boundary Survey. According to the author, Dr. George Engelmann, it is similar to *Echinocereus dasyacanthus* except for its fewer ribs, stouter spines, purple flowers, smaller fruit, and larger seed.

Description: — Cespitose, or perhaps sometimes simple and occasionally budding above, 1 to 2.5 dm. high; ribs 13, straight, more or less undulate; areoles circular, or a little longer than broad, about 1 cm. apart; radial spines 15 to 17, acicular, about 1 cm. long, white or purplish; central spines 1 to 5, not in a single row, a little stouter but scarcely longer than the radials; flowers appearing below the top of the plant, large, 6 to 7 cm. long, perhaps even broader than long, light purple; outer perianth-segments greenish yellow; inner perianth-segments oblanceolate, acute, 3 to 4 cm. long; ovary and fruit spiny.

Synonymy:—Echinocereus fendleri (Engelmann) Rümpler in Forster, Handb. Cact. ed. 2:829. 1885.

Cereus dasyacanthus minor Engelmann, Proc. Amer. Acad. 3:279. 1856.

Cereus roetteri Engelmann, Proc. Amer. Acad. 3:345. 1856.

Echinocereus kunzei Gürke, Monatsschr. Kakteenk. 17:193. 1907.

ECHINOCEREUS FENDLERI

Except for its erect habit and the dark central spine, this species strongly resembles the more widespread *Echinocereus enneacanthus*. The blossoms open fairly wide, are bright red with darker centers, and open about 1½ inches across. In some plants the spines are almost black.

This species was named in honor of August Fendler (1813-1883) who collected extensively in New Mexico and Venezuela.

In common with several species of *Echinocereus*, this species varies greatly in armament and the size of its blossoms.

The following note made by Mr. William Hess may be valuable in comparing species. "I would not compare this with *enneacanthus* as the latter always grows in bunches or rather makes many and much larger stems, while *fendleri* has never more than 2 or 3 short stout branches. It would be better to compare it with *viridiflorus* because of its vari-colored spines and similar size and habit."

Description:—Cespitose; stems about 8, ascending or erect, 1 to 3 dm. long, 5 to 7.5 cm. in diameter; ribs rather prominent, 9 to 12, somewhat undulate; spines very variable as to color, length, and form; radial spines 5 to 10, more or less spreading, 1 to 2 cm. long, acicular to subulate; central spine solitary, usually porrect, 4 cm. long or less, dark colored, often black-bulbose at base; flowers borne at the upper part of the plant, often very large, 10 cm. broad when fully expanded, but sometimes smaller, deep purple; inner perianth-segments spatulate, 3 to 4 cm. long, acute, the margin sometimes serrulate; filaments purple, very short, 1 cm. long or less; style very pale; ovary deep green, its areoles bearing white felt and white bristly spines; fruit ovoid, 2.5 to 3 cm. long, purplish, edible; seeds 1.4 mm. long.

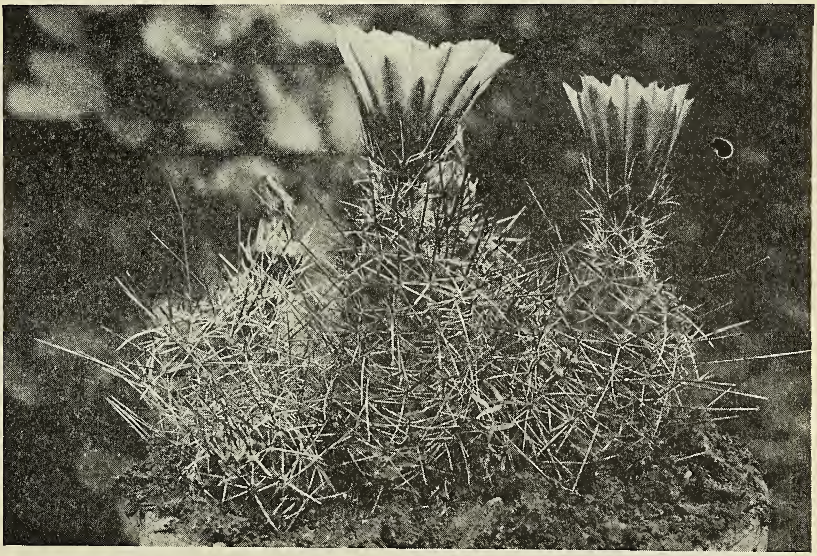
Type locality:—Near Santa Fé, New Mexico.

Distribution:—Texas to Utah, Arizona, and northern Sonora and Chihuahua, Mexico.

Synonymy:—Echinocereus fendleri (Engelmann) Rümpler in Forster, Handb. Cact. ed. 2. 801. 1885.

Cereus fendleri Engelmann, in Gray, Pl. Fendl. 50. 1849.

Cereus fendleri pauperculus Engelmann in Gray, Pl. Fendl. 51. 1849.



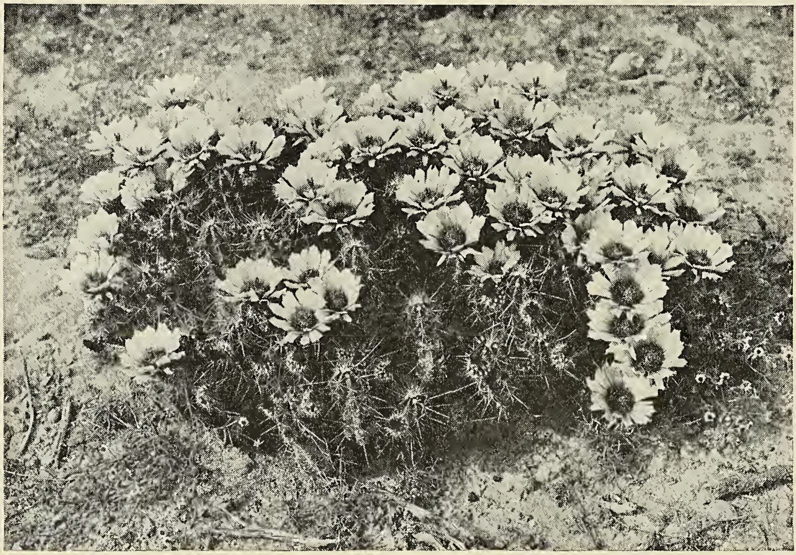
FENDLER'S PITAYA—*Echinocereus fendleri.*

PITAYA—Strawberry Cactus
Echinocereus enneacanthus

It is not definitely known just what plant was first described as *Echinocereus enneacanthus,* but a large robust species in south Texas and northern Mexico has been known by that name for many years and the description seems to fit it very well.

The plant has many cylindrical stems, most of them branching from the root. It often forms clumps with one hundred or more elongated stems. These clumps are often more than a yard across. The stems are erect or ascending. The ribs are prominent, 7 to 9 or probably more in number, tuberculate. The spines are borne on the top of each tubercle, and are grayish or brownish. The radials are about one half inch long. The central spine varies from 1 to 2 inches in length. The plant is dark green in color, slightly flabby, and easily broken.

The flowers are borne on the side of the plant, from about half way up to near the top. The blossoms are a rich reddish-purple in color, and about two inches across. They open about noon in bright sunlight and close about 5 o'clock for two or three consecu-



Pitaya—*Echinocereus enneacanthus*

One of the most widespread and common Echinocereii in Texas. It is also known as Strawberry Cactus because of the delicious fruit of strawberry flavor.

tive days. Their period of blossoming ranges from April to June. To see this plant in bloom, with its cluster of several hundred flowers, is a never-to-be-forgotten experience.

The fruit is greenish or brownish when ripe, and has a fragrant odor. It is called strawberry cactus by the American people on account of the strawberry-like flavor of the fruit. The fruit is used for making preserves. Cob cactus is another name given in reference to the cob-like shape of its branches. *Pitaya* is commonly used by the Mexicans, but this really means the fruit. The plant itself is known by them as *Alicoche*.

In distribution it probably has the widest range of the *Echinocereus* group. One may find it beginning in Willacy County west along the Rio Grande into the Big Bend District, and north as far as San Antonio. It is known as the common Pitaya throughout southwest Texas. It does equally well on limestone hillsides and on sandy loam flats.

The plant is easily distinguished from *Echinocereus triglochidiatus* by the smaller circumference of the stems and the later blossoming period. The blossoms of *E. triglochidiatus* are smaller, brick-red and remain open day and night several consecutive days. *E. enneacanthus* blossoms are large and showy and the richest reddish-purple.

This cactus attains its best growth in a well drained sandy loam, but does well on gravel hillsides or in clay.

Description: — Cespitose, with many stems, often forming clumps one meter in diameter or more; joints often elongated, prostrate, 5 to 7 cm. in diameter; ribs 7 to 8, prominent, more or less tuberculate, somewhat flabby, dull green; areoles 2.5 cm. apart; radial spines unequal, usually less than 12 mm. long, acicular, at first yellowish, becoming brownish; central spine solitary, usually elongated, nearly terete, 3 to 5 cm. long; flower purple, 7.5 cm. broad; perianth-segments nearly oblong; style cream-colored, a little longer than the stamens; fruit globular, juicy, edible.

Type locality:—Near San Pablo, south of Chihuahua, Mexico.

Distribution: — Southern Texas, Northern Mexico and New Mexico.

Synonymy:—Echinocereus enneacanthus Engelmann in Wislizenus, Mem. Tour. North. Mex. 112. 1848.

Cereus enneacanthus Engelmann, Pl. Fendl. 50. 1849.

Echinocereus carnosus Rümpler in Forster, Handb. Cact. ed. 2. 796. 1885.

Echinocereus enneacanthus carnosus Quehl. Monatsschr. Kakteenk 18:114. 1908.

ECHINOCEREUS LLOYDII

This cactus was collected in 1909 near Tuna Springs, Texas by T. E. Lloyd, and later named in his honor by Dr. Rose. From the scientific description one will note there are 11 ribs, and the spines are rather short, wine-colored, and paler at the base. The flowers are large and reddish-puple.

Description:—Stems in clusters of 6 or more, very stout, 20 to 25 cm. high, 10 cm. in diameter, bright green; ribs 11, about 3 cm. apart, nearly straight; areoles 15 mm. apart, rather large, circular, somewhat woolly when young; spines rather short, about 10 mm. long, wine-colored, paler at base, radial spines 14; centrals 4 to 6, nearly porrect; flowers large, 8 cm. long, reddish-purple; areoles on the ovary beaing clusters of reddish spines; stigma-lobes numerous; perianth-segments narrowly obovate, obtuse or obtusish.

Synonymy:—Echinocereus lloydii Britton and Rose.

ECHINOCEREUS DUBIUS

This cactus was first named by Dr. George Engelmann in 1856. It resembles *Echinocereus enneacanthus* in general appearance. The flowers differ in being pale purple and in having rather few and narrow petals. The fruit is very spiny. Dr. Engelmann placed it near *Echinocereus enneacanthus* and *Echinocereus stramineus* in his classification.

Description:—Somewhat cespitose; stems 12 to 20 cm. long, pale green, of a soft flabby texture, 7 to 9-ribbed; ribs broad; spines white; radial spines 5 to 8, 12 to 30 cm. long; centrals 1 to 4, 3.5 to 7.5 cm. long, angled, often curved; flowers pale purple, 6 cm. long or more, with rather few and narrow perianth-segments; scales on flower-tube bearing 1 to 3 white bristles in their axils; fruit very spiny 2.5 to 3 cm. long; seeds covered with confluent tubercles.

Type locality:—Sandy bottoms of the Rio Grande at El Paso.

Distribution:—Southwestern Texas, perhaps confined to the El Paso region.

Synonymy: — Echinocereus dubius (Engelmann) Rümpler in Forster, Handb. Cact. ed. 2. 787. 1885.

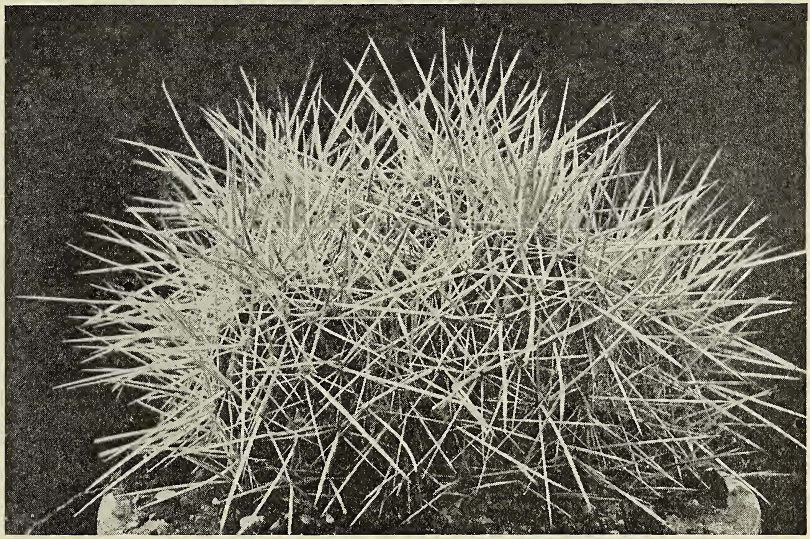
Cereus dubius Engelmann, Proc. Amer. Acad. 3:282. 1856.

ECHINOCEREUS STRAMINEUS

This species is one of the few cacti where botanists write "Has luscious red fruit with a strawberry flavor. Can be eaten with sugar and cream. The spines are few and easily removed."

Collectors who have seen this cactus best remember it in reference to the massing of the cylindrical heads into clumps varying from a few inches across the mounds as large as five feet across and four feet in height.

The plant would resemble *Echinocereus enneacanthus* except that the cylindrical stems bear 11 to 13 ribs which are almost hidden by the long spines. The spines are at first brownish to straw-colored, but turn white with age. The blossoms are large and



"PITAHAYA"—*Echinocereus stramineus*

A west Texas species which prefers dry mountains and hills. Exceptional plants have been known to form mounds 5 feet across and 4 feet high, with as many as 400 joints.

bright purple in color. The fruit is red, palatable, spiny at first, but turns smooth as it ripens.

Its habit of growing in the mountains of western Texas easily separates it from many cacti of similar general appearance.

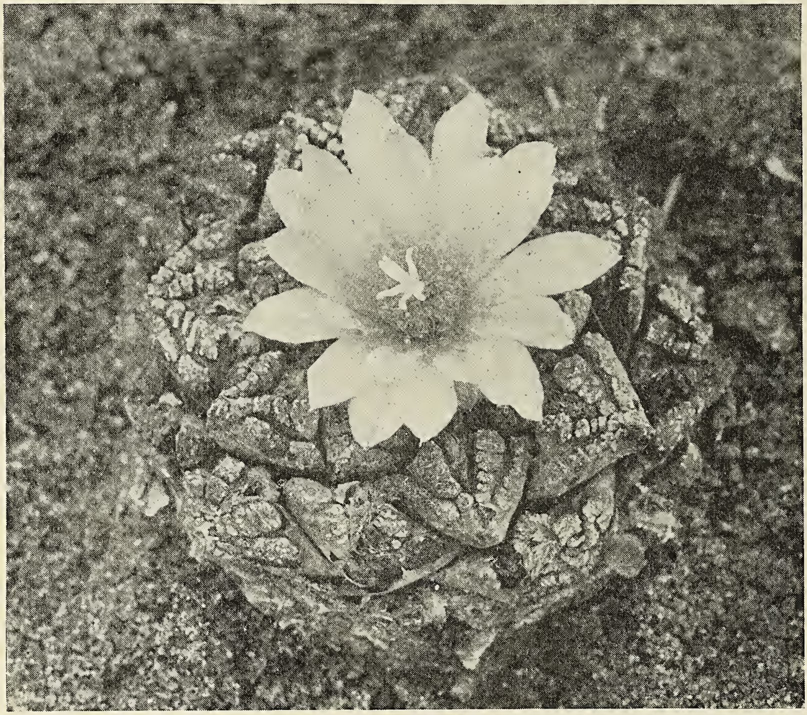
Description: — Plants grouped in masses forming immense mounds 1 to 2 meters in diameter and 3 to 10 dm. high; joints 12 to 25 cm. long, 3 to7 cm. in diameter; ribs about 13, almost hidden by the long spines; spines at first brownish to straw-colored, in age nearly white; radial spines 7 to 14, 2 to 3 cm. long, spreading; central spines 3 or 4, 5 to 9 cm. long; flowers purple, 8 to 12 cm. long; perianth-segments oblong, 3 to 4 cm. long, rounded at apex; spines from the axils of scales on ovary and flower-tube, 2 to 5, short, white; fruit nearly globular, 3 to 4 cm. in diameter, red, spiny at first, becoming glabrous, edible; seeds 1.5 mm. in diameter, somewhat oblique.

Type locality:—Mountain slopes, El Paso, Texas.

Distribution: — Western Texas, southern New Mexico, and northern Chihuahua.

Synonymy:—Echinocereus stramineus (Engelmann) Rümpler in Forster, Handb. Cact. ed. 2 797. 1856.

Cereus stramineus Engelmann, Proc. Amer. Acad. 3:282. 1856.



Living Rock—*Ariocarpus fissuratus*

The plant is low, grayish in color, and difficult to find as it looks so much like stone. The flowers are usually pink.

LIVING ROCK—Chautle—Chaute—
Ariocarpus fissuratus.

This is the well-known Living Rock. It is one of the greatest cusiosities in the Cactus family. Its appearance may well be described as a plant carved from stone in a most intricate fashion.

There are about three species of this arid plant. Only one species is native to Texas. It grows along the Rio Grande westward into the Big Bend District and extends southward into northern Mexico. It grows on dry stony ground, where rain seldom falls, and when not in flower is easily mistaken for the rocks which surround it.

The stems are low, extending only about an inch above the surface of the ground. The plant itself resembles the common

LIVING ROCK—*Ariocarpus fissuratus*
In native habitat in Brewster County.

carrot in its large succulent taproot. The stem is dark gray in color, spineless, with rough, triangle-shaped tubercles. These tubercles may even have the appearance of horns. The flowers are about ½ inch across and appear in the center of the flat top of the stem. The flowers appear singly or with two to four, whitish to pink, or even purple blossoms, crowded together. The fruit is small, oval, and pale green.

This species passed under the scientific name *Anhalonium* for many years, but *Ariocarpus* has priority and has been generally accepted. It is known as *Chautle, Chaute,* and *Peyote cimarrons* by the Mexican people, and is sold on the markets of Mexico as a remedy. Star rock is a name used by certain tribes of Indians. When adding this curious plant to your collection, use coarse gravelly sand, and give comparatively little water.

Description:—Plant body scarcely appearing above the ground, flat or somewhat rounded, sometimes 15 cm. broad; tubercles, imbricated, ovate, the upper part 2 to 3 cm. broad at base, acute or obtuse, the whole surface more or less fissured and irregularly warty; areoles filled with a dense mass of hairs; flowers 3 to 4 cm. broad, white to purple; inner perianth-segments oblong-oblanceolate; style and stigma-lobes white; fruit oval, pale green, 10 mm. long; seeds black, tuberculate-roughened.

Type locality:—Near the juction of the Pecos with the Rio Grande.

Distribution: — Western Texas and northern Coahuila and Zacatecas, Mexico. Along the Mexican border near the Great Bend of the Rio Grande, extending southward into Northern Mexico.

Synonymy:—Ariocarpus fissuratus (Engelmann) Schumann in Engler and Prantl. Pflanzenfam. 3:195. 1894.

Mammillaria fissurata Engelmann, Proc. Amer Acad. 3:270. 1856.

Anhalonium fissuratum Engelmann, Cact. Mex. Bound. 75. 1859.

Anhalonium engelmannii Lemaire, Cactées 42. 1868.

Ariocarpus lloydii Rose, Contr. U. S. Nat. Herb. 13:308. 1911.

PEYOTE—Mezcal Button—Dry Whisky

Lophophora williamsii

This is a Mexican plant which extends into the southern part of Texas and is abundant in patches from Hidalgo County to the Big Bend country. It is called *Peyote* by the Mexicans. This is the old Indian or Aztec name. The Amercian people call it Mescal Button because it is a narcotic used by the Indians in their religious ceremonies. It is said to leave a peculiar effect on the vision in that it produces objects in beautiful colors. It is also reported that the person under its influence can see all the bad things that he or she has done and then all the good things in very beautiful and attractive colors. The Spaniards called it Sacred Mushroom because the Indians used it in their religious ceremonies, and because it, when dried, resembles a dried mushroom. Undoubtedly, the Spaniards never saw the green plant at that time. Many newspaper and magazine articles have been written about *Peyote,* and probably most of them are much exaggerated.

Its habitat is like most other cacti. It occurs in colonies on certain hillsides and then may not occur for another ten miles.

El Peyote—*Lophophora williamsii*

Known to produce color hallucinations, and long used in the ceremonial rites of certain tribes of Indians.

It is at home in sandy loam or clay flats, but also occurs in gravel soil, mostly on the south side of gravel hills, rarely on top.

The plants are blue green, about one inch above the surface of the soil, and usually under thorny shrubbery for protection. The plant resembles a common carrot in the shape of its large succulent tap root and the small crown exposed above the ground. The cactus is flabby, the top being covered with little tufts of wool at intervals of one half to one inch. The flowers are pale pink, about one half inch across when fully open. They open about ten in the morning, and close in the late afternoon, reopen-ing two to three consecutive days. The blossoms appear at intervals throughout the summer from April to November. The stamens are yellow, and the pistil whitish.

Peyote does well in cultivation and will stand a freeze to about 26° F.

For a complete account of this plant, see Peyote, an abridged compilation from the files of the Bureau of Indian affairs, prepared by Dr. Robert L. Newborne.

The following remarks taken from Vol. 3, page 84, "The Cactaceae" by Britton and Rose are of interest:—

"This plant contains a narcotic and has been the subject of much study regarding its chemical, medicinal, and therapeutic properties. Dr. L. Lewin isolated an alkaloid which he named anhalonin. Since then one or more other alkaloids have been discovered. The active drug contained in this plant, however, it is claimed, does not lie in the alkaloids but in certain resinous bodies discovered by Dr. Erwin E. Ewell. The dried plants have been used since pre-Columbian times by certain North American Indians in some of their religious ceremonies and dances. The physiological effects which follow the eating of the dried plants are remarkable visions, and these have been described in considerable detail by writers who have visited the Indians and who have recorded laboratory experiences. There is considerable commerce carried on in this plant by some of the Indian tribes, although it is forbidden by law. The globular plants are sliced into 3 or 4 sections and then dried in the sun and these dried pieces form the "mescal buttons" of the trade.

Description:—Plants dull bluish green, globular to top-shaped or somewhat flattened at top, 5 to 8 cm. broad, with a thickened tap-root, sometimes 10 cm. long or more; ribs 7 to 13, nearly vertical or irregular and indistict, tubercled; flowers central, each surrounded by a mass of long hair, pale pink to white, 2.5 cm. broad when fully open, with a broad funnelform tube; outer perianth-segments and scales green on the back, callous-tipped; filaments much shorter than the perianth-segments, nearly white; style white below, pinkish above, shorter than the perianth-segments; stigma-lobes 5, linear, pinkish; ovary naked; fruit 2 cm. long or less; seeds 1 cm. in diameter, with a broad basal hilum.

Type locality:—Not cited.

Distribution:—Central Mexico to southern Texas. Also western Texas.

Synonymy:—Lophophora williamsii (Lemaire) Coulter, Contr. U. S. Nat. Herb. 3:131. 1894.

Echinocactus williamsii Lemaire in Salm-Dyck, Allg. Gartenz. 13:385. 1845.

Anhalonium williamsii Lemaire in Förster, Handb. Cact. ed. 2. 233. 1885.

Anhalonium lewinii Hennings, Gartenflora 37:410. 1888.

Mammillaria williamsii Coulter, Contr. U. S. Nat. Herb. 2:-129. 1891.

Lophophora williamsii lewinii Coulter, Contr. Nat. Herb. 3:-131. 1894.

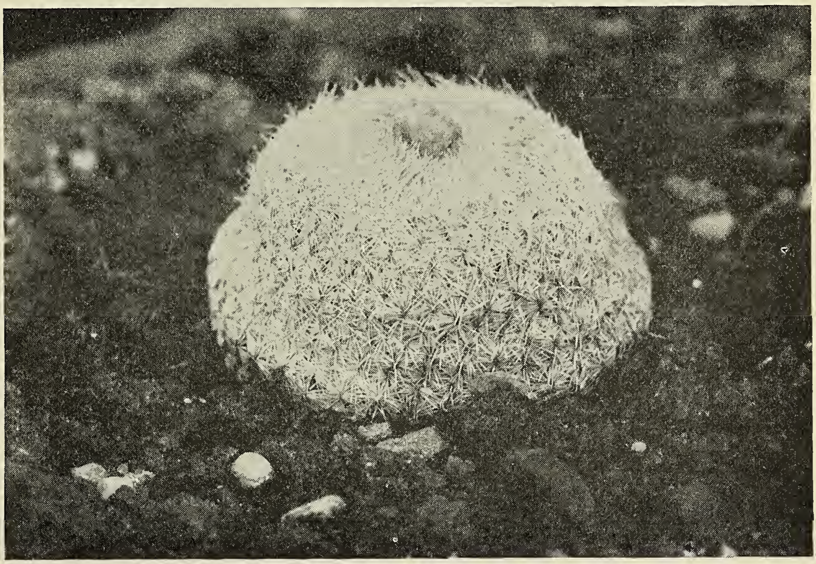
Echinocactus lewinii Hennings, Monatsschr: Kakteenk. 5:94. 1895.

Mammillaria lewinii Karsten, Deutsche Fl. ed. 2. 2:457. 1895.

Lophophora lewinii Thompson, Rep. Mo. Bot. Gard. 9:133. 1898.

BUTTON CACTUS—Epithelantha micromeris

This is a dainty little cactus varying in size from a dime to a little over a dollar. The name "button cactus" aptly describes its general appearance. The scarlet fruits are called "chilitos," and are slightly acid and edible.



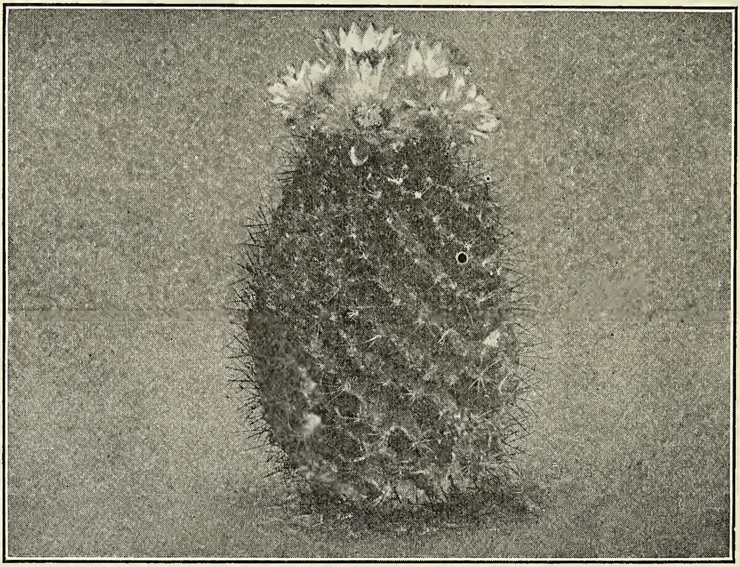
Epithelantha micromeris

Appropriately called button cactus. The plants are covered with a soft network of white spines, and vary in size from a dime to a dollar.

The flowers are very small, about ¼ inch across, whitish to flesh-colored, and blossom early. The perianth-segments "petals," vary from eight to ten.

The genus *Epithelantha* is distinct from the *Mammillarias* in that the blossom comes from the new growth instead of the old growth.

Description:—Plants small, simple or cespitose, nearly globular, but depressed at apex, 6 cm. in diameter or less; tubercles very low, small, arranged in many spirals, 1 mm. long; spines



HEDGEHOG CACTUS—*Fish-hook cactus*—*Hamatocactus setispinus*

An addition to any flower bed, as the big yellow blossoms form continuously from April to late summer. A fairly common cactus in the mesquite area, but rarely seen as it usually nestles close to a mesquite tree or under a sheltering bush, where it is well concealed by grass and weeds. Birds like the scarlet berries which nestle among the spines at the top.

numerous, white, the lower radials about 2 mm. long, the upper radials on the young tubercles 6 to 8 mm. long and connivent over the apex, narrowly clavate, the upper half finally falling off; flowers from near the center of the plant in a tuft of wool and spines; flower very small, whitish to light pink, 6 mm. broad; perianth-segments 8 to 10; stamens 10 to 15 stigma-lobes 3; fruit 8 to 12 mm. long; seed 1.5 mm. broad.

Synonymy:—Epithelantha micromeris (Engelmann) Weber.

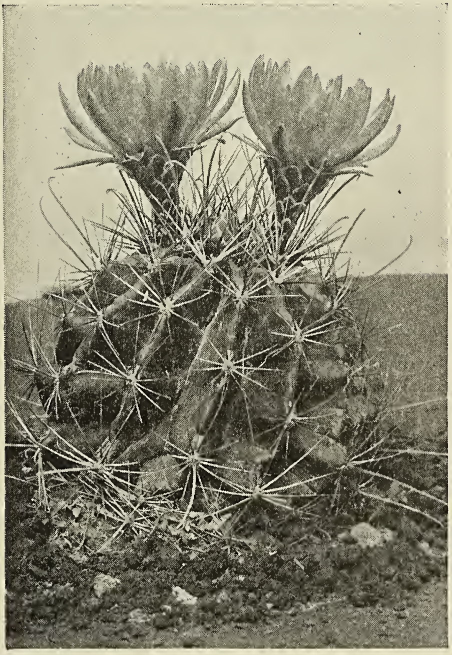
Mammillaria micromeris Engelmann, Proc. Amer. Acad. 3:-260. 1856.

Mammillaria micromeris greggii Engelmann, Proc. Amer. Acad. 3:261. 1856.

Cactus micromeris Kuntze, Rev. Gen. Pl. 1:268. 1891.

Cactus micromeris greggii Coulter, Contr. U. S. Nat. Herb. 3:101. 1894.

Mammillaria greggii Safford, Ann. Rep. Smiths. Inst. 1908: 531. pl. 4, f. 1. 1909.



HEDGEHOG CACTUS—*Hamatocactus setispinus*

The globose type confines its habitat to the mesquite thickets while the cylindrical type prefers gravel hills.

TWISTED-RIB CACTUS—Hedgehog Cactus—Fish Hook Cactus
Hamatocactus setispinus

Hamatocactus setispinus is known by cactus collectors as *Echinocactus setispinus*. Its range is from the Brazos to the Rio Grande and westward to the San Pedro river. It also extends south of the Rio Grande to Victoria, Tamaulipas, Mexico. It reaches Austin and probably goes even farther in its northern limits. It is abundant on some of the islands along the Gulf Coast, and seems to do well in any kind of soil, as long as the soil is well drained. In the Lower Rio Grande Valley, it is most abundant in mesquite thickets. It will stand freezing weather, but it is doubtful if it will stand much below 25 degrees F more than two or three days at a time.

It does well in cultivation and is a free flowering plant from early spring until late fall. The flowers are single or in clusters, lemon yellow with a red center. They have a very peculiar odor, which is attractive to many bees. The flowers open about noon and close about 5 o'clock in the afternoon for two or three consecutive days.

The stems are simple or branched, two to twelve inches high. The young plants blossom when about two years old. The plant usually has 13 ribs, twisted or spiral, with well defined tubercles, on which the spines form. The spines are variable, but usually seven or more in number. The central spine is longer than the radials and conspicuously hooked.

From a botanical standpoint, it is a very interesting plant. Its flowers and fruit indicate that it has no close relatives in the cactus family, and for this reason Britton and Rose have placed it in a genus by itself.

There seems to be two well defined forms or varieties. The most common form is the larger one with high ribs and robust spines, and is confined mostly to mesquite thickets. On the gravel hiils in Hidalgo and Starr Counties and far south in Tamaulipas is a form about two to three inches in diameter and rather tall, sometimes reaching one foot or more in height. The ribs are low, the flowers smaller and sometimes pure yellow or nearly so. The fruit is sweet and is cherished by birds and wild animals.

This is one of the easiest plants to collect and transplant. It can be dug up by prying with the toe of one's boot. The roots are fibrous, and if cut back to three inches before planting, the roots will not rot but send up a network of new fibers to feed the plant body. Plants can be transferred to new soil anytime without interfering with the blossoming period. Good drainage is fairly important. Older plants which are corky and brown at the base should not be transplanted.

The brilliant crimson fruits which nestle in the crown of the plant are as ornamental as the flowers, and birds are very fond of them.

Description:—Plants up to 15 cm. high, with long fibrous roots; ribs usually 13, more or less oblique, thin, high, undulate on the margin; radial spines 12 to 16, slender, often 4 cm. long, some white, others brownish; central spines 1 to 3, longer than radials; flower 4 to 7 cm. long, yellow, with a red center; inner perianth-segments oblong, acute, widely spreading; fruit 8 mm. in diameter, nearly naked; seeds 1.2 to 1.6 mm. in diameter.

Type locality:—Thickets along the Colorado River, Texas.

Distribution:—Southern Texas and northern Mexico.

Synonymy:—Echinocactus setispinus Engelmann, Bost. Journ. Nat. Hist. 5:246. 1845.

Echinocactus muehlenpfordtii Fennel, Allg. Gartenz. 15:65. 1847.

Echinocactus hamatus Muehlenpfordt, Allg. Gartenz. 16:18. 1848. Not Forbes, 1837.

Echinocactus setispinus hamatus Engelmann, Bost. Journ. Nat. Hist. 6:291. 1850.

Echinocactus setispinus setaceus Engelmann, Bost. Journ. Nat. Hist. 6:201. 1850.

Echinocactus setispinus cachetianus Labouret, Monogr. Cact. 203. 1853.

Echinocactus hamulosus Regel, Ind. Sem. Hort. Petrop. 34. 1856.

Echinopsis nodosa Linke, Wochenschr. Gartn. Pflanz. 1:85. 1858.

Echinocactus nodusus Hemsley, Biol. Centr. Amer. Bot. 1:535. 1880.

Echinocactus setispinus muehlenpfordtii Coulter, Contr. U. S. Nat. Herb. 3:370. 1896.

Echinocactus setispinus mierensis Schumann, Gesamtb. Kakteen 340. 1898.

Echinocactus setispinus orcuttii Schumann, Gesamtb. Kakteen 340. 1898.

BARREL CACTUS—Viznaga—Biznaga
Ferocactus wislizeni

There are thirty known species of the genus *Ferocactus* with only two known to be native of Texas.

Ferocactus wislizeni is a very beautiful scenic desert plant, which has saved the life of many a human being. It is known as the "Viznaga" or Barrel Cactus and is used to make candy. Another common name is Fish-hook cactus.

The stems are globular to cylindric, often very large, up to six feet or more high, single or branched, prominently ribbed. The flowers appear in clusters at the top of the plant. They are commonly yellow, but sometimes rose or other shades of red.

The central spine forms into a perfect hook of great strength, and often becomes six inches long. The blossoms are followed by large yellow seed pods that stay on for months and produce a very pretty effect all winter.

The following notes treating the genus as a whole and taken from Vol. 23, Part 4, Shrubs of Mexico by Dr. Paul C. Standley are of interest.

"The species of Ferocactus are well known in the arid regions of Mexico and the United States because of their large size and abundance, and the varied uses made of them. In the United States they are usually known by the name Barrel cactus. By the Indians they were sometimes employed as cooking vessels, the interior being scooped out and mashed, and the water thus obtained being replaced in the cavity and heated with hot stones, after which meat and other substances were placed in the liquid and cooked. The liquid obtained by crushing the pulp has sometimes been used as a substitute for water in the desert. The pulp is often fed to horses and cattle.

The candied pulp makes an excellent sweetmeat, which is much used in Mexico, and the southwestern United States, and is often sold in the eastern United States as "cactus candy." The Papago Indians of Arizona are reported to have prepared a sweetmeat by boiling the pulp in the syrup of *Carnegiea gigantea.*

The usual Mexican name for plants of this genus is "*biznaga*" or "visnaga." The name *bisnaga* is applied in Spain to the parsnip. (Pastinaca sativa), and the word is of Arabic origin. The Mexican word, however, is believed to have been derived from the Nahuatl, *huitzli* meaning spine and *nahuac,* around, i.e., covered with spines.

Concerning these plants Robelo writes as follows: "It is well known that the Mexicans in their bloody and gloomy religion performed the rite of sacrificing their flesh drawing blood from the ears, thighs, arms, and legs, nose and even the tongue. For such sacrifices they employed the spines of the *biznaga* and metl (maguey); and these objects being consecrated or even deified, the *biznaga* founded a cult, which was personified by a deity

Huitznahuatl, to whom was erected a temple, Huitznahuateapan, and to the place where the spines were kept was given the name Huitzcalco." The Mexicans also used the name *teacamotu,* "divine vessel," for the plants; while Hernandez mentions the "comitl," "Tepenexcomitl," and "hueycomitl," all of which probably belong to this genus. The *biznaga* was sacred to the god Mixcoatl.

Buelna reports the Otomí name as "pe," and the name "caballuna" is reported for an unidentified species.

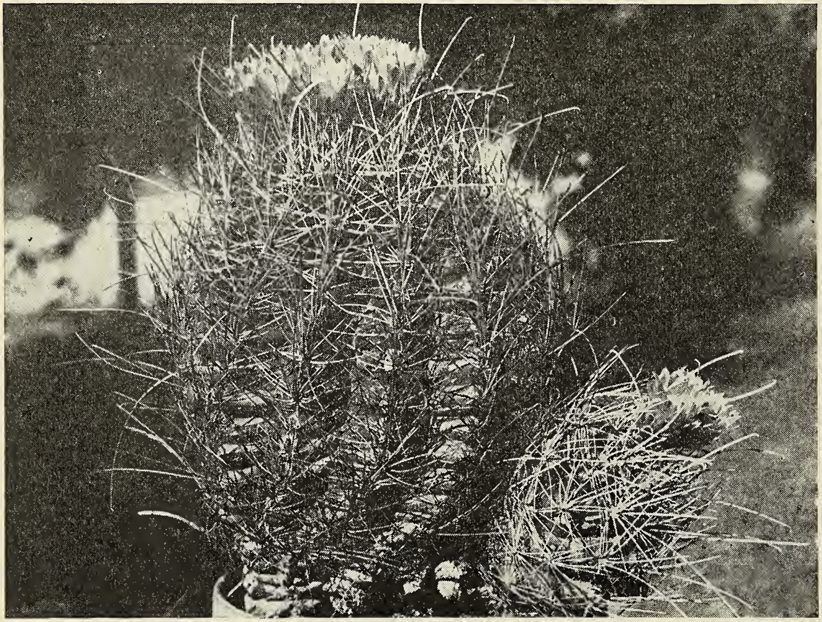
Clavigero gives a description of one of the species of Ferocactus in Baja California, and says, "In New Spain some people use the spines for toothpicks, and in some of the missions of California they employed them for knitting stockings, straightening out the tips and reducing the thicker part. Among these spines the *viznaga* produces its handsome flowers, tinged with white, red, and yellow, which are followed by the fruit, much smaller than that of the *tammia,* and full like that of the *cardon,* with viscous juice and seeds, which latter the Californians eat, after preparing them like those of the *cardon.* In Mexico they make a good sweetmeat from the juicy pulp of the viznaga."

Clavigero also makes the following shrewd statement, which indicates that he had no mean knowledge of plants: "It is certainly wonderful that the plants of which I have spoken, and others of which I shall speak later, have more juice in arid places than other kinds of trees have in humid regions; but it is still more remarkable that they maintain themselves without any deterioration with little or no dew, although it may not rain for 10 months or more, as often happens in California. I believe that these plants are more juicy because they transpire less, inasmuch as they have no leaves, for these, as is the fundamental belief of physicists, are the principal organs of transpiration among plants; it may be conjectured that the Creator denied these plants leaves because He destined them to inhabit dry lands."

Description:—At first globular but becoming cylindric, when very old much elongated, 2 meters long or more, usually simple, but when injured often giving off several heads or branches; ribs numerous, often 25, 3 cm. high; areoles elliptic, large, sometimes 2.5 cm. long, brown-felted, 2 to 3 cm. apart, or the flowering ones often approximate; spines variable; radials, absent in young plants, thread-like to acicular, the longest 5 cm. long; central spines several, white to red, annular, all subulate, one of them much stouter, usually strongly flattened, strongly hooked; flowers yellow, some red, 5 to 6 cm. long; fruit yellow, oblong, scaly, 4 to 5 cm. long; seeds dull black, the surface covered with shallow indistinct pits.

Type locality:—Doñana, New Mexico.

Distribution:—El Paso, Texas, west through southern New Mexico and Chihuahua to Arizona and Sonora and perhaps south



Ferocactus hamatacanthus is a variable species and has many forms, but the flowers and fruit on all varieties are the same. It usually blossoms in mid-summer and the fruit remains on the stem into the winter months.

along the Gulf of California into Sinaloa. Reported also from Lower California.

Synonymy:—Echinocactus wislizeni Engelmann in Wislizenus, Mem. Tour. North. Mex. 96. 1848.

Echinocactus emoryi Engelmann in Emory, Mil. Reconn. 157. 1848.

Echinocactus wislizeni decipiens Engelmann in Rothrock, Rep. U. S. Geogr. Surv. 6:129. 1878.

Echinocereus emoryi Rumpler in Forster, Handb. Cact. ed. 2. 804. 1885.

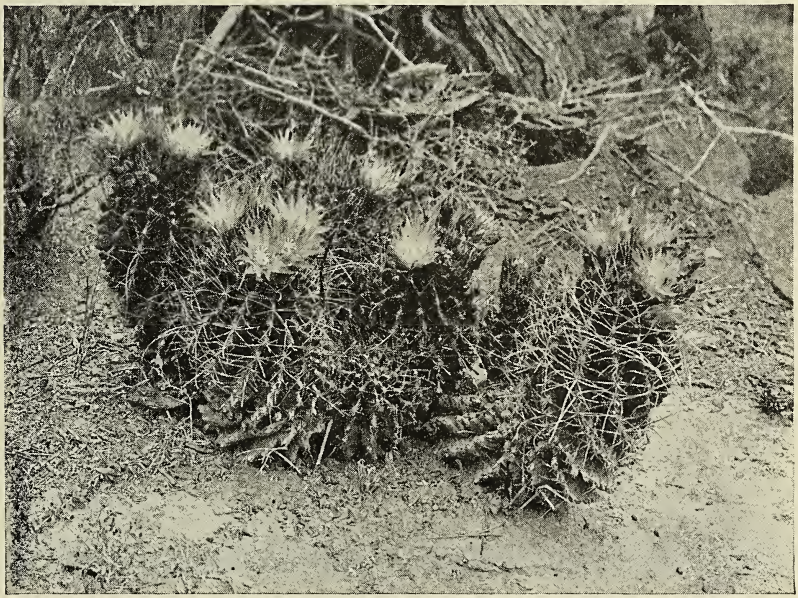
Echinocactus wislizeni albispinus Toumey, Gard. and For. 8:-154. 1895.

Echinocactus falconeri Orcutt, West. Amer. Sci. 12:162. 1902.

Echinocactus arizonicus Kunze, Monatsschr. Kakteenk. 19:-149. 1909.

TURK'S HEAD—Viznaga—Ferocactus hamatacanthus

This is the well known *Echinocactus longihamatus* of the earlier cactus collectors. It is easily recognized by its large head and



TURK'S HEAD—*Ferocactus hamatacanthus*

The flowers are a lemon yellow, some with red centers. The fruits are called "Limos de viznaga," are greenish in color, and used like limes in flavoring pies, cakes, and drinks.

long hooked spines. It has a wide range of distribution, central Texas to New Mexico and south into Mexico. It prefers gravel hills or highlands for its home. It also occurs on the clay dunes near the Texas Coast. It is not very abundant in Cameron County and north Tamaulipas, Mexico. It requires high ground that does not absorb much water during the rainy seasons.

The stems are simple, rarely branched, globular to oblong, dark green, turning reddish on exposure to strong sunlight. The ribs are prominent, straight or spiral. The spines are born on the crest of the ribs and are brownish or grayish in color. Those on the top of the plant are very long and slightly curved or hooked at the end. The spines are rather brittle, and as the older ones break off, they leave the plant "necked" near the base.

The flowers are a beautiful lemon yellow, some with red centers, in clusters or sometimes single. They flower from June to August. Like the Hedgehog cactus, they open for two or three consecutive days in bright sunlight, about eleven in the morning, and close in the late afternoon.

The fruit is greenish in color, oblong, persistent, remaining on the plant nearly all winter. Due to a high acid content, they are called "Limas de Viznaga" by Mexicans, and used like limes in flavoring pies, cakes, and drinks.

The name Turk's Head is used in the Big Bend region.

It does well in cultivation, and will stand freezing to about 28° F.

It is very variable as to spines and shape. H. T. Fletcher of Alpine writes of it "This species stores a large amount of water and in desert areas lives have been saved by cutting into them for the water stored in them."

The following notes by Britton and Rose in "The Cactaceae" are of interest.

'This species develops elongated glands, 2 to 4 mm. long, in the areoles between the flower and the spines, as do some of the others; these at first are soft, but in age become hard and spine-like. The fruit of this species is unlike that of most other species of the genus; the skin is thin and the flesh juicy and edible.'

This species resembles *Hamatacanthus setispinus*. It differs from this cactus in the longer and stouter, strongly hooked, central spine, the drab-green fruits, and larger flowers. The fruit also remains on the plant all winter. The habitat is more often slopes of limestone hills, sandy slopes, and gravel hillsides.

Hamatacanthos setispinus has scarlet fruits, and the central spine is more delicate, shorter, and slightly hooked or not hooked at all. In this species the flowers are yellow with red centers. The habitat is more often open mesquite thickets and rather heavy soil.

Description:—Solitary, globular to oblong, up to 60 cm. high; ribs usually 13, sometimes 17, strongly tubercled, 2 to 3 cm. high; areoles large, 1 to 3 cm. apart; radial spines about 12, acicular, terete, 5 to 7 cm. long; central spines 4, elongated, angled, sometimes 15 cm. long, one of them hooked at apex; flowers large, 7 to 8 cm. long, yellow, in some forms said to be scarlet within; fruit oblong, 2 to 5 cm. long, fleshy, edible, dark brown to drab-colored (not red); seeds pitted.

Type locality:—Mexico.

Distribution:—Southern Texas, New Mexico, and northern Mexico.

Synonymy:— Echinocactus hamatocanthus Muhlenpfordt, Allg. Gartenz. 14:371. 1846.

Echinocactus flexispinus Engelmann in Wislizenus, Mem. Tour. North. Mex. 111. 1848.

Echinocactus longihamatus Geleotti in Pfeiffer, Abbild. Beschr. Cact. 2:pl. 16. 1848.

Echinocactus sinuatus Dietrich, Allg. Gartenz. 19:345. 1851.

Echinocactus setispinus sinuatus Poselger, Allg. Gartenz. 21:-119. 1853.

Echinocactus setispinus robustus Poselger, Allg. Gartenz. 21:-119. 1853.

Echinocactus setispinus longihamatus Poselger, Allg. Gartenz. 21:119. 1853.

Echinocactus longihamatus hamatacanthus Labouret, Monogr. Cact. 201. 1853.

Echinocactus treculianus Labouret, Monogr. Cact. 202. 1853.

Echinocactus longihamatus gracilispinus Engelmann, Proc. Amer. Acad. 3:273. 1856.

Echinocactus longihamatus crassispinus Engelmann, Proc. Amer. Acad. 3:273. 1856.

Echinocactus longihamatus brevispinus Engelmann, Proc. Amer. Acad. 3:274. 1856.

Echinocactus flavispinus Meinshausen, Wochenshr. Gartn. Pflanz. 1:28. 1858.

Echinocactus haematochroanthus Hemsley, Biol. Centr. Amer. Bot. 1:532. 1880.

Echinocactus hamatacanthus longihamatus Coulter, Contr. U. S. Nat. Herb. 3:365. 1896.

Echinocactus hamatacanthus brevispinus Coulter, Contr. U. S. Nat. Herb. 3:366. 1896.

Echinocactus longihamatus sinuatus Weber in Schumann, Gesamtb. Kakteen 342. 1898.

FEROCACTUS UNCINATUS

This cactus is generally known as turk's head and catclaw cactus. The plant is short-cylindric, bluish green in color, slightly covered with a bloom, and has spindle-shaped roots. The ribs are usually 13 in number, and strongly tubercled. In mature plants the tubercles are large and heavy. The central spine is long and hooked, yellow below, reddish above. The flowers are dark orange to chocolate brown in color and hidden in the compact spine cluster at the top of the plant.

Technically this plant differs from all other species in having the tubercles grooved on the upper side and the flower borne at the opposite end of the groove from the spine-cluster.

The plant is native to western Texas. It is most commonly found on rocky ridges and foothill slopes.

The stems attain a height of 12 to 18 inches, and are often 6 to 8 inches in diameter.

Description:—Plant short-cylindric, 10 to 20 cm. high, bluish, slightly glaucous, with spindle-shaped roots; ribs usually 13, straight, strongly tubercled, undulate; flowering areoles narrow, extending from the spine-clusters to the base of the tubercles with the flower at the opposite end, felted: areoles also bearing one or more large flat yellow glands, these surrounded by a ring of short yellow hairs; central spine usually solitary, 12 cm. long or less, erect, yellow below, reddish above, hooked at tip; 3 lower radial spines spreading or reflexed, hooked; upper radials straight; flowers brownish, 2 to 2.5 cm. long, widely spreading; perianth-segments numerous, linear-oblong; filaments numerous, short; scales on ovary and flower-tube triangular, scarious-margined, in age broadly auriculate at base; fruit small, oblong, 2 cm. long, at first green, turning brown to crimson and finally scarlet, naked except the appressed scales, somewhat fleshy, edible; seeds black, small, oblong, 1 to 1.5 mm. long, with basal hilum; cotyledons foliaceous.

Type locality:—Mexico.

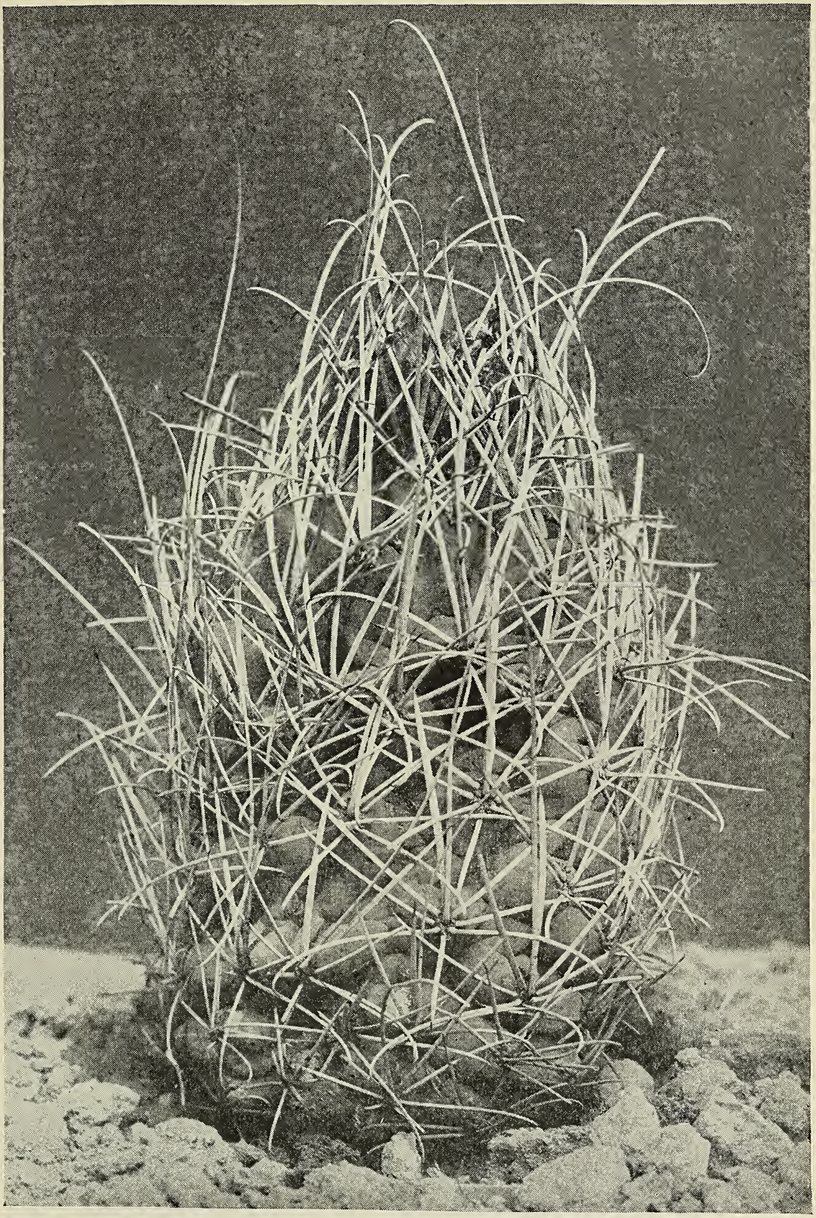
Distribution: — Rocky ridges and foothill-slopes in western Texas to central Mexico.

Synonymy: — Echinocactus uncinatus Galeotti in Pfeiffer, Abbild. Beschr. Cact. 2: pl. 18. 1848.

Echinocactus ancylacanthus Monville in Labouret, Monogr. Cact. 201. 1853.

Echinocactus uncinatus wrightii Engelmann, Proc. Amer. Acad. 3:272. 1856.

Echinocactus wrightii Coulter, Cycl. Amer. Hort. Bailey 2:-513. 1900.



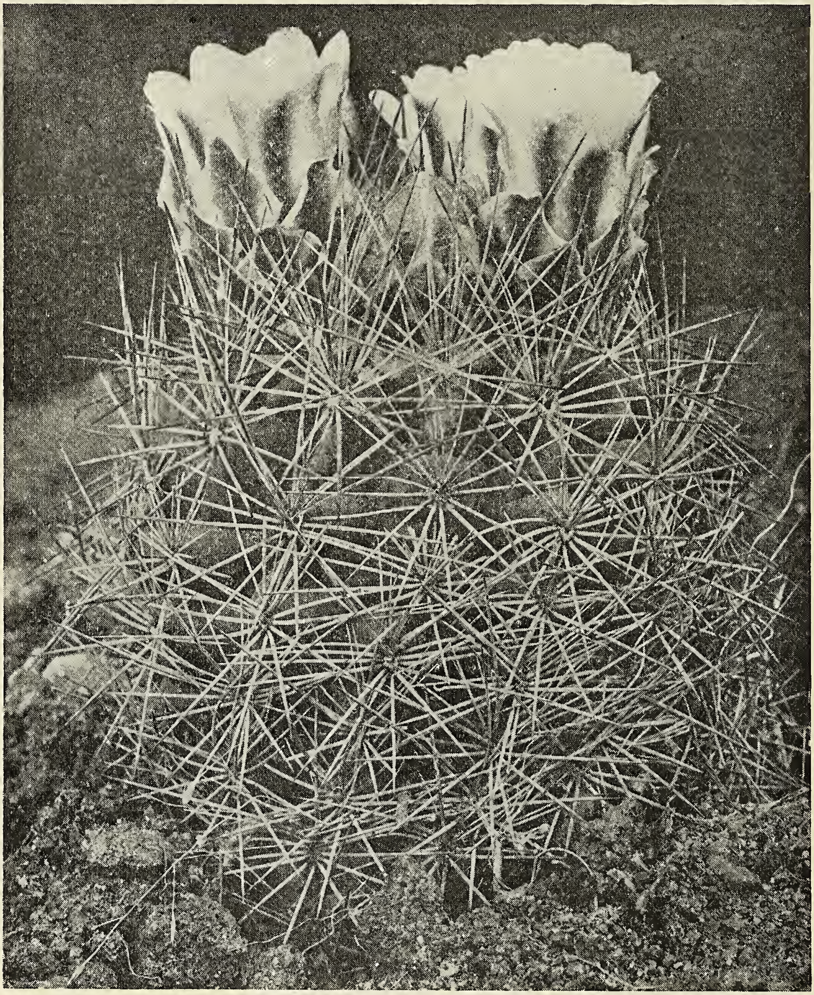
TURK'S HEAD—*Ferocactus uncinatus*

This cactus is easily identified by the unusually long, hooked, central spines, the large, heavy tubercles, and the dark orange to chocolate colored flowers hidden in the compact spine clusters at the top of the plant.

WHITE-FLOWERED VIZNAGITA—Echinomastus intertextus

There are six species in this genus. Two are found in Texas. They were formerly treated as *Echinocactus*.

Echinomastus intertextus is a small plant, nearly always globose or short cylindrical. The flowers are white to cream-colored, about one inch across. The pink pistil and white perianth is unusual for a day blooming cactus. The spines are pectinate.



Echinomastus intertextus—*White-flowered "viznagita"*

The white flowers and pink pistil are unusual for a day-blooming cactus.

The remarks from The Cactaceae, Britton and Rose may be of some assistance in identification. 'Engelmann states that the scales on the fruit are with or without some wool in their axils. The fruit is always in a mass of wool, but so far as we have seen the scales are always naked in their axils.'

Description:—Simple, globular or nearly so, 2.5 to 10 cm. in diameter; ribs 13, somewhat acute, more or less divided into tubercles; areoles 5 to 6 mm. apart, somewhat elliptic; spines rigid, red with darker tips; radial spines 16 to 25, appressed, 8 to 15 mm. long, 3 or 4 of the upper radial spines white or nearly so, more slender than the others, almost bristle-like; central spines 4, subulate, 3 of them turned upward and similar to the radials, 10 to 18 mm. long, the other one very short, porrect; flowers 2.5 cm. long, nearly as broad as long, purplish; outer perianth-segments about 20, broadly ovate, white-margined; inner perianth-segments 20 to 25, oblong, mucronate; fruit nearly globular, 8 to 10 mm. in diameter, with a few scarious scales; seeds black, shining, 2 mm. in diameter.

Type locality:—Not definitely cited.

Distribution: — Southwestern Texas, to southeastern Arizona and northern Mexico.

Synonymy:—Echinocactus intertextus Engelmann, Proc. Amer. Acad. 3:277. 1856.

Cereus pectinatus centralis Coulter, Contr. U. S. Nat. Herb. 3:386. 1896.

Echinocereus pectinatus centralis Schumann, Gesamtb. Kekteen 271. 1898.

Echinocereus centralis Rose, Conth. U. S. Nat. Herb. 12:293. 1909.

ECHINOMASTUS DASYACANTHUS

This species is similar to the foregoing but the flowers are much larger, the inner perianth-segments are acute to acuminate, and its range is more northern and eastern.

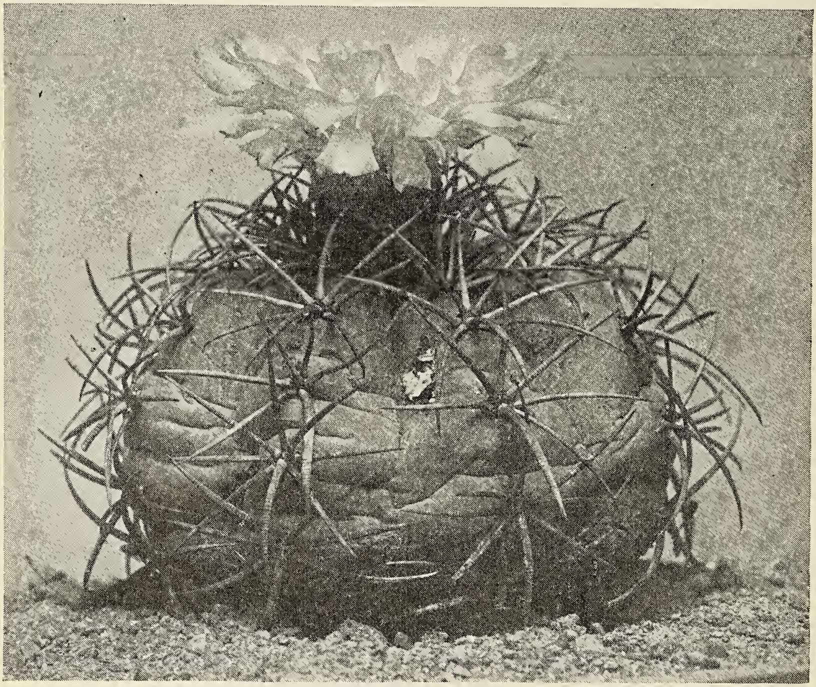
Description:—Plants cylindric, 10 to 15 cm. high; ribs somewhat spiraled, made up of numerous compressed tubercles; spines slender, more or less purplish; radials 19 to 25, 12 to 22 mm. long; centrals about 4, nearly equal; top of flowering plant and young areoles very woolly; scales and outer perianth-segments red with white margins; inner perianth-segments white or purplish, about 2.5 cm. long, acute or acuminate; ovary bearing a few ovate scales, these naked in their axils; stigma-lobes 9, erect, truncate at apex, deep purple.

Type locality:—Near El Paso, Texas.
Distribution:—Southwestern Texas.

Synonymy: — Echinocactus intertextus dasyacanthus Engelmann, Proc. Amer. Acad. 3:277. 1856.

DEVIL'S HEAD—Bisnagre
Echinocactus horizonthalonius

The genus *Echinocactus* was established in 1827. About 138 species have passed under this name. Britton and Rose in "The



ECHINOCACTUS HORIZONTHALONIUS
The only representative of this genus in Texas. Common names are Devil's Head and Bisnagre. The blossoms are a delicate to deep pink.

Cactaceae" published by The Carnegie Institution of Washington, recognize 9 species. Of these, only one is reported from Texas.

Echinocactus horizonthalonius is commonly known as Devil's Head and Bisnagre. It is the true hedgehog cactus of the desert. Niggerhead is the name used in some localities.

The heads are simple, hemispherical, short cylindric, mostly rounded. The ribs vary from 7 to 13, usually eight in number. These are broad and rounded as illustrated in the photograph, or rarely spiral, and bear comparatively few clusters of stout spines. The spines are stout, somewhat flattened, ringed, mostly recurved, and reddish or bluish. The buds are covered with a cottony coat. The flowers are deep pink. The blossoms appear from May to late August. The fruits are scarlet. The plant is grayish with the green showing through, giving the effect of a bloom like cabbage.

Their range is over a great stretch of country, along the Texas-Mexican Boundary from El Paso to Eagle Pass and as far north and east of the mountains of west Texas as Ft. Stockton and Marathon.

Occasional plants are cylindrical in shape. The very young plants are only an inch or two across and look like tiny pincushions. Plants as small as two inches in diameter blossom.

This cactus grows nearest like the following species, *Homalocephala texensis.* But the ribs are rounded instead of angular, fewer in number, and the petals are not frilled at the tips. Both have delicate pink blossoms that appear in the center of the plant.

In reproducing their native habitat of gravel hills and gravelly mountain slopes, be sure to use a rich soil mixed with about two thirds sand and gravel and give good drainage.

Description:—Simple, globular or sometimes depressed or short-cylindric, 4 to 25 cm. high, glaucous; ribs 7 to 13, obtuse, often spirally arranged; spines 6 to 9, somewhat curved or straight, 2 to 4 cm. long, often very stout, more or less flattened, often annulate, reddish or sometimes blackish at base; central spine solitary, stouter than the radials; flowers pale rose to pink, 5 to 7 cm. long before expanding, broader than long when fully open; outer perianth-segments linear with more or less pungent tips; inner perianth-segments narrowly oblong, about 3 cm. long; throat of flower short and broad, covered with numerous stamens; tube of flower wanting or nearly so; filaments white; style pink; stigma-lobes pinkish to olive; ovary and fruit bearing linear scales, their axils very woolly; fruit dehiscing by a basal pore, oblong, red, 3 cm. long, clothed with white long wool; seeds 2 mm. long, more or less angled, brownish black, papillose; hilum large, lateral but below the midde.

Type locality:—Not cited.

Distribution:—Western Texas, southern New Mexico to Arizona, and Northern Mexico.

Synonymy: — Echinocactus horizonthalonius Lemaire, Cact. Gen. Nov. Sp. 19. 1839.

Echinocactus equitans Scheidweiler, Bull. Acad. Sci. Brux. 61:-88. 1830.

Echinocactus horizonthalonius curvispinus Salm-Dyck, Cact. Hort. Dyck. 1849. 146. 1850.

Echinocactus horizonthalonius centrispinus Engelmann, Proc. Amer. Acad. 3:276. 1856.

Echinocactus laticostatus Engelmann and Bigelow, Pac. R. Rep. 4:32. 1856.

Echinocactus parryi Engelmann, Proc. Amer. Acad. 3:276. 1856.

Echinocactus horizonthalonius obscurispinis R. Meyer, Monatsschr. Kakteenk. 21:181. 1911.

DEVIL'S PIN-CUSHION—"Viznaga" "Manco caballo" "Candy Cactus"—Homalocephala texensis

This is the well known *Echinocactus texensis*. It has a very wide distribution in Texas, but is not abundant in any one locality. It is at home in most any kind of soil providing that the soil is high and well drained. Like most cacti, it prefers dry gravel hillsides. It does well in cultivation and will stand rather cold weather.

In the Lower Rio Grande Valley it is called *Visnaga* and *Manco caballo*. Its large rigid spines are very harmful to the hoofs of horses and cattle, and the Mexican ranchmen uproot them and turn the roots to the sun to slowly dry them up. The name *Manco caballo* means horse-crippler. The ribs are 13 to 27 in number, very prominent, and armed with clusters of very strong spines.

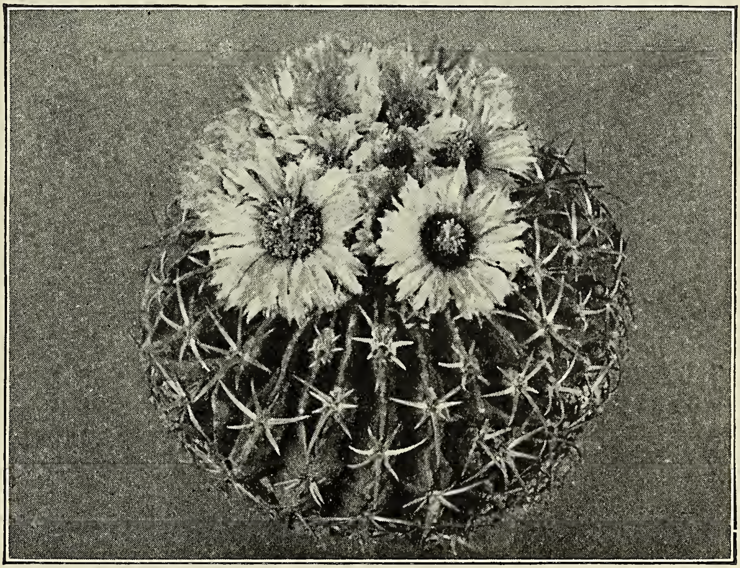
The flowers are very beautiful, feather-like and fragrant, shell to deep pink, gradually becoming deeper pink to reddish toward the center. The stamens are yellow and loaded with pollen.

The stems are simple or branched, but nearly always simple, and four inches to one foot across. They vary from a few inches to a foot in height and are even higher when the plant is very old. Old plants often have three or four small heads growing out of the crown of the original plant.

The fruit is scarlet in color, and ripens in the summer. It is variable, sometimes juicy and sweet, sometimes hard and leathery. Usually several form in a cluster.

The plant blossoms in the spring, usually in April. The flowers open for two or three consecutive days in bright sunlight, from noon to about five o'clock. The flowers are single or in clusters at the top of the plant.

An interesting bit of Texas Pioneer History is recorded in the



Devil's Head—*Homalocephala texensis*

This plant is truly a master of any ground space it chooses to occupy. Horses and cattle alike avoid stepping on it as the stout thorns will penetrate their hoofs and cause long-lasting festering sores and consequent lameness.

remarks of Britton and Rose, Vol. 3, The Cactaceae. The writer is doubtful if the fences were very high.

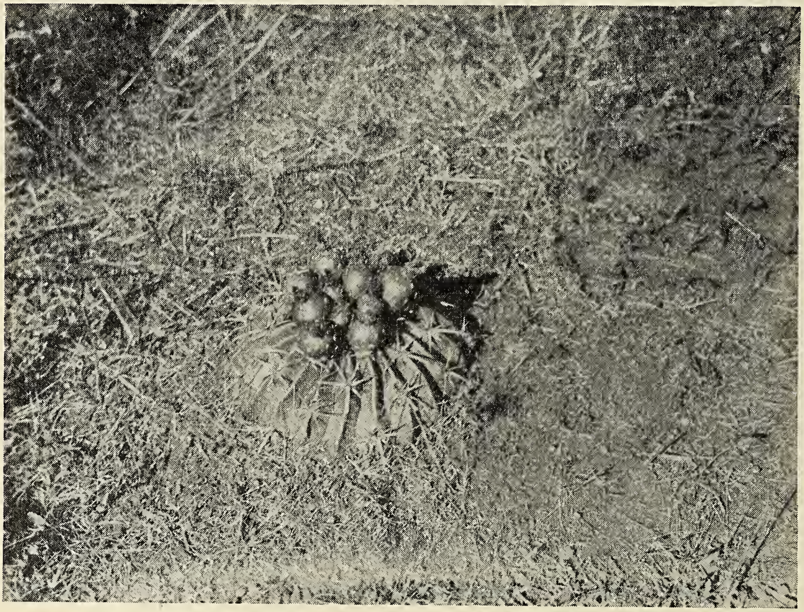
Dr. C. R. Ball writes of this plant as follows:—"This plant is extremely abundant on the high plains of western and northern Texas. In establishing farms in this section large numbers of this cactus are plowed out in the breaking of the sod land. Occasionally the farmers gather them and haul them to the margins of the field and there build fences much like the stone walls so familiar in New England. The plants are easily corded and the strong sharp spines make the fences quite formidable."

Type locality:—Texas; type grown in a botanical garden from seed.

Distribution: — Southern New Mexico, Texas, and northern Mexico. Of wide distribution in Texas.

Synonymy: — Echinocactus texensis Hopffer, Allg. Gartenz, 10:297. 1842.

Echinocactus lindheimeri Engelmann, Bost. Journ. Nat. Hist. 5:246. 1845.



DEVIL'S HEAD CACTUS—*Homalocephala texensis*

The cluster of bright scarlet fruits is even more attractive than the pink blossoms.

Echinocactus platycephalus Muhlenfordt, Allg. Gartenz. 16:9. 1848.

Echinocactus texensis gourgensii Cels in Labouret, Monogr. Cact. 196. 1853.

Echinocactus texensis longispinus Schelle, Handb. Kakteenk, 161. 1907.

ROOT CACTUS—FISH HOOK CACTUS
Ancistrocactus scheeri

This plant as well as *Thelocactus bicolor* is closely related to the genus *Coryphantha*.

It prefers gravel hillsides and high sandy flats where the water never stands. Hidalgo County is its eastern limit. It extends along the Rio Grande probably to the Big Bend district.

The stems are single or branched, globular to oblong, 4 to 10 inches high, dark green, very spiny. It has about 13 ribs, that are somewhat spiraled and divided into tubercles which are

Ancistrocactus scheeri

Due to the crowding of the numerous rigid hooked spines at the top of the plant, the small greenish-yellow flowers seldom open wide. The roots are large, thick, and succulent.

grooved to the middle. The tubercles are tipped with large spine clusters.

The central spine is strongly hooked and very crowded at the top of the plant. Often the spines are so crowded at the top of the plant that the flowers can scarcely open.

The flowers are greenish, rather small, and rarely open wide.

They bloom singly or in clusters as early as January. The fruit is about one half to three fourths inches long, green, and ripens in May or June.

This plant has very peculiar roots in that they are very large and fleshy. They often extend downward in sandy soil. They are always constricted at the top.

The plant does well in cultivation and will stand cold weather to at least 25° F.

There are only three recognized species in this interesting genus. Two are native to Texas.

Description:—Globular to clavate, 3.5 to 5 cm. long; ribs usually 13, indistinct, somewhat spiraled, strong divided into stout, terete tubercles grooved only to middle; radial spines 15 to 18, spreading, 12 mm. long or less, white to straw-colored; central spines 3 or 4, the lowest one strongly hooked; flowers small, 2.5 cm. long, greenish yellow; ovary small, nearly naked; seeds large (about 2 mm. long) brown and minutely tuberculate (according to Coulter).

Type locality:—Not cited.

Distribution:—Southern Texas and northern Mexico. From Pleasanton, Atascosa County south to the Rio Grande in Texas.

Synonymy: — Echinocactus scheeri Salm-Dyck, Cact. Hort. Dyck. 1849. 155. 1850.

ANCISTROCACTUS BREVIHAMATUS

Ancistrocactus brevihamatus was first described by Dr. George Engelmann as *Echinocactus brevihamatus*. It is a west Texas species. It resembles *Ancistrocactus scheeri* in general appearance, but differs from it in its tubercles, which are grooved to the base, the groove woolly or slightly so. In *Ancistrocactus sheeri* the tubercles are grooved half way from the spine cluster. The flowers of *Ancistrocactus brevihamatus* are rose-colored, while those on *Ancistrocactus sheeri* are a pale yellowish-green in color and nearly hidden by the large spine clusters at the apex of the stem.

This species is rather rare and is not generally found in collections.

Regarding this species and the one preceding Mr. William Hess gives the following statement—"Our observation is that the flowers and habit are identical. While one has long central spines, the other has shorter."

Description:—Globular to obovoid, 5 to 10 cm. high, 5 to 7.5 cm. in diameter, dark green; ribs usually 13, compressed, strongly tubercled; tubercles grooved on upper side from spine-cluster to base, the groove woolly; radial spines 10 to 14, terete, white, 10 to 20 mm. long; central spines 4, the lower one porrect, hooked at apex; flowers rose-colored, 25 to 32 mm. long, not so broad as long; inner perianth-segments 15 mm. long, 4 mm. broad; midrib darker colored than margins; fruit about 1.5 cm. long, thin-walled, nearly naked; seeds brownish black, about 2 mm. long, smooth or with low flattened papillae, with a deep-set hilum.

Type locality:—On the San Pedros, Texas.

Distribution:—Southern Texas. From Pleasanton, Atascosa County south to the Rio Grande River and west to Uvalde.

Synonymy: — Echinocactus brevihamatus Engelmann, Proc. Amer. Acad. 3:271. 1856.

Echinocactus scheeri brevihamatus Weber in Schumann, Gesamtb. Kakteen 336. 1898.

THELOCACTUS BICOLOR

This is a Mexican species that extends into southern Texas and is only known along the Rio Grande in Starr and Zapata Counties. It grows on the south side of gravel hills and limestone ridges, but is apparently not very abundant. This is due to a bright red fungus that holds it in check. At least two thirds of the plants are diseased, so that they gradually lose their vitality and dry up.

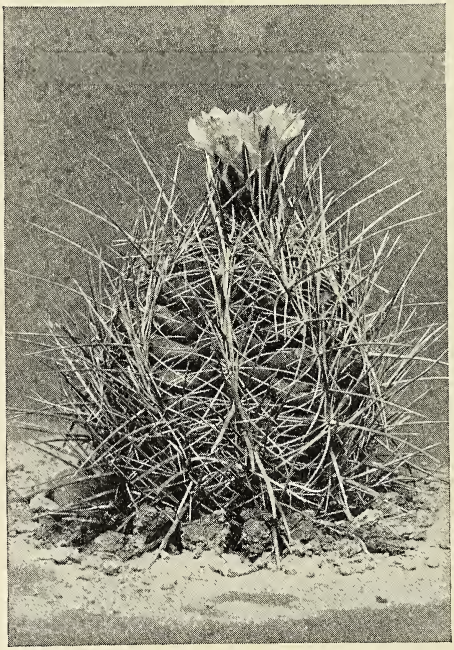
The plants are simple or branched, globose to conic, about four to eight inches high, with about eight ribs which are tubercled and very spiny. The spines are reddish to brown or gray.

The flowers are a pretty pink or reddish purple in color, showy, and blossom from early spring to late fall. They open at midday, and close near five o'clock in the afternoon for two or three consecutive days.

This cactus does not do well in cultivation. When planted in dry soil containing lime, and given plenty of sunshine and very little water, it will thrive for several years. A plant collected at Saltillo, Mexico lived for seven years in cultivation. It finally got too wet during a long rainy spell and the roots rotted.

The Texas species are less spiny than the Mexican species and their spines have less color.

Description:—Plants simple, globose to conic, glaucous, small, up to 3 cm. high, very spiny; ribs usually 8, broad, somewhat tubercled; areoles, approximate; spines highly colored, sometimes bright red or yellowish or red and yellow; radial spines 9 to 18, widely spreading or sometimes bent backward at tip, 3 cm. long or less; central spines usually 4, ascending or porrect, all straight, 3 to 5 cm. long, subulate; flowers large, 5 to 6 cm. long and fully as broad when expanded; outer perianth-segments pale purple; inner perianth-segments deep purplish pink, oblong, acute; scales on ovary and flower-tube imbricated, ovate, with scarious and



THELOCACTUS BICOLOR

A Mexican species extending into Starr and Zapata counties. The specific name refers to the two-color spines of most plants. The flowers are a pretty pink or reddish purple and blossom from spring to fall.

ciliate margins; filaments white to purple; stigma-lobes pale to pinkish yellow; fruit small, about 1 cm. long, dehiscing by a large irregular basal opening; seeds 2 mm. long, black, broader at apex, tuberculate with a circular and depressed basal hilum.

Type locality:—Mexico.

Distribution:—Southern Texas to central Mexico.

Synonymy:—Echinocactus bicolor Galeotti in Pfeiffer, Abbild. Beschr. Cact. 2: pl. 25. 1848.

Echinocactus rhodophthalmus Hooker in Curtis's Bot. Mag. 76: pl. 4486. 1850.

Echinocactus rhodophthalmus ellipticus Hooker in Curtis's Bot. Mag. 78: pl. 4634. 1852.

Echinocactus ellipticus Lemaire, Jard. Fleur, 3: pl. 270. 1853.

Echinocactus bicolor schottii Engelmann, Proc. Amer. Acad. :277. 1857.

Echinocactus bolansis Rünge, Gartenflora 38: 106. 1889.

Echinocactus bicolor bolansis Schumann, Gesamtb. Kakteen 303. 1898.

Echinocactus bicolor tricolor, Schumann, Gesamtb. Kakteen 303. 1898.

Echinocactus schottii Small, Fl. Southeast. U. S. 814. 1903.

NEOLLOYDIA TEXENSIS

There are seven recognized species of *Neolloydia* in the United States. Only one species is indigenous to Texas. The genus was named in honor of Prof. Francis E. Lloyd, an enthusiastic cactus student.

The stems are small, cylindric, and very spiny. The tubercles are arranged in long spirals. The flowers are usually pink or purple, growing from the nascent (newly forming) tubercles at the top of the plant.

Description:—Globular to short-oblong, 4 to 6 cm. long; tubercles arranged in long spirals, somewhat imbricated, a little flattened dorsally; radial spines 10 to 15, white, widely spreading, about 1 cm. long; central spines 1 to 3, much stouter than the radials, elongated, 2 to 3 cm. long, black; flowers not seen; fruit small, globular, almost hidden by the spines, greenish, thin-walled, dry; seeds black, tuberculate, 1.5 mm. in diameter; hilum large, basal, white lunate.

Synonymy:—Neolloydia texensis. Britton and Rose. Cact. 4:-18. 1923.

CORYPHANTHA MACROMERIS

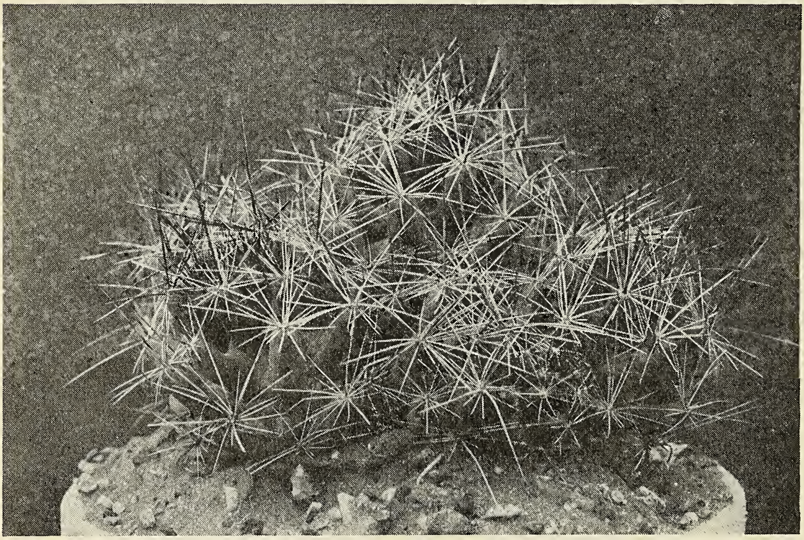
This cactus is of a loose growing appearance. The one to many stems branch from a thick heavy root, and due to their fleshy structure have a somewhat flabby appearance. The stems are a mass of heavy tubercles. The tubercles vary in size and length, and are tipped with spine clusters. The flowers are large, wine-purple, and blossom abundantly from the upper parts of the stem.

Coryphantha macromeris differs from *Coryphantha runyonii* by the larger and more numerous spines and the longer tubercles. *Coryphantha runyonii* is confined to southern Texas, while *Coryphantha macromeris* is a western Texas species.

The stems spread from the top of the root like the common *Pitaya, Echinocereus enneacanthus,* but each branch is tubercled instead of ridged.

When transplanting stems that are not rooted, set on dry sand in good sunlight. Give almost no water until the roots take form. The plant rots rapidly when decay sets in on account of the soft nature of the tissues.

Thirty-seven species make up this genus. About eight are



CORYPHANTHA MACROMERIS

The flowers are large, wine-purple, and blossom abundantly from the upper parts of the stem in late summer.

native to Texas. They were formerly treated in the genus *Mammillaria,* but differ from this genus by the grooved tubercles, green fruit, and large yellow or purple flowers. They form a very interesting group of cacti and are much sought by the cactus fancier.

Coryphantha macromeris and *Coryphantha runyonii* are not closely related to other members of the genus. The tubercles of both species are much more elongated and flattened, and the groove on the upper surface never extends to the base.

Description:—Plant branching at base, often many-headed, up to 2 dm. long; tubercles large, soft, loosely arranged, elongated, 12 to 30 cm. long, grooved on upper side about two-thirds of their length; spines 10 to 17, slender, the radials white; central spines several, black, the longer ones 5 cm. long; flowers large, purple, 6 to 8 cm. broad; scales on flower-tube ciliate; ovary bearing a few scales with hairy axils; fruit 15 to 25 mm. long; seeds globose, brown but sometimes described as yellow, smooth.

Type locality:—Near Doñana, New Mexico.

Distribution: — Southern New Mexico, western Texas, and Chihuahua, south to Zacatecas, Mexico.

Synonymy:—Coryphantha macromeris (Engelmann) Lemaire, Cactées 35. 1868.

Mammillaria macromeris Engelmann in Wislizenus, Mem. Tour. North Mex. 97. 1848.

Mammillaria heteromorpha Scheer in Salm-Dyck. Cact. Hort. Dyck. 1849. 128. 1850.

Echinocactus macromeris Poselger, Allg. Gartenz. 21:102. 1853.

Echinocactus heteromorphus Poselger, Allg. Gartenz. 21:126. 1853.

Mammillaria dactylithele Labouret, Monogr. Cact. 146. 1853.

Cactus macromeris Kuntze, Rev. Gen. Pl. 1:260. 1891.

Cactus heteromorphus Kuntze, Rev. Gen. Pl. 1:260. 1891.

CORYPHANTHA RUNYONII—Runyon's Coryphantha

This is a newly described species of *Coryphantha* from the Lower Rio Grande Valley. It forms low clumps, sometimes 24 inches in diameter, but usually 8 to 10 inches in diameter. Some clumps weigh as high as 50 pounds. It grows on gravel hillsides or high clay flats near Rio Grande City and Roma, and southward into Mexico. It was observed at La Llorona about 50 miles south of the Border.

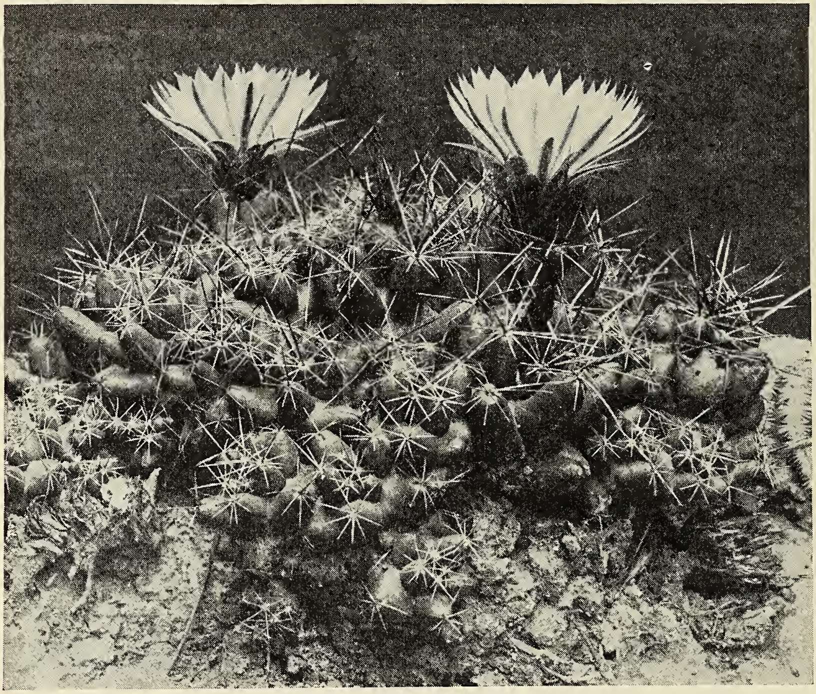
The stems are about 4 to 6 inches high, covered with irregular tubercles, which are grooved on the upper side, about half way down from the tip. The tubercles bear spines at their tips. The spines are irregular in length and variable in color, mostly grayish or brownish.

It has a very large succulent taproot, extending deep into the earth, and bearing numerous heads, so crowded together that they appear as a single plant.

The flowers are very showy, pink to reddish purple, one or more single blossoms appearing at a time from April to August. The petals are frilled at the tips. They open in bright sunlight about noon, and close late in the afternoon for about two consecutive days. The fruit is oblong, one half inch in diameter, about three fourths inch long, and of a greenish color.

This cactus does well in cultivatoin if not kept too wet and will stand cold weather to about 25 degrees F.

Description:—Forming low clumps, sometimes 5 dm. in diameter, grayish green, with a thick, elongated tap-root; tubercles



Coryphantha runyonii

A recently described species from the lower Rio Grande Valley. The flowers are large, showy, and pink to reddish-purple.

rather short, 1 to 2 cm. long, terete or somewhat flattened, grooved on the upper half, rarely more, but never to the base; radial spines 6 or more, spreading, acicular, very variable in length, 3 cm. long or less, sometimes all yellow or sometimes one or more in a cluster brown, otherwise yellow; central spines on young plant solitary, dark brown to black but in old plants sometimes 2 or 3, somewhat angled, up to 6 cm. long; flowers large, purple, 5 cm. broad; outer perianth-segments ciliate; inner perianth-segments spatulate, oblong, acute; fruit green; seeds brown.

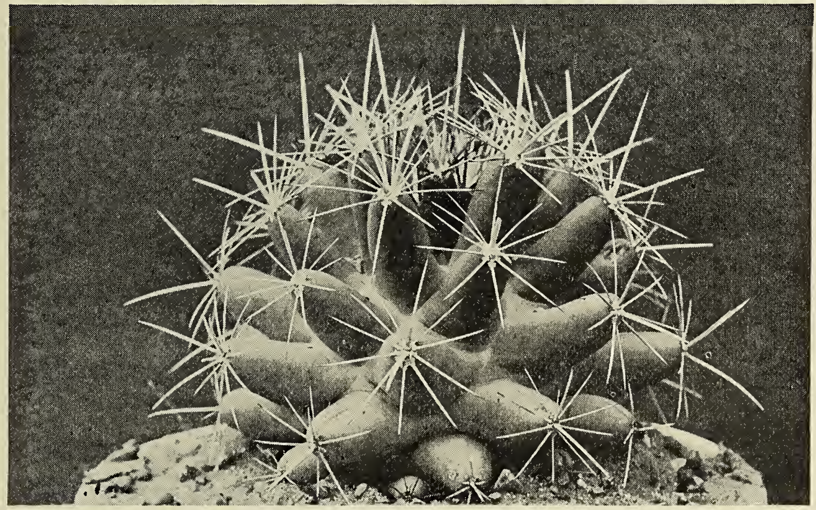
Type locality:—Near Rio Grande City.

Distribution:—Found along the Rio Grande from Brownsville to Laredo.

Synonymy:—Coryphantha runyonii Britton and Rose. The Cactaceae. Carnegie Institution. Vol. 4. 26.

LONG-TUBERCLED CORYPHANTHA—Coryphantha muehlenfordtii

A very attractive and extremely interesting species of the *Coryphantha* group, easily recognized by its long, well defined tubercles, each tipped with a showy spine cluster. It is generally



Coryphantha muehlenpfordtii

known in cactus collections as *Coryphantha scheeri* and is much sought by cactus fanciers.

It blossoms about the first of June and then afterwards at intervals of a month until September. The flowers are generally produced in a large cluster at the top of the stem. It has the added peculiarity of also producing flowers in the grooves and in the center of the upper side of the old tubercles. This is an extremely rare characteristic in the cactus family. It is a west Texas and New Mexico species with a well defined range in each state.

The stems are about five inches high, and three and one-half inches in diameter. The tubercles are about one inch in length, grooved above (all the way to the base), and tipped with about twelve to fifteen spines, each about an inch long. There are nine to twelve radials spines, and two to three centrals. About three or four of the radials are very weak; the balance are stiff and strong.

The flowers may appear singly but are mostly in clusters. They open about 10 in the morning and close in the afternoon. Generally they do not reopen. The flowers are showy, orange tinted with red. The filaments are reddish; the anthers yellow or orange; the style yellow.

The fruit is greenish, about one to one and one-half inches long and one-half inch in diameter. They taper towards each end and are usually tipped with the dried flower stem.

Description:—Plants nearly globular, usually simple, short-oblong, 20 cm. long, 7.5 to 15 cm. in diameter; tubercles large, 1 to 2.5 cm. long; axils of young tubercles grooved and young spine-areoles very woolly; grooves bearing large dark-colored glands; spines variable, reddish to yellow with brown to black tips; radials 6 to 16, usually about 2 cm. long, straight; central spines 1 to 4, subulate, stouter than the radials, 3 to 3.5 cm. long, from nearly straight to curved at tip or even strongly hooked; flowers yellow, 6 cm. long; scales on flower-tube and outer perianth-segments more or less lacerated; inner perianth-segments oblong, entire, acute; fruit greenish, oblong, 3 to 3.5 cm. long, naked; seeds large, 3 mm. long, brown, shining smooth.

Type locality:—Mexico.

Distribution:—Northern Chihuahua, western Texas, and southern New Mexico.

Synonymy:—Coryphantha muehlenfordtii (Poselger) Britton and Rose.

Mammillaria scheeri Muehlenfordt, Allg. Gartenz. 15:97. 1847. Not Muhlenpfort, 1845.

Echinocactus muehlenpfordtii Poselger, Allg. Gartenz. 21:102. 1853.

Mammillaria scheeri valida Engelmann, Proc. Amer Acad. 3:265. 1856.

Coryphantha scheeri Lemaire, Cactées 35. 1868.

Cactus scheeri Kuntze, Rev. Gen. Pl. 1:261. 1891.

COMB-SPINED CORYPHANTHA—Coryphantha pectinata

This cactus was first described by Dr. Engelmann as *Mammillaria pectinata.* A very good illustration is given in the

Mexican Boundary Survey. It is a rare species and is seldom seen in collections. Its range is limited to western Texas and the northern tip of adjacent Mexico.

The stems are usually simple, small, and globose. The upper tubercles are longer than the lower ones, and are usually arranged in thirteen spiral rows. The spines are all radial, or comb-like, with the lower ones sometimes bent backward or recurved. The flowers are yellow.

The following observation by Mr. William Hess is of interest. "*C. pectinata* and *C. echinus* are no doubt the same with the exception that the latter has a central spine 1 to 1.5 cm. long. They are fairly common in the valleys near Sanderson and towards Fort Stockton."

Description:—Usually simple, globose, 3 to 6 cm. in diameter; tubercles usually arranged in 13 spirals; upper tubercles 10 to 12 mm. long, about twice as long as lower ones; areoles a little longer than broad; spines 16 to 24, all radial, those on lower areoles appressed and often a little recurved, those from upper part of upper areoles 12 to 18 mm. long, connivent over apex, yellowish white with black tips; flowers yellow, 5 cm. long; ovary 6 to 8 mm. long; fruit 12 mm. long.

Type locality:—On the Pecos River in western Texas.

Distribution:—Southern Texas and adjacent parts of Mexico. Also west Texas.

Synonymy: — Coryphantha pectinata (Engelmann). Britton and Rose. Cact. 4:34. 1923.

Mammillaria pectinata Engelmann, Proc. Amer. Acad. 3:266. 1856.

Mammillaria pectinata cristata Hortus in Forster, Handb. Cact. ed. 2. 403. 1885.

Cactus pectinatus Kuntze, Rev. Gen. Pl. 1:259. 1891.

CORYPHANTHA ECHINUS

This species was first described by Dr. Engelmann in 1856 as *Mammillaria echinus* and illustrated in the Mexican Boundary Survey, 1859. It is easily distinguished from *Coryphantha pectinata* by its long straight central spines. Its range is limited to west Texas and adjacent parts of Mexico. It is seldom seen in collections.

The stems are solitary, globose to cone-shaped, and covered with tightly appressed white spines. The flowers are yellow.

Description:—Solitary, globose to subconic, 3 to 5 cm. in diameter, almost hidden under the closely appressed spines; areoles orbicular or a little longer than broad; radial spines numerous, white, 10 to 16 mm. long; central spines 3 or 4, the 3 upper erect or connivent over the apex, the lower one porrect on side of plant, erect near top, subulate, straight, 1.5 to 2.5 cm. long, often blackish; flowers 2.5 to 5 cm. long, yellow; outer perianth-segments linear-lanceolate; inner perianth-segments 20 to 30, narrow; stigma-lobes about 12; fruit oblong, 12 mm. long.

Type locality:—On the Pecos River, Texas.

Distribution: — Western Texas, particularly the valleys near Sanderson and towards Fort Stockton.

CORYPHANTA VIVIPARA

This is a central state species that extends into northwest Texas. According to Britton and Rose it has a very wide range of distribution even to reaching into Canada.

It is a very pretty species and usually well known with collectors, but under many different names. The round form and whitish spines suggest a snow ball at a distance. It requires well drained soil and will stand hard freezing if kept dry during the winter.

The stems are globular, solitary or in clusters, sometimes forming large mounds. The tubercles are prominent and tipped with white spine clusters. Each cluster has about sixteen white radials and four to six centrals. The flowers are pinkish.

Description:—Plants solitary or in clusters forming mounds 3 to 6 dm. in diameter, globular, with prominent tubercles; areoles large, woolly; radial spines about 16, rather delicate, radiating, white; centrals 4 to 6, divergent, much stouter, brownish, swollen at base; ovary green, naked; outer perianth-segments greenish; inner ones somewhat pinkish, long-ciliate; innermost perianth-segment pinkish purple, narrow, acuminate, entire, spreading; filaments much shorter than the segments, pinkish, but paler below; style greenish to purple above, longer than the stamens; stigma-lobes linear, purple, about 8, apiculate; fruit green when mature, juicy, nearly globular, 1.5 cm. in diameter, with several (sometimes 5 or 6) small ciliate scales scattered over its surface; seeds light brown, 1.5 mm. long.

Type locality:—Near the Mandan towns on the Missouri, lat. near 49°.

Distribution:—Manitoba to Alberta, Kansas, south to northern Texas and Colorado. Mr. E. Mortensen records its as "quite common near San Angelo. Also, south of Fredericksburg near the Pedernales River."

Synonymy: — Coryphantha vivipara (Nuttall) Britton and Rose in Britton and Brown, Illustr. Fl. ed. 2. 2:571. 1913.

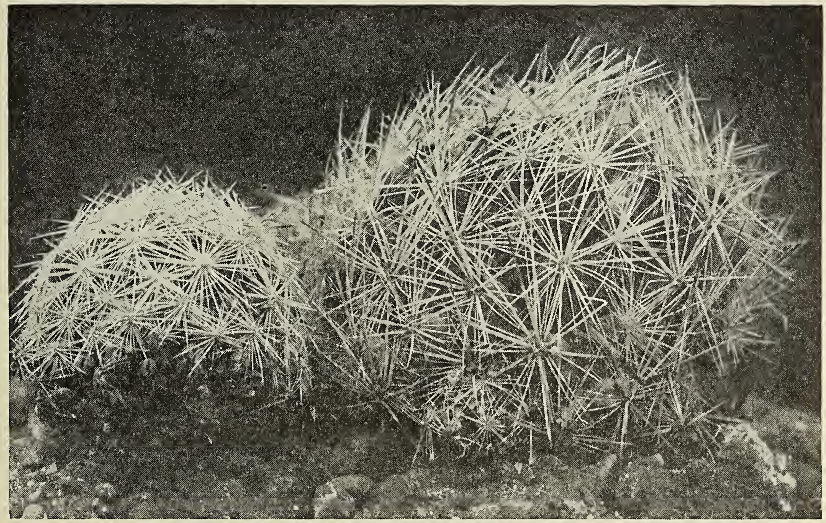
Cactus viviparus Nuttall, Fraser's Cat. No. 22. 1813.

Mammillaria vivipara Haworth, Suppl. Pl. Succ. 72. 1819.

Mammillaria radiosa Engelmann, Bost. Journ. Nat. Hist. 6:196. 1850.

Echinocactus radiosus Poselger, Allg. Gartenz. 21:107. 1853.

Echinocactus viviparus Poselger, Allg. Gartenz. 21:107. 1853.



CORYPHANTHA VIVIPARA

One of a very variable group which ranges from Arizona to Texas and north to Canada. Each locality produces its own form. Not less than six distinct varieties have been named. **Coryphanta neo-mexicana** is one of these.

Mammillaria vivipara vera Engelmann, Proc. Amer. Acad. 3:269. 1856.

Mammillaria vivipara radiosa Engelmann, Proc. Amer. Acad. 3:269. 1856.

Mammillaria vivipara radiosa Engelmann, Cact. Mex. Bound. 15. 1859, as subspecies.

Cactus radiosus Coulter, Contr. U. S. Nat. Herb. 3:120. 1894.

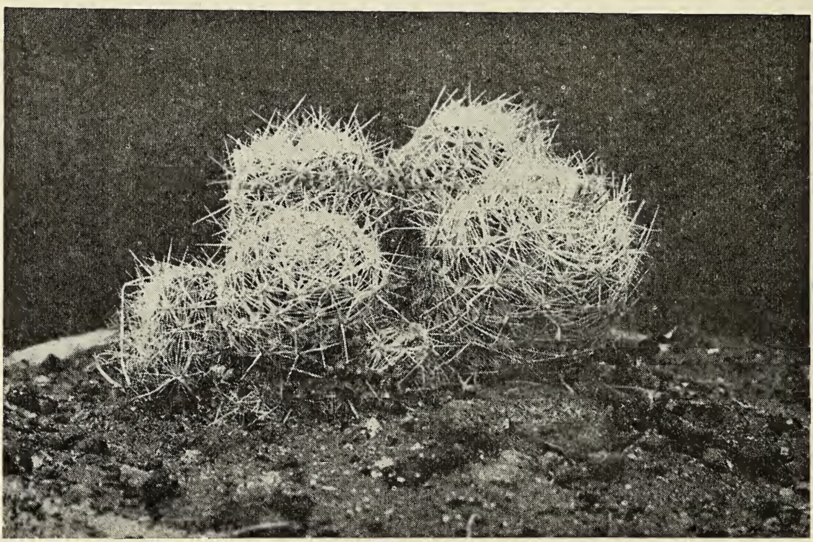
Mammillaria hirschtiana Haage, Monatsschr. Kakteenk. 6:-127. 1896.

Coryphantha radiosa Rydberg, Fl. Rocky Mountains 581. 1917.

NEW MEXICO CORYPHANTHA—Coryphantha neo-mexicana

This species is very closely related to *Coryphantha vivipara,* and probably runs into this species. It was first described by Dr. Engelmann in 1856 and is illustrated in the Mexican Boundary Survey. Its range of distribution is western Texas, New Mexico and adjacent parts of Mexico.

The plants are usually solitary, sometimes forming in clusters, globular to short oblong, the whole body hidden under a mass of white spines. The radial spines are very numerous and white. The central spines are several in number, and brownish to black



Coryphantha neo-mexicana

towards the tip. The flowers are large in comparison with the size of the plant. Like many other cacti it is a variable species.

Description:—Plants usually solitary, globular to short-oblong, 8 to 12 cm. long, the whole body usually hidden under a mass of spines; radial spines numerous, acicular, usually white; central spines several, much stouter than the radials, pale below, brown or black towards top; flowers 4 to 5 cm. broad when fully expanded; outer perianth-segments greenish or the ones nearer center purplish, ciliate; inner perianth-segments broadly linear, acuminate and apiculate, more or less serrate above; filaments greenish, much shorter than perianth-segments; stigma-lobes extending beyond filaments, white, obtuse, not apiculate as in *Coryphantha vivipara;* fruit 2.5 cm. long, green, juicy, naked except a few hairy scales neat top, capped by withered perianth, depressed at apex.

Type locality:—Western Texas to New Mexico, doubtless at El Paso.

Distribution:—Western Texas, New Mexico, and northern Chihuahua, Mexico.

Synonymy: — Mammillaria vivipara radiosa neo-mexicana Engelmann, Proc. Amer. Acad. 3:269. 1856.

Mammillaria radiosa neo-mexicana Engelmann, Cact. Mex. Bound. 64. 1859.

Mammillaria radiosa borealis Engelmann, Cact. Mex. Bound. 68. 1859.

Mammillaria radiosa texana Engelmann, Cact. Mex. Bound. 68. 1859.

Cactus radiosus neo-mexicanus Coulter, Contr. U. S. Nat. Herb. 3:120. 1894.

Cactus neo-mexicanus Small, Fl. Southeast. U. S. 812. 1903.

Mammillaria neo-mexicana A. Nelson in Coulter and Nelson, Man. Bot. Rocky Mountains 327. 1909.

NIPPLE CACTUS—Coryphantha sulcata

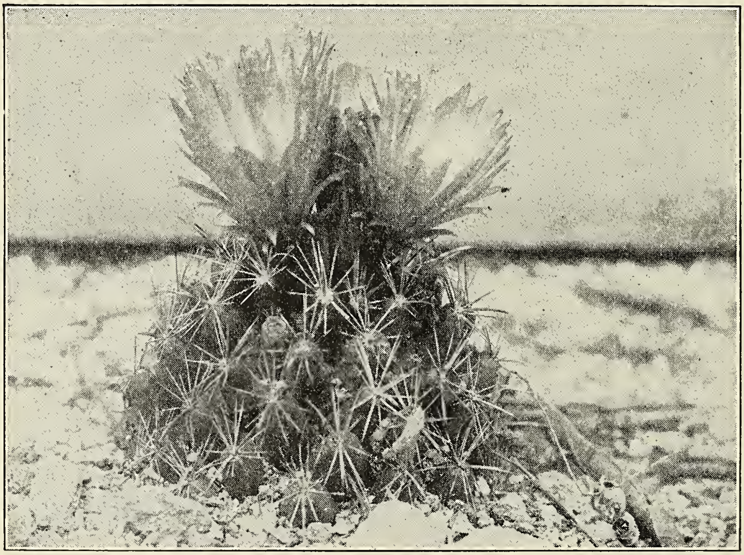
These plants grow singly or in clusters. Individual plants vary from small rounded masses of spine-tipped nipples, to larger plants more oblong and cylindric in shape. The nipples are large and heavy, and grooved all the way on the upper side.

The tubercles are often slightly curved upward. The central spine is stout, about ½ inch long. The radial spines have the peculiarity of branching at the top. The flowers are lemon-yellow and large for the size of the plant. The fruits are green, smooth, oblong and variable in shape, and remain on the plant throughout the winter.

In appearance this plant somewhat resembles *Neobesseya similis,* but the flowers of *Neobesseya similis* are greenish-yellow, and the fruit bright scarlet with black globose seeds. The fruit of *Coryphantha sulcata* is green with brown oblong seeds.

This little cactus has a very limited range iin central Texas. It likes limestone hills and high sandy flats, but will grow in any well drained soil. It behaves well in cultivation if kept from excessive moisture. New plants are formed by "shoots" from the central plant.

Description:—Cespitose, 8 to 12 cm. in diameter; tubercles rather large, 10 to 12 mm. long, somewhat flattened, soft; radial spines acicular, straight, white; central spines several, one somewhat stouter than the others, porrect or slightly curved outward, others erect; flowers several, from near center of plant, 5 cm. in diameter or more, yellow, with a red center; inner perianth-segments lanceolate, apiculate; filaments reddish; style greenish yellow, exserted beyond stamens; stigma-lobes 7 to 10, yellow, notched at apex, fruit oblong, greenish; seeds oblong, shining, dark brown.



Coryphantha sulcata—*Finger cactus*

An example of beauty produced in nature, seemingly under the most adverse conditions. The plants grow best in poor dry gravel soil. The flowers are large, yellow, and satiny in texture and new buds open throughout the summer.

Type locality:—Industry, Texas.
Distribution:—Southern Texas.

Synonymy: — Mammillaria sulcata Engelmann, Bost. Journ. Nat. Hist. 5:246. 1845.

Mammillaria strobiliformis Mühlenpfordt, Allg. Gartenz, 16:-19. 1848. Not Engelmann, 1848.

Mammillaria calcarata Engelmann, Bost. Journ. Not. Hist. 6:195. 1850.

Coryphantha calcarata Lemaire, Cactées 35. 1868.

Cactus calcaratus Kuntze, Rev. Gen. Pl. 1:259. 1891.

Cactus scolymoides sulcatus Coulter, Contr. U. S. Nat. Herb. 3:116. 1894.

Mammillaria radians sulcata Schumann, Gesamtb. Kakteen 496. 1898.

Cactus sulcatus Small, Fl. Southeast. U. S. 812. 1903.

NEOBESSEYA SIMILIS

Neobesseya similis is similar to *Coryphantha sulcata* but the tubercles in mature plants do not seem to be so heavy. In *Coryphantha sulcata* the tubercles bend upward and the grooves are deep. In *Neobesseya similis* the tubercles are straight or nearly so, and the grooves inconspicuous.

The blossoms are a peculiar yellowish green, one and one-half inches across, with decidedly long narrow pointed petals. The stamens are short, yellow, delicate, and concealed in the cup. The stigma is heavy and green. The fruit is scarlet and contains black globose seeds. When not eaten by birds and ants, they remain on the plant all winter.

Description:—Plants sometimes growing in large clumps 1 to 1.5 dm. high by 2 to 3 dm. in diameter, containing 25 individuals or more; larger plants 6 to 10 cm. in diameter; tubercles deep green, cylindric, sometimes 2 cm. long, when young the groove filled with white wool; spines all puberulent; radial spines 12 to 15, spreading, dirty white with brownish tips; central spine solitary or often wanting, similar to but stouter and longer than the radials; flowers 5 to 6 cm. long, light yellow, the outer lobes tinged with brown and green; inner perianth-segments long, narrow, acuminate; flower-tube definite, covered nearly to its base with short greenish stamens; style green; stigma-loges 4 to 6, linear; fruit globular or short-oblong, 10 to 20 mm. in diameter; seeds large, globose, 2 mm. in diameter.

Type locality:—Near Industry, Texas.

Distribution:—Eastern Texas.

Synonymy: — Mammillaria similis Engelmann, Bost. Journ. Nat. Hist. 5:246. 1845.

Mammillaria similis caespitosa Engelmann, Bost. Journ. Nat. Hist. 6:200. 1850.

Echinocactus similis Poselger, Allg. Gartenz. 21:107. 1853.

Mammillaria nuttallii caespitosa Engelmann, Proc. Amer. Acad. 3:265. 1856.

Mammillaria missouriensis caespitosa S. Watson Bibl. Index 1:403. 1878.

Cactus missouriensis similis Coulter, Contr. U. S. Nat. Herb. 3:111. 1894.

Mammillaria missouriensis similis Schumann, Gesamtb. Kakteen 498. 1898.

Cactus similis Small, Fl. Southeast. U. S. 812. 1903.

Coryphantha similis Britton and Rose in Britton and Brown, Illustr. Fl. ed. 2. 2:571. 1913.

NEOBESSEYA WISSMANNII

This is a central Texas species which usually goes under the name of *Mammillaria missouriensis* and is becoming very scarce. It is very closely related to the next species and probably runs into it. A very good colored plate in Vol. 1, Bluhende Kakteen by Schumann will help to identify it.

The stems are solitary or in masses, forming large mounds of twenty to thirty heads or even more. The heads are usually globose, covered with long tapering tubercles. The tubercles spread out noticeably and are tipped with spine clusters. The spines are white to gray or cream to yellowish. The flowers are large for the size of the plant, and vary from orange to yellow.

Description:—Plant solitary, or forming mounds 2 to 3 dm. in diameter and 1 dm. high with 25 heads or more; areoles elliptic when young, conspicuously white-woolly, the head usually globose, tubercles rather large, spreading, somewhat narrowed towards apex; spines 7 to 14, when young white to brownish, in age gray with yellow swollen base, acicular, 1.5 to 2 cm. long, sometimes all radial and spreading, rarely 1 or 2 centrals and these porrect; flowers large, 4 to 5 cm. long, dark yellow; scales on flower-tube strongly nerved; margin of perianth-segments naked; inner segments abruptly long-apiculate; fruit globose, 8 mm. in diameter.

Type locality:—Not cited, presumably Texas.

Distribution:—Central Texas.

Synonymy: — Neobesseya wissmannii (Hildemann). Britton and Rose.

Mammillaria simils robustior Engelmann, Bost. Journ. Nat. Hist. 6:200. 1850.

Mammillaria nuttallii robustior Engelmann, Proc. Amer. Acad. 3:265. 1856.

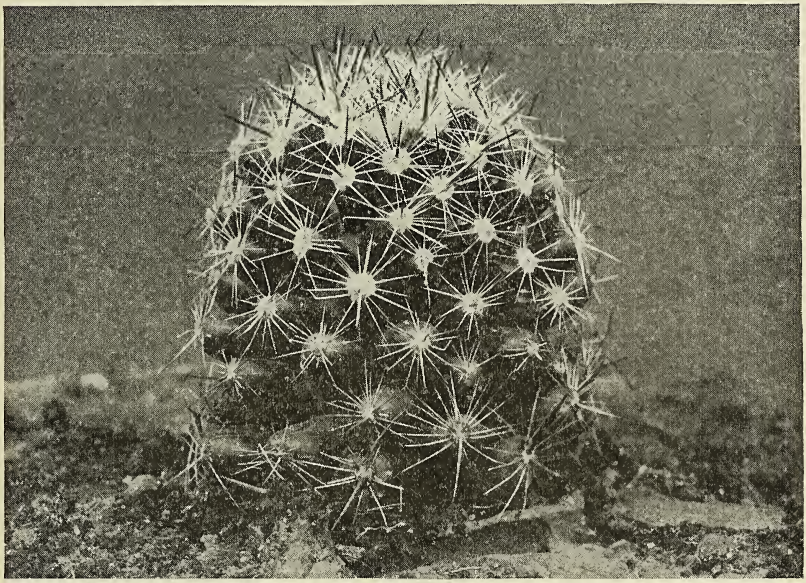
Mammillaria missouriensis robustior S. Watson, Bibl. Index. 1:403. 1878.

Mammillaria wissmannii Hildmann in Schumann, Gesamtb. Kakteen 498. 1898.

Cactus robustior Small, Fl. Southeast. U. S. 812. 1903.

NEOBESSEYA MISSOURIENSIS

The new genus *Neobesseya* consists of four species. All are native to the United States, three being native to Texas. They were formerly treated as *Mammillarias* and were taken out of that genus by Britton and Rose. They are nearest the genus *Coryphantha,* but differ from that genus in the fruit and seed. The genus is named in honor of Dr. Charles Edwin Bessey, an eminent botanical teacher and professor in the University of Nebraska.



Neobesseya missouriensis

The stems are simple, or in masses that sometimes form a foot or more across. The cactus is becoming very scarce and probably will soon become extinct. It is a very interesting genus and is much sought for by cactus students and fanciers.

Neobesseya missouriensis has its type localty in Missouri as the species name would indicate. Britton and Rose make the following remarks in "The Cactaceae," Vol. IV.

'This little cactus has a wide distribution on the Great Plains; both its conspicuous yellow flowers and its round red fruits are very attractive.'

It is not generally known in Texas, being confined to the northern part of the State.

Description:—Plants solitary or cespitose, globose, 2.5 to 5 cm. in diameter; tubercles more or less spiraled, 10 to 15 mm. long; spines 10 to 20, acicular, gray, pubescent, all radial or sometimes 1 central; flowers greenish yellow; outer perianth-segments narrowly oblong, gradually tapering to an acute apex, ciliate; inner segments linear-lanceolate, attenuate; fruit globose, scarlet, about 1 cm. in diameter; seeds 1 mm. in diaeter.

Type locality:—On the high hills of the Missouri, probably to the mountains.

Distribution:—North Dakota to Montana, Colorado to Kansas Oklahoma, and northern Texas.

Synonymy: — Neobesseya missouriensis (Sweet) Britton and Rose. Cact. 4:53. 1923.

Cactus mammillaris Nuttall, Gen. Pl. 1:295. 1818. Not Linnaeus, 1753.

Mammillaria missouriensis Sweet, Hort. Brit. 171. 1826.

Mammillaria simplex Torrey and Gray, Fl. N. Amer. 1:553. 1840.

Mammillaria nuttallii Engelmann, Pl. Fendl. 49. 1849.

Mammillaria nuttallii borealis Engelmann, Proc. Amer. Acad. 3:264. 1856.

Cactus missouriensis Kuntze, Rev. Gen. Pl. 1:259. 1891.

Mammillaria missouriensis nuttallii Schelle, Handb. Kakteenk. 241. 1907.

Coryphantha missouriensis Britton and Rose in Britton and Brown, Illustr. Fl. ed. 2. 2:570. 1913.

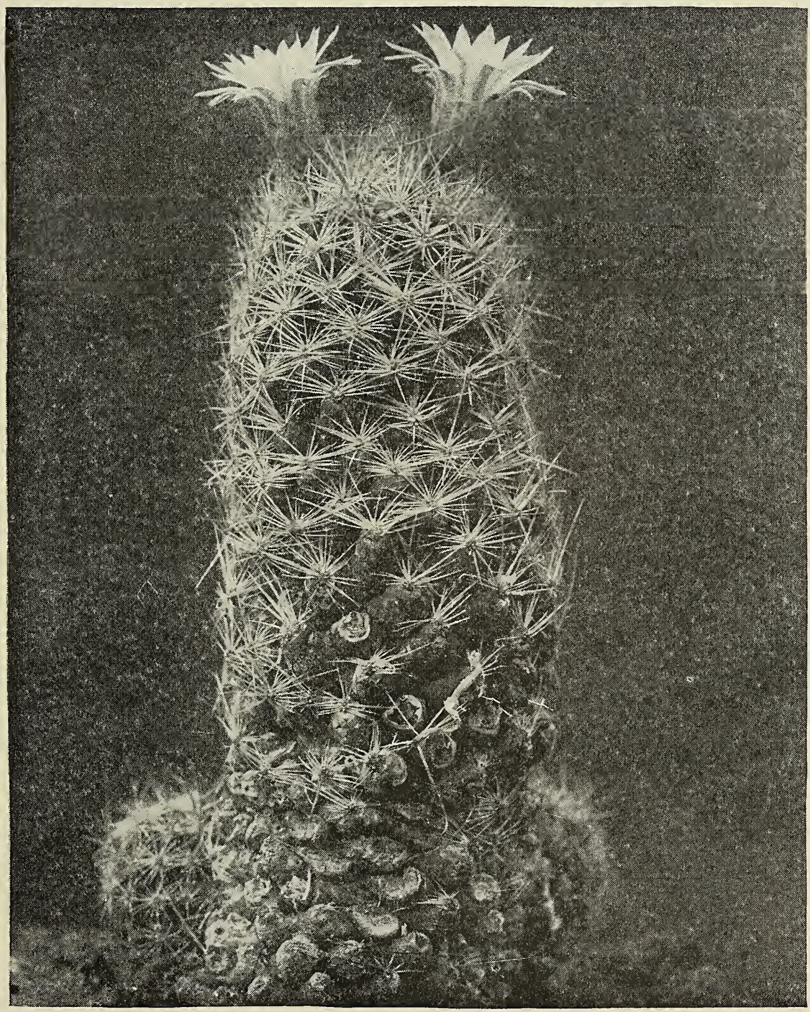
ESCOBARIA TUBERCULOSA

Eight species make up the *Escobaria* group, with about half the number native to Texas. The genus was named for the Escobar Brothers, both distinguished Mexican cactus students. The genus was formerly known as *Mammillaria*.

The stems are small, globose or cylindric, single or caespitose, never milky. The roots are always fibrous. The tubercles are spiny, but the spines are never hooked. The flowers are pink or yellowish, and appear at the bottom of the groove of the youngest tubercles (which are at the top of the plant). The flowers appear early in the spring.

Escobaria tuberculosa is one of the largest species of the genus.

It is native to southwest Texas, New Mexico, and adjacent Mexico. The stems are single or branched, 3 to 6 inches high, usually cylindric. The tubercles are spiraled and spiny towards the top of the plant. The spines are white or grayish, falling from the older tubercles, and leaving them "necked" toward the base of the plant. The flowers are pink, about one inch across. The petals are pointed and in two rows. The stamens and pistil are of a



Escobaria tuberculosa

Easily distinguished from other members of the genus by the delicate white spines. Older plants lose their spines on the bottom tubercles.

cream color. The blossoms open late in the day (about two o'clock), and close at sundown.

The plant is easily distinguished from the other members of this genus by the white and delicate spines. Older plants lose their spines on the bottom tubercles, thus producing a corky and woody base.

Description:—Usually growing in clumps, cylindric or becoming so, 5 to 18 cm. high, 2 to 6 cm. in diameter; tubercles more or less regularly arranged in spirals, 6 mm. long; radial spines numerous, white, sometimes as many as 30, acicular, 4 to 15 mm. long; central spines several, stouter than radials, brown to blackish or colored only at tips, one of them usually porrect; flowers 2.5 cm. in diameter when fully expanded, light pink; outer perianth-segments acute, ciliate; inner perianth-segments narrowly pointed; fruit oblong, up to 20 mm. long, red; seeds pitted, with a small ventral hilum.

Type locality:—Mountains near El Paso and eastward.

Distribution:—Southwestern Texas, southern New Mexico and adjacent Mexico. Common throughout the Big Bend District of Texas. (Sanderson, Marathon, Alpine south to the Rio Grande).

Synonymy:—Mammillaria strobiliformis Scheer in Salm-Dyck, Cact. Hort. Dyck. 1849. 104. 1850. Not Engelmann, 1848.

Echinocactus strobiliformis Poselger, Allg. Gartenz, 21:107. 1853.

Mammillaria tuberculosa Engelmann, Proc. Amer. Acad. 3:268. 1856.

Cactus tuberculosus Kuntze, Rev. Gen. Pl. 1:261. 1891.

Cactus strobiliformis Kuntze, Rev. Gen. Pl. 1:261. 1891.

Mammillaria strobiliformis pebescens Quehl, Monatsschr. Kakteenk. 17:87. 1907.

Mammillaria strobiliformis durispina Quehl, Monatsschr. Kakteenk. 17:87. 1907.

Mammillaria strobiliformis rufispina Quehl, Monatsschr. Kakteenk. 17:87. 1907.

Mammillaria strobiliformis caespititia Quehl, Monatsschr, Kakteenk. 19:173. 1909.

Escobaria tuberculosa (Engelmann) Britton and Rose, Cact. 4:54. 1923.

ESCOBARIA DASYACANTHA

Escobaria dasyacantha so closely resembles *Escobaria tuberculosa* in general appearance that it is often mistaken for it. The seeds are different, and the plant is always globose or nearly so. The spines on the lower tubercles of the older plants do not usually fall off; thus avoiding the "necked" appearance of *Escobaria tuberculosa*.

It probably runs into the first species and for that reason is difficult to identify except in its extreme form.

The stems are globose to short oblong. The tubercles are tipped with about twenty white radial spines, and about eight (more or less) stout, reddish or brownish, central spines. The flowers are pinkish or nearly the same color as those in *Escobaria tuberculosa*. Mr. William Hess adds: — "The flowers of this species open in the morning and close about 3 or 4 o'clock in the afternoon, and are of a deeper rose pink than *E. tuberculosa*."

Escobaria dasyacantha is a west Texas species.

Description:—Globose to short-oblong, usually 4 to 7 cm. in diameter but sometimes 20 cm. long; radial spines 20 or more, white, bristle-like; central spines about 9, stouter and longer than the radials, upper half usually reddish or brownish, often 2 cm. long; flowers pinkish; perianth-segments narrowly oblong, ciliate, apiculate; stigma-lobes green; fruit clavate, scarlet, 15 to 20 mm. long; seeds black, 1 mm. in diameter, slightly flattened, pitted, with a narrow white subbasal hilum.

Type locality:—El Paso and eastward.

Distribution: — Western Texas, southern New Mexico, and northern Chihuahua, Mexico.

Synonymy: — Mammillaria dasyacantha Engelmann, Proc. Amer. Acad. 3:268. 1856.

Cactus dasyacanthus Kuntze, Rev. Gen. Pl. 1:259. 1891.

Escobaria dasyacantha (Engelmann) Britton and Rose, Cact. 4:55. 1923.

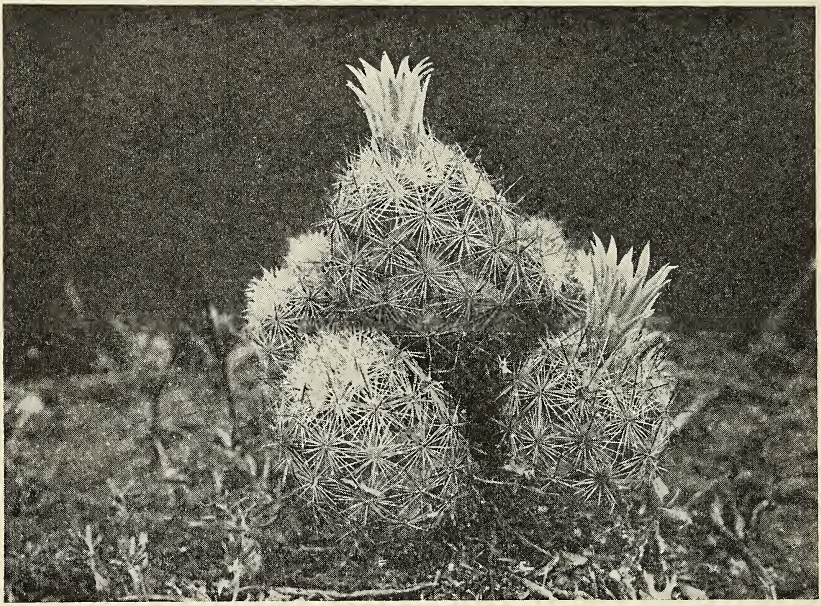
RUNYON'S ESCOBARIA—Escobaria runyonii

Owing to the fact that this little cactus has a wide distribution, it is strange that it had never been collected until 1921. On the Texas side of the Rio Grande, it extends from Hidalgo County to the Devil's River and probably farther west. In Mexico it extends as far south as Victoria, Tamps., Mexico.

On first acquaintance it is easily mistaken for *Neomammillaria multiceps*, which it resembles in size, color of spines, flower and fruit. This similarity explains why it was formerly collected and sold as the above mentioned *Neomammillaria*. But it does not have the fine woolly hairs of *Neomammillaria multiceps;* instead, it has brown spines and is more oblong and higher.

The stems are single or cespitose, and vary from one to four inches in height. They average from a dozen to 100 heads in each cluster. The stems are erect, the brown central spines pointing mostly upward. The plant blossoms from the top of the stem and never from the base of the tubercles as in *Neomamillaria multiceps*. The flowers are yellowish. The fruit is bright red and oblong to club-shaped.

The roots are fibrous and spread in all directions near the



RUNYON'S ESCOBARIA

First discovered in 1921 by the author for whom it is named. The flowers are small and cream-yellow, and the fruits scarlet and oblong.

surface of the earth. The plants bloom very early in the Spring, beginning about February and finishing in May. They do well in cultivation.

Mr. William Hess adds this valuable observation:—"There are two forms. One has brown colored spines, the other white."

Description:—Cespitose, with numerous (sometimes 100) globose to short-oblong heads, grayish green, 3 to 5 cm. long with fibrous roots; tubercles 5 mm. long, terete in section with very narrow groove above; groove at first white-woolly, not glandular; radial spines numerous, acicular, white, 4 to 5 mm. long; central spines stouter than radials, 5 to 7, slightly spreading with brown or black tips, 6 to 8 mm. long; flowers 1.5 cm. long, pale purple; segments with a dark purple stripe down the middle and pale margins; outer perianth-segments narrow-oblong, with thin ciliate margins; innre perianth-segments narrower than outer, with margins entire, acute; filaments purplish; style very pale; stigma-lobes 6, green; fruit scarlet, globose to short-oblong, 6 to 9 mm. long, juicy.

Type locality:—Reynosa, Mexico and Starr County, Texas.

Synonymy:—Escobaria runyonii. Britton and Rose. Cact. 4:55. 1923.

ESCOBARIA SNEEDII

This is a newly described species. The original description appears in The Cactaceae by Britton and Rose. It is a small, densely cespitose species indigenous to western Texas.

The stems are jointed or branched, forming masses that spread out over the ground. It is very rare and to date is reported only from the Franklin Mountains. The flowers are described by Mrs. Hugh Slater of El Paso as pink to saffron.

The tubercles are numerous, terete, and hidden beneath the many spines which cover the plant.

Description:—Densely cespitose, sometimes with as many as 50 joints, creeping or spreading; joints cylindric, up to 6 cm. long, 1 to 2 cm. in diameter; tubercles numerous, hidden under the many spines, terete, 2 to 3 mm. long, in age naked; groove narrow, hairy throughout its length; axils of tubercles not setose; spines 20 in a cluster or more, nearly white, or the large ones brown at tip, longest one 6 mm. long, all usually appressed, but the longer ones near top, connivent; flowers small, 10 mm. long or less when dry, the outer segments long-ciliate; fruit (immature) a little longer than thick, 5 to 7 cm. long, green (?), at first juicy, naked; seeds globose, brown, nearly 1 mm. in diameter, pitted.

Type locality:—Franklin Mountains.

Synonymy:—Escobaria sneedii. Britton and Rose. Cact. 4:-56. 1923.

NIPPLE CACTUS—Dolichothele sphaerica

This is the famous *Mammillaria sphaerica,* as known by cactus collectors, and is one of the most interesting plants in this region. It has a very wide distribution, ranging from Corpus Christi as far north or farther than Live Oak County, as far south as Victoria, Tamps., Mexico, and along the Rio Grande westward to probably the Devil's River. Three species make up the genus; only one is native to Texas. It was originally treated as a *Mammillaria* but differs from that genus by the large sulphur yellow flowers and the large green fruit.

The stems are low and depressed, single or in large cespitose masses or clumps. The tubercles are long and tender, green, and bear spines on the tip of each tubercle. The flowers are very showy, large for the size of the plant, lemon yellow. They open

DOLICHOTHELE SPHAERICA

One of the most attractive cacti for blossoms. The flowers are large and sulphur yellow, with the stamens spiralled around the ten-rayed stigma.

in bright sunlight, and close in the late afternoon. The blossoms last about three consecutive days. Sometimes as many as twenty-five flowers on a single cluster open at one time, completely covering the plant, and giving off a fragrance comparable with a field of honey daisies. The blossoms appear from May to August. The roots are very large, fleshy, thick, succulent, and very much like the root of *Ancistrocactus sheerii.* The flowers and fruit are produced at the base of the tubercles as in the *Mammillarias.*

The fruit is dark green and does not ripen until several months after the flowers have gone. They are fragrant and juicy.

This cactus does well in cultivation, and will stand cold weather without injury.

Description: — Low and depressed, often growing in large cespitose masses 2 dm. in diameter, with a large thickened root; tubercles soft and turgid, resembling those of the following species (D. longimamma) but shorter, 12 to 16 mm. long; areoles small, circular, at first short-lanate; spines 12 to 15, glabrous, generally pale yellow, a little darker at base at first, in age darker, often reddish, 7 to 9 mm. long, spreading or a little curved backward; central spine 1, straight; flowers appearing toward top of plant but not from axils of younger tubercles, with a rotate limb 6 to 7 cm. broad; inner perianth-segments widely spreading, oblanceolate, acute to apiculate, tapering at base into a slender claw; stigma-lobes 8, yellow, narrow; fruit greenish white to purplish, short-oblong, 10 to 15 mm. long, juicy, very fragrant; seeds black, flattened, with a straight ventral face, rounded on the back, pitted; hilum subventral.

Type locality:—Near Corpus Christi, Texas.

Distribution:—Southern Texas and northern Mexico, especially along the Rio Grande from Eagle Pass to the sea.

Synonymy:—Mammillaria sphaerica Dietrich in Poselger, Allg. Gartenz. 21:94. 1853.

Cactus sphaericus Kuntze, Rev. Gen. Pl. 1:261. 1891.

Mammillaria longimamma sphaerica K. Brandegee, Cycl. Amer. Hort. Bailey, 2:975. 1900.

Dolichothele sphaerica (Dietrich) Britton and Rose, Cact. 4:-61. 1923.

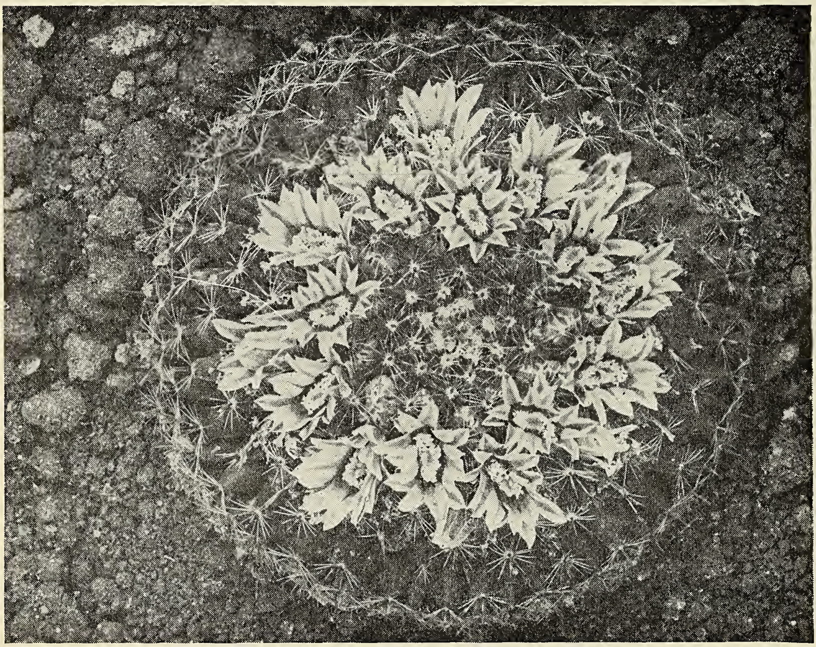
HEMISPHERE CACTUS—Pichilinga
Neomammillaria hemisphaerica

This little plant was first collected near Matamoros, Mexico, and is very abundant in the Lower Rio Grande Valley. It is at home in most any kind of soil providing the soil is well drained.

It is very closely related to *Neomammillaria heyderi,* if it does not actually run into this species. It is very abundant in certain localities, but otherwise scattered throughout the entire Valley and Northern Mexico.

The plants are dark green, one to two inches high, and about two to five inches in diameter, low, half sphere-shaped, covered with nipples. The nipples bear spines at the tips.

The flowers are medium in size, about half an inch across, yellowish to brownish, tinted with red. The plants bloom very early in the spring, beginning in February and ending about May. The flowers are single or in crowns around the top of the plant. The blossoms come at the base of the tubercles. It is very peculiar in its fruiting. The fruits do not appear for six months to one year after the flowers. Sometimes the fruits produced by previous flowers appear with the new flowers, thus giving the



PIN CUSHION CACTUS—*Neomammillaria hemisphaerica*

Of interest to the observer as the scarlet club-shaped fruits, **"Chilitos"** take from six months to a year to develop, thus often appearing with the next year's flowers.

impression that the fruit ripens immediately after the flowers have gone.

The fruits are bright red, showy, club-shaped, and remain on the plant for two or three weeks. They are called *"Chilitos"* by the Mexicans because they resemble a red pepper indigenous to this region.

The roots are usually taproots, or slightly fibrous, but generally deep seated.

Description:—Deep-seeted in the soil, hemispheric, 8 to 12 cm. broad, dark green; tubercles only slightly angled, not very closely set, 1 to 1.5 cm. long, somewhat pointed, their axils nearly naked in the dormant stages; spine-areoles woolly when young, becoming glabrate in age; radial spines 9 to 13, widely spreading, acicular, the upper ones more delicate, 4 to 8 mm. long, brownish or smoky, often with black tips; cetnral spine solitary, porrect, brown; flowers small, cream-colored, 1 to 1.5 cm. long; inner perianth-segments acute; filaments pinkish; style pinkish; stigma-lobes 6 to 10, greenish yellow; fruit slender, clavate, red, 1 to 1.5 cm. long.
Type locality:—Below Matamoros on the Rio Grande.
Distribution:—Southeastern Texas and northeastern Mexico.

Synonymy: — Neomammillaria hemisphaerica (Engelmann). Britton and Rose. Cact. 4:75. 1923.

Mammillaria hemisphaeric Engelmann in Wislizenus, Mem. Tour. North. Mex. 105. 1848.

Mammillaria heyderi hemisphaerica Engelmann, Proc. Amer. Acad. 3:263. 1856.

Cactus heyderi hemisphaericus Coulter, Contr. U. S. Nat Herb. 3:97. 1895.

Cactus hemisphaericus Small, Fl. Southeast. U. S. 811. 1903.

"BIZNAGA DE CHILILLOS"—Neomammillaria heyderi

Neomammillaria heyderi so closely resembles *Neomammillaria hemisphaerica* that only the close observer notes the difference. *Neomammillaria heyderi* is the flat growing species, and is more concave. It seems to pull itself into the soil. It is not easily seen until one is right on it. In flowers, fruit, and tubercles the two species are almost alike. The rounded top of *Neomammillaria hemisphaerica* and the flat, somewhat concave top of the *heyderi* seem to be the easiest mark of distinction.

Neomammillaria heyderi has the same form as *Neomammillaria applanata* but differs in having the stout spines of *applanata* with a background of white laterals.

Descripion:—Plant globose or somewhat flattened at apex; tubercles conic, 12 mm. long, when young bearing wool in their axils; young spine-areoles white-woolly; radial spines 20 to 22, white, setaceous, the lower ones stouter and longer; central spine solitary, brown at base and apex, 5 to 7 mm. long; flowers pinkish, the segments linear-oblong; fruit oblong, red.
Type locality:—Not cited.
Distribution:—Texas and northern Mexico.

Synonymy:—Neomammillaria heyderi (Muhlenpfordt). Britton and Rose. Cact. 4:75. 1923.

Mammillaria heyderi Muhlenpfordt, Allg. Gartenz. 16:20. 1848.

Cactus heyderi Kuntze, Rev. Gen. Pl. 1:260. 1891.

Mammillaria buchleimeana Quehl, Monatsschr. Kakteenk. 27:-97. 1917.

NEOMAMMILLARIA APPLANATA

Neomammillaria applanata is easily grown. Like all of this new genus, the plants are of the flat cushion-like form. The flowers are white, striped with pink to mauve. Their chief beauty is the bright scarlet fruits that come into full color at about the same time as the flowers. This is due to the fact that the fruit takes a full year to mature after the flowers form.

Neomammillaria applanata is similar to both *Neomammillaria hemisphaerica* and *Neomammillaria heyderi* but the tubercles are more spreading and fewer, and the clusters of spines at the top of each tubercle are stronger and fewer. In number the spines average six instead of twenty. They also lack the background of white laterals. The flowers and fruit are about the same in all species.

All are early blooming species. The flowers may appear as early as February, but the aveage is early in March.

Description: — Plants much flattened; tubercles somewhat angled, their axils naked; radial spines 10 to 18, the radials widely spreading, lower ones darker brown than upper; central spine one, porrect, dark brown; young spine-areoles very woolly; flower-buds pointed, greenish; outer perianth-segments greenish, lanceolate, acuminate margins not ciliate; inner segments 2.5 cm. long, cream-colored, lanceolate, acuminate, with a broad green stripe down the middle; filaments white, shorter than the style; stigma-lobes green; fruit scarlet, naked, 2.5 cm. to 3.5 cm. long; seeds brown.

Synonymy:—Neomammillaria applanata (Engelmann). Britton and Rose. Cact. 4:76. 1923.

Mammillaria applanata Engelmann in Wislizenus, Mem. Tour. North. Mex. 105. 1848.

Mammillaria declivis Dietrich, Allg. Gartenz. 18:235. 1850.

Mammillaria texensis Labouret, Monogr. Cact. 89. 1853.

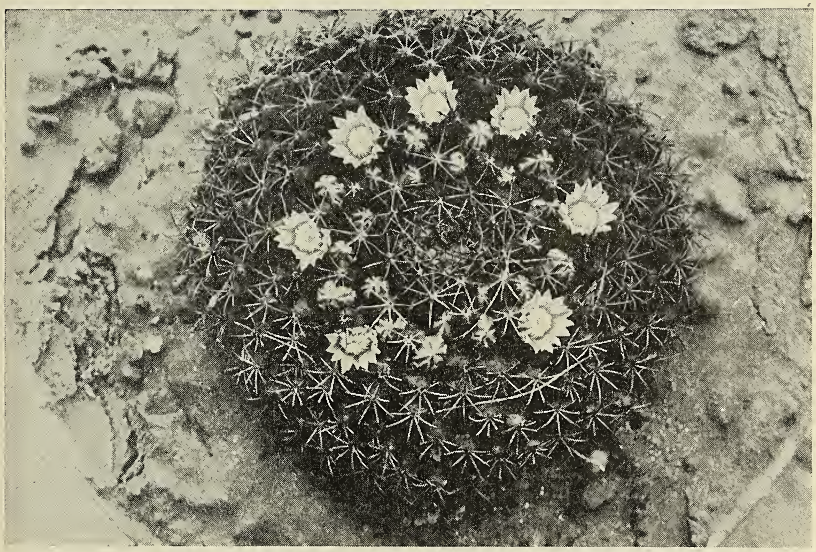
Mammillaria heyderi applanata Engelmann, Proc. Amer. Acad. 3:263. 1856.

Cactus texensis Kuntze, Rev. Gen. Pl. 1:261. 1891.

NEOMAMMILLARIA MEIACANTHA

This species is very closely related to the*Neomammillaria heyderi* group. This difference is best noted in the pyramidal tubercles, and the short spines and fruit. It is also a west Texas species.

The stems are simple, rarely branched, low, nearly flat across the top, and depressed in the center. The tubercles are irregular in shape and usually angled. About seven radial spines and one central spine tip each tubercle. These are grayish to brownish,



Neomammillaria meiacantha

Species similar to the **Neomammillaria heyderi** group but differing in the pyramidal tubercles, d'stinct short spines, and ovoid fruit. A cactus which prefers to remain hidden until one is right on it.

and about one-fourth to three-eighths inches long. The flowers are cream to whitish with a darker stripe on the petals, and about three-fourths of an inch across. The stamens are yellow, and the style light green. The fruit is ovoid, and red when mature.

Mr. William Hess gives the following note:—"We might call this the giant form of *N. heyderi* as to growth, tubercles and fruit except that the color of the fruit of *meiacantha* is a rose red, while the other three species are a brick red."

Description: — Somewhat depressed, 12 cm. broad or more; tubercles milky, bluish green, more or less angled, somewhat flattened dorsally, their axils naked; spines 5 to 9, ascending, pale flesh-colored, the tips darker, the lower a little stouter than the upper; central spines porrect, similar to but a little stouter than radials and often subradial; spine-areoles short-woolly at first; flowers not very abundant, at least on cultivated plants; inner perianth-segments white with a pink sripe along inside of midrib, one-fourth its width, greenish brown on outside; filaments white; style pink; stigma-lobes yellow; fruit scarlet, 22 mm. long; seeds brownish.

Type locality:—Western Texas and New Mexico.

Distribution:—Texas, New Mexico, and northern Mexico.

Synonymy:—Neomammillaria meiacantha (Engelmann). Britton and Rose. Cact. 4:84. 1923.

Mammillaria meiacantha Engelmann, Proc. Amer. Acad. 3:-263. 1856.

Cactus meiacanthus Kuntze, Rev. Gen. Pl. 1:260. 1891.

HAIR-COVERED CACTUS—Neomammillaria multiceps

This is the well known *Mammillaria pusilla* or *Mammillaria texensis* of the Cactus Collector. It prefers mesquite thickets for its home. It is never abundant, but has a wide range of distribution in southern Texas and northeastern Mexico.

The plants are low, single or in dense clumps often producing numerous heads. Individual heads are very small, one-half to one inch across, sometimes a little larger. These often "hump up" into irregular masses. They usually grow so low that they are seen only by accident. They are commonly found in crevices of rocks. Britton and Rose state that they are very plentiful, with a rather wide distribuion, and seem to prefer mesquite thickets where the soil is very rich.

There are two distinct varieties. The most common has brown spines. The other has gray or nearly white spines. The flowers and fruit of the two varieties are very much alike. The cactus appears woolly all over due to the abundance of small fine hairs underneath the spines.

The flowers are medium in size (for this genus), being about one-half inch across, and yellowish. They open in bright sunlight about noon, and close late in the afternoon. The blossoms last two or three consecutive days. The plant blooms in early spring, usually during February, March, and April. The fruit appears in late summer. The fruits are red, oblong, or club-shaped. The roots are small taproots, or fibrous.

This cactus does well in cultivation if kept from excessive moisture.

Description:— Cespitose, often forming large clumps; separate plants globose to short-oblong, often only 1 to 2 cm. in diameter; tubercles small, terete, hairy in their axils; radial spines hair-like, white; central spines several, pubescent, yellowish at base, dark brown above; flowers about 12 mm. long, whitish to yellowish salmon, often becoming reddish on outside; fruit oblong, 8 to 12 mm. long, scarlet; seeds black, 1 mm. long, punctate.

Type locality:—Not cited.

Distribution:—Texas and northeastern Mexico.

Synonymy:—Neomammillaria multiceps (Salm-Dyck). Britton and Rose. Cact. 4:125. 1923.

Mammillaria multiceps Salm-Dyck, Cact. Hort. Dyck. 1849. 81. 1850.

Mammillaria multiceps elongata Meinshausen, Wochenschr. Gartn. Pflanz. 1:27. 1858.

Mammillaria multiceps grisea Meinshausen, Wochenschr. Gartn. Pflanz. 1:27. 1858.

Mammillaria multiceps humilis Meinshausen, Wochenschr, Gartn. Pflanz. 1:27. 1858.

Mammillaria multiceps perpusilla Meinshausen, Wochenschr. Gartn. Pflanz. 1:27. 1858.

Mammillaria pusilla texana Engelmann, Cact. Mex. Bound. 5. 1859.

Mammillaria texana Poselger in Young, Fl. Texas. 279. 1873.

Cactus multiceps Kuntze, Rev. Gen. Pl. 1:260. 1891.

Cactus stellatus texanus Coulter, Contr. U. S. Nat. Herb. 3:-108. 1894.

Cactus texanus Small, Fl. Southeast. U. S. 812. 1903.

NEOMAMMILLARIA LASIACANTHA

This is a western Texas species with a range of distribution throughout southwest Texas, New Mexico, and adjacent parts of Mexico.

The plant is very small and covered with small tubercles, each tipped with forty to sixty white spines. This abundance of spines completely covers the plant and gives it a snowy white appearance.

The flowers are small, whitish or pinkish, usually opening near the middle of March. The blossoms open about 10 in the morning and close in the early afternoon. Being very sensitive to darkness, they often start to close when a large dark cloud covers the sun's disk.

This cactus is very closely related to the next species. In fact the two may not be distinct species. The spines in this species are hairy as the name signifies.

Description:—Globose, 2 to 2.5 cm. in diameter; tubercles small, their axils naked; spines 40 to 60, in more than one series, white, puberulent, 2 to 4 mm. long; flowers 12 mm. long, whitish or pink; fruit 1 to 2 cm. long; seeds blackish, pitted.
Type locality:—On the Pecos in western Texas.
Distribution:—Western Texas and northern Chihuahua, Mex.

Synonymy:—Neomammillaria lasiacantha (Engelmann) Britton and Rose. Cact. 4:128. 1923.
Mammillaria lasiacantha Engelmann, Proc. Amer. Acad. 3:261. 1856.
Mammillaria lasiacantha minor Engelmann, Cact. Mex. Bound. 5. 1859.
Cactus lasiacanthus Kuntze, Rev. Gen. Pl. 1:259. 1891.

NEOMAMMILLARIA DENUDATA

This species is very closely related to *Neomammillaria lasiacantha.* The resemblance is so strong that *Neomammillaria denudata* is often mistaken for it. *Neomammillaria denudata* is a very small, white spined cactus, with western Texas and adjacent Mexico as its range of distribution.

The stems are single or in clusters. The tubercles are small and completely covered with the spines they bear. The spine clusters sometimes equal eighty in number. The flowers open about March 15. Like most other cacti the blossoms open in bright sunlight and close late in the afternoon for three or more consecutive days. The flowers are one-half inch across, cream colored, with a brownish stripe on the inside of the perianth-segments. The stamens are yellow, the style greenish.

It is a very attractive and peculiar species in that it produces its flowers from near the center of the top of the stem and not from the new growth of the tubercles.

Mr. William Hess makes this comparison with the foregoing species:—"This is a larger form of *N. lasiacantha* as to flower and size. The spines are almost hairless."

Description:—Globose, 2.5 to 3.5 cm. in diameter; tubercles 5 to 6 mm. long; spines 50 to 80, glabrous or nearly so, 3 to 5 mm. long, the innermost usually much shorter; flowers and fruit from near the center but not from the axils of young tubercles; flowers 10 to 12 mm. long; perianth-segments few, about 12, oblong, obtuse, the margins white, the center light purple; stamens white; style and stigma-lobes green; fruit clavate, red, 1.5 to 2 cm. long; seeds black with basal hilum.

Type locality:—Western Texas.

Distribution:—Western Texas and northern Coahuila, Mexico.

NEOMAMMILLARIA DENUDATA

A pigmy among cacti, being only one to two inches in diameter. The flowers are large for its size, white with light purple centers and white stamens. The brilliant red fruits are equally attractive.

Synonymy:—Neomammillaria denudata (Engelmann) Britton and Rose. Cact. 4:129. 1923.

Mammillaria lasiacantha denudata Engelmann, Cact. Mex. Bound. 5. 1859.

Cactus lasiacanthus denudatus Coulter, Contr. U. S. Nat. Herb. 3:100. 1894.

Mammillaria lasiandra denudata Quehl, Monatsschr. Kakteenk. 19:79. 1909.

NEOMAMMILLARIA POTTSII

Neomammillaria pottsii is usually known as *Mammillaria leona* in cactus collections. It is a cylindric form extending into the Big

Bend Country from Mexico. The stems are single or cespitose. The individual plants are cylindric, and covered with whitish or grayish spines that almost hide the tubercles. The radials are about thirty in number and rather weak. The centrals vary from six to a dozen, and are strong, straight or nearly so. The flowers are small, purple, and borne in a circle just below the top of the plant. It is a very attractive plant and fairly abundant throughout its range.

Description: — More or less cespitose, the individual plants cylindric, 12 cm. long or more; tubercles almost hidden by the spines; radial spines about 30, white, weak, short; central spines 6 to 12, much stouter and longer, more or less ascending, grayish with brown tips; axils of tubercles woolly; flowers borne in a circle about 2 cm. below top of plant, about 1 cm. long; inner perianth-segments light purple, somewhat spreading at tip, acute; stamens pale, much shorter than the style, purplish above; stigma-lobes narrow; fruit red, clavate; seeds blackish brown, the surface deeply pitted.

Type locality:—Not cited.

Distribution:—In the highlands of the Rio Grande, Texas; Nuevo Leon and Coahuila to Chihuahua and Zacatecas, Mexico.

Synonymy: — Neomammillaria pottsii (Scheer) Britton and Rose. Cact. 4:136. 1923.

Mammillaria pottsii Scheer in Salm-Dyck, Cact. Hort. Dyck. 1849. 104. 1850.

Mammillaria leona Poselger, Allg. Gartenz. 21:94. 1853.

Echinocactus pottsianus Poselger, Allg. Gartenz. 21:107. 1853.

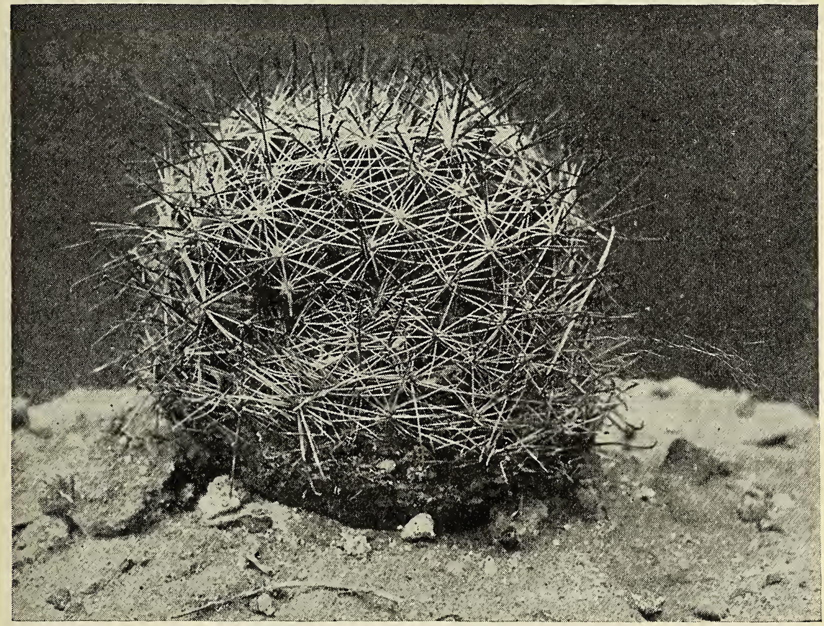
Cactus pottsii Kuntze, Rev. Gen. Pl. 1:261. 1891.

NEOMAMMILLARIA WRIGHTII

This is an extremely rare *Mammillaria* and seems to be on the verge of extinction. It enters Texas near El Paso and on the Upper Pecos, from New Mexico. A splendid drawing of this plant showing the fruit is given in the Mexican Boundary Survey.

The stems are simple, globose or short cylindrical, with an almost flat top. They are two to three inches high, or slightly higher when old. The tubercles are rather crowded, flabby, dark green, tipped with about twenty spines. Each cluster consists of about sixteen radials and two to four centrals. The radials are cream or nearly white in color, spreading and interlacing. The centrals are red or dark red, two or three hooked and one straight, sometimes all hooked, the hooks turned up or down. The fruit is ovoid, reddish when ripe, three-fourths inch long, three-eights inch in diameter. It is rather unusual in shape for the *Mammillaria* group, and stays on all winter.

Description:—Depressed-globose, simple; tubercles terete, 10 to 12 mm. long, with naked axils; radial spines 8 to 15, white, spreading, acicular; central spines 1 to 3, stouter than the radials, brown to black, 1 or sometimes 2 or 3 hooked at apex; flowers large, 25 mm. long and as broad as long when expanded; outer segments about 13, triangular-obtuse, fimbriate; inner perianth-segments



NEOMAMMILLARIA WRIGHTI

A very rare cactus in collections and rare in the open. It was named in honor of Charles Wright who explored extensively in Texas and Cuba.

bright purple; fruit obovoid, large, 25 mm. long, purple; seeds 15 mm. long, black, with a narrow ventral hilum.

Type locality:—Anton Chico on the Pecos east of Santa Fé, New Mexico.

Distribution:—Mountains of northeastern New Mexico.

Synonymy: — Neomammillaria wrightii (Engelmann) Britton and Rose. Cact. 4:152. 1923.

Mammillaria wrightii Engelmann, Proc. Amer. Acad. 3:262. 1856.

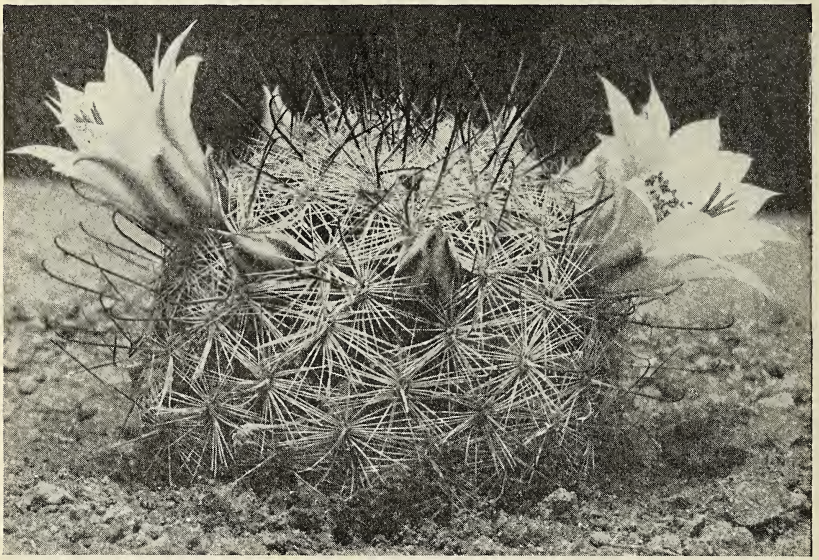
Cactus wrightii Kuntze, Rev. Gen. Pl. 1:261. 1891.

NEOMAMMILLARIA MICROCARPA

This is the well known *Mammillaria grahamii* among cactus collectors and fanciers. It has been known so long under that name that many refuse to call it anything else. It is a hooked-spine species. Often the hooks hold so fast that the plant is jerked from its moorings by passing animals.

It has a wide range of distribution throughout the desert region of west Texas.

The stems are simple or branched, globose to cylindrical, ces-

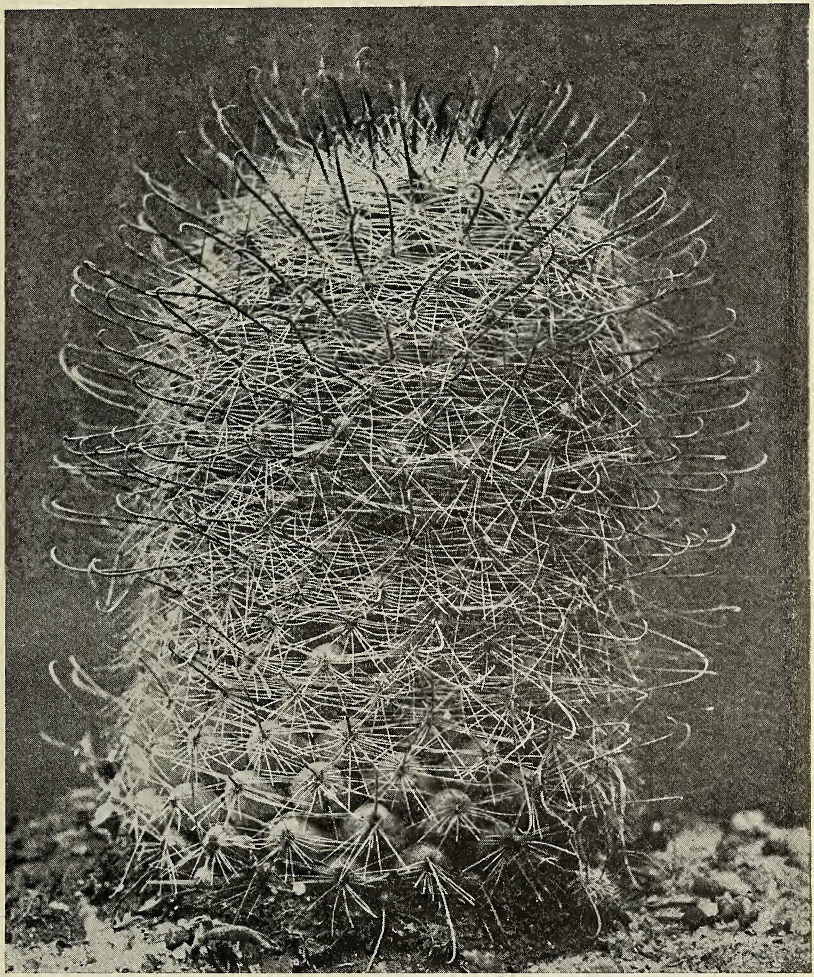


MAMMILLARIA GRAHAMII

pitose. The tubercles are small. The radial spines are about fifteen to thirty in number, spreading, cream-colored, darker or reddish towards the tip. The central spines are one to three in number, stout, dark or reddish brown.

The flowers are pinkish to purplish near the top of the plant, opening in strong sunlight about ten in the morning and closing in the afternoon for two or three consecutive days.

Description:—Globose to cylindric, simple or budding either at base or near middle, often cespitose, but in small clusters, sometimes 8 cm. high; tubercles small, corky when old; axils of tubercles naked; radial spines 15 to 30, spreading, white, sometimes with dark tips, slender, rigid, glabrous, 6 to 12 mm. long; central spines 1 to 3, dark, when more than one the lower stouter, often 18 mm. long, hooked; flowers from near top of plant, 2 to 2.5 cm. long, broadly funnel-shaped; outer perianth-segments ovate, ob-



NEOMAMMILLARIA MICROCARPA

An attractive species of wide distribution. It is easily distinguished by the numerous soft white spreading radials and the hooked central spine. The flowers are pale rose to purplish with paler margins.

tuse, short-ciliate; inner perianth-segments purplish, sometimes with whitish margins, obovate, acuminate; style longer than stamens, purplish; stigma-lobes 7 or 8, linear, green; fruit clavate, 2 to 2.5 cm. long, scarlet; seeds black, shining, pitted globose, 0.8 to 1 mm. in diameter.

Type locality:—"On the Gila 3,000 to 4,000 feet above the sea."

Distribution:—Southwestern Texas and Chihuahua to Arizona and Sonora; recorded from southern California and southern Utah.

Synonymy:—Neomammillaria microacrpa (Engelmann) Britton and Rose. Cact. 4:155. 1923.

Mammillaria microcarpa Engelmann in Emory, Mil. Reconn. 157. 1848.

Mammillaria grahamii Engelmann, Proc. Amer. Acad. 3:262. 1856.

Cactus grahamii Kuntze, Rev. Gen. Pl. 1:260. 1891.

Mammillaria grahamii arizonica Quehl. Monatsschr. Kakteenk. 6:44. 1896.

Coryphantha grahamii Rydberg, Fl. Rocky Mountains 581. 1917.

Echinocereus pentalophus
The flowers are large, pink to purplish, with paler centers.

Bibliography

1.—Books and Bulletins

Blühende Kakteen.—3 Vols. 180 colored plates. By Dr. Max Gürke, Dr. Karl Schumann, and Dr. F. Vaupel. 1900-1921.

Cactaceae, The.—4 Vols. Many colored plates. By Britton and Rose. The latest monograph of Cacti as published by Carnegie Institution of Washington.

Cacteae in Horto Dyckensi Cultae.—266 pages. 1849. By Jos. Salm-Dyck.

Cactaceae of Northeastern and Central Mexico,—together with a Synopsis of the principal Mexican Genera. By William Edward Safford. 1909.

Cacti in New Mexico.—By E. O. Wooten. 1911. Bulletin No. 78, New Mexico College of Agriculture and Mechanic Arts.

Cactus Culture for Amateurs.—By William Watson. London. 135 pages. First edition 1889, now in fourth edition.

Experiments on the Digestibility of Prickly Pear by Cattle.—By R. F. Hare. 1908. Bulletin No. 69, New Mexico College of Agriculture and Mechanic Arts.

Ornamental Cacti, their Culture and Decorative Value. — By Charles Henry Thompson. 1912. Bureau of Plant Industry Bulletin No. 262.

Peyote.—An Abridged Compilation from the Files of the Bureau of Indian Affairs. By Dr. Robert E. L. Newberne.

Prickly Pear and other Cacti as a Food for Stock.—By David Griffiths and R. F. Hare. Bulletin No. 60, New Mexico College of Agriculture and Mechanic Arts.

The Prickly Pear as a Farm Crop. — By David Griffiths. Bureau of Plant Industry, Bulletin No. 124, 1908.

The Thornless Prickly Pear. — By David Griffiths. Farmers Bulletin No. 483. 1912.

Cacti. — By David Griffiths and Charles Henry Thompson. Circular No. 66. U. S. Dept. of Agriculture. Price 25c. 1929 ed.

In Quest of Lost Cacti. — By John K. Small. Journ. of N. Y. Bot. Garden 21:161-178. Sept. 1920.

The Cacti.—An interesting plant group in the Study of Survival, John K. Small. Jour. of N. Y. Bot. Garden. 25:197-201. 1924.

The Tuna as a Food for Man. — By R. F. Hare and David Griffiths. Bulletin No. 64, New Mexico College of Agriculture and Mechanic Arts, 1907.

Behavior under Cultural Conditions, of Species of Cacti known as Opuntia. — By David Griffiths, 1913. Bulletin of the Department of Agriculture, No. 31.

Handbuch der Cacteenkunde. — By Carl Friedrich Forster, 1886. 1029 pages with many illustrations. Leipzig.

Monographie de la Famille es Cactées. — 674 pages. By J. Labouret. Paris, 1853.

Reports of Explorations and Surveys for a Railroad from the Mississippi River to the Pacific Ocean. Cactaceae.—By George Engelmann and Dr. John M. Bigelow. Vol. 4, 1853-54.

Mexican Boundary Survey.—Volume 2, Part 1, 1859. Cactaceae by Dr. George Engelmann.

Preliminary revision of the North American Species of Echinocactus, Cereus and Opuntia.—By John M. Coulter. Contributions from the United States National Herbarium, Vol. III, No. 7, 1896.

The principal Cactus Insects of the United States.—By W. D. Hunter, F. C. Pratt and J. D. Mitchell. Bureau of Entomology, Bulletin 113. 1912.

Les Cactées, Les Plantes grasses autres que les Cactées.—Lemaire (C.) Paris, 1868.

Gesamtbeschreibung der Kakteen.—By Karl Schumann, reprinted 1296. Neudamn. This is Schumann's Monograph of Cactaceae, published several years ago.

II.—Articles appearing in Magazines.

Notes on California Cacti.—By A. H. Alverson. Cact. Journ. I. 20-21, 1898.

Raising Cacti and Succulent from Seed.—Cact. Journ. I. 18-19. 1898.

Opuntia macrorhiza.—Addisonia: 37. 1926. Pub. by New York Botanical Gardens.

Hybridizing Cacti and Succulents.—Cact. Journ. I: 40-41. 1898.

Cacti in the Vicinity of Field Creek, Texas.—By E. R. Behrens, Cact. Journ. II: 171. 1899.

Culture of Stapelias—By George H. Bourne. Cact. Journ. I: 23-24. 1898.

Twenty Minutes with the Phyllocactus—Cact. Journ. I: 37-38. 1898.

Studies in Cactaceae.—By Britton and J. N. Rose. Contri. U. S. Nat'l. Herb. 16: 239-242. 1912-16.

The Cacti of Trinidad.—By N. L. Britton. Bulletin Dept. Agric. Trinidad and Tobago 192: 81-87. 1921.

The Genus Epiphyllum and its Allies.—by N. L. Britton and J. N. Rose. Contri. U. S. Natl. Herb. 16:255-262. 1912-16.

A Preliminary Treatment of the Opuntoideae of North America. — Smithsonian Misc. Coll. 50, Pt. 4.

Cactaceous Plants.—By Lewis Castle. Horticultural Press, 1884. London.

On the Structure of Epiphyllum truncatum.—By F. J. Chittenden Cact. Journ. I: 34-36. 1898.

The Protective Devices of Succulents.—By Fred J. Chittenden. Cact. Journ. I: 3-4. 1898.

The Structure of Cereus.—Cact. Journ. I: 82-83. 1898.

A Few Remarks on Haworthias.—By Thomas Cooper. Cact. Journ. 1: 39-40. 1898.

A Few Remarks on Aloes and Gasterias.—Cact. Journ. I: 50-51. 1898.

Opuntia vulgaris and rafinesqui.—By J. M. Coulter. Bot. Gaz. I: 47. 1876.

My Conception of Opuntia macrorhiza Engelm.—By David Griffiths. Plant World 19: 141-144. 1916.

Conduction in Cactaceae and some other Desert Plants.—By Ansel F. Heiemwau, Univ. of Arizona.

Las Cactaceae de los Alrededores de Zapallar.—By Federico Johow. Rev. Chilena His. Nat. 25: 152-166. 1921.

A Monstrous Opuntia.—By Eleanor M. Lucas. Cact. Journ. II: 2-3. 1899.

Origin and Nature of Mucilage in Cacti and Certain other Plants. — By Francis E. Lloyd.

Some Morphological Relationships of the Cactaceae.—By C. F. Maxwell. Transactions of the Texas Academy of Science. Vol. L. No. 3, 1894.

On the Characters of Species in Cacti.—By Thomas Meehan. Bot. Gaz. 11: 117-118. 1886.

Las Cactaceas de Mendoza.—By Renato Sanzin. Rev. Chilena Hist. Nat. 25: 96-119. 1921.

The Jointed Cactus.—By S. Schonland. Journ. Dept. Agric. Union South Africa 9: 216-225. 1924.

Gesamtbeschreibung der Kakteen.—By Prof. Dr. Karl Schumann.

Opuntia macrorhiza, Large Rooted Prickly Pear.—Addisonia, Plate 19, Page 37. Volume 1, 1916.

Nuevas Notas cactologicts.—By Carlow Spegazzini. Anal. Soc. Cien. Argentina 99: 85-156. 1925.

Die Kakteen in den Steppen des Sudwestliches Nordamerika.—By J. C. Th. Uphof. Gartenwelt 28: 36, 107-108. 1924.

How to Treat Imported Cacti.—By F. A. Walton. Cact. Journ. II, 84. 1898.

Stapelia gigantia.—By C. F. Wood. Cact. Journ. I: 23. 1898.

Hamatocactus setispinus, Twisted-Rib Cactus.—By J. N. Rose. Addisonia, Vol. 8, plate 279, page 45. 1923.

Journal of the Cactus and Succulent Society of America.—1800 Marengo St., Los Angeles, California. The first number appeared July, 1929. The best current cactus magazine on the market.

Glossary

ACANTHOCLADOUS—Having spiny branches.
ACUMINATE—Ending in a tapering point.
ABORTION—Imperfect development or non-development of an organ.
ACANTHOPHOROUS—Spine bearing.
ACEROSE—Needle shaped.
ACICULAR—Bristle-shaped or slender needle-shaped.
ACUTE—Terminating in an acute angle.
ANNULATE—Marked with rings.
ANTRORSE—Directed upward or forward.
APICULATE—Ending in a short pointed tip.
APPRESSED—Lying flat against or together for the whole length.
AROELE—Space marked out on a surface as by the reticulation of veins. Plural—Areolae.
ATTENUATE—Slenderly tapering, or narrow.
AXIL—The angle formed on the upper side of the attachment of a leaf with the stem.
BULBOUS—An underground port'on shaped like an onion bulp.
CADUCOUS—Dropping off very early, as the calyx of a poppy at the time of expansion.
CAESPITOSE—Near or just above the surface of the ground.
CAMPANULATE—Bell-shaped; elongated cup shaped or shorter, and broad from the base.
CENTIMETER—The hundredth part of a meter. 2½ centimeters are the same as an inch.
CILIATE—Marginally fringed with hairs.
CLAVATAE—A division of cacti, in which the joints are cylindrical or club-shaped, and the spines unsheathed.
COMMISSURE—The face by which two carpels cohere.
COMPRESSED—Flattened lengthwise.
CONFLUENT—Blended into one; passing by degrees the one into the other.
CYLINDRIC—Having the form of a cylinder.
COTYLEDONS—The seed leaves of the embryo.
CRENATE—Toothed by crenatures; scalloped.
CUSPIDATE—Tipped with a cusp, or sharp and rigid point.
CYLINDROPUNTIA—Cacti with cylindrical or terete joints of the genus Opuntia.
CYLINDRACEAE—A division of cacti with comparatively stout joints, and spines sheathed in a scabbard. This includes **Opuntia imbricata** and **Opuntia leptocaulis.**
DECUMBENT—Reclining but with summit ascending.
DEFLEXED—Bent or turning abruptly downward.
DEHISCENT—The mode of opening of a capsule or anther by valves, slits, or regular lines.
DEPRESSED—Flattened from above, so as to be greater in width than in height.
DETACHED—Disconnected, unconnected.
DIVERGENT—Inclining away from each other.
DORSAL—Relating to the back.
ELLIPTIC—In the form of an ellipse.
ELONGATED—Lengthened.
EXERTED—Protruding beyond or out of, as the stamens beyond the corolla.

FOLIACEOUS—Leaf like in texture or appearance, or bearing leaves.
FRUIT—A ripened ovary. Ex. tunas of the prickly year.
FULVI-SPINOSAE—A division of cacti. Bushy or spreading plants, with brown or partly brown spines and fleshy joints including **Opuntia engelmannia.**
GLANDULAR—Bearing glands or having the nature of glands.
GLAUCOUS—Covered or whitened with a bloom, like that on a cabbage leaf.
GLOBOSE—Having or approaching a spherical form.
GLOBULAR—Globose or nearly so.
GLOCHIDS—Barbs; bristles with barbed tips.
HEMISPHERIC—Half a sphere; half round as a ball cut in two.
HILUM—The scar or place of attachment of a seed.
HYPOCOTYL—Region of stem below the cotyledons.
JOINT—Section of the stem or branch of an Opuntia.
IMBRICATE—Overlapping like shingles on a roof.
LANCEOLATE—Shaped like a lance or spear head; narrower than oblong, and tapering to each end, or at least to the apex.
LINEAR—Narrow, several times narrower than wide, and the margins parallel.
LUNATE—Half-moon shaped; crescent shaped.
MILLIMETER—One tenth of a centimeter. About one twenty-fifth of an inch.
MONILIFORM—Necklace shaped; cylindrical and with contractions at intervals.
MUCILAGINOUS—Slimy; of the consistence or appearance of mucilage.
MUCRONATE—Tipped with an abrupt, short point.
OBLANCEOLATE—Lanceolate but tapering toward the base more than toward the apex.
OBOVATE—Ovate with the broader end toward the apex.
OBCONICAL—Conical, but attached at the apex.
OBLIQUE—Unequal sides or slanting.
OBTUSE—Blunt or rounded at the extremity.
ORBICULAR—Said of a flat body with a circular outline.
OVARY—That part of the flower in which the seeds form. The lower part of the pistil.
OVATE—Of the shape of the longitudinal section of a hen's egg, the broader end basal. Having the base broader than the apex. Used in describing shapes of leaves.
PAPILLAE—Minute, nipple shaped projections.
PAPILLOSE—Bearing or resembling papillae.
PECTINATE—Pinnatifid with narrow and closely set segments, like comb-teeth.
PERIANTH—The floral envelopes or leaves of the flower consisting of calyx, corolla, or both.
PORRECT—Standing so one end is always away from the body; stretching out, as the spines of certain cacti.
PROCUMBENT—Lying along the ground.
PROLIFEROUS—Bearing progeny, in the way of off shoots.
PROSTRATE—Lying quite flat on the ground.
PUBESCENT—Clothed or furnished with hairs or down, especially with soft or downy and short hairs.
PUBESCENTES—A division of cacti, with pubescent joints and sometimes without spines, though usually rich in bristles.
PUNCTATE—Dotted, either with depressions like punctures of translucent internal glands, or with colored dots.
PUNGENT—Terminating in a rigid and sharp point or acumination, like a prickle.

PYRIFORM—Pear-shaped.
RECURVED—Curved backward or downward.
REFLEXED—Abruptly bent or turned downward or backward.
RETUSE—A round apex with a shallow notch.
RUGOSE—Covered or thrown into wrinkles.
SCABROUS—Rough to the touch.
SERRATE—Beset with antrorse teeth.
SERRULATE—Serrate with very fine teeth.
SETISPINAE—A division of cacti. Low plants with small joints and fine bristle-like spines, including **Opuntia filipendula** and **Opuntia setispinus.**
SHEATH—A tubular or enrolled part or organ; the covering of the spines in certain cacti.
SOLITARY—Single, only one from the same place.
SPATULATE—Oblong with the lower end attenuate. Shaped like a druggist's spatula.
SPINE—A stiff, thorn-shaped or pointed growth of a plant. A sharp pointed woody or indurate body, commonly a branch, sometimes a petiole or stipule.
STIGMA—That part of surface of a pistil which receives the pollen for the fecundation of the ovules.
SUBULATE—A'wl shaped.
STYLE—The usually attenuated portion of a pistil or carpel between the ovary and stigma.
TERETE—Round in the sense of having a circular tranverse section.
TERMINAL—Growing at the end.
TOMENTOSE—Densely pubescent with a matted wool.
TRUNCATE—As if cut off at the end.
TUBERCLE—A small tuber or an excrescence.
TUBERCULATE—Beset with knobby projections or excrescences.
TUNAE—A division of cacti. Bushy plants, often with abundant yellow spines, including the common prickly pear, **Opuntia lindheimeri.**
TUBEROUS—Shaped like a tuber.
TURGID—Swollen beyond natural size. Inflated.
UMBILICUS—The hilum of a seed.
UNDULATE—Wavy.
VENTRAL—Belonging to the side opposite the dorsal.

Common and Local Names

ALICOCHE—Usually applied to the caespitose types of cacti, particularly **Echinocereus.**

BANANA CACTUS—**Echinocereus enneacanthus,** referring to the banana shape of the many stems.

BIZNAGA—VIZNAGA—**Ferocactus wislizeni** and other cacti of this type. Bisnaga, Bisnegre and Bisagre are corruptions of the Spanish word Visnaga and have a very local usage in Texas. It appears that the illiterate Mexican is unable to distinguish the sound B from V.

BISNAGA DE CHILILLOS — **Neomammillaria heyderi** and similar species.

BISNAGRE—BISAGRE—See Biznaga.

CANDLELABRUM CACTUS—Name applied to **Opuntia imbricata** and similar species in reference to the candlelabrum-like whorls of its many branches.

CARDENCHE—Name applied to **Opuntia imbricata** in the vicinity of Durango and Zacatecas, Mexico.

CHAUTE—**Ariocarpus fissuratus.** Chautle is the common name for Ariocarpus, the word Chaute wes sent into Washington by collectors, who could not understand Spanish and in this way has drifted into some of the books.

CHAUTLE—**Ariocarpus fissuratus.** See Chaute.

CHILITOS—Fruit of the **Mammillarias,** especially those bearing crimson club-shaped fruits.

CHOLLA—Common name of the cylindric-stemmed, cane-like Opuntias, particularly **Opuntia imbricata.**

CLAVELLINA—**Opuntia schottii** and other low prostrate forms

COB CACTUS — **Echinocereus enneacanthus** and others with similar stem structure.

COLA DEL DIABLO—**Selinocereus spinulosus.**

COW-TONGUE CACTUS—**Opuntia linguiformis** in reference to the long tongue like "pads."

COYONOSTLE—**Opuntia imbricata** and other similar species. Name applied to cholla cactus and all other cylindric, cane-like cacti.

COYOTE PRICKLY PEAR—The common cholla cactus, **Opuntia imbricata.**

DEVIL'S HEAD—**Homalocephalus texensis** and similar ground species with strong thorns.

DEVIL'S PIN CUSHION—Common name for **Homalacephalus texensis** and many other low growing, strong-spined species.

DEVIL'S ROPE—Name used in Australia for **Opuntia imbricata.**

DRY WHISKEY—**Lophophora williamsii. Wrongly** applied to **Ariocarpus fissuratus.**

DUMPLING CACTUS—**Lophophora williamsii.**

FINGER CACTUS—**Mammillarias** having teat-shaped tubercles as **Coryphantha sulcatus.**

FISHHOOK CACTUS—**Hamatacactus setispinus** and other species having a central hooked spine.

GARAMBULLAS—The word Garambullas is applied to nearly all currant-like fruits, whether from Cacti or other plants. In Central America they call **Myrtillocactus geometrizans,** Garambullo, but the word really means the fruit and not the plant. Garambullo is not applied to **Opuntia leptocaulis,** but it is possible that the Mexicans call the fruit by that name.

GARAMBULLO—Name applied to the fruits of "Tasajillo," **Opuntia leptocaulis.** See Garambullas.

GOCONOXTIE—Name applied to **Opuntia imbricata** in certain parts of Mexico.

HEDGEHOG CACTUS—**Hamatocactus setispinus.**

HIKULI—Indian name for **Lophophora williamsii.**

INDIAN FIG—Common name for prickly pear, especially the species that are cultivated for their fruits.

JOCONOXTLE—A species of Opuntia grown in Mexico. The tunas are eaten only when cooked.

KAMABA—Indian name for **Lophophora williamsii.**

LACE CACTUS—**Echinocereus reichenbachii** in reference to the lace-like appearance of the spines.

LENGUA DE VACA—**Opuntia linguiformis** in reference to the elongated pads.

LIMAS DE VIZNAGA—Fruit of **Echinocereus longihamatus.**

LIVING ROCK—**Ariocarpus fissuratus.**

MANCO CABALLO—**Echinocactus texensis,** commonly called Devil's head.

MELCOCHA—See miel de tuna.

MELON CACTUS—**Echinocactus horizonthalonius** and others of the shape described in the term "melon."

MERRY WIDOWS—**Echinocereus reichenbachii** in reference to the flower which resembles one of the large spreading hats at one time popular in the United States.

MESCAL BUTTON—**Lophophora williamsii.**

MIEL DE TUNA—A thick syrup made by boiling tuna.

MISSION PEAR—All edible tunas.

NIGGERHEAD—**Echinocactus horizonthalonius** and many of the "hemisphere" Mammillarias.

NIGHT BLOOMING CEREUS—**Penicereus greggii.**

NIPPLE CACTUS — All **Mammillarias** having nipple of teat-shaped tubercles.

NOPAL—Mexican name applied to all flat-jointed species of Opuntia.

NOPAL CEGADOR—**Opuntia rufida.** Nopal cegador is applied to all kinds of Opuntia that bear glochids instead of spines. The tiny spines or glochids are said to blind cattle, horses, etc.

NOPALITOS—Strips of the young and tender mucilaginous pads of prickly pear, which are cooked like string beans by the Mexicans. The tender stems of the **Opuntias** are eaten by the Mexican people during Lent, as vegetables at this season are very scarce.

OCHOTERENA—**Opuntia rufida.**

ORGANO—Organo is applied to **Acanthocereus pentagonus** in Southern Texas, but in Mexico it is applied to **Pachycereus marginatus.**

PANCAKE CACTUS—Referring to any of the flat round **Mammillarias.**

PEAR—Any **Opuntia.** An abbreviation for prickly pear.

Pencas—Mexican term used for prickly pear "pads" which are eaten extensively by cattle in arid regions.

PEST PEAR—Term used for any Opuntia which is a nuisance to land. In Australia the two common pest pears are **Opuntia inervis** and **Opuntia stricta.**

PEYOTE—**Lophophora williamsii.**

PEYOTE CIMARRONS—**Ariocarpus fissuratus.**

PETAYA—Fruit from species of **Cereus** and **Echinocereus,** particularly **Echinocereus enneacanthus.**

PICHILINGA—The common name of **Neomammillaria hemisphaerica** and allied species throughout southern Texas. The plant is very well known by the Mexicans under that name.

PIOTE BEAN—See Peyote.

PITAHAYA, or PITAJAYA—Name given any species of Cereus throughout Mexico. A word of Carib and Haytian origin, early brought to Mexico by the Spanish Conquistadores. Applied more generally to the fruits of climbing and tree-like forms of cacti.

PITAHITA—Diminutive of Pitahaya.

PITAYA—Modified form or Pitahaya. More generally applied to the edible fruits and plants of low growing cacti.

PRICKLY PEAR—Applied to flat-jointed species of **Opuntia.**

SACASIL—**Wilcoxia poselgeri.**

STRAWBERRY CACTUS—**Echinocereus enneacanthus.**

TASAJILLO—Term applied to the common finger cactus, **Opuntia leptocaulis.**

TASAJO—Term used in Chihuahua for **Opuntia leptocaulis** and other large stemmed species.

TEAT CACTUS — All **Mammillarias** with teat-shaped tubercles, **Coryphantha sulcata, Neomammillaria hemisphaerica** and others.

TUNA—The larger edible fruits of the prickly pear, particularly of the species **Opuntia ficus-indica.**

TUNA JUELL—Applied to **Opuntia imbricata** in certain parts of New Mexico and Texas.

TUNA PASADAS—Dried tuna fruits.

TUNAS SECAS—Dried tunas.

TWISTED-RIB CACTUS—**Hamatocactus setispinus,** in reference to the spiral ribs.

VELAS DE COYOTE—Term used in Mexico in reference to **Opuntia arborescens** and **Opuntia imbricata.**

VISNAGA—Term applied to **Echinocereus wislizeni,** the common barrel cactus, and occasionally to the Devil's head, **Homalocephalis texensis.**

WOKOWI—Name used in certain parts of Mexico for **Lophophora williamsii.**

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of the

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Chemist

1854-1932

Founder and First President of the Academy

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Geologist

1859-1932

Fellow of the Academy

PICTURE STORY OF THE AZTEC PEREGRINATIONS

By

Colonel M. L. Crimmins

Fort Sam Houston, Texas

The origin of the Aztecs is of great interest to students of the prehistoric southwest. Traces of their dialect—the Uto-Aztecan—are found over a larger area than any other American tribe. Traces of their dialect have been found among the Utes as far north as Montana, among the Paiutes as far west as California, among the Comanches formerly of Texas, the Aztecs of Mexico, the Hopi, the Pima, and Papago of Arizona. This is a large, diamond-shaped area extending about two thousand miles north and south and one thousand miles east and west. It is not improbable that the Mimbres of southern New Mexico were related to the Aztecs a thousand years ago, as much of their pottery designs are like those of Casas Grandes.

Dr. Edgar L. Hewett, Director of the School of American Research at Santa Fe, New Mexico believes the Aztecs started their long peregrination from Aztlan, which he identifies as Casas Grandes, Chihuahua, near where General Pershing had his headquarters during the Punitive Expedition in 1916 and 1917. It is probable that the Aztecs remained there from about 960 A. D. to 1064 A. D. when they started their peregrinations that lasted until they stopped at the site of the City of Mexico, about 1325 A. D.

There are three primary historical sources telling of their migration. The Codex Boturini, the Codex Aubin, and the Mapa de Siguenza. This paper deals with the Mapa de Siguenza.

When Gemeli Careri, the Italian explorer, was on his voyage around the world from 1663 to 1699, he stopped at the City of Mexico and copied this map now in the National Museum of that City. He published the book [1] of his travels in Venice in 1728. His map shows undoubted Italian influence. The robes of his Aztecs are more like Roman togas, his children look like cupids, and his Aztecs have Italian features. That is the map produced by Lord Kingsborough in Volume IV. of his "Antiquities of Mexico" and by Paul Radin in his "Sources and Authenticity of History of Ancient Americans."'

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[1] Giro del Mondo, by Gemeli Careri.

The Rameriz map reproduced herewith as Plate I seems to be the best. It gives more interesting details about the battles and servitude of other people than the Codex Boturini. The Mapa de Siguenza ended in a definite and important epoch—the founding of the Aztecs of an independent nation. It tells of their defeat and how they sought refuge in a lagoon where they built the City of Mexico—Tenochtitlan.

The following story by Rameriz as given in connection with the map is herewith translated by J. Haggard—Villasana, Archives, University of Texas, January 12, 1932.

HISTORICAL HIEROGLYPHIC PAINTING OF THE PILGRIMAGE OF THE AZTEC TRIBES TO THE VALLEY OF MEXICO

This valuable hieroglyphic painting is found in the National Museum of Mexico. Although it has already been published in many works, we are here reprinting it, being certain that through it rather than through any others, an idea may be obtained of the Aztec writing. Following is its interpretation, according to Sr. D. José Fernando Ramírez, curator of the museum.

This painting is an itinerary: it represents the long pilgrimage that the Aztecs made from Aztlan to the valley of Mexico. The path is marked by the narrow copper colored belt which winds like a snake from number 1 to number 48 the journey and direction of the Aztecs is indicated by the black trail which is seen at intervals along the same narrow belt; the time spent in the pilgrimage is shown by the bundles of *xiuhmolpillis* grass which the reader will see, for example, at the right of lake number 1, and at the right of figure number 4; the time of their permanency in each stopping-place is given by the green dots seen either to the right or to the left of figures as those of numbers 5 and 7; the villages in which the pilgrims tarried are marked by their respective hieroglyphics. The bundle of grass is the hieroglyphic of the cycle or period of 52 years; each one of the green dots indicates one of the years of this cycle.

With this general idea in mind, let us see what each one of the figures, indicated by numbers, represents.

Numbers 1 and 2. The Aztecs used to state that they had started from a place surrounded by water, Aztlan by name, because a bird had appeared to them several times singing from the top of a tree: *Tihui*, we are coming [or, let us go, *ya vamos*.] They had believed that a superior will had ordered them to leave the island, and they had left under the orders of Huitriton, Tenoch, Tocpation, and others. Number 1 shows the lake, the island, the tree, and the bird of this wandering tradition. The bird is singing: so it is stated by the number of tildes issuing from its mouth. The Aztecs are listening: this is indicated by the attention with which the men of number 2 watch him. At the foot of the mountain, number 1, there are two heads: this means that not all the inhabitants left the island. In the lake, there is a man stretched out in a boat; this is probably the hieroglyphic of the name of the place left by the emigrants. The bundle of grass at the right of the lake signifies that the latter began their pilgrimage at the beginning of a new cycle. In the same figure, number 2, the Aztecs are seen already on the road: each chief of tribe has a figure on his head which is the phonetic hieroglyphic of his respective name.

Number 3. Here we see a *teocalli*, or temple, a tree, a phonetic hieroglyphic, and a *xiuhmolpilli* or bundle of grass. The hieroglyphic is without doubt the name of the place in which the Aztecs made their first stop; the other figures mean that they remained there until the end of the cycle and that they built a temple.

Number 4. The figures in this number indicate that in the place named by the hieroglyphic the emigrants counted another cycle.

Number 5. One hieroglyphic says *Cincotlan;* the dots say that the Aztecs remained there ten years.

Number 6. *Tocolo.* Here, according to the bundle seen at the side, the Aztecs counted another cycle.

Number 7. *Octotlan.* Here they remained five years, according to the dots on the right.

Number 8. *Mizquiahuala.* Here it is stated that they raised a temple, completed another cycle, and lost one of their chiefs, the one indicated in number 2 by the letter *m*, which is that of a corpse in a shroud, according to the custom in Mexico. Notice that this chief has the same figure on his head in number 8 and number 2.

Number 9. *Nalpan.* Here it is stated that they remained fifteen years.

Number 10. *Tetepanco.* Here it is stated they remained five years.

Number 11. *Oxitlipan.* Here it is seen that they remained ten years.

Number 12. *Tetzapotlan.* Permanency: 4 years.

Number 13. *Ilhuilcatepec.* Again 4 years.

Number 14. *Papantla.* Two years.

Number 15. *Tzonpanco.* Five years.

Number 16. *Apazco.* Four years.

Number 17. *Atlicataquian.* Two years.

Number 18. *Cuauhtitlan.* Here they remained three years, and one of their chiefs deserted them—the one indicated in number 2 by the letter *k*,—and went to found the town of

Number 19, whose identification is unknown.

Number 20. *Azcapotzalco.* Here they remained 7 years and they saw the end of another cycle. The different position occupied by the bundle of grass and an old tradition both authorize, according to Sr. Ramírez, the conjecture that here they made a chronological correction.

Number 21. *Chalco.* They must not have spent a full year here.

Number 22. *Pantitlan.* They did not spend a year here either.

Number 23. *Tolpetlac.* Here they remained two years.

Number 24. *Tlecohuatl.* They must not have spent even one year here.

Number 25. *Cuauhtepec.* Two years of residence.

Number 26. *Chocomoztoc.* Eight years of residence. The seven dots which are seen above the figure of this number are part of the hieroglyphic of the town. Seven in Mexican is *chicome*, cave is *oztotl*: hence *Chicomoztoc.*

Number 27. *Huitzquilocan.* Residence: three years.

Number 28. The name of this place is not known. Residence: four years.

Number 29. *Xaltepozauhcan*: four years.

Number 30. *Cozcacuauhco*: four years.

Number 31. *Techcatitlan*: five years.

Number 32. *Azcaxochic*: four years.

Number 33. *Tepetlapa*: five years.

Number 34. Hardly one year.

Number 35. *Teozomaco*: six years.

Numbers 36, 37, 38, 39, and 40. *Chapultepec, Tlatelolco, Colhuacan,* a part of the lake of Mexico, an unknown place, perhaps another part of the lake. In Chapultepec, where it is stated they spent four years, the Aztecs lived with great difficulty and were continually at war with the natives. Broken in the last encounter, they sought safety through the only point which remained open to them, on the side of Mexico, which then extended to the foot of the same mountain. Some of the fugitives went to *Tlatelolco* (number 37); but, overtaken on the shores of the lake, at a place *p* whose hieroglyphic name is formed by half body of a deer and half its head, they were defeated, as is expressed by the human body which is seen mutilated and bloody. Of those who escaped alive, some were taken prisoners and conveyed to *Colhuacan* (number 38) as shown by the two bleeding human figures which are running along the upper part of the road, and the five heads, also bloody, which are seen at the left; others were saved in the part of the lake numbered 39; but the king of Colhuacan succeeded in finding them and made them his subjects, as is shown by figures *f*, *i*, *s*, this last one (*s*) is the image of the king, and the others (*f* & *i*) represent the subject tribes. They remained there four years and closed the fifth cycle.

Number 41. It is believed that this hieroglyphic represents the fact that the Aztecs took refuge in the thickets and swamps in the interior of the lake, where it is stated they remained six years.

Number 42. Here it seems to be indicated that a human sacrifice was made, and that there was a battle.

Numbers 43, 44, 45, and 46. Posts in each of which the Aztecs remained ten years.

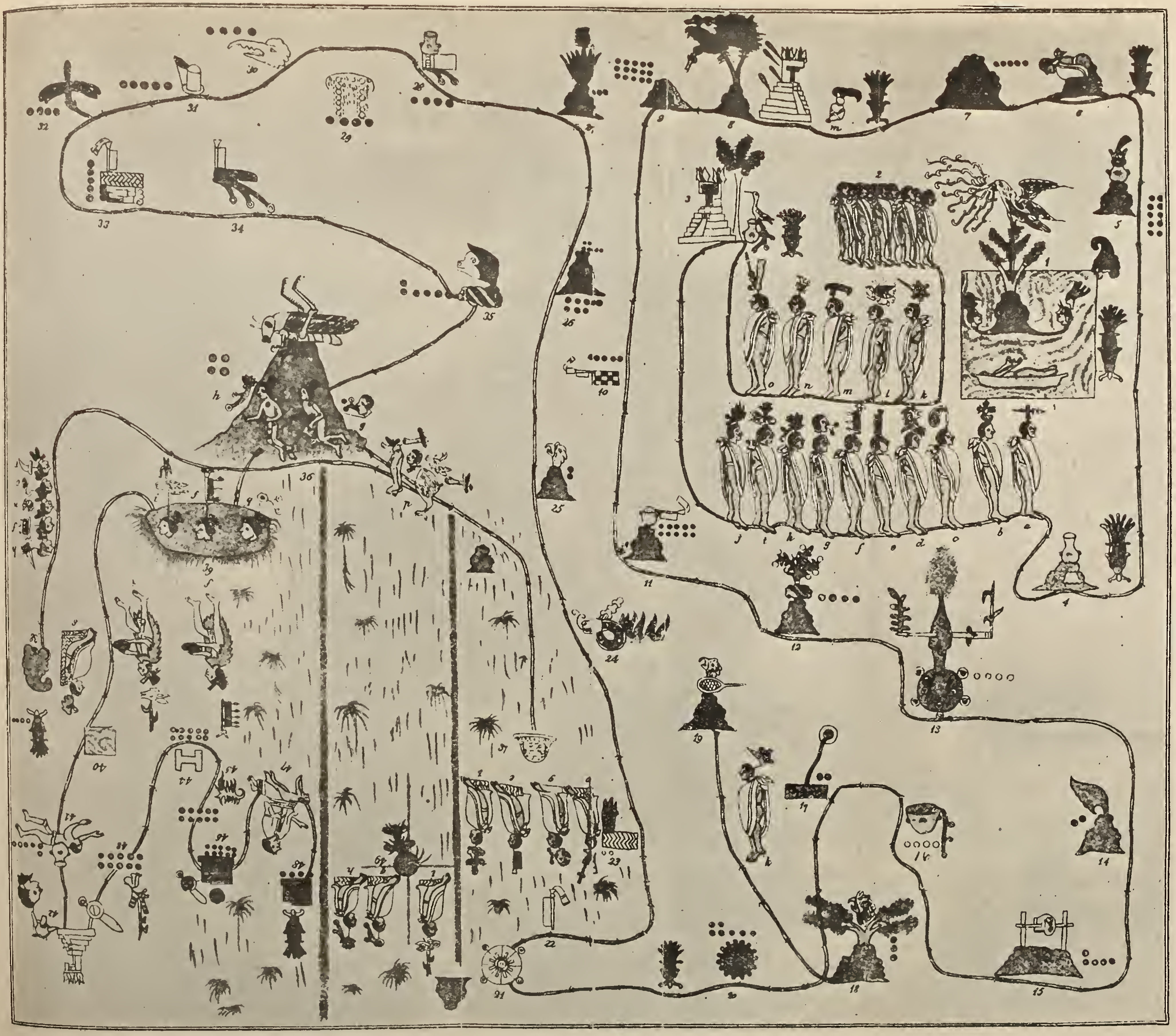
Number 47. *Mixiuhcan.* The group represents a woman who had just given birth to a child.

Number 48. The Aztecs remained here four years and closed the seventh cycle.

Number 49. *Tenochtitlan*, end of the pilgrimage and foundation of the present City of Mexico. The cactus, the badge of the city, is seen here; the four wards (divisions) of the city are indicated by the two blue lines crossing at right angles; the tribes which were left are indicated by the seven chiefs who are seated in two files.

I hope that the reader has understood that this interpretation can be considered only as an essay. It is, as may be seen, incomplete, and we are far from assuming that it is exact in every detail.

f Mexico.



Historical hieroglyphic painting of the pilgrimage of the Aztec tribes to the valley of Mexico.

OCCURRENCE AND MINING OF SULFUR IN TEXAS

By
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To most people sulfur is regarded as one of the essential plant foods or as a yellow powder to be bought at the corner drug store and to be used occasionally to dust on growing plants or burned as a disinfectant in a room after sickness. Few persons indeed know that Texas produces annually about 2,500,000 tons of sulfur, valued at $45,000,000, and that this is approximately 85 per cent of the world's sulfur production and 98 per cent of the United States sulfur production. Thanks to the Texas Legislature, the entire sulfur industry has become quite noted, or notorious, whichever one may choose to call it, within the past two years. Recently a production tax of $0.75 per ton has been imposed which will mean a state revenue of almost $2,000,000 per year, in addition to about half that amount in general property taxes. So there must be quite a sizeable sulfur industry here in Texas.

So important are sulfur and its derivatives that industrial leaders and statisticians use the yearly consumption of sulfuric acid, into which the majority of sulfur is made, as one of the basic factors in the estimation of the progress and industrial development of a particular locality or nation. The feasibility of such a plan is easily seen when the use of sulfur products in the various industries is understood. The automobile is dependent upon sulfur for fuel, oil, rubber tires, all plated parts, paints and enamels, and numerous other smaller articles. All business must use paper, the manufacture of which involves the use of sulfur in some form. Much of the nation's food and clothing comes from land enriched with fertilizer having sulfur as one of its constituents. A goodly percentage of the nation's freight and transportation expenditure is for the conveyance of sulfur and its products. Thus, the wide diversity of the uses of sulfur makes its consumption a most accurate barometer of the nation's welfare.

The amount of sulfur in the earth's crust is estimated to be about one-tenth of one per cent. It occurs in a variety of mineral forms, but those of commercial importance are the sulfates, the sulfides or pyrites, and the native, or free, sulfur. A large number of minerals occur in the form of the sulfate, the most abundant of which is probably the sulfate of calcium, more commonly known as gypsum. These minerals are of no importance as a source of sulfur. A process has been patented by which calcium sulfate can be used as a raw material for the manufacture of Portland cement, with a view to reclaiming the sulfur dioxide produced in the clinkering process for the manufacture of sulfuric acid. This process, however, has never been developed on a commercial scale.

The sulfide ores were for many years the most important source of sulfur for the manufacture of sulfuric acid. These ores include the sulfides of lead, zinc, copper, iron, antimony, arsenic, and selenium, but the copper, lead, zinc, and iron sulfides are the only ones that have been used as a source of sulfur. Arsenic, antimony, and selenium are objectionable constituents in the ores to be used in the manufacture of sulfuric acid, and even the presence of lead and zinc is sometimes undesirable. Probably the greatest sources of sulfide ores are the extensive deposits of iron pyrites that occur in Spain. Large deposits of this mineral occur in the metamorphic rocks of the Pre-Cambrian extending from New Hampshire to Alabama. Pyrite also occurs in commercial quantities in Indiana, Illinois, Ohio, and California, and in the Canadian provinces of Ontario and Quebec.

Prior to the discovery of native sulfur in the United States, iron pyrites was exported in large quantities from Spain to European ports and to the United States for the manufacture of sulfuric acid. In this process the mineral is roasted in furnaces at moderate temperatures. The roasting process converts the ore to the oxide, and the sulfur passes out of the furnace in the form of sulfur dioxide. This gas is then collected and used in the manufacture of sulfuric acid by either the contact or the chamber process. One of the advantages of this mineral as a source of sulfur lies in the fact that the residue from the roasting process may be used as a raw material for the smelting of iron.

Lead and zinc sulfide ores occur in the Appalachian belt along the Atlantic seaboard, in the Virginia-Tennessee belt, in the Saucon Valley of Pennsylvania, and in the Upper Mississippi Valley. Mixed ores of lead and zinc, together with gold ,silver, copper, etc., are prominent in the Cordilleron section of western United States. A few of the smelters in these regions are equipped to use the by-product sulfur dioxide in the manufacture of sulfuric acid, but this practice is not general. With the discovery of native sulfur in the Gulf Coastal area of Texas and Louisiana, and the development of an economic method for mining these deposits, the use of pyrite ores as a source of sulfur has steadily decreased.

Although free sulfur is of very common occurrence in the sedimentary rocks of the earth's crust, it is seldom found in sufficient concentration to be of commercial importance. Native sulfur may be formed in several ways. The type known as solfataric sulfur is often found in fissures of lava and tuff in the vicinity of active and almost extinct volcanoes. Since hydrogen sulfide and sulfur dioxide are known to be common constituents of volcanic gases, the occurrence of this type of sulfur can be explained by one of the following equations:

$$(1) \quad H_2S + 2SO_2 = H_2SO_4 + 2S$$
$$(2) \quad 2H_2S + O_2 = 2H_2O + 2S$$
$$(3) \quad 3SO_2 + 2H_2O = 2H_2SO_4 + S$$

Very few deposits of this nature are of commercial importance, but some have been worked on a small scale in Japan. Sulfur of this type has also been found in the crater of Popocatepetl, in Mexico, and several other such deposits are said to occur in the volcanic regions of the Chilean and Argentine Andes.

Native, or free, sulfur is also of common occurrence in the vicinity of some mineral springs Its formation can be explained by the incomplete oxidation of the hydrogen sulfide according to equation (2) above, but there is considerable evidence that the sulfur in such vicinities may be due to bacterial action. Deposits of this type occur throughout the western States, and a few—namely, those which occur at Cove Creek mine, Utah, and at Cody and Thermopolis, in Wyoming—have been worked on a small scale. Such deposits, however, are of a superficial nature, and play a very minor part in the world production.

The "gypsum type" of sulfur is of world-wide occurrence, and is so called because of its constant association with gypsum. Deposits of this nature are obviously in no way connected with volcanic activity, and their close association with sedimentary formations has made the explanation of their mode of occurrence exceedingly difficult. Many hypotheses have been advanced, but none of them has been proved sufficiently to merit universal acceptance. The most generally accepted of these hypotheses, is that the sulfur has been produced as a result of the reduction of gypsum by material of an organic nature. This hypothesis, however, is based upon certain reactions which are known to take place at elevated temperatures but which have not been produced experimentally under the conditions which are known to have existed in the formations. The Sicilian deposits of Europe and the sulfur that occurs in the Gulf Coast area of Louisana and Texas are well known occurrences of the gypsum type of sulfur.

For many years the Sicilian deposit constituted a world monopoly. These deposits consist of from 25 to 40 per cent of free sulfur in a matrix of gypsum and calcite, with occasional occurrences of relatively large masses of pure sulfur. It is mined for the most part in open quarry operations ranging from 200 to 500 feet in depth. The ore is carried to the surface by manual labor, and is placed in kilns known as "calceroni" These kilns usually consist of a shallow pit about twenty feet in diameter with walls about ten feet high. The sulfur ore is placed in these kilns in such a manner as to provide draft holes at several points. Fires are then started by dropping burning waste or straw down though these draft-holes. Part of the sulfur in the ore is burned, and the heat of combustion is sufficient to melt the sulfur in the remaining ore. The melted sulfur drains to the bottom of the calceroni, where it is collected and drained into molds at more or less regular intervals. This method is very uneconomical, as about 30 per cent of the total sulfur charged into the kiln is burned. No effort is made to utilize the sulfur dioxide that is produced.

In 1869 sulfur was discovered in Calcasieu Parish, Louisiana. in a well being drilled for oil. This deposit was in the geological structure known as a salt dome. In America these domes occur only in the area known as the Gulf Coastal Plain. About two hundred such domes have since been located in this region. Though most of these domes contain some sulfur, only about seven have been found thus far to contain a sufficient amount to be of commercial importance.

The sulfur that occurs in these domes is of the gypsum type, similar to that of the Sicilian deposits, the gangue material being gypsum and a porous type of limestone. The native sulfur is disseminated through the gangue, with occasional pockets of massive sulfur occurring in cavities of the gangue. The deposits are located at depths varying from 400 to 2000 feet, and the super-imposed strata consist of pack sands and loose clay formations.

The loose and friable nature of the overlying formations, together with the poisonous gases which are encountered, make it impossible to sink a shaft and mine the sulfur by underground methods. Consequently, these deposits were a potential but unobtainable resource for many years. About 1900, Herman Frasch patented a process for mining the Louisiana deposit. The basic principle of this patent depended upon the low melting point of sulfur, 248°F, and upon the higher temperatures that could be obtained by heating water under a pressure of about 125 pounds per square inch. The essential feature of the process consisted of pumping water at a temperature of about 325°F and 125 pounds pressure down a well and into the porous formation in which the sulfur occurred. The heat content of the water melted the sulfur, which then collected at the bottom of the well. The liquid sulfur was pumped to the surface and discharged into a temporary wooden vat, where it was allowed to cool and solidify.

As originally operated, this process was crude and inefficient, yet it produced a high grade of sulfur at a much lower cost than that at which the Sicilian sulfur could be produced. Many improvements have since been made in the plant and the equipment for mining, and greater efficiencies have been attained, but the basic principle involved in the extraction of sulfur from the deposit remains the same.

At present three companies are operating sulfur mines, and all of them are in Texas. The oldest of these is the Freeport Sulfur Company, which is operating mines at Bryan Mound and at Hoskins Mound, both near Freeport. The deposit at Bryan Mound is about depleted, but large amounts of sulfur have been removed from there, particularly during the war when it was practically the only American source of sulfur.

The Texas Gulf Sulfur Company is operating primarily at New Gulf in Wharton County, where it has the largest sulfur mines in the world. This company first mined a large deposit at Gulf in Matagorda County, but this location is now being abandoned.

The latest entry into the sulfur mining field is the Duval Sulfur Company, which has been operating a deposit at Palangana dome in Duval County for the past three or four years.

The actual application of the Frasch process to the mining of sulfur as it is now operated by the above companies may be divided quite logically into two departments—the plant department in which the steam is generated and the water heated, and the field department, which handles the drilling, steaming, and pumping of the individual wells. The sulfur mining equipment of the Freeport Sulfur Company at Hoskins Mound furnishes an excellent illustration of the commercial application of the Frasch process.

The power plant at Hoskins Mound contains twelve 700-horsepower Stirling type boilers, which are operated at about 200 per cent rating, thus making a total of approximately 16,000 horsepower available. Under normal operating conditions natural gas is used for fuel, but in an emergency this may be switched to fuel oil within five minutes time. The plant proper also contains two 500 KV-A and one 1,000 KV-A General Electric turbo-generators, two low-pressure (250 pounds per square inch) air compressors, and five high-pressure (1,000 pounds per square inch) air compressors, having a total rated capacity of 3,800 cubic feet of free air per minute. In addition to this equipment, there are sixty-one steam pumps, which are required to handle the enormous amount of water used, boiler feed water pre-heaters, mine water heaters, and numerous other pieces of auxiliary equipment.

The daily water consumption of the mines is near 7,000,000 gallons Part of this water is surface water taken from Austin Bayou, and part of it comes from deep wells. During periods of drouth, the surface water is taken from a 350,000,000-gallon storage reservoir, which is filled when good water is available. Of the 7,000,000 gallons required each day, 2,000,000 gallons are used for boiler feed water and 5,000,000 gallons are heated by steam to a temperature of 335°F and pumped directly to the wells.

The boiler water receives a closely contolled chemical treatment by the cold lime-soda-sodium aluminate method. The water receives the dosage of chemicals in a long, baffled flume and passes directly into a large settling basin. After a three-day sedimentation period, it is passed through a rapid sand filter to remove all suspended matter. Whenever needed, sodium sulfate is added to the boiler water to maintain the correct sulfate-carbonate ratio. The water passes from the filter to the "bleed-water" heat exchangers, where it is partially heated by the spent water coming up from the sulfur-bearing stratum. The feed water then enters the pre-heaters, where the temperature is raised to 218 degrees Fahrenheit by exhaust steam from the generators and prime movers in the plant. The heaters are vented, and all dissolved oxygen is removed before the water enters the boilers. As the water enters the main boiler feed line, which supplies all the boilers, it is given a light dosage of di-sodium phosphate, which very effectively prevents scale formation in the boilers.

The blow-down water from the boilers is used to aid in heating the mine water, and hence there is no heat loss. As a result, a continuous boiler blow-down of often as high as 20 per cent is maintained. This amount is flexible, and can be varied in such a way as to aid in the maintenance of an economical heat balance.

The mine water ordinarily receives a cold lime-soda treatment, supplemented by the addition of ferrous sulfate coagulant whenever required. The treated mine water is heated initially by direct contact with the hot flue gases, thus saving approximately 80 per cent of the heat which is commonly lost up the stack. The water then passes into the exhaust mine water heaters, where it is heated to 212 degrees Fahrenheit by the continuous boiler blowdown and by exhaust steam from the generators and prime movers. Whenever necessary, live steam may be used to keep the temperature up to 212 degrees Fahrenheit. These heaters are equipped with vent condensers whereby the dissolved gases are removed without causing a heat loss.

The preheated mine water is then pumped into the high-pressure heaters, where it is heated to 335 degrees Fahrenheit by direct contact with the live steam. These heaters operate at boiler pressure and are practically 100 per cent efficient in the utilization of all the available heat in the steam. The heated water is then pumped through well-insulated ten-inch lines to the field for use by the field department.

The entire Hoskins Mound plant is a model for the economic production of steam and hot water; it also furnishes a record of outstanding engineering achievement in every respect. The general arrangement of the whole system is such that it is sufficiently flexible to utilize all available heat under all conditions. The heat lost up the stack is probably lower than that of any other power plant in operation. An accurate and a comprehensive record of all operation is kept and is checked daily for any possible sources of heat losses. In effect, every B. t. u. is followed from the gas to the molten sulfur to see that it does not go astray and that it does every bit of work of which it is capable. With such a system which functions so perfectly in this water-heating plant, heat efficiencies even greater than those encountered in the most highly praised central-power plant are to be expected, and, better still, they are realized.

The field department handles the drilling of the new wells and the actual production of the sulfur. The wells are drilled with the standard rotary well-drilling equipment which is used in drilling for oil. The well is drilled to the top of the cap rock, which forms the roof of the sulfur-bearing limestone. It is then cased with a ten-inch pipe to prevent the unconsolidated formation above from caving in and filling up the well. The drilling operation is then resumed and the well is extended to the top of the anhydrite stratum which forms the floor of the formation in which the sulfur occurs. The well is then equipped with an 8-inch hot-water line, a 4-inch sulfur line, and a 1¼-inch air line, all located concentrically within the larger pipe. The eight-inch line rests on the anhydrite floor. Thirty-five feet of the lower end of this pipe is perforated to permit the hot water to pass out into the sulfur-bearing formation and to allow the molten sulfur to enter the well. A flange is welded inside this perforated pipe a short distance above the bottom, and the four-inch sulfur line rests on this flange. The air line is suspended from the top of the well and extends to within about two hundred feet of the bottom.

Water at a temperature of about 325 degrees Fahrenheit is then pumped down the eight-inch line and out through the perforations above the flange at the bottom into the sulfur formation. The heat in the water melts the sulfur, which then flows down through the formation and collects in a pool around the bottom of the well. The pressure of the water causes the liquid sulfur to flow into the well through the lower perforation and to rise a considerable distance in the four-inch line. When a sufficient quantity of melted sulfur has accumulated, the quantity of hot water that is pumped into the well is reduced, air at 500 pounds pressure is turned into the air line, and the molten sulfur is brought to the surface by the air lift.

At first the periods of pumping are rather short because a comparatively small amount of molten sulfur is available, but the duration of pumping periods is increased as rapidly as possible. The optimum condition is attained when continuous pumping removes just that amount of sulfur that is melted by the hot water being pumped into the well. Once a well has started to produce, it is never allowed to cool, because whenever a well "freezes"—that is, the sulfur solidifies in the sump at the bottom of the well—it is lost to production and must be abandoned. All lines through which the molten sulfur passes must be equipped with steam "gut lines" to prevent the freezing of the sulfur.

The sulfur produced by all the wells within a definite area is pumped by air to so-called "relay stations" and then pumped by centrifugal pumps to the storage vats. As the molten sulfur enters the relay station it flows into a separator in which the air and other gases are released to the atmosphere, and the sulfur passes into a constant-level flow tank. From the level tank, the sulfur is discharged into the steam-heated relay pit. The production of each well is accurately measured and recorded by specially designed orifice meter equipment devised by engineers of the Freeport Sulphur Company. The metering of the sulfur is aided by the fact that at about 320 degrees Fahrenheit its viscosity is near that of water. At higher temperatures the sulfur becomes quite viscous, and at lower temperatures there is danger of its freezing and plugging the system.

Whenever the relay pit gets full, it is accurately sampled and the contents pumped by large centrifugal pumps to the storage vats. The samples thus obtained are sent to the laboratory for analysis. In this way, an accurate check is kept on the quality of sulfur being produced.

The storage vats are huge wooden enclosures averaging 800 to 1,000 feet long, 200 feet wide, and 40 feet high, and containing approximately 300,000 tons of sulfur. The vats are built up gradually as the sulfur is pumped into them, the walls being at all times only three or four feet above the level of the sulfur. When the vat is full, the sulfur is allowed to solidify throughout. The heat transfer is so slow through the solid sulfur that this cooling takes from six months to a year. The wood retaining walls are then removed, leaving the huge golden-yellow block of solid sulfur having a purity of over 99.95 per cent. A standard gauge railroad track is then laid alongside, the sulfur is broken up by blasting with dynamite, loaded into box cars or gondolas by large steam shovels, and shipped to points all over the world to satisfy an ever-increasing demand.

During 1929 the sulfur consumption in the United States was divided as follows:

	Long tons
Heavy chemicals	560,000
Fertilizers and insecticides	415,000
Pulp and paper	265,000
Explosives	67,000
Dyes and coal-tar products	47,000
Rubber	43,000
Electro-chemicals	23,000
Fine chemicals	15,000
Paint and varnish	5,000
Food products	5,000
Miscellaneous	137,000
Total	1,582,000

An examination of the above table shows that sulfur in one form or another is absolutely essential to modern life. Sulfuric acid, into the manufacture of which 70 per cent of the world's sulfur goes, is used to make fertilizer to grow our foodstuff; it is used to make the gasoline and lubricating oil for our cars; it is used in the manufacture of many of the iron and steel products in daily use; it is used to make the paints and pigments with which our buildings, bridges, pipe lines, and many other things are painted and protected from corrosion; it is used in the manufacture of explosives and gases upon which the very life of the nation depends in time of war. Sulfur is used in the manufacture of paper of all sorts; it is used in the manufacture of rubber products—in short, sulfur is used in the growth or preparation of over 60 per cent of all materials used by mankind.

SOILS OF TRANS-PECOS TEXAS AND SOME OF THEIR VEGETATIVE RELATIONS

By

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INTRODUCTION

That extreme western portion of Texas lying west of Pecos River and commonly referred to as Trans-Pecos Texas is a vast area of more than 20,000,000 acres, comprising somewhat over one-tenth of the total area of the State. This great region, which is nearly as large as the state of Maine, occupies all of nine counties and part of one other, some of these counties having an area greater than the combined areas of Delaware and Rhode Island.

The Trans-Pecos region differs as a whole from other parts of Texas in physiography, local relief, native vegetation, and in characteristic land forms. Within this region occur transition zones between four great physiographic regions of continental scope, each characterized by diverse forms of surface configuration representing features of the Rocky Mountain province on the north, the Great Plains on the east, the Mexican Plateau on the southwest, and the Basin Range in the west.

PHYSIOGRAPHY

The western part is crossed from northwest to southeast by the great Cordilleran uplift represented here by three parallel belts of roughland ridges giving rise to the various mountains of the area and the intervening troughs of flat plains or basins, sometimes referred to as bolsons. The mountains and other roughlands are subjected to severe erosion, but large areas of the basins and plains have so little slope as to have no well-developed drainage channels.

The eastern section is subdivided into Pecos Basin, a flat plain; Edwards Plateau, a high, eroded, limestone plain cut by erosion into a region of very rough stony land; and Culberson Plateau, a high, dissected area of deep soft beds of gypsum. The Mountains and Basins consist of mountain ranges, isolated mountain and hilly areas, buttes,

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mesas, dissected pleateaus, and various valleys, basins, and plateau plains. The varied land forms of the mountains and roughlands are due to orogenic uplift of ridges and separate bodies, by protrusion of igneous rocks, followed by erosion of these and of large areas of sedimentary rocks. The basins and intermontane plains comprise very deep deposits of mountain debris washed from the local highlands.

The Trans-Pecos region is a high area, the elevations above sea level ranging mostly from about 3,000 to 4,000 feet in the basins and plains and 5,000 to 8,000 feet in the mountains. The highest point in Texas, 9,020 feet above sea level, is located near the south end of Guadalupe Mountains where El Capitan Peak rises to an elevation of more than one mile above the floor of Salt Basin a few miles to the west.

All the developed drainage system carries run-off water into the Rio Grande, a large proportion first entering Pecos River. These rivers have narrow shallow valleys through the plains and basins areas but have cut deep gorges and canyons through mountains and rough lands.

CLIMATE

The climate of the Trans-Pecos region is, in general, arid to semi-arid in type. The average anual precipitation ranges from about 10 inches to 15 inches except in the vicinity of Davis Mountains, where it is about 17 inches. Rainfall is largely local and irregular from year to year, there being periods of several years wherein rainfall is much lower than the average, followed by years in which it may be much greater. As a rule, the largest amount of the rainfall comes in the latespring and summer months. Many rains are torrential and of the thunderstorm type.

The winters are short and mild with longer periods of relatively uniform temperatures than prevail as a rule on the more easterly lying plains, which are frequently swept by sudden cold waves during the winter. The mean temperature for the summer months is 74.6 degrees F. at Fort Davis, and 60.8 degrees F. is the mean for the year at this place. The average yearly period free from frost at Fort Davis is 227 days.

The native vegetation of the region is largely of the so-called "desert shrub" type, though in many valleys and on some mountains there is a growth of grasses and trees that occur in regions to the east where rainfall is much greater. The character of the natural vegetation is related largely to the character of the soils and to the amount of rainfall. In many places where soils are thin and rainfall is low, there is only a very thin growth of plants, whereas the deep soils most favorably situated with regard to moisture conditions support a heavy growth of various shrubs and trees or grasses

SOILS

The developed soils of the Trans-Pecos area belong to light-brown and brown-soil groups, which are characteristic of semi-arid and arid regions. Soil development under the conditions of a relatively warm dry climate where moisture evaporation naturally great is increased by high elevations, and under a light vegetative growth of grasses, tends to form light-colored soils with fewer differences in the soil profile layers than occur in regions of greater rainfall. The light vegetative growth does not furnish much organic matter to the surface soil, and therefore the color of this layer is not dark. The small amount of rainfall is not sufficient to cause the transfer of much soil material from the upper to the lower soil horizons by the processes of eluviation and illuviation. The small amount of moisture, reduced further to a large extent by the great rate of evaporation of the high altitude and dry climate, tends to permit the accumulation of salts in the soil horizons. The characteristic layer of accumulated calcium carbonate therefore, occurs beneath the soils where they have been in place long enough to have been subjected to the influences of regional soil development. In places considerable calcium sulphate occurs in association with the carbonate in the soil layers, there being some areas where this substance is very abundant.

On the mountains and roughland areas soil development is very slight, as erosion removes the soil material about as fast as the rocks disintegrate into fine earth. Over the mountain areas, therefore, there is at most only a very thin layer of soil in places or an accumulation of fine earth in shelves and throughout accumulations of rock debris on the slopes. Two principal kinds of rocks form the mountains: limestone, which occupies a very large portion of mountains and other roughlands, including the Edwards Plateau; and igneous rocks, which make up large bodies of mountain and some less prominent roughlands.

The soils of the basins and plains are developed from deep deposits of gravel and fine earth materials washed from the local high lands. In places, the gravel occupies the greater portion of the soil mass, but large areas are occupied by a surficial deposit of fine earth material many feet deep over the beds of gravel. Here the surface is mostly smooth or nearly flat and the soil material is long subjected to the undisturbed influences of soil development. Here the characteristic regional profile of the soils of greatest maturity is as follows:

1. A thin crust 1/16 to ½ inch thick. This is slick on the upper side, but on the lower side is a mass of lightly bound roundish pellets. In an air-dry condition this crust is very distinctly formed. It is very fragile and pulverizes readily between the fingers. This is light brown calcareous soil in many places, and rests on that described in 2.
2. A bed ½ to 2 inches thick, of fine or coarse, roundish, granular fragments, loose and readily pulverized to fine grains with slight pressure. This rests on the layer described in 3.
3. A layer of soil slightly darker than the layers above. In an air-dry condition this layer is rather hard but is not impervious to water. It appears to be a lightly bound mass of clods which vary in size according to texture. The mass is readily broken apart with slight force, the more tightly bound, harder and larger clods making up the bulk when the texture is clay, and silty textures having the smaller and more fragile clods. This layer supports the largest number of plant roots. It is normally free of large accumulations of soluble salts. The soil has a fairly well-developed columnar build. This layer ranges in thickness from 6 to 15 inches. It is not sharply separated from the layer below but merges with it through a short range of transition.
4. This layer consists of material somewhat similar to 3, but is lighter in color, contains a relatively larger amount of calcium carbonate, and is more friable. The mass of clods is less tightly bound and, as a rule, are small and pulverize easily. The columnar form is present. Both hard and small fine and small lumps of free calcium carbonate occur, these increasing in number with increase in depth. This layer varies in thickness, the lower part extending to a depth of 3 to 5 feet beneath the surface. It rests upon the layer below in places, though in other places there is a short zone of transition.
5. This is a layer of accumulated calcium carbonate (in places with also considerable calcium sulphate) which consists of either a highly calcareous clay in which the white soft carbonate may or may not constitute the principal bulk of the mass, or it may be almost pure calcium carbonate, the upper part crusted by thin consolidated layers of the calcium carbonate in many places. This layer (often locally referred to as caliche) is several inches to several feet in thickness.

The soils over large areas contain considerable calcium carbonate and calcium sulphate in all the soil horizons and in some places where underdrainage in deficient there are appreciable amounts of soluble salts or alkali.

The alluvial soils of the region occupy relatively narrow strips along the larger streams, but on the whole they constitute a very small proportion of the total area. The largest areas occur in the vicinity of El Paso along the Rio Grande and about 50 miles downstream from the place. The chief other areas of alluvium occur along Pecos River and on some of the larger creeks. The alluvium is chiefly red or brown in color and consists of transported soil materials that have not remained undisturbed sufficiently long to have attained true soil characteristics. Most of the material is quite calcareous and comprises deep beds of miscellaneous soil materials washed from upland soils of the semi-arid and arid regions.

The soils developed from the rock formations of the county are divided into the following series: (1) Brewster series, comprising reddish soils derived from igneous rock parent materials; and (2) Ector series, light brown in color, from limestone. The Brewster and Ector stony soils, with the accompanying Rough stony lands, comprise the mountains and roughlands of the region.

The Brewster soils as found in this region consist of very thin soils layers with only slightly developed soil characteristics, due to the soil material washing away rapidly from the mountain and hilly roughlands. In the smoother areas, however, where the rocks have a surface covering of several inches of soil material, a thin layer of accumulated calcium carbonate lies immediately on the parent rocks beneath. Most of the soils are very stony, and Brewster stony loam, the chief soil of the series, covers large areas in the igneous-rock mountains, the largest areas occurring in Davis Mountains. Associated with the Brewster soils are large areas of Rough stony land which cannot be classed as a soil.

The Ector soils consist of brown calcareous soils developed from limestone. These occur on the limestone areas, mostly mountains, hills, eroded plateaus, and rolling highlands. Here also there is little soil accumulation or development due to the fine earth being carried away by erosion almost as fast as rock disintegration occurs. The stony-loam type occurs almost exclusively associated with areas so rough and stony as to comprise Rough story land with no soil. The stony soils have only a very thin layer of fine earth material a few inches thick on smooth places and as a slight admixture in broken stony material.

The soils developed in the basins and plains from the ancient fine earth debris washed from mountain slopes are of three principal soil series: the Reagan, Reeves, and Verhalen. The Reagan soils are brown and slightly darker than the Reeves, which are very light brown. The darker color of the Reagan is due to a larger amount of organic matter which accumulates from the heavier grass vegetation of the Reagan, there being practically no growth of grass on some of the Reeves soils. The Verhalen soils are the reddish soils of the basins and plains in association with the Reeves soils. The Reeves soils are underlain in many areas by soft gypsum, or this is associated with the calcium carbonate beneath these soils. The Verhalen soils appear to be developed largely from the parent materials washed from the igneous-rock mountain areas.

The dominant texture of the basins and plains soils is clay loam or silty clay loam, though some bodies of loams and sandy soils also occur in places. Large areas of very gravelly soils also are included with these series, whereas great beds of gypsum in Salt Basin, Culberson Plateau, and other places have been included with Reeves series as Reeves Chalk.

The alluvial soils have been included in several series. Those along the Rio Grande, are chiefly brown and belong to the Gila series. The reddish soils along Pecos River are grouped in the Pecos series; the brown and light brown in the Arno and Patrole series. The small strips of alluvium of the creeks in and near the mountains are dark and belong to the Toyah series. Where natural drainage is slow, there is a rather high accumulation of alkali in the soils along the Rio Grande and Pecos River.

NATIVE VEGETATION

The native vegetation of the Trans-Pecos area is varied and comprises plants peculiar to semi-arid and arid regions, although some typical plants of humid and subhumid regions also occur in places. On the basins and plains areas the vegetation is grasses and shrubs, these being in places, very scant. Large areas have practically no grass and are occupied by species of *Covillea and Flourensia.* In places grama grasses occur, and in other locations plants and grasses indicating alkali conditions occur. The mountains and roughlands have in places rather abundant grama grass cover, and in other places are practically destitute of grasses. On some of the mountains and in the valleys and canyons small pine or oak or juniper trees grow with various shrubs. On some of the roughland areas, largely those of limestone lechuguilla, sotol, and yucca dominate the plant community.

As one drives through this region, the plant communities are readily recognized. On the Edwards Plateau and other limestone roughlands and mountains, the lechugilla, sotol, and yucca plants and a few other shrubs, with occasional tufts of grass, give a characteristic note to the landscape; the grama grass cover, with occasional clumps of pine or oak or cedar, marks the igneous rock mountains; and creosote bush and black brush constitute almost the only vegetation over large areas of the flat plains and basins. Small mesquite and tornillo trees occur in some of the Rio Grande valley flood plain areas, whereas mesquite trees feature other bottom lands along Pecos River and other streams. Various other small trees such as buckeye, persimmon, walnut, and cherry occur in some of the mountain valleys. In some sections, white brush is abundant and, with catclaw and other plants, affords, a valuable honey-plant growth, which in the Marathon section provides a resource for a considerable industry in the production of honey. The guayule, from which rubber is manufactured, is found in places growing on the thin limestone soils, and formerly a small factory at Marathon extracted rubber from these plants, but now practically all of this valuable plant has been used up in this region. The wax plant or candelilla grows abundantly on the thin soils in the Big Bend sections and small outdoor factories extract the wax from the plants hauled in by Mexicans. On the flat heavy soils in some sections of the basins, there are large areas where practically the only vegetation is a dense growth of tobosa grass giving rise to the local term of "tobosa flats." In some sandy basins sand sage and mesquite shrubs constitute the outstanding vegetative growth.

A very large proportion of the shrubs and grasses comprise valuable grazing and browse for cattle, sheep, and goats, and stock raising is a very important industry throughout all parts of the region.

Owing to the value of much of the native vegetation as a natural resource, the need is realized for more information relating to its character and distribution. This is true primarily of all the species of economic importance, but is particularly true of all the forage plants. It was this consideration that caused a botanist to accompany the soil survey parties while the reconnaissance soil survey of that area was in progress.

The vegetation of the Trans-Pecos area remains largely unchanged from its natural distribution, although in places it has been modified to some extent by the influence of range livestock. It falls naturally into several general groups, some of which occur in communities of geographic significance which can be shown on a map, while other characteristic plants and associations of plants inject themselves as individuals into other associations or are confined in promiscuous small areas that cannot be here outlined separately.

The following list includes the more important plants growing within the area surveyed:

Common name	*Species*
Black grama grass	Bouteloua hirsuta
Blue grama grass	Bouteloua gracilis
Woolly-foot grama grass	Bouteloua eriopoda
Yeso grass	Bouteloua breviseta
Chino grass	Bouteloua ramosa
Grama grass	Bouteloua chondrosioides
Side-oats grama grass	Bouteloua curtipendula
Buffalo grass	Bulbilis dactyloides
Curley mesquite grass	Hilaria cenchroides
Tobosa grass	Hilaria mutica
Burro grass	Scleropogon brevifolius
Tussock grass	Sporobolis airoides
Saccaton	Sporobolis wrightii
	Sporobolis flexuosus
	Sporobolis asperifolius
	Sporobolis cryptandrus
Texas timothy	Lycurus phleoides
Triodia grass	Triodia pilosa
	Triodia pulchella
	Triodia mutica
Needle grass	Aristida glauca
Needle grass	Aristida pansa
Needle grass	Aristida ternipes
Needle grass	Aristida wrightii
Needle grass	Aristida purpurea
Needle grass	Aristida schiediana
Needle grass	Aristida adscensiones
Needle grass	Stipa tenuissima
Broom sage, Bluestem	Andropogon scoparius
Broom sage, Bluestem	Andropogon saccharoides
Broom sage, Bluestem	Andropogon cirrhatus
Broom sage, Bluestem	Andropogon feensis

Coarse grass	Elyonurus barbiculmis
Coarse grass	Epicampes berlandieri
Coarse grass	Epicampes emersleyi
Coarse grass	Chloris virgata
Coarse grass	Heteropogon contortus
Coarse grass	Leptochlea dubia
Salt grass	Distichlis spicata
Sotol	Dasylirion texanum
Sotol	Dasylirion leiophyllum
Lechuguilla	Agave lecheguilla
Creosote bush	Covillea tridentata
Blackbrush	Flourensia cernua
Lote bush	Condalia obtusifolia
White brush; Cabradora	Lippia ligustrina
White brush	Lippia wrightii
Canatilla	Ephedra trifurca
Canatilla	Ephedra antisyphilitica
Canatilla	Ephedra torreyana
Yucca, Spanish dagger	Yucca elata
Yucca	Yucca thompsoniana
Yucca	Yucca treculeana
Yucca	Yucca macrocarpa
Tasajillo	Opunta leptocaulis
Tasajillo	Opunta kleiniae
Prickly pear	Opuntia species
Tree cactus	Opuntia imbricata
Huajillo	Mimosa species
Catclaw	Acacia species
Catclaw	Acacia greggii
Green bush	Viguiéra stenoloba
Winter fat	Eurotia lanata
Chamiza: shadscale	Atriplex conescens
Chacate	Krameria grayii
Parosela	Parosela formosa
Parosela	Parosela frutescens
Sand sage	Artemesia filifolia
Cenizo	Leucophyllum frutescens
Cenizo	Leucophyllum minus
Cenizo	Coldenia greggii
Sacahuiste	Nolina texana
Sacahuiste	Nolina erumpens
Candelilla or waxplant	Euphorbia antisyphilitica
Mariola	Parthenium incanum
Guayule	Parthenium argentatum
Tomatilla	Lycium torreyi
Little buckthorn	Microrhamnus ericoides
Broomweed	Gutierrezia sarothrae
Agrito	Odostemon trifoliatus
Crotonweed	Croton neomexicanus
Ocotillo	Fouquieria splendens
Sangregado	Jatropha spathulata
Resurrection plant	Selaginella lepidophylla

Coarse weed	Acanthochiton wrightii
Globe mallow	Sphaeralcea incana
Locoweed	Astragalus earlii
Guayacan	Porlieria angustifolia
Spectacle plant	Dithyraea wislizeni
Adolphia	Adolphia infesta
Coarse gypsum shrub	Coldenia hispidissima
Pickleweed	Allenrolfea occidentalis
Blanket flower	Gaillardia pinnatifida
Pepperweed	Lepidium alyssoides
Allthorn or Junco	Koeberlinia spinosa
(Peculiar plant in Big Bend)	Hechtia texensis
Rayless goldenrod	Aplopappus heterophyllus
Cachanilla	Pluchea sericea
Ash	Fraxinus velutina
Hackberry	Celtis reticulata
Mexican walnut	Juglans rupestris
Madroña	Arbutus xalapensis
Desert willow	Chilopsis linearis
Soapberry: wild china	Sapindus drummondii
Wild cherry	Prunus virens
Mexican persimmon: Chapote	Diospyros texana
Sumac	Rhus virens
Sumac	Rhus microphylla
Sumac	Rhus trilobata
Mexican buckeye	Ugnadia speciosa
Mesquite	Prosopis chilensis glandulosa
Screwbean or Tornillo	Prosopis pubescens
Oak	Quercus grisea
Oak	Quercus pungens
Oak	Quercus emoryi
Oak	Quercus undulata
Oak	Quercus novomexicana
Spanish oak	Quercus texana
Juniper: alligator bark	Juniperus pachyphloea
Juniper: Utah	Juniperus pinchoti
Juniper: one-seeded	Juniperus monosperma
Juniper: Tascate	Juniperus mexicana
Juniper: drooping	Juniperus flaccida
Pine: Pinon	Pinus cembroides
Pine: nutpine	Pinus edulis
Pine: western yellow	Pinus brachyptera
Pine: white	Pinus flexilis

The vegetation of the Trans-Pecos Area can be divided into five general groups, as follows:

1. Grassland, which is subdivided into three types
2. Mesquite-sand sage
3. Yeso-salt grass
4. Bottomland, mixed trees, and shrubs
5. Creosote-black brush

In addition, there are plants associations that cannot well be shown separately, as they occur in places within the various groups outlined. These are chiefly the lechuguilla sotol, pine oak, and others.

1. *Grassland.*—Probably about two-thirds of the area is occupied by the grassland groups. Where one or more species of grass is abundant enough to give character to the vegetation, the range is regarded grassland. Though it may be essentially a pure stand of grasses, such as occur in tobosa grass flats, much of the larger portions of the grassland is characterized by the presence of some woody plants. Usually two or more species of woody plants are associated in most sections of grassland, frequently one more abundant than the others. The three types of Grassland are: (a) Roughland-grassland with large amounts of associated shrubs; (b) Roughland-grassland of relatively thick cover of grasses; and (c) Smoothland grassland.

The first of these consists of a rather thin cover of grasses in most places and depends largely on the depth of the soil. In general, the less rough places have a growth mainly, of grama grasses, the amount depending on thickness of soil. The main species are black, woolly foot, and side oats grama, although in some of the Big Bend areas Chino grass is very abundant. Some needle grass also occurs. Associated with this grassland are many shrubs of which the more common are lechuguilla and sotol and, in southerly sections, cenizo, huajillo, guayule, guayacan, candelilla, and Resurrection plant. In the Big Bend district some of the peculiar shrubs, *Hechtia texensis*, also occur. Various other common shrubs are catclaw, mesquite, ocotillo, cacti, yucca, *Parosela formosa, Viguiera stenoloba,* prickly pear, mariola, little buckthorn, canatilla, sumac, lote bush, selloa, and agrito. Small oaks, pine, and juniper grow on some of the higher mountains. Sacahuiste occurs in places. This grassland occurs mostly on the Edwards Plateau, Carmen, Santiago, Delaware, Grass, Hueco, and Franklin Mountains, and Sierra Diablo. Numerous very narrow valleys within these areas have a relatively large amount of grasses and smaller proportions of shrubs. In the Edwards Plateau area some of these valleys have considerable buffalo grass. The Grassland of this community occurs largely on the limestone (Ector) soils, and limestone Rough stony land.

The Roughland-grassland of relatively thick cover also varies in proportion and amounts of plants according to the depth of soil and character of the surface. On the smoother surfaces the grass dominates and after rains becomes thick and abundant in many places. This community of grasses consists largely of black grama, though there are also some blue, side oats, woolly foot gramas and *Bouteloua chondrosioides*. On the rougher slopes, where usually considerable soil is lodged between the rocks, there are considerable amounts of such coarse grasses as needle grasses, bluestems, *Elyoncrus barbiculmis, Epicampes berlandieri, E. emersleyi, Heteropogon contortus*, Texas timothy, and others. The grama grasses, with these coarser grasses, constitute largely the excellent range of the Davis Mountain section. Associated with these grasses in places are some pine, oak, and juniper. On some of the lower slopes in places, usually in thin soil areas, are some sotol and lechuguilla. A thin scattering of shrubs in places consist mainly of yucca, sumac, buckeye, persimmon, catclaw, and others This plant association occurs chiefly in Davis, Chisos, Bofecillos, Chinati, Tierra Vieja, and Eagle mountains and some other smaller roughland areas of igneous rocks. The narrow valleys of these mountains have a thick growth of the grasses. The principal soils are Brewster stony soils, and associated Rough stony land.

The Smoothland-grassland consists largely of several species of grama grass, mainly black and blue grama, with in places some needle grasses, sacahuiste, small amounts of curly mesquite, and others, whereas in other places tobosa grass is dominant and practically the only growth over considerable areas. Shrubs occur thinly scattered for the most part over this grassland, these consisting mostly of lote bush, catclaw, canatilla, tree cactus, yucca, mesquite, and others. The soils on which this grassland occurs are mostly deep and free of stones, although some are gravelly. The main areas occur on Marfa, Presidio, and Diablo Plateaus, Valentine, and Marathon basins and on parts of the Pecos Plain. The principal soils on which this community occurs are of the Reagan series.

2. *Mesquite-sand sage.*—The dominant growth of this community consists of mesquite shrubs, with considerable sand sage in places. The plant cover is very thin and scattering, although after rains some coarse grasses and weeds are numerous, consisting of some species of **Sporobolus,** wild flax, and some Acanthochiton wrightii, Gutierrezia sp., spectacle plant, globe mallow and others. Occasional accom-

panying shrubs are yucca, canatilla, Chamiza, and lote bush. This plant association occurs on deep sands, and in places where the mesquite dominates, and the sand is blown up around the shrubs with only a small amount of the branches projecting from the sounds. This growth occurs over the main portion of Hueco Bolson. This is a comparatively small proportion of the Trans-Pecos Area. This plant community occurs mainly on Reeves sandy soils.

3. *Yeso-salt grass.*—This community of peculiar plants comprises a very sparse growth of probably less than five to ten per cent growth cover. Yeso grass *(Bouteloua breviseta)* occurs in places, with tussock grass in scattered depressions. In places, especially near salt lake beds, there is a considerable amount of salt grass *(Distichlis spicata)* indicating a considerable amount of salt or alkali present in the soil. A very thin scattering of stunted shrubs consist mostly of *Coldenia hispidissima*, juniper, yucca, *Krameria grayii*, sumac, cactus, and mesquite shrubs. Some chamiza, broom weed, *Dondia diffusa*, creosote bush, and burroweed also occur in places. This vegetation occurs entirely on areas of "gypland" in Salt Basin and on Culberson Plateau. Much of this land is bare soft gypsum with only a very slight layer of soil, although it is several inches deep in uneroded positions. This group occupies shallow soils of the Reeves series, much of it being on Reeves silty-clay loam.

4. *Bottomland, mixed trees, and shrubs.*—This community of plants is confined to the alluvial bottomlands which, in the aggregate, constitute a relatively small proportion of the area. The larger vegetation consists mainly of small trees of mesquite and screw bean in Rio Grande Valley and in mountain valleys of some oaks, walnut, wild cherry, cotton, willow, and ash. In Pecos River Valley mesquite, desert willow, and tamarisks prevail. In addition to this growth, in the river bottoms there is considerable of such shrubs as **Pluchea sericea,** and tomatillo, and some salt grass, and saccaton. The smaller valleys have many of the grasses of Grassland types and considerable catclaw. The soils are of Gila, Pecos, Toyah, and other alluvial series.

5. *Creosote-blackbrush.*—This type of vegetation occurs over probably about one-third of the Trans-Pecos Area. It is composed mainly of the two shrubs, creosote and black-

brush, which are sometimes called desert shrubs. A very slight amount of other plants occur in association with this group. The creosote bush grows alone over much of the land with very slight amounts of catclaw (*Acacia vernicosa)*, ocotillo, lote bush, and in some rougher positions a scattering of lechuguilla and sotol, cacti, prickly pear, yucca, and occasional clumps of burro grass. The creosote bush grows most dominantly on the very shallow and very gravelly soils, or in positions where soils have the very slightest amount of moisture. The black brush occurring in close association with creosote bush chooses the deeper soils and depressions with better moisture conditions and is accompanied in many places by small amounts of burro grass, tobosa grass, tussock grass and *Triodia* species, with occasional shrubs such as mesquite, lote bush, yucca, prickly pear, and catclaw. Where spots of soil occur with considerable salt content salt grass, chamiza, and pickleweed are also found. This group occurs chiefly on a large portion of Pecos Plain, in parts of Valentine, Sierra Blanca, Salt, Stillwell, Marathon, San Francisco, and Big Bend basins; in areas of Edwards and Diablo plateaus; and on Rio Grande gravel plain. It also occurs in Alamito, Tornillos, and Maravillas valleys. The soils are mostly moderately heavy in texture and are located where moisture is usually very slight. The surface is mostly smooth and flat. The Reeves silty-clay loam and the gravelly loam are occupied mainly by the creosote bush, whereas the Reeves silty clay loam, deep phase, has much of the black brush.

CHLOROPHYLL DEFICIENCIES INDUCED IN COTTON (GOSSYPIUM HIRSUTUM) BY RADIATIONS[1]

By

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Chlorophyll deficiencies, both partial and complete, have been found rather frequently among numerous species of plants. The inheritance of many of these has been studied in detail in various crops of economic importance, particularly in maize and sorghum. A considerable portion of the genetic studies that have been made in these two species have dealt with chlorophyll deficiencies. Hitherto only one instance of a complete chlorophyll deficiency has been recorded in *Gossypium,* that reported by Stroman and Mahoney [4] in 1925. This chlorophyll-deficient seedling type segregated out from a cross of two different species of cotton, *Gossypium barbadense* and *Gossypium hirsutum.* It was shown to be due to the presence of two recessive genes, one of which was contributed by each parent. Stroman and Mahoney reported also on a seedling type showing chlorophyll deficiency in a part of each leaf. This type was hereditary.

Likewise numerous chlorophyll deficiencies have been produced artificially in various plants that have been subjected to X-ray treatment. Our studies concerning the effects of X-radiation on cotton have yielded several cases of chlorophyll deficiencies.

The plants grown from X-rayed dry seed developed large numbers of variegated leaves with chlorophyll-deficient areas. This was particularly true when a line of virescent yellow cotton was used. All the plants produced from seeds of this line that had been subjected to a heavy X-ray treatment (100 K. V., 5 ma., for 60 minutes, at a target distance of 17 cm.) produced variegated leaves on either all or some portion of the plant. When lighter treatments were given, the amounts of variegation were less.

[1] Contributed from the Agricultural Experiment Station, Technical Series, paper No. 180.

[2] Professor of Genetics, Agricultural and Mechanical College of Texas.

[3] Agronomist, Texas Agricultural Experiment Station.

[4] Stroman, G. N., and Mahoney, C. H., Heritable chlorophyll deficiencies in seedling cotton: Texas Agric. Exper. Sta., Bull. 333, 1925.

The variegated leaves produced were of two types, splotched and angular. Leaves of both types had areas that were devoid of chlorophyll. Two leaves showing splotched variegation are shown on Plate II, fig. 1. These leaves indicate that some very distinct cytoplasmic disturbance or abnormal chromosome behavior or both had been induced. Plate II, figs. 2, 3, and 4 show examples of angular variegations, or sectorial chimeras, in which chlorophyll-deficient areas are evident. These are of particular interest as being highly indicative of nuclear changes. An unequal nuclear division early in development will cause different sec-

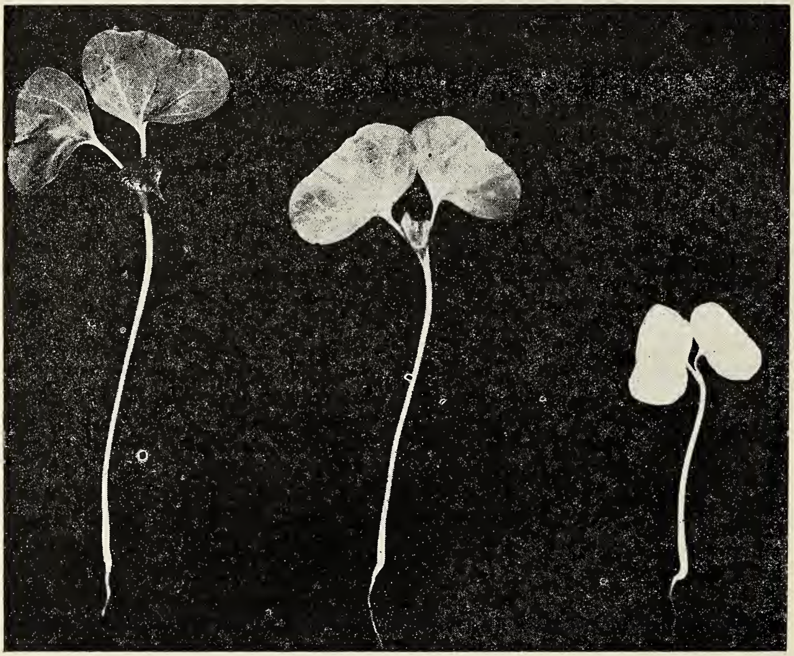

Fig 1. Cotton seedlings of the three types, green, virescent yellow, and yellow.

tions of the leaf to develop into different types whenever different genes are distributed to the two areas. The colorless sections can be accounted for by assuming that the genes for color have become lost from that area. If the radiation should cause a mutation of one gene to albinism and then non-disjunction should occur so that the chromosome bearing the normal allelomorph were lost from the cell, the

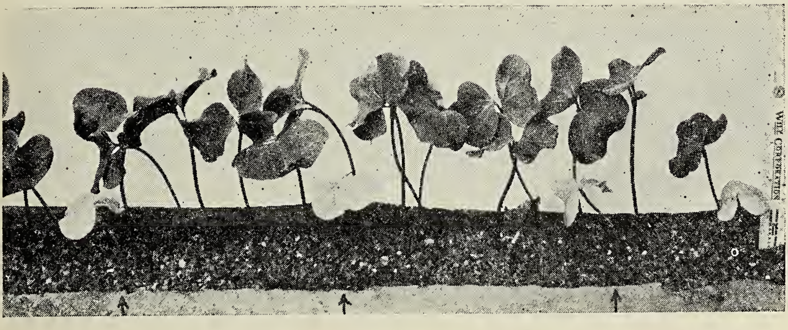

Fig. 2. Yellow seedlings segregating from red-leaf cotton grown in the greenhouse.

Fig. 3. Yellow seedlings segregating from red-leaf cotton grown in the field.

Fig. 4. Yellow seedlings segregating from green-leaf cotton grown in the field.

production of these albino sections of the leaves would be brought about.

The production of such large numbers of variegated leaves in the X-rayed lines shows that radiations produce very pronounced effects on cotton. This is especially true when it is considered that variegated leaves are rarely ever produced by non-rayed cotton. The only variegated leaf observed on several hundred control plants is shown on Plate II, fig. 5. The variegated area in this case is very small.

The chlorophyll deficiencies mentioned above are due to somatic changes[5] and do not necessarily affect the germ cells. However, germinal mutations were produced also. Chlorophyll-deficient seedlings of a type that we have named yellow appeared among the progeny from three different plants that had been grown from X-rayed seed. These plants were from three different lines of cotton: homozygous red-leaf cotton, homozygous green-leaf cotton, and a line that was green leaf but was heterozygous for virescent yellow. No yellow seedlings were found among the controls from any of these lines. Figure 1 shows seedlings of the three types, green, virescent yellow, and yellow. This gives an idea of the relative amount of pigment in these three types of seedlings, also of their differences in rate of growth. Yellow seedlings segregating from the red-leaf line grown in the greenhouse are shown in figure 2, from the red-leaf line grown in the field in figure 3, and from the green-leaf line grown in the field in figure 4.

A larger view of the leaves of a single yellow seedling is shown on Plate II, fig. 6. The word "yellow," or "golden," describes the color of these seedlings rather accurately. They are completely devoid of chlorophyll. The yellow hue is caused by the yellow pigment that is present in these seedlings. This yellow pigment is present in green cottons, but is covered up by the chlorophyll. The black areas are the resin glands, which are also present in all cotton and show up plainly in the yellow seedlings because of the absence of chlorophyll. The yellow segregates from the red-leaf line contained numerous red flecks. These facts indicate that yellow deviates from other cotton only in that it contains no chlorophyll. This fact is further emphasized by cross-sections of a green seedling leaf and of a yellow seedling leaf (Pl. II, fig. 7).

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[5] Horlacher, W. R., and Killough, D. T., Somatic changes induced in Gossypium hirsutum by X-raying seeds: Jour. Hered., vol. 22, p. 253-262, 1931.

Yellow is lethal. These seedlings die after using up the stored food material of the seed. Death usually occurs about two weeks after emergence, at which time the yellow seedlings will have reached a height of 4.5 cm. as compared with 10 cm. by green seedlings and 9 cm. by virescent yellow seedlings.

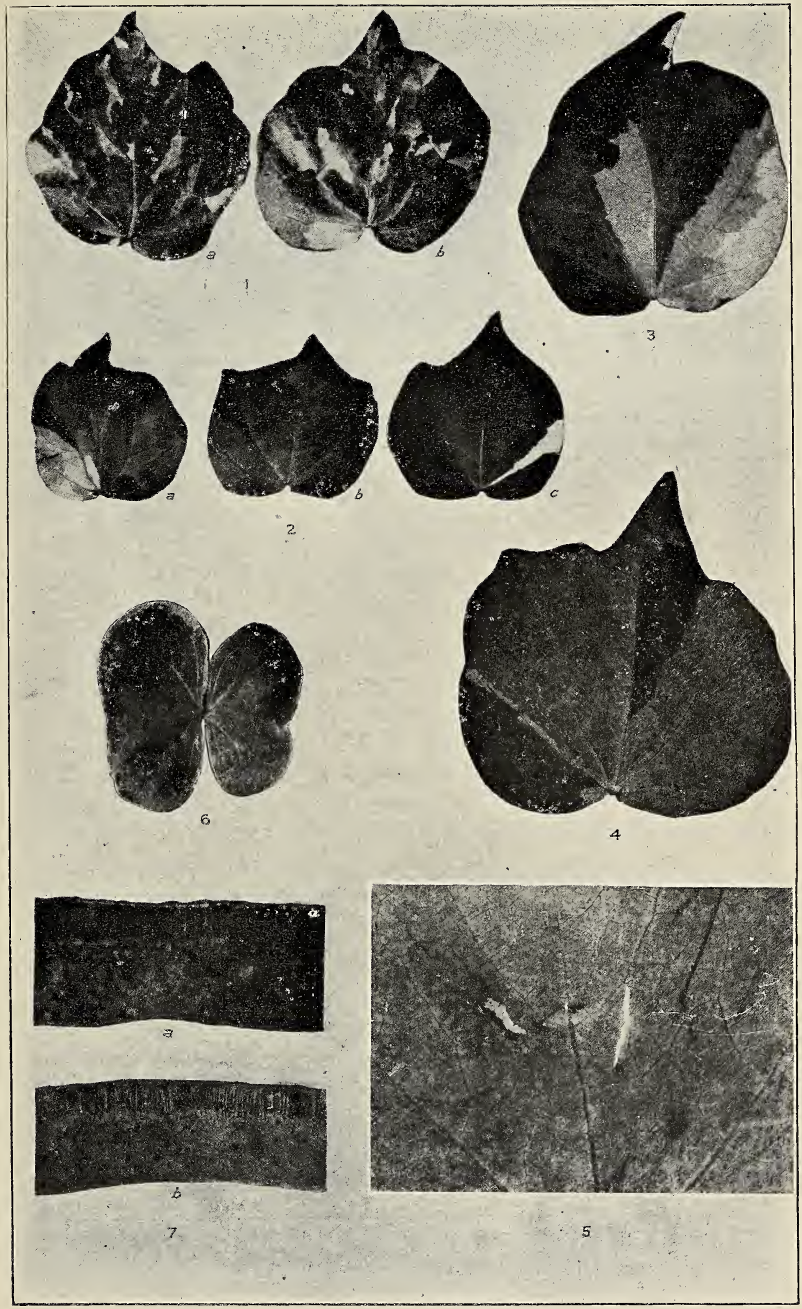
Data concerning the exact nature of the inheritance of yellow could not be taken from the generation in which the yellow seedlings first appeared, because it could not be determined whether the mutation was induced in all or only a part of the parent plant. Seedling progeny grown from heterozygous plants of that generation have, however, been found to segregate in a ratio of 3 green : 1 yellow, the exact figures being 41 green : 15 yellow. "Green" as used here includes both green and virescent yellow seedlings. This shows that yellow is produced by a single gene which is recessive to normal green.

Several other mutations, both those that are evident in the somatic tissue of the plant grown from the X-rayed seed and those that are definitely hereditary have been induced in cottons that we have X-rayed. These include changes in the type of plant, in leaf shape, in leaf form, and other changes in color than those described in this paper. Taken together they show definitely that mutations can be induced in *Gossypium* by radiations.

PLATE II

Figures—

1. Two leaves showing splotched variegation with chlorophyll-deficient areas.
2. Angular variegation in cotton leaves. Note chlorophyll-deficient areas in the leaves in *a* and *c*.
3. Cotton leaf showing angular variegation with two chlorophyll-deficient areas.
4. Cotton leaf showing angular variegation. Note chlorophyll-deficient area on the left.
5. The only variegated leaf observed among several hundred control cotton plants. This variegated area is very small.
6. The cotyledon leaves of a yellow cotton seedling. These leaves are completely devoid of chlorophyll. The black dots are resin glands.
7. Cross section of the cotyledon leaf of a green cotton seedling, *a*, and a yellow cotton seedling, *b*. The light color of the yellow cotton seedling is due to the absence of chlorophyll. x85.


a
b
1
3
a
b
c
2
6
4
a
b
7
5

CATALOGUE OF TEXAS HEPATICAE

With Notes on the Habitat and Distribution

By

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INTRODUCTION

The sources from which this list have been prepared have necessarily been largely the collections in the herbarium of The University of Texas. Through correspondence it has been possible to amplify the list of species in the university herbarium by procuring the names of specimens that have been sent away for identification and are not in our collections.

Very few references to Texas Hepaticae are to be found in the literature on American bryophytes. It is quite probable that an examination of the herbaria of the country will reveal many Texas species that have not been referred to in the literature. Revisions of genera, such as those of Professor Evans on the genus *Asterella* and the genus *Marchantia,* will undoubtedly bring to light other Texas forms.

It will be seen from an examination of the list that Texas, at least the region about Austin, is especially rich in members of the Marchantiaceae. Ten of the genera included in the order in "North American Flora" have been found in Texas, all but one of which *(Ricciocarpus)* is frequent, at least in the Austin area. It is very probable that other species of some of these genera will be found in the state, as well as some genera not yet known in the state.

From the list of families and genera of the Order Marchantiales it will be seen that the family Sauteriaceae and the genus *Bugecia* of the family Marchantiaceae are arctic or alpine and probably will not be found in Texas, even in the mountains of the Trans-Pecos country. From their range, it seems certain that *Lunularia* and *Dumortieria* must occur in Texas, and since Mexican and California species can be expected in Texas, *Targionia* and *Cryptomitrium* may also occur here.

The Jungermanniales are very poorly represented in this part of the state, or else they have been overlooked in collecting. It is quite certain that they are not so abundant as in the moister parts of the country. According to Evans and Nichols, "the Jungermanniales are about nine times as numerous in Connecticut as the Marchantiales."[1]

It will be observed that this list shows that about twice as many members of Marchantiales as Jungermanniales have been found in Texas.

Order MARCHANTIALES

(Families and genera as given in *North American Flora*)

Family RICCIACEAE—

Genus Riccia. 25 species known in North America; 16 occur in Texas.
Genus Ricciocarpus. One species in N. A.; in Texas.
Genus Oxymitra. One species in N. A.; in Texas.

Family CORSINIACEAE—

Genus Corsinia. One species; in Texas.

Family TARGIONIACEAE—

Genus Targionia. One species in N. A.; in Arizona and Mexico.
Genus Cyathodium. One species in N. A.; "Cuba; perhaps Mexico".

Family SAUTERIACEAE—

Genus Clevia. One species in N. A.; arctic and alpine.
Genus Sauteria. One species in N. A.; arctic and alpine.
Genus Peltolepis. One species in N. A.; arctic and alpine.

Family REBOULIACEAE—

Genus Plagiochasma. Seven species in N. A.; all southwestern U. S. and Mexico. *P. rupestre*, cosmopolitan.
Genus Grimaldia. Four species in N. A.; *G. fragrans* in Texas; *G. californica* also perhaps.
Genus Cryptomitrium. One species in N. A.; in California and Mexico.
Genus Reboulia. One species in N. A.; in Texas; cosmopolitan.
Genus Asterella. Fifteen species in N. A.; two in Texas, four others probable.

Family MARCHANTIACEAE—

Genus Lunularia. One species in N. A.; probably in Texas.
Genus Conocephalum. One species in N. A.; in Texas.
Genus Dumortiera. Two species in N. A.; both probably in Texas.
Genus Bugecia. One species in N. A.; "on calcarcous rocks at high altitudes".
Genus Preissia. One species in N. A.; apparently not southern.
Genus Marchantia. Five species in N. A.; two known in Texas, *M. polymorpha* must also occur there.

LITERATURE

The literature on the Hepaticae of North America is scanty and not entirely satisfactory for beginners. Many

[1] Evans, A. W., and Nichols, G. E., The bryophytes of Connecticut: State Geol. & Nat. Hist. Survey Bull. 11, p. 17, 1908.

of the publications carry no illustrations, and for one who has little or no training in visualizing a technical description illustrations are imperative. The following publications comprise the comprehensive literature on the Hepaticae, and the Bibliography at the end of this paper presents numerous special papers of interest in connection with a study of this group.

North American Flora, Pt. I, Vol. 14, includes the orders Sphaerocarpales and Marchantiales, and for those who are somewhat experienced with Hepaticae nothing more could be desired. Its lack of illustrations makes it difficult for beginners. This can be obtained from the publishers, New York Botanical Garden, Bronx Park, New York, N. Y.

Mosses with a hand Lens, by A. J. Grout. M. A. Howe gives a brief account of the Hepaticae. Its numerous illustrations make the book very helpful to beginners, and since the student of this group is quite certain to become interested in mosses, sooner or later, it is a very good guide to begin with. It is obtainable from Dr. A. J. Grout, 1 Vine Street, New Brighton, New York, N. Y.

A Descriptive Catalogue of the North American Hepaticae, north of Mexico, by Underwood, has been long out of print. It covers the entire field of the Hepaticae and is worth having, though it contains no illustrations. It may perhaps be obtained from C. E. Stechert & Co., 31-33 East 10th Street, New York, or from Henry George Fiedler, 89 Chambers St., New York, N. Y.

The Bryophytes of Connecticut, by Evans and Nichols, contain keys that are especially helpful for the Jungermanniales, which comprise so large a proportion of the Connecticut Hepaticae. Since this group is represented by so few species in Texas, however, these keys are not so useful here as in a moister region. This is probably still obtainable from George S. Godard, State Librarian, Hartford, Conn.

Order SPHAEROCARPALES
Family SPHAEROCARPACEAE
Genus **SPHAEROCARPOS** (Micheli) Boehm.

Sphaerocarpos texanus Aust. (Pl. 4, fig. 1)

Moist, sandy soil, along paths and in bare places. Fruits from December to March.

Distribution—Texas: San Marcos (Wright, 1849), Austin, Bastrop, College Station (LaMotte). Virginia to Missouri, Florida, California. Uruguay, Europe, and northern Africa.

References—Bull. Torrey Club, vol. 6, pp. 157-158, 1877; N. A. Flora, vol. 14, p. 4, 1923.

Recognized by the minute, sac-shaped involucres on the female gametophyte, which contain the archegonia and later sporophytes. Involucres are short-cylindrical, about 1.5 mm. in length and have a small opening at the apex. The spores are permanently united in fours.

Genus **RIELLA** Mont.

Riella americana Howe and Underwood.

Growing erect or semi-erect in water.

Distrisbution—Texas: Limpia Canyon (Howe and Underwood), and pond near Lubbock (Studhalter).

References—Bull. Torrey Club, vol. 30, pp. 214-224, 1903; N. A. Flora, vol. 14, p. 7, 1923.

This rare liverwort can be recognized by its habit of growth and by the ruffled or ribbonlike thallus.

Order MARCHANTIALES
Family RICCIACEAE

Genus **RICCIA** (Micheli) Linnaeus

KEY (adapted from Howe, N. A. Flora, vol. 14, p. 11, 1923)—

1. Thallus "spongy," i.e. with large air chambers communicating with the outer surface, giving the thallus a spongy appearance.
  2. Thallus floating in water or creeping on wet ground; main segments of thallus narrowly linear.______________*R. fluitans*
  2. Thallus growing on moist soil.
    3. Spores separating before maturity; thallus conspicuously spongy.
      4. Spores angular, areolate or ridged.
        5. Spores areolate, at least on the outer face.
          6. Areola of outer face of spores 8-13 microns broad; thallus margins obtuse; scales rudimentary____*R. sullivantii*
          6. Areola of outer face of spores 10-30 microns broad, those of the middle sometimes larger and enclosing a free-ending spur or an isolated tubercle. __________________________________*R. crystallina*
        5. Spores marked with short, delicate ridges which rarely anastomose; thalli dioecious.________________*R. frostii*
      4. Spores ovoid, ellipsoidal, subglobose, spinulose.____*R. membranacea*
    3. Spores adhering in fours.____________________*R. curtisii*
1. Thallus "solid," i.e. with very narrow vertical or subvertical air-canals which are usually not noticeable at the surface.
  7. Thallus-margins naked or showing latero-ventral scales, not ciliate.
    8. Scales conspicuous, extending beyond the margin of the thallus, whitish-hyaline.________________________*R. austini*
    8. Scales usually inconspicuous, not reaching the margin.
      9. Dorsal surface of the thallus more or less green, not calcified.
        10. Spores angular, distinctly wing-margined.
          11. Scales whitish or brownish, rarely tinged with violet.
            12. Thallus margins green, hyaline or occasionally violet.

13. Median sulcus narrow and acute.__*R. sorocarpa*
13. Median sulcus obtuse, commonly occupying one-third or more of the width of the thallus.
14. Thalli 6-10 mm. long, the segments mostly 1.5-2.5 mm. wide.__________________*R. glauca*
14. Thalli mostly 3-6 mm. long, the segments mostly 1-1.5 mm. wide.__________*R. arvensis*
12. Thallus-margins commonly yellowish-brown or salmon-colored, thin and membranous.________ ______________________________*R. campbelliana*
11. Scales blackish-purple; thallus segments 0.6-1.25 mm. wide. ____________________________*R nigrella*
10. Spores obscurely or not at all angled; wing margins wanting or rudimentary. Thalli 2-20 mm. long, the segments 1-3.5 mm. wide, the margins not papillate.
15. Spores at first violet, soon violet-black and opaque. ____________________________*R. McAllisteri*
15. Spores brown; thallus-margins blackish purple. _________________________________*R. dictyospora*
9. Dorsal surface of thallus chalk-white, calcified. ______ ____*R. albida*
7. Thallus-margins normally bearing few to many cilia or setae.
16. Monoecious; thallus segments 0.6-2.5 mm. wide.
17. Cilia 0:05-0.4 mm. long, none on dorsal surface above capsules.
18. Antheridial ostioles conspicuous; cilia stout; median sulcus rather broad, occupying one-third to two-fifths the width of the thallus________*R. beyrichiana*
18. Antheridial ostioles inconspicuous or lacking; cilia slender; median sulcus narrow.______________*R. hirta*
17. Cilia or setae 0.3-0.9 mm. long, slender, commonly 1-12 on dorsal surface above each capsule____*R. trichocarpa*
16. Dioecious; thallus-segments 2-7 mm. wide; cilia stout.___ ____*R. donnellii*

Riccia fluitans L.

Thallus growing floating in water or on moist soil as water recedes. Rarely fruiting.

Distribution—Texas: San Marcos, Marble Falls, Enchanted Rock north of Fredericksburg, Ottine marshes. Cosmopolitan.

Reference—Howe, N. A. Flora, vol. 14, p. 13, 1923; Underwood, N. A. Hepaticae, p. 28, 1883.

This species is recognized by its floating habit and by its slender, linear thallus.

Riccia crystallina L. (Pl. 3, fig. 1)

On moist earth, often near springs or on margins of ponds. Fruits in spring, February to April.

Distribution—Texas: Austin area (Onion Creek and Colorado River below Austin dam), Dripping Spring, Marble Falls. Throughout United States, West Indies, Europe.

References—Howe, N. A. Flora, vol. 14, p. 15, 1923; Underwood, N. A. Hepaticae, p. 27, 1883.

This species is recognized by the conspicuously spongy nature of the thallus.

Riccia curtisii T. P. James

On moist, sandy soil. Fruits often as early as December.

Distribution—Texas: Austin, Bastrop, Hammett's Crossing on Pedernales River, Young's Ranch in Blanco County. North Carolina to Florida.

References—McAllister, Bull. Torrey Club, vol. 43, pp. 117-126, 1916; Haynes, Bull. Torrey Club, vol. 47, pp. 279-287, 1920; Howe, N. A. Flora, vol. 14, p. 17, 1923.

Recognized by the spongy thallus and the spores that adhere in fours.

Riccia austini Stephani (Pl. 3, fig 3)

Seems to prefer calcareous soils, though occasionally found in sandy habitat. Often fruits as early as December.

Distribution—Texas: Bastrop, Real County, sandy seashore at Aransas Pass. Connecticut to Texas, California.

References—Howe, Mem. Torrey Club, vol. 7, p. 24, 1899 (as *R. americana* nov. sp.); Howe, N. A. Flora, vol. 14, p. 17, 1923.

Easily recognized by its conspicuous, whitish scales, which extend considerably beyond the thallus margins. When dry the scales are uppermost on the thallus.

Riccia sorocarpa Bisch.

Sandy soil. Fruits in winter, usually January and February, though may be later, if moisture conditions are suitable.

Distribution—Texas: Austin (Botanical Gardens) and vicinity, Bastrop. Massachusetts to Washington, California, Alabama, Greenland, Europe, Asia, and northern Africa.

References—Underwood, N. A. Hepaticae, p. 24, 1883, Howe, N. A. Flora, vol. 14, p. 18, 1923.

Small and not easily recognized; distinguished from *R. glauca* and *R. arvensis*, which are near it in size, by the narrow median sulcus as compared with the wide sulcus in these two species.

Riccia glauca L. (Pl. 4, figs. 3-5)

Sandy soil. Reproduces during mid-winter.

Distribution—Texas: Bastrop. California, Europe.

References—Underwood, N. A. Hepaticae, p. 23, 1883; Howe, N. A. Flora, vol. 14, p. 18, 1923.

Riccia arvensis Aust.

"Rocky ground and cultivated fields." I have found it only at Granite Mountain near Marble Falls and at Enchanted Rock north of Fredericksburg growing in dense masses, in places covering several square feet. These perennnial plants dry up during the summer and become active when moistened.

References—Underwood, N. A. Hepaticae, p. 25, 1883; Haynes, Bull. Torrey Club, vol. 47, pp. 279-287, 1920; Howe, N. A. Flora, vol. 14, p. 19, 1923.

R. glauca and *R. arvensis* are very similar in the characters of the individual thalli and spores, and both have the wide median sulcus. Although *R. glauca* is in general much larger than *R. arvensis*, a small specimen might not be far different from it in size. .The dense mats of thalli of *R. arvensis* and its habitat give a very definite clue to its identification.

Riccia campbelliana M. A. Howe

Sandy soil. Fruits during January and February.

Distribution—Texas: Bastrop, College Station (LaMotte), Enchanted Rock north of Fredericksburg, Granite Mt. near Marble Falls. California.

References—Howe, Mem. Torrey Club, vol. 7, p. 26, 1899; Howe, N. A. Flora, vol. 14, p. 19, 1923.

Distinguished by its membranous, salmon-colored thallus margins.

Riccia nigrella DC.

Sandy soil, along with *R. campbelliana, R. curtisii, R. trichocarpa*, and others.

Distribution—Texas: Bastrop, Granite Mt. near Marble Falls, Enchanted Rock north of Fredericksburg.

References—Underwood, N. A. Hepaticae, 1883; Howe, Mem. Torrey Club, vol. 7, p. 28, 1899; Howe, N. A. Flora, vol. 14, p. 20, 1923.

Distinguished, with some difficulty, by its small size, the dark purple of the under surface of the thallus and the dark purple ventral scales.

Riccia McAllisteri M. A. Howe

Distribution—Texas: Granite Mt. near Marble Falls, Enchanted Rock north of Fredericksburg, Austin.

References—Bryologist, vol. 20, pp. 33-37, 1917; Howe, N. A. Flora, vol. 14, p. 21, 1923.

Should be distinguished by the spores, which are obscurely or not at all angled and without wing margins, and which are at first violet and finally opaque. Spore characters are, however, troublesome for beginners.

Riccia dictyospora M. A. Howe (Pl. 3, fig 6)

Sandy soil, with *R. campbelliana, R. trichocarpa, R. curtisii*, and others.

Distribution—Texas: Austin, Bastrop, Industry. Connecticut and Georgia.

References—Howe, Bull. Torrey Club, vol. 28, pp. 161-165, 1901; Howe, N. A. Flora, vol. 14, p. 22, 1923.

This species can be distinguished from *R. McAllisterii*, which it resembles in possessing spores that are not angular and are without wing margins, by its brown, rather translucent spores as compared with the violet-black, opaque spores of the former.

Riccia albida Sull. (Pl. 3, fig. 2)

Growing on calcareous rocks of the Edwards Plateau. Fruits early, November and December.

Distribution—Texas: Uvalde, Kerrville, Real County. Type material collected by Wright in Texas.

Reference—Howe, N. A. Flora, vol. 14, p. 23, 1923.

Recognizable by its white, more or less calcified, spongy surface, both in living and dried material.

Riccia beyrichiana Hampe

On sandy soil. Fruits in winter.

Distribution—Texas: Austin, Bastrop, Padre Island. Massachusetts to Florida, California, British Columbia, Europe.

References—Underwood, N. A. Hepaticae, p. 23, 1883; Howe, Bull. Torrey Club, vol. 28, pp. 161-165, 1901; Howe, N. A. Flora, vol. 14, p. 23, 1923.

Distinguished by its stout cilia, which are usually present at the margin, and also by its broad median sulcus.

Riccia hirta Aust. (Pl. 3, figs. 4, 5; Pl. 4, fig. 2)

Sandy soil. Fruits during the moist months.

Distribution—Texas: Austin, Bastrop. Connecticut to Louisiana.

References—Underwood, Bot. Gaz., vol. 19, pp. 273-278, 1894; Howe, N. A. Flora, vol. 14, p. 24, 1923.

The plants are small and are not easily recognized, but the narrow median sulcus separates it from the other Riccias with ciliate margins. Cilia, however, are sometimes lacking.

Riccia trichocarpa M. A. Howe

Usually on sandy soil, along paths, and in newly denuded areas. Fruits during the moist winter months.

Distribution—Texas: Austin, Bastrop, Enchanted Rock north of Fredericksburg, West Cave half a mile west of Hammett's Crossing on Pedernales River (30 miles west of Austin).

References—Howe, Bull. Torrey Club, vol. 25, pp. 183-193, 1898; Howe, Mem. Torrey Club, vol. 7, p. 17, 1899; Howe, N. A. Flora, vol. 14, p. 25, 1923.

Recognized easily by its small size and by its numerous, conspicuous bristles around the margin and on the surface above each capsule.

Riccia donnellii Aust. (Pl. 3, fig. 7)

On sandy soil, "gardens and cattle ranges." Fruits during January and February.

Distribution—Texas: Bastrop, Austin, College Station (LaMotte). Florida.

References—Underwood, N. A. Hepaticae, p. 27, 1883; Howe, N. A. Flora, vol. 14, p. 25, 1923.

Recognized by the dioecious thalli and the conspicuous cilia. The antheridial ostioles are very conspicuous. This is the largest of our Riccias.

Genus **RICCIOCARPUS** Corda

Ricciocarpus natans (L.) Corda

Thalli usually floating in ponds; as ponds dry up it often lives on the moist margins.

Distribution—Texas: Liberty. Cosmopolitan. Ontario to British Columbia, San Luis Potosi in Mexico, Cuba.

References—Underwood, N. A. Hepaticae, p. 27, 1883, (as *R. lutescens*); Howe, N. A. Flora, vol. 14, p. 26, 1923.

Recognized by its floating habit and the thick thallus bearing numerous rhizoids. The thallus tends to be circular, and this with its stoutness makes it very different from Riccia fluitans.

Genus **OXYMITRA** Bisch.

Oxymitra androgyna M. A. Howe (Pl. 4, fig. 6)

Found in exposed places, along paths, and in naked areas; usually on sandy soil, though not uncommon on calcareous soil. Fruiting from December to March. Thallus perennial.

Distribution—Texas: Austin (common), Bastrop, Granite Mt. near Marble Falls, College Station (Blodgett), Enchanted Rock north of Fredericksburg.

References—Howe, Bryologist, vol. 17, pp. 72-75, 92-94, 1914; Howe, N. A. Flora, vol. 14, p. 27, 1923.

The thallus has large whitish scales, which project beyond its margin to form a conspicuous fringe. Upon drying the thallus rolls up, and the scales come to be uppermost. The fruiting thalli have cone-like involucres arising in the median sulcus.

Family CORSINIACEAE

Genus **CORSINIA** Raddi

Corsinia coriandrina (Spreng.) Lindb. (Pl. 4, fig. 7)

On moist, sandy soil, forming extensive matted areas, which propogate by tuberous outgrowth of the thallus. Fruits in winter.

Distribution—Texas: Austin, Bastrop, College Station (LaMotte). Possibly Louisiana. Europe, Algeria, Japan, and South America.

References—Evans, Bryologist, vol. 22, pp. 54-73, 1919; Howe, N. A. Flora, vol. 14, p. 29, 1923.

It can be recognized by the thick thallus with chlorophyll-bearing upper part and the lower storage tissue; the sporophytes are borne singly or in groups in depressions in the thallus, and each is surrounded by an irregular green calyptra scarcely rising above the surface of the thallus.

Family REBOULIACEAE

Key (A. W. Evans, N. A. Flora, vol. 14:39, 1923)—

1. Pseudoperianth lacking.
   2. Female receptacle becoming dorsal, the stalk without a rhizoid-furrow; operculum falling away in fragments.____1. Plagiochasma
   2. Female receptacle terminal, the stalk with a single rhizoid-furrow.
      3. Female receptacle shortly or not all lobed; operculum remaining intact.
         4. Involucre undivided ___________________2. Grimaldia
         4. Involucre bilabiate _________________3. Cryptomitrium
      3. Female receptacle distinctly lobed; involucre bilabiate; operculum falling away in fragments ______4. Reboulia
1. Pseudoperianth present, consisting of a white to purple inflated tube contracted at the mouth, soon becoming longitudinally split into narrow segments usually remaining attached at their tips ____5. Asterella

Genus **PLAGIOCHASMA** Lehm. and Lindb.

Members of this generic group have stalked female receptacles and more or less sessile male receptacles. They are separated from the rest of the American Rebouliaceae by the lack of a rhizoid-furrow in the stalk of the female receptacle. American members of the Marchantiaceae, all of which resemble the Rebouliaceae in their general appearance, have the rhizoid-furrows, except Lunularia cruciata, an introduced species, rarely found outside of green-houses.

Plagiochasma wrightii Sull.

On limestone along creeks. Fruits in February.

Distribution—Texas: Austin and vicinity (Onion Creek), San Marcos (Wright, 1849). Oklahoma, Arizona, Mexico.

References—Evans, Bull. Torrey Club, vol. 32, pp. 259-308, 1895; Evans, N. A. Flora, vol. 14, p. 42, 1923.

Plagiochasma cuneatum A. W. Evans

On limestone rocks and soil. Fruits in February.

Distribution—Texas: Hamilton's Pool (30 miles west of Austin near Pedernales River).

Reference—Evans, Am. Jour. Bot., vol. 19, pp. 626-631, 1932.

Its jointed thallus and the large spores (100 microns in diameter) differentiate P. cuneatum from P. wrightii, the spores of which average 75-80 microns in diameter.

Genus **GRIMALDA** Raddi

Distinguished from the other members of the family by the bleached ventral scales, which extend beyond the margin of the thallus and form tufts of chaffy bristles at the base and apex of the stalk of the female receptacle.

Grimaldia fragans (Balbis) Corda

On dry hillsides, in usually calcareous soil. Fruits in February and March.

Distribution—Texas: Austin, Bastrop, College Station (LaMotte), Ottine. Widely distributed east of Rocky Mountains. Europe and northern Asia.

References—Underwood, N. A. Hepaticae, p. 35 (as *G. barbifrons*) 1883; Evans, N. A. Flora, vol. 14, p. 43, 1923.

Genus **REBOULIA** Raddi

This genus is quite similar to *Grimaldia*, although in the Austin area its only species is noticeably larger; the ventral scales are much less conspicuous, scarcely reaching the margin of the thallus.

Reboulia hemisphaerica (L.) Raddi (Pl. 4, fig. 8)

On calcareous soil, growing best in protected canyons and shaded locations. Fruits during January and February, the earliest of the family to form spores.

Distribution—Texas: Austin (abundant), Bastrop, College Station, Marble Falls. Widely distributed in United States, also in Mexico, West Indies, South America, Europe, Asia, and Australasia.

References—Evans, N. A. Hepaticae, p. 37, 1883; Evans, N. A. Flora, vol. 14, p. 46, 1923.

Genus **ASTERELLA** Beauv.

The genus is distinguished when in fruit by the fimbriate false perianth surrounding the sporophyte.

Asterella tenella (L.) Beauv. (Pl. 4, figs. 9, 10)

Damp rocks in protected ledges; moist soil where competition is not too keen. Fruits between February and March.

Distribution—Texas: Austin, Bastrop, Harwood, Marble Falls, College Station (Blodgett), Hunt County (Saunders). Maine to Ontario and southward to Georgia and Louisiana.

References—Evans, N. A. Species of Asterella, p. 261, 1920; Evans, N. A. Flora, vol. 14, p. 48, 1923.

Asterella echinella (Gottsche) Underw.

On rocky banks usually on limestone. Fruits during February and March.

Distribution—Texas: Austin, Young's Ranch in Blanco County, Granite Mt. near Marble Falls, Miller's Ranch in Real County, Enchanted Rock north of Fredericksburg.

References—Evans, N. A. Species of Asterella, p. 261, 1920; Evans, N. A. Flora, vol. 14, p. 48, 1923.

The female disc of *A. echinella* bears numerous blunt tubercles, whereas the disc of *A. tenella* is smooth. *A tenella* is the larger species and seems to prefer a moister habitat.

Family MARCHANTIACEAE

KEY (A. W. Evans, N. A. Flora, vol. 14:57, 1923)—

1. Thallus with air-chambers and epidermal pores, pale green or more or less pigmented with purple, the upper surface divided into polygonal areas.
   2. Epidermal pores of thallus simple; air chambers in a single layer with vertical green filaments; male receptacle sessile; psuedo perianth lacking.
      4. Receptacles without epidermal pores; stalk of female receptacle without a rhizoid-furrow; cupules present, crescentic ________________1. LUNULARIA
      3. Receptacles with epidermal pores; stalk of female receptacle with a single rhizoid-furrow; cupules lacking________________2. CONOCEPHALUM
   2. Epidermal pores of thallus compound; receptacles stalked and provided with epidermal pores, the stalks with two (or more) rhizoid-furrows; psuedoperianth present.
      4. Air-chambers apparently in several layers, destitute of green filaments ________________4. BUGECIA
      4. Air-chambers in a single layer with vertical green filaments.
         5. Apical innovations present; cupules lacking_5. PREISSIA
         5. Apical innovations lacking, cupules present, cup-shaped. ________________6._ MARCHANTIA
1. Thallus (at least at maturity) without air chambers or epidermal pores, dark green, the upper surface not divided into polygonal areas, receptacles stalked, without epidermal pores, the stalks with two rhizoid-furrows; psuedoperianth and cupules lacking. ________________3. DUMORTIERA

Genus **CONOCEPHALUM** Weber

Recognized by its cone-shaped female disc; in sterile condition it is distinguished from members of the Rebouliaceae by its single layer of air chambers, the boundaries of which are distinctly visible through the epidermis; it is distinguished from *Marchantia* by its lack of gemma cups and by its simple air-pores as compared with the barrel-shaped air-pores of the latter.

Conocephalum conicum (L.) Dumort. (Pl. 4, figs, 11, 12)

Shaded banks and limestone ledges along streams. Fruits during March and April.

Distribution—Texas: Hammett's Crossing on Pedernales River 30 miles west of Austin, Granite Mountain near Marble Falls.

References—Underwood, Bot. Gaz., vol. 20, pp. 59-71, 1895; Evans, N. A. Flora, vol. 14, p. 58, 1923.

Genus **MARCHANTIA** (Marchant f.) Linnaeus

The Marchantias are distinguished from all other forms that are in any way similar by their gemmae, which are borne in cupules on the surface of the thallus. *Lunularia* has crescent-shaped gemma-cups. *M. polymorpha* L. must occur in Texas, since it occurs in Mexico and Central America, but it has not yet been reported. *Lunularia* also probably occurs here, as it is so common in greenhouses, but it has not yet been reported.

Marchantia paleacea Bertol.

In moist shaded places among streams and near springs. Fruits from March to May.

Distribution—Texas: Blanco River near Kyle, Dripping Springs, Mill Seat (10 miles west of Dripping Springs). Arizona to Guatemala, Cuba, Jamaica, Africa, Asia.

References—Evans, American Species of Marchantia, p. 253, 1917; Evans, N. A. Flora, vol. 14, p. 64, 1923.

Marchantia domingensis Lehm. and Underw. (Pl. 4, figs. 13, 14)

On moist limestone ledges near water and on calcareous soils on stream banks. Fruits during April and May.

Distribution—Texas: Austin below Austin dam (Fort Worth (Thompson), Hallettsville (Nealey), Salado (Sealey), Granite Mountain near Marble Falls, Enchanted Rock north of Fredericksburg.

References—Evans, American Species of Marchantia, p. 269, 1917; Evans, N. A. Flora, vol. 14, p. 64, 1923.

The two Texas species are distinguished in sterile material by the cross-shaped inner pore in *M. paleacea*, which is lacking in *M. domingensis*. The gemma cups of the former have deeply and acutely cut lobed margins, whereas the latter species has margins slightly or not at all lobed.

Order JUNGERMANNIALES
Family METZGERIACEAE
Genus **PALLAVICINIA** S. F. Gray

Pallavicinia lyellii (Hook.) S. F. Gray

In boggy places. Fruits from February to April.

Distribution—Texas: Conroe, marshes near Ottine, Beaumont, Atlanta. New Foundland, Ontario to tropical America, Europe, Asia, Africa, New Zealand.

References—Underwood, N. A. Hepaticae, p. 57 (as *Steetzia Lyellii* Lehm.), 1883; Evans, Rhodora, vol. 5, pp. 170-173, 1903; Howe in Grout's Mosses with a Hand Lens, p. 261, 1924.

The thallus is very green and thin and has a distinct midrib. The spore capsule is cylindric, several times longer than broad.

Genus **PETALOPHYLLUM** Nees and Gottsche

Petalophyllum ralfsii (Wils.) Nees and Gottsche

On sandy soil in wet places. Fruits in March.

Distribution—Texas: Austin (M. S. Young), Bastrop, College Station (C. H. Farr).

Reference—Evans, Bryologist, vol. 22, pp. 54-73, 1919.

This plant appears like a large *Fossombronia* to which it is closely related. The thallus is lobed to form leaf-like extensions from the upper surface of the flat thallus. The spore capsule is spherical.

Genus **FOSSOMBRONIA** Raddi

Fossombronia angulosa Raddi

On poor, sandy soil. Fruits from January to March.

Distribution—Texas: Austin-Cameron road. Common in northeastern United States, Europe.

Reference—Underwood, N. A. Hepaticae, p. 60, 1883.

Referring to this Austin material, Dr. M. A. Howe says, "It is possibly the briefly described *F. texana* Lindb., but in default of any authentic specimens (except perhaps in the Lindberg herbarium in Finland) nobody seems to know exactly what *F. texana* is."

Fossombronia longiseta Aust.

Collected by Wright in Texas (1847-1852), but no definite locality was given. Reported also from California and Arizona.

Reference—Underwood, N. A. Hepaticae, p. 60, 1883.

Fossombronia salina Lindb.

On moist soil and damp limestone ledges. Fruits from January to March. Thallus perennial.

Distribution—Texas: Austin (common), Blanco River, Bastrop, Marble Falls.

References—Evans, Rhodora, vol. 5, pp. 170-173, 1903; Evans and Nichols, Bryophytes of Conn., p. 46, 1908.

Fossombronia wondraczekii (Corda) Dumort.

On moist, sandy soil. Fruits from January to March.
Distribution—Texas: Austin.
References—Evans, Rhodora, vol. 5, pp. 170-173, 1903; Evans and Nichols, Bryophytes of Conn., p. 47, 1908.

Family JUNGERMANNIACEAE

Genus **FRULLANIA** Raddi

Frullania inflata Gottsche

On the bark of trees. Fruits in spring.
Distribution—Texas: Austin (not common). Connecticut to Mexico.
References—Evans, Bryologist, vol. 15, pp. 22-26, 1912; Evans, Bryologist, vol. 26, pp. 65-67, 1923.

Frullania squarrosa (R. Bl. and N.) Dumort.

On rocks and trees. Fruits in spring.
Distribution—Texas: Austin, Deep Eddy, Onion Creek, Smithville. Connecticut, Ohio, southward into northern South America, Asia, Africa, Australia.
References—Underwood, N. A. Hepaticae, p. 64, 1883; Evans, Trans. Conn. Acad. Sci., vol. 10, pp. 1-39, 1897; Evans and Nichols, Bryophytes of Conn., p. 73, 1908.

Frullania riparia Hampe

On bark of trees in protected canyons, "on shaded rocks." Fruits in spring.
Distribution—Texas: Austin, Shoal Creek, Onion Creek.
Reference—Evans, Trans. Conn. Acad., vol. 10, pp. 1-39, 1897.

Frullania brittoniae Evans

On rocks and trees, in canyons. Fruits in spring.
Distribution—Texas: Austin. New England to Illinois and southward to Virginia.
Reference—Evans, Trans. Conn. Acad. Sci., vol. 10, pp. 1-39, 1897.

Frullania eboracensis Gottsche

On trees, occasionally on rocks. Fruits in spring.
Distribution—Texas: Austin, Onion Creek, Shoal Creek, all in Travis County.
Reference—Underwood, N. A. Hepaticae, p. 61, 1883.

Genus **CEPHALOZIA** Dumort.

Cephalozia connivens (Dicks.) Lindb.

Moist, sandy stream banks. Fruits in February and March.
Distribution—Texas: Bastrop. Connecticut south to Florida and the Gulf states.
References—Howe, Bull. Torrey Club, vol. 29, pp. 281-289, 1902; Evans, Bryologist, vol. 20, pp. 17-28, 1917; Grout, Mosses with a Hand Lens, p. 291, 1924.

Cephalozia macrostachya Kaalas

Moist soil along streams, usually sand. Fruits in February and March.

Distribution—Texas: Bastrop. Connecticut to Texas.

References—Evans, Rhodora, vol. 17, pp. 107-120, 1915; Evans, Bryologist, vol. 20, pp. 17-28, 1917.

Genus **SCAPANIA** Dumort.

Scapania nemorosa (L.) Dumort.

Moist, sandy banks. Fruits from January to March.

Distribution—Texas: Caldwell County (McBryde), College Station (LaMotte).

References—Underwood, N. A. Hepaticae, p. 109, 1883; Grout, Mosses with a Hand Lens, p. 283, 1924.

Genus **PORELLA** (Dill.) Linnaeus

Porella pinnata L.

Growing on bark of trees, usually close to ground in moist areas. Fruits in February and March.

Distribution—Texas: Ottine marshes, Conroe, Liberty.

References—Underwood, N. A. Hepaticae, p. 76, (as *Madotheca porella* Nees), 1883; Grout, Mosses with a Hend Lens, p. 278, 1924.

Genus **ANTHOCEROS** (Mich.) Linnaeus

This genus can be recognized by its deep green thallus, lacking air-chambers, and by its green hornlike sporophyte arising singly or several from the surface of the thallus.

Anthoceras laevis L. (Pl. 4, fig. 15)

On moist ground and occasionally on wet rocks. It does not stand competition. Fruits from February to April.

Distribution—Texas: Austin, Bastrop, Industry, Kounze, Marble Falls, Enchanted Rock north of Fredericksburg. New England and Ontario to Iowa and south, Gulf States and Mexico. Europe and Asia.

References—Underwood, N. A. Hepaticae, p. 45, 1883; Howe, Bull. Torrey Club, vol. 25, pp. 1-25, 1898.

This species is recognized by its yellow spores.

Anthoceros punctatus L.

On moist ground and occasionally on wet rocks. Fruits perhaps a month later than *A. laevis*.

Distribution—Texas: Austin, Bastrop, Industry, Enchanted Rock north of Fredericksburg.

References—Underwood, N. A. Hepaticae, p. 45, 1883; Howe, Bull. Torrey Club, vol. 25, pp. 1-25, 1898.

The thallus of *A. punctatus* is very similar to that of *A. laevis*. The dark-brown to black spores distinguish it from *A. laevis*.

Order ANTHOCEROTALES
Family ANTHOCEROTACEAE
Genus **NOTOTHYLAS** Sull.

Notothylas is distinguished from *Anthoceros* by the fact that the capsule barely projects beyond the basal sheath that surrounds the sporophyte in both genera. *In Anthoceros* the sporophyte projects for the most of its length beyond the sheath.

Notothylas orbicularis (Schwein.) Sull.

On moist soil near seepy places. Fruits during January and February.

Distribution—Texas: Conroe (Lewis and Tharp), Liberty (Lewis and Tharp). New England to Indiana to North Carolina. South America, Europe.

References—Underwood, N. A. Hepaticae, p. 45, 1883; Howe, Bull. Torrey Club, vol. 25, pp. 1-25, 1898.

BIBLIOGRAPHY

Austin, C. F., New Hepaticae: Bull. Torrey Club, vol. 6, pp. 157-158, 1877.

Evans, Alexander, W., The Genus Plagiochasma and its North American species: Bull. Torrey Club, vol. 42, pp. 259-308, 1895.

———— A revision of the North American species of Frullania, a genus of Hepaticae: Trans. Conn. Acad. Sci., vol. 10, pp. 1-39, 1897.

———— Preliminary lists of New England plants: Rhodora, vol. 5, pp. 170-173, 1903.

———— A new Frullania from Florida: Bryologist, vol. 15, pp. 22-26, 1912.

———— Notes on New England Hepaticae, XII: Rhodora, vol. 17, pp. 107-120, 1915.

———— Notes on North American Hepaticae, VII: Bryologist, vol. 20, pp. 17-28, 1917.

———— The American species of Marchantia: Trans. Conn. Acad. Sci., vol. 21, pp. 201-313, 1917.

———— Notes on North American Hepaticae, VIII: Bryologist, vol. 22, pp. 54-73, 1919.

———— The North American species of Asterella: Contrib. U. S. Nat. Herb., vol. 20, pp. 247-312, 1920.

———— Corsiniaceae: North American Flora, vol. 14, pp. 29-30, 1920.

———— Rebouliaceae: North American Flora, vol. 14, pp. 39-56, 1923.

———— Marchantiaceae: North American Flora, vol. 14, pp. 57-66, 1914.

———— A new Plagiochasma from Texas: Am. Jour. Bot., vol. 19, pp. 626-631, 1932.

Evans, Alexander W., and Nichols, G. E., The Bryophytes of Connecticut: Conn. State Geol. & Nat. Hist. Survey, Bull. 11, 1908.

Grout, A. J., Mosses with a Hand Lens, 3rd ed., 1924 (contains a section on Hepaticae by M. A. Howe).

Haynes, Caroline C., Illustrations of six species of Riccia, with the original descriptions: Bull. Torrey Club, vol. 47, pp. 279-287, 1920.

Howe, M. A., The Anthocerotaceae of North America: Bull. Torrey Club, vol. 25, pp. 1-24, 1898.

____________ New American Hepaticae: Bull. Torrey Club, vol. 25, pp. 182-192, 1898.

____________ The Hepaticae and Anthocerotes of California: Mem. Torrey Club, vol. 7, pp. 1-208, 1899.

____________ Riccia Beyrichiana and Riccia dictyospora: Bull. Torrey Club, vol. 28, pp. 161-165, 1901.

____________ Notes on American Hepaticae: Bull. Torrey Club, vol. 29, pp. 281-289, 1902.

____________ Oxymitra (Tesselina) in the United States: Bryologist, vol. 17, pp. 72-75, 1914.

____________ Further observations on the Texan Oxymitra (Tesselina): Bryologist, vol. 17, pp. 92-94, 1914.

____________ Notes on North American species of Riccia: Bryologist, vol. 20, pp. 33-37, 1917.

____________ Ricciaceae: North American Flora, vol. 14, pp. 11-27, 1923.

Howe, M. A., and Underwood, L. M., The genus Riella, with descriptions of new species from North America and the Canary Islands: Bull. Torrey Club, vol. 30, pp. 214-224, 1903.

McAllister, F., The morphology of *Thallocarpus Curtisii*: Bull. Torrey Club, vol. 43, pp. 117-126, 1916 (*R. curtisii*)

Underwood, L. M., Descriptive catalogue of the North American Hepaticae, north of Mexico: Bull. Ill. State Lab. Nat. Hist., vol. 2, pp. 1-133, 1883.

________________ Notes on our Hepaticae; II, the genus Riccia: Bot. Gaz., vol. 19, pp. 273-278, 1894.

________________ Notes on our Hepaticae; III, the distribution of the North American Marchantiaceae: Bot. Gaz., vol. 20, pp. 59-71, 1895.

PLATE III

PLATE IV


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PROCEEDINGS

of the

TEXAS ACADEMY OF SCIENCE

Annual Meeting, November 27, 28, 1931

A general meeting of the members of the Texas Academy of Science was held at Witte Museum, San Antonio, Texas, Friday and Saturday, November 27 and 28, J. K. Strecker (President) occupying the chair. New members were elected, several old members were elevated to the rank of Fellow, and officers for the coming year were elected. A program of numerous papers in two sections was enjoyed during the two days. After the general meeting the Executive Committee held a business session.

New Fellows.—W. S. Adkins, G. W. Goldsmith, R. P. Marstellar, Jacolyn Manning, Helen J. Plummer, Gayle Scott, Victor J. Smith, M. A. Stewart, F. L. Thomas, O. A. Ullrich.

Officers elected for 1931-1932.—H. Y. Benedict, president; W. E. Carter, vice-president, sec. 1; E. N. Jones, vice-president, sec. 2; J. F. Sinclair, vice-president, sec. 3; H. B. Parks, secretary-treasurer.

Report of the Treasurer.—The following report for the period from November 16, 1930, to November 27, 1931, was presented:

EXPENDITURES

Postage	$ 52.99
Express	3.20
Printing	309.59
Seal	15.00
Incidental expenses	25.00
Office supplies	6.75
	$412.53

RECEIPTS

Cash brought forward	$ 14.80
Refund for money advanced at Oberholser meeting	4.50
Membership fees from A.A.A.S.	50.00
Fees and dues received	192.00
Sale of "Texas Cacti"	180.60
Sale of old publications	86.85
	$528.75

STATEMENT

Total expenses	$412.53
Total receipts	$528.75
Amount on hand	$116.22

Report of the Auditing Committee.—We have examined this account and have found this report correct.

Frederick A. Burt
W. R. Horlacher
Ellen Schultz Quillin

Papers presented.—In the meeting of the Executive Committee it was ordered that the following papers presented or read by title during the annual meeting be printed in the Proceedings. It was further ordered that in the future when an important paper is at the disposal of the Publication Committee, it shall be printed as soon as possible and in this way combine the Bulletin and the earlier volume of the Transactions and Proceedings.

Color Photography Illustrating Texas Wild Flowers, by J. M. Kuehne, University of Texas, Austin, Texas.

Texas Academy of Science, Its Origin and Founders, by Frederick W. Simonds, University of Texas, Austin Texas.

New Discoveries of the Department of Anthropology of the University of Texas, by J. E. Pearce, University of Texas, Austin, Texas.

Aztec Influence on Primitive Art in the Southwest, by M. L. Crimmins, San Antonio, Texas.

Archeological Explorations by the Witte Museum in the Big Bend of Texas, by Emma Gutzeit, San Antonio, Texas.

Sulphur Industries of Texas, by William Cunningham, University of Texas, Austin, Texas.

Earthquake of August 16, by E. H. Sellards, University of Texas, Austin, Texas.

Rift Valleys in the Trans-Pecos and the Rio Grande, by C. L. Baker, University of Texas, Austin, Texas.

Silting of Lake Worth, by T. U. Taylor, University of Texas, Austin, Texas.

Formative Processes in Aluminum-bearing Concretions, by F. A. Burt, A. & M. College, College Station. Texas.

New Discoveries Relative to Potash Deposits, by E. P. Schoch, University of Texas, Austin, Texas.

Birds That Go to School, by Don O. Baird, State Teachers College, Huntsville, Texas.

Nature Study in Child Education, by C. H. Gable and Ellen Schulz Quillin, San Antonio, Texas.

Chlorophyll Deficiencies induced in Cotton, by W. R. Horlocher and D. F. Killough, A. & M. College, College Station, Texas.

Problem of Sedimentary Cycles in Deposits of Pennsylvanian Age in Texas, F. B. Plummer, University of Texas, Austin, Texas.

Some New Fossil Ammonids from the Basal Permian of Texas, by F. B. Plummer, University of Texas, Austin, Texas.

Current Trends in Health Education, by Don O. Baird, State Teachers College, Huntsville, Texas.

Estimation of Losses of Cotton from Phymatotrichum (root rot), by W. N. Ezekiel and J. J. Taubenhaus, Experiment Station, College Station, Texas.

Core Rot a New Disease of Freesias, by W. N. Ezekiel and J. J. Taubenhaus, Texas Agric. Exper. Station, College Station, Tex.

Mineral Content of Honey, by Cathora Remy, San Antonio, Tex.

Age Incidence in the Lines of Retzius in the Enamel of Human Permanent Teeth, by J. H. Swanson, College of Arts and Industries, Kingsville, Texas.

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Transactions

of the

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1931 TO 1932

TOGETHER WITH THE PROCEEDINGS
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In Memoriam

JOHN KERN STRECKER
Naturalist

1875-1932

Member, 1902
Raised to Fellow, 1929
President, 1930

CHECK LIST OF DISEASES OF PLANTS IN TEXAS[1]

J. J. TAUBENHAUS and WALTER N. EZEKIEL[3]

INTRODUCTION

Plant diseases annually levy heavy toll on the yield and quality of Texas crops. In this way, diseases may rob the farmer of part or all of the profits from crops and thus affect the economic welfare of the entire region. Further widespread interest in plant diseases is brought about by the frequent attacks of diseases on home plantings, even in the cities.

The individual grower, were he the theoretical average for the State, would lose in different years from 10 to 20 per cent of all his crops from plant diseases. This does not sound alarming, but it is estimated that the aggregate annual loss from Phymatotrichum root rot alone, in Texas, lies between fifty and one hundred million dollars. Considering all plant diseases, the total annual loss for Texas may reasonably be estimated as at least twice this figure, or two hundred million dollars at normal price levels.

Plant pathologists today are busily engaged in studying the causes of these diseases with a view to developing control methods. Much has already been done in that direction and much more still remains to be accomplished. For years, the Texas Agricultural Experiment Station has been working on the plant diseases that affect crops grown in Texas. The results of these studies have been published in various technical journals and Station bulletins, but a combined list of the diseases known to occur in Texas has been lacking. It is hoped that the present list, admittedly incomplete, may be of value not only to research workers in plant pathology in Texas and in the South, but also to teachers in vocational agriculture, county agents, growers, and land owners.

The list contains data on Texas plant diseases accumulated during the last sixteen years by the senior writer, who also assumes full responsibility for the identification of the causes of various plant diseases. However, doubtful specimens have been submitted to the Plant Disease Survey, Bureau of Plant Industry, U. S. Department of Agriculture,

[1] Published with the approval of the Director as Contribution No. 227, Technical Series, Texas Agricultural Experimental Station.
Chief of Division of Plant Pathology and Physiology.
Plant Pathologist.

and to specialists in various parts of the country, to whom grateful acknowledgment is here made. In the present list, the names of fungi are mainly in accord with those given in the "Check List of Diseases of Economic Plants in the United States" (United States Department of Agriculture, Department Bulletin 1366, 1926) and Seymour's "Host Index of the Fungi of North America" (Harvard University Press, 1929). The common and scientific names used for plants are those given in "Standardized Plant Names" (American Joint Committee on Horticultural Nomenclature, 1923) and in Ellen D. Schulz' "Texas Wild Flowers" (Laidlaw Brothers, 1928).

The host plants mentioned in the list have been arranged in five groups. The first group includes cereal, forage, fiber, and hay crops; the second, truck crops; the third, fruits, nuts, and berries; the fourth, shade and forest trees, and ornamental herbaceous plants and shrubs; and the fifth, non-cultivated herbaceous and woody annuals and perennials with the exception of native trees and shrubs included in group four. Most of the common weeds are included in group five. In each group, the hosts are arranged alphabetically by the common name, but the technical name of the plant is given also. The importance of each plant is indicated by small numbers in parentheses: (1) includes commercial nursery plants and new introductions grown as yet primarily in the nursery; (2) includes plants grown on a very small scale in backyard gardens, either for food or ornamental purposes but not usually intended for the market; (3) represents plants grown in somewhat less limited areas but still not on a field basis, as in farmers' gardens, home orchards, or in street or park planting in cities, also native plants growing in limited areas; (4) includes plants grown on a large scale for commercial or market purposes or on a large scale in nature and includes most important cultivated crops, native forest trees, and grasses. Notations of this sort are not given for the non-cultivated plants in the last group.

The diseases of each plant are likewise arranged alphabetically by their common names. Following the name of each disease is given the name of the fungus or bacterium or other cause of the disease. For the cultivated plants, the relative importance of each disease is indicated by the following symbols in parentheses: (†) diseases that occur occasionally and cause little loss, usually of less than 5 per cent of the plants exposed to infection; (††) diseases that are of somewhat more importance but which rarely cause losses of more than 5 to 15 per cent; (†††) diseases that occur frequently and may cause losses of 15 to 40 per cent; and (††††) diseases that occur frequently and almost invariably cause disastrous losses of over 40 per cent. For instance, Phymatotrichum root rot has been listed as (†) under the common hackberry, which is highly resistant to the disease, only occasional seedlings being affected; under the fig, on the other hand, root rot is given a (††††) rating since fig trees are invariably killed by root rot when they are exposed to infection.

The writers wish to express their indebtedness for information on the prevalence of certain plant diseases in Hidalgo County and in Bell County, respectively, to their colleagues, Mr. W. J. Bach and Mr. S. E. Wolff; to the late Dr. L. H. Pammel, to the late Professor H. Ness, and to Mr. V. L. Cory, Range Botanist, for identification of many of the plants mentioned here; and to Mrs. F. B. Plummer for editorial assistance.

GROUP 1

CEREAL, FORAGE, FIBER, SUGAR, AND HAY CROPS

Alfalfa, *Medicago sativa* (3) (4)
- Crown gall, *Bacterium tumefaciens* EFS. and Town. (††)
- Crown rot, *Sclerotium rolfsii* Sacc. (†)
- Crown wart, *Urophlyctis alfalfae* (Lagh.) Magn. (†)
- Dodder, *Cuscuta* sp. (†)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
- Root knot, *Caconema radicicola* (Greef) Cobb (††)
- Rust, *Uromyces medicaginis* Pass. (††)
- Violet root rot, *Rhizoctonia crocorum* (Pers.) DC. (†)

Artichoke, Jerusalem, *Helianthus tuberosus* (2)
- Crown rot, *Sclerotium rolfsii* Sacc. (†††)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††††)
- Powdery mildew, *Erysiphe cichoracearum* DC. (††)
- Rust, *Puccinia helianthi-mollis* (Schw.) Jack. (††)

Barley, *Hordeum vulgare* (3) (4)
- Bacterial blight, *Bacterium translucens* L. R. Jones, A. G. Johnson, C. S. Reddy (††)
- Covered smut, *Ustilago hordei* (Pers.) Kell. and Sw. (††)
- Leaf and stem stripe, *Helminthosporium gramineum* Rabh. (††)
- Leaf rust, *Puccinia anomala* Rostr. (†)
- Loose smut, *Ustilago nuda* (Jens.) Kell. and Sw. (†††)
- Powdery mildew, *Erysiphe graminis* DC. (†††)
- Scab, *Gibberella saubinetii* (Mont.) Sacc. (††)
- Spot blotch, *Helminthosporium sativum* Pam. (††)
- Stem rust, *Puccinia graminis* Pers. (†††)

Bean, Mung, *Phaseolus aureus* (2) (3)
  Crown rot, *Sclerotinia sclerotiorum* (Lib.) Mass. (††)
  Leaf blight, *Bacterium phaseoli* EFS. (†)
  Mosaic, virus (†)
  Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)

Bean, Velvet, *Stizolobium deeringianum* (3)
  Crown rot, *Sclerotium rolfsii* Sacc. (†)
  Leaf spot, *Phyllosticta mucunae* Ell. and Ev. (†)
  Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
  Root knot, *Caconema radicicola* (Greef) Cobb (†)

Bermuda Grass, *Capriola dactylon* (2) (3) (4)
  Leaf spot, *Helminthosporium giganteum* Heald and Wolf (††)
  Rust, *Puccinia cynodontis* DeLac. (††)
  Smut, *Ustilago cynodontis* P. Henn. (††)

Broom Corn, *Holcus technicus* (4)
  Covered kernel smut, *Sphacelotheca sorghi* (Lk.) Clint. (††)
  Leaf stripe, *Bacterium andropogoni* EFS. (††)
  Loose kernel smut, *Sphacelotheca cruenta* (Kuehn) Potter (††)

Broomcorn Millet, *Panicum miliaceum* (3) (4)
  Black blotch, *Phyllachora graminis* (Pers.) Fckl. (†)

Clover, Bur, *Medicago maculata* (3)
  Leaf spot, *Cercospora medicaginis* Ell. and Ev. (††)

Corn, Indian, *Zea mays* (4)
  Aspergillus ear mold, *Aspergillus niger* V. Tiegh. (††)
  Aspergillus ear mold, *Aspergillus glaucus* Link. (††)
  Ear rot, *Diplodia zeae* Lev. (††)
  Ear rot, *Fusarium moniliforme* Sheld. (††)
  Leaf spot, *Cercospora sorghi* Ell. and Ev. (††)
  Mosaic, virus (†)
  Root and stem rot, *Gibberella saubinetii* (Mont.) Sacc. (††)
  Rust, *Puccinia sorghi* Schw. (††)
  Seedling blight, *Sclerotium rolfsii* Sacc. (†)
  Smut, *Ustilago zeae* (Beckm.) Ung. (†††)

Cotton, *Gossypium hirsutum* (4)
  Angular leaf spot, black arm, boll rot, *Bacterium malvacearum* EFS. (†††)
  Anthracnose, *Glomerella gossypii* (E. A. Southw.) Edg. (†)
  Black leaf spot, *Macrosporium nigricantium* Atk. (†)
  Black stem, *Helminthosporium gossypii* Tucker (†)
  Boll rot, *Choanephora cucurbitarum* (B. and Rav.) Thax. (†)
  Boll rot, *Diplodia gossypina* Cke. (††)
  Boll rot, *Fusarium* sp. (†††)
  Boll rot, *Pestalozziella gossypina* Atk. (†)
  Crown rot, *Schizophyllum alneum* (L.) ex Schrt. (†)
  Frosty mildew, *Ramularia areola* Atk. (††)
  Leaf spot, *Cercospora althaeina* Sacc. (††)
  Leaf spot, *Mycosphaerella gossypina* (Cke.) Earle (†)
  Malnutrition, physiologic (†)

Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††††)
Root knot, *Caconema radicicola* (Greef) Cobb (††)
Rust, *Aecidium gossypii* Ell. and Ev. (*Puccinia hibisciata* (Schw.) Kell.) (†)
Seedling blight, *Sclerotium rolfsii* Sacc. (†)
Seedling blight, *Pythium debaryanum* Hesse (†)
Sore-shin, *Corticium vagum* Berk. and Curt. (††)
Strangulation, caused by tight soil (†)
Wilt, *Fusarium vasinfectum* Atk. (††)

Cowpea, *Vigna sinensis* (2) (3) (4)
Bacterial blight, *Bacterium phaseoli* EFS. (††)
Bacterial streak, *Bacillus lathyri* Manns and Taub. (†)
Leaf spot, *Cercospora cruenta* Sacc. (†††)
Leaf spot, *Cercospora vignae* M. Raciborski (††)
Mosaic, virus (†)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
Powdery mildew, *Erysiphe polygoni* DC. (††)
Root knot, *Caconema radicicola* (Greef) Cobb (††)
Rust, *Uromyces vignae* A. Barclay (††)
Stem blight, *Sclerotium rolfsii* Sacc. (†)
Stem rot, *Corticium vagum* Berk. and Curt. (††)
Wilt, *Fusarium vasinfectum* var. *tracheiphilum* EFS. (††)

Guar, *Cyamopsis tetragonoloba* (3)
Crown rot, *Sclerotium rolfsii* Sacc. (††††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†)

Guayule, *Parthenium argentatum* (3)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
Crown rot, *Fusarium* sp. (?) (††)

Johnson Grass, *Holcus halepensis* (4)
Anthracnose, *Colletotrichum lineola* Cda. (†)
Leaf blight and root rot, *Helminthosporium turcicum* Pass. (††)
Leaf spot, *Cercospora sorghi* Ell. and Ev. (††)
Leaf spot, *Phyllosticta sorghina* Sacc. (†)
Leaf spot, *Septoria pertusa* Heald and Wolf (††)
Rust, *Puccinia purpurea* Cke. (††)
Smut, *Sphacelotheca sorghi* (Lk.) Clint. (††)

Kudzu-bean, *Pueraria thunbergiana* (3)
Leaf and stem rot, *Diplodia puerariae* Barthol. (†)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)

Mescalbean, *Sophora secundiflora* (2) (3)
Leaf spot, *Phyllosticta sophorae* Ell. and Ev. (†)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)

Millet, *Chaetochloa italica* (3) (4)
Leaf spot, *Piricularia grisea* (Cke.) Sacc. (†††)

Oats, *Avena sativa* (4)
- Anthracnose, *Colletotrichum graminicolum* (Ces.) Wils. (†)
- Covered smut, *Ustilago levis* (Kell. and Sw.) Magn. (††)
- Crown rust, *Puccinia coronata* Cda. (†††)
- Halo leaf spot, *Bacterium coronafaciens* Charlotte Elliott (††)
- Leaf spot and crown rot, *Helminthosporium avenae* Eidam (††)
- Loose smut, *Ustilago avenae* (Pers.) Jens. (†††)
- Powdery mildew, *Erysiphe graminis* DC. (†††)
- Stem rust, *Puccinia graminis* Pers. (††)

Peanut, *Arachis hypogaea* (3) (4)
- Black mold, *Aspergillus niger* V. Tiegh. (†)
- Chlorosis, caused by too much calcium in the soil (†)
- Leaf spot, *Cercospora personata* (Berk. and Curt.) Ell. and Ev. (††)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
- Seedling blight, *Corticium vagum* Berk. and Curt. (††)
- Stem and pod rot, *Diplodia natalensis* Evans (††)
- Stem rot, *Sclerotium rolfsii* Sacc. (††)
- Wilt, *Fusarium vasinfectum* Atk. (††)

Pigeon-pea, *Cajanus indicus* (3)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
- Rust, *Uromyces dolicholi* Arth. (†)

Rice, *Oryza sativa* (4)
- Black smut, *Tilletia horrida* Tak. (††)
- Leaf blast, *Piricularia grisea* (Cke.) Sacc. (†††)
- Leaf blight, *Helminthosporium oryzae* Van Breda de Haan (††)
- Leaf spot, *Cercospora oryzae* Miyake (††)
- Glume blight, *Phoma glumarum* Ell. and Tr. (†)
- Green smut, *Ustilaginoidea virens* (Cke.) Tak. (†)
- Seedling blight, *Sclerotium rolfsii* Sacc. (†)
- Stem rot, *Sclerotium oryzae* Catt. (†)
- Straighthead, non-par. (††)

Rye, *Secale cereale* (3) (4)
- Foot rot, *Helminthosporium sativum* Pam. (††)
- Mosaic, virus (†)
- Powdery mildew, *Erysiphe graminis* DC. (††)
- Scab, *Gibberella saubinetii* (Mont.) Sacc. (†)
- Stem rust, *Puccinia graminis* Pers. (††)

Sesbania, *Sesbania canabina* (3)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†)
- Root knot, *Caconema radicicola* (Greef) Cobb (†)

Sorghum, *Holcus sorghum* (4)
- Anthracnose, *Colletotrichum lineola* Cda. (†)
- Covered kernel smut, *Sphacelotheca sorghi* (Lk.) Clint. (†††)
- Head smut, *Sorosporium reilianum* (Kuehn) McAlp. (††)
- Leaf blight, *Helminthosporium turcicum* Pass. (††)
- Leaf spot, *Cercospora sorghi* Ell. and Ev. (†)
- Leaf stripe, *Bacterium andropogoni* EFS. (††)
- Loose kernel smut, *Sphacelotheca cruenta* (Kuehn) Potter (†††)
- Rust, *Puccinia purpurea* Cke. (††)
- Seedling blight, *Sclerotium rolfsii* Sacc. (†)

Sorgo, *Holcus sorghum saccharatus* (4)
- Anthracnose, *Colletotrichum lineola* Cda. (†)
- Bacterial stripe, *Bacterium andropogoni* EFS. (†)
- Leaf spot, *Phoma insidiosa* F. Tassi (†)
- Rust, *Puccinia purpurea* Cke. (†)

Soybean, *Soja max* (3)
- Bacterial pustule, *Bacterium phaseoli sojense* Hedges (†)
- Crown rot, *Corticium vagum* Berk. and Curt. (†)
- Fusarium wilt, *Fusarium vasinfectum* var. *tracheiphilum* EFS. (††)
- Leaf spot, *Cercospora cruenta* Sacc. (†)
- Mosaic, virus (†)
- Powdery mildew, *Erysiphe polygoni* DC. (†)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††††)
- Root knot, *Caconema radicicola* (Greef) Cobb (†††)
- Stem and crown rot, *Sclerotium rolfsii* Sacc. (†††)
- Streak, *Bacillus lathyri* Manns and Taub. (†)

Sudan Grass, *Holcus sorghum sudanensis* (4)
- Anthracnose, *Colletotrichum graminicolum* (Ces.) Wils. (†)
- Covered kernel smut, *Sphacelotheca sorghi* (Lk.) Clint. (†)
- Head smut, *Sorosporium reilianum* (Kuehn) McAlp. (†)
- Leaf blight, *Helminthosporium turcicium* Pass. (†)

Sugarbeet, *Beta vulgaris* (3); Mangel-wurzel, *Beta vulgaris macrorhiza* (3)
- Crown gall, *Bacterium tumefaciens* EFS. and Town. (†)
- Crown rot, *Sclerotium rolfsii* Sacc. (††)
- Curly-top, virus (†)
- Leaf spot, *Cercospora beticola* Sacc. (††)
- Leaf spot and root rot, *Phoma betae* (Oud.) Frank (†)
- Mosaic, virus (†)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
- Root knot, *Caconema radicicola* (Greef) Cobb (††)
- Root rot, *Corticium vagum* Berk. and Curt. (†)
- Scab, *Actinomyces scabies* (Thax.) Gues. (†)

Sugarcane, *Saccharum officinarum* (2) (3)
- Anthracnose or red-rot, *Colletotrichum falcatum* F. A. Went (††)
- Eye leaf-spot, *Helminthosporium sacchari* Butl. (††)
- Mosaic, virus (†)
- Red spot, *Cercospora vaginae* W. Krueger (††)
- Root knot, *Caconema radicicola* (Greef) Cobb (†)
- Root rot, *Marasmius stenophyllus* Mont. (††)
- Sheath rot, *Sclerotium rolfsii* Sacc. (††)

Sunflower, *Helianthus annuus* (3) (4)
- Leaf spot, *Cercospora pachypus* Ell. and Kell. (††)
- Leaf spot, *Septoria helianthi* Ell. and Kell. (††)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
- Powdery mildew, *Erysiphe cichoracearum* DC. (††)
- Root knot, *Caconema radicicola* (Greef) Cobb (††)
- Rust, *Puccinia helianthi-mollis* (Schw.) Jack. (†††)
- Violet root rot, *Rhizoctonia crocorum* (Pers.) DC. (††)

Sweetclover, White, *Melilotus alba* (3)
- Crown rot, *Sclerotinia trifoliorum* Eriks. (†)
- Mosaic, virus (†)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††††)
- Root knot, *Caconema radicicola* (Greef) Cobb (††)
- Stem rot, *Corticium vagum* Berk. and Curt. (†)

Vetch, *Vicia sativa; V. villosa* (3)
- Downy mildew, *Peronospora viciae* DeBy. (††)
- Powdery mildew, *Erysiphe polygoni* DC. (††)
- Root knot, *Caconema radicicola* (Greef) Cobb (†)

Wheat, *Triticum aestivum* (4)
- Anthracnose, *Colletotrichum graminicolum* (Ces.) Wils. (†)
- Foot rot, *Phoma* sp. (†)
- Foot rot, *Helminthosporium sativum* Pam. (††)
- Foot rot, *Septoria graminum* Desm. (†††)
- Glume blotch, *Septoria nodorum* Berk. (†)
- Leaf rust, *Puccinia triticina* Eriks. (††)
- Loose smut, *Ustilago tritici* (Pers.) Rostr. (†††)
- Mosaic, virus (†)
- Nematode, *Tylenchus tritici* (Stein.) Bast. (†)
- Powdery mildew, *Erysiphe graminis* DC. (††)
- Scab, *Gibberella saubinetii* (Mont.) Sacc. (†)
- Speckled leaf-blotch, *Septoria tritici* Desm. (†)
- Stem rust, *Puccinia graminis* Pers. (††)
- Stinking smut, *Tilletia laevis* Kuehn (†††)

GROUP II

TRUCK CROPS

Anise, *Pimpinella anisum* (2) (3)
- Crown rot, *Sclerotinia sclerotiorum* (Lib.) Mass. (††)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)

Artichoke, Globe, *Cynara scolymus* (2)
- Leaf spot, *Cercospora obscura* Heald and Wolf (††)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
- Southern blight, *Sclerotium rolfsii* Sacc. (†††)
- Stem end rot, *Corticium vagum* Berk. and Curt. (††)

Asparagus, *Asparagus officinalis* (2) (3)
- Leaf blight, *Ascochytula asparagina* (†)
- Leaf spot, *Cercospora asparagi* Sacc. (††)
- Root rot, *Corticium vagum* Berk. and Curt. (†)
- Rust, *Puccinia asparagi* DC. (†)
- Stem rot, *Diplodia asparagi* Pk. (†)

Bean, *Phaseolus vulgaris* (2) (3) (4)
- Anthracnose, *Glomerella lindemuthiana* Shear (†)
- Chlorosis, caused by too much calcium in the soil (††)
- Crown rot, *Sclerotinia sclerotiorum* (Lib.) Mass. (†)
- Dry root rot, *Fusarium martii phaseoli* Burk. (†)
- Gray mold rot, *Botrytis cinerea* Auct. (†)
- Leaf blight, *Bacterium phaseoli* EFS. (†††)

Leaf blotch, *Cercospora cruenta* Sacc. (††)
Leaf spot, *Phyllosticta phaseolina* Sacc. (†)
Mosaic, virus (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
Root knot, *Caconema radicicola* (Greef) Cobb (††††)
Rust, *Uromyces appendiculatus* (Pers.) Lk. (†††)
Southern blight, *Sclerotium rolfsii* Sacc. (†††)
Stem canker, *Colletotrichum caulicolum* Heald and Wolf (††)
Stem and root rot, *Corticium vagum* Berk. and Curt. (†††)
Streak, *Bacillus lathyri* Manns and Taub. (†)

Bean, Lima, *Phaseolus lunatus macrocarpus* (2) (3)
Anthracnose, *Glomerella lindemuthiana* Shear (†)
Crown rot, *Sclerotinia sclerotiorum* (Lib.) Mass. (†)
Leaf blight, *Bacterium phaseoli* EFS. (†††)
Leaf spot, *Cercospora cruenta* Sacc. (†††)
Mosaic, virus (†)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
Powdery mildew, *Erysiphe polygoni* DC. (†††)
Root knot, *Caconema radicicola* (Greef) Cobb (††††)
Rust, *Uromyces appendiculatus* (Pers.) Lk. (†)
Stem and root rot, *Corticium vagum* Berk. and Curt. (†††)

Bean, Tepary, *Phaseolus acutifolius latifolius* (2) (3)
Dry stem and root rot, *Fusarium martii phaseoli* Burk. (†)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
Rust, *Uromyces appendiculatus* (Pers.) Lk. (††)

Beet, *Beta vulgaris* (2) (3) (4)
Crown gall, *Bacterium tumefaciens* EFS. and Town. (††)
Crown and root rot, *Sclerotinia sclerotiorum* (Lib.) Mass. (†)
Curly-top, virus (†)
Leaf spot, *Cercospora beticola* Sacc. (†††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
Root knot, *Caconema radicicola* (Greef) Cobb (†††)
Root rot, *Corticium vagum* Berk. and Curt. (††)
Scab, *Actinomyces scabies* (Thax.) Gues. (†)
Southern blight, *Sclerotium rolfsii* Sacc. (†††)

Broccoli, *Brassica oleracea botrytis* (3) (4)
Black-rot, *Bacterium campestre* (Pam.) EFS. (††)
Leaf spot, *Alternaria brassicae* (Berk.) Sacc. (††)

Brussels Sprouts, *Brassica oleracea gemmifera* (2) (3)
Black-rot, *Bacterium campestre* (Pam.) EFS. (††)
Drop, *Sclerotinia sclerotiorum* (Lib.) Mass. (†)
Root rot, *Corticium vagum* Berk. and Curt. (††)

Cabbage, *Brassica oleracea* (2) (3) (4)
Black leaf spot, *Alternaria brassicae* (Berk.) Sacc. (††)
Black-rot, *Bacterium campestre* (Pam.) EFS. (††)
Downy mildew, *Peronospora parasitica* (Pers.) DeBy. (†††)
Drop, *Sclerotinia sclerotiorum* (Lib.) Mass. (†)
Leaf spot, *Cercospora bloxami* Berk. and Br. (††)

Cabbage (concluded)
- Oedema, non-par. (†)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†)
- Powdery mildew, *Erysiphe polygoni* DC. (†)
- Ring-spot, *Mycosphaerella brassicicola* (Fr.) Lindau (†)
- Root knot, *Caconema radicicola* (Greef) Cobb (†††)
- Slimy soft rot, *Bacillus carotovorus* L. R. Jones (††)
- Southern blight, *Sclerotium rolfsii* Sacc. (†)
- White rust, *Albugo candida* (Pers.) O. Kuntze (†)
- Wilt or yellows, *Fusarium conglutinans* Woll. (†††)
- Wire-stem, *Corticium vagum* Berk. and Curt. (††)

Cabbage, Chinese, *Brassica pekinensis* (2) (3)
- Black leaf spot, *Alternaria brassicae* (Berk.) Sacc. (†)
- Black-rot, *Bacterium campestre* (Pam.) EFS. (†)
- Drop, *Sclerotinia sclerotiorum* (Lib.) Mass. (†)
- Southern blight, *Sclerotium rolfsii* Sacc. (††)

Cantaloupe, *Cucumis melo* (2) (3) (4)
- Anthracnose, *Colletotrichum lagenarium* (Pass.) Ell. and Hals. (††)
- Bacterial wilt, *Bacillus tracheiphilus* EFS. (††)
- Charcoal rot, *Sclerotium bataticola* Taub. (†)
- Chlorosis, caused by too much calcium in the soil (†)
- Downy mildew, *Pseudoperonospora cubensis* (Berk. and Curt.) Rostew. (†††)
- Fruit rot, *Bacillus melonis* Gidd. (†)
- Gray rot, *Diplodia natalensis* Evans (†)
- Gummy stem-blight, *Mycosphaerella citrullina* (C. O. Smith) Gross. (†)
- Leaf blight, *Macrosporium cucumerinum* Ell. and Ev. (††)
- Mosaic, virus (†)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†)
- Powdery mildew, *Erysiphe cichoracearum* DC. (†††)
- Root knot, *Caconema radicicola* (Greef) Cobb (††††)
- Southern blight, *Sclerotium rolfsii* Sacc. (†††)
- Timber rot, *Sclerotinia sclerotiorum* (Lib.) Mass. (†)
- Wilt, *Fusarium* sp. (†)

Carrot, *Daucus carota* (2) (3) (4)
- Crown rot, *Sclerotinia sclerotiorum* (Lib.) Mass. (††)
- Dodder, *Cuscuta* sp. (†)
- Leaf spot, *Cercospora apii carotae* Pass. (††)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††††)
- Root knot, *Caconema radicicola* (Greef) Cobb (††)
- Soft rot, *Bacillus carotovorus* L. R. Jones (†)
- Southern blight, *Sclerotium rolfsii* Sacc. (†††)
- Stem rot, *Corticium vagum* Berk. and Curt. (††)
- Violet root rot, *Rhizoctonia crocorum* (Pers.) DC. (†)

Cauliflower, *Brassica oleracea botrytis* (2) (3) (4)
- Black-rot, *Bacterium campestre* (Pam.) EFS. (††)
- Crown rot and drop, *Sclerotinia sclerotiorum* (Lib.) Mass. (†)
- Downy mildew, *Peronospora parasitica* (Pers.) Deby (††)

Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†)
Root knot, *Caconema radicicola* (Greef) Cobb (†)
Stem rot, *Corticium vagum* Berk. and Curt. (†)
Wilt or yellows, *Fusarium conglutinans* Woll. (††)

Chayote, *Chayota edulis* (2)
Anthracnose, *Colletotrichum lagenarium* (Pass.) Ell. and Hals. (††)
Leaf spot, *Cercospora cucurbitae* Ell. and Ev. (††)
Southern blight, *Sclerotium rolfsii* Sacc. (††)

Collards, Kale, *Brassica oleracea acephala* (2) (3)
Black leaf spot, *Alternaria brassicae* (Berk.) Sacc. (††)
Black-rot, *Bacterium campestre* (Pam.) EFS. (††)
Downy mildew, *Peronospora parasitica* (Pers.) DeBy (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†)
Root knot, *Caconema radicicola* (Greef) Cobb (†)
Southern blight, *Sclerotium rolfsii* Sacc. (††)
Stem rot, *Corticium vagum* Berk. and Curt. (†)
White rust, *Albugo candida* (Pers.) O. Kuntze (†)
Wilt or yellows, *Fusarium conglutinans* Woll. (†)

Cucumber, *Cucumis sativus* (2) (3) (4)
Angular leaf spot, *Bacterium lachrymans* EFS. (††)
Anthracnose, *Colletotrichum lagenarium* (Pass.) Ell. and Hals. (††)
Bacterial wilt, *Bacillus tracheiphilus* EFS. (††)
Downy mildew, *Pseudoperonospora cubensis* (Berk. and Curt.) Rostew. (†††)
Leaf spot, *Phyllosticta cucurbitacearum* Sacc. (††)
Mosaic, virus (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†)
Powdery mildew, *Erysiphe cichoracearum* DC. (†††)
Root knot, *Caconema radicicola* (Greef) Cobb (†††)
Southern blight, *Sclerotium rolfsii* Sacc. (††)
Stem and root rot, *Corticium vagum* Berk. and Curt. (†)
Timber rot, *Sclerotinia sclerotiorum* (Lib.) Mass. (†)
Wilt, *Fusarium* sp. (†)

Dasheen, *Colocasia esculenta* (2)
Dry rot, *Fusarium solani* (Mart.) App. and Woll. (†)
Java black rot, *Diplodia tubericola* (Ell. and Ev.) Taub. (††)
Root knot, *Caconema radicicola* (Greef) Cobb (††)
Slimy soft rot, *Bacillus carotovorus* L. R. Jones (††)
Southern blight, *Sclerotium rolfsii* Sacc. (†††)

Dill, *Anethum graveolens* (2)
Drop, *Sclerotinia sclerotiorum* (Lib.) Mass. (†)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)

Eggplant, *Solanum melongena* (2) (3) (4)
Bacterial wilt, *Bacterium solanacearum* EFS. (†)
Leaf spot, and fruit rot, *Phomopsis vexans* (Sacc. and Syd.) Harter (†††)

Eggplant (concluded)
- Mosaic, virus (†)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
- Root knot, *Caconema radicicola* (Greef) Cobb (††)
- Southern blight, *Sclerotium rolfsii* Sacc. (††)
- Stem and root rot, *Corticium vagum* Berk. and Curt. (††)

Endive, *Cichorium endivia* (3) (4)
- Anthracnose, *Marssonina panattoniana* (Berl.) Magn. (†)
- Damping-off, *Corticium vagum* Berk. and Curt. (††)
- Drop, *Sclerotinia sclerotiorum* (Lib.) Mass. (†)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)

Escarole, *Cichorium intybus* (2)
- Anthracnose, *Marssonina panattoniana* (Berl.) Magn. (†)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
- Root rot, *Corticium vagum* Berk. and Curt. (††)

Garlic, *Allium sativum* (2) (3)
- Black leaf and stalk rot, *Macrosporium sarcinula parasiticum* Thuem. (††)
- Pink root, *Fusarium malli* Taub. (†††)
- Southern blight, *Sclerotium rolfsii* Sacc. (†)

Gourd, *Cucurbita* sp. (2)
- Downy mildew, *Pseudoperonospora cubensis* (Berk. and Curt.) Rostew. (††)

Horseradish, *Radicula armoracia* (2)
- Leaf spot, *Alternaria brassicae* Sacc. (††)
- Leaf spot, *Phyllosticta decidua* Ell. and Kell. (††)
- Leaf spot, *Ramularia armoraciae* Fckl. (††)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
- Stem and root rot, *Corticium vagum* Berk. and Curt. (††)

Kohlrabi, *Brassica oleracea caulorapa* (2) (3)
- Downy mildew, *Peronospora parasitica* (Pers.) DeBy. (††)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
- Root knot, *Caconema radicicola* (Greef) Cobb (††)

Lettuce, *Lactuca sativa* (2) (3) (4)
- Anthracnose, *Marssonina panattoniana* (Berl.) Magn. (†)
- Bottom rot, *Corticium vagum* Berk. and Curt. (†)
- Chlorosis, caused by too much calcium in the soil (†)
- Drop, *Sclerotinia sclerotiorum* (Lib.) Mass. (††)
- Leaf spot, *Macrosporium cladosporioides* Desm. (†)
- Mosaic, virus (†)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
- Rio Grande disease, virus (†)
- Root knot, *Caconema radicicola* (Greef) Cobb (†††)
- Slimy soft rot, *Bacillus carotovorus* L. R. Jones (†††)
- Southern blight, *Sclerotium rolfsii* Sacc. (†)

Mustard, *Brassica alba* (2)
- Downy mildew, *Peronospora parasitica* (Pers.) DeBy. (†)
- White rust, *Albugo candida* (Pers.) O. Kuntze (††)

Okra, *Hibiscus esculentus* (2) (3) (4)
- Leaf spot, *Cercospora althaeina* Sacc. (†)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††††)
- Root knot, *Caconema radicicola* (Greef) Cobb (†††)
- Root rot, *Corticium vagum* Berk. and Curt. (††)
- Wilt, *Fusarium vasinfectum* Atk. (††)

Onion, *Allium cepa* (2) (3) (4)
- Black leaf and stalk rot, *Macrosporium sarcinula parasiticum* Thuem. (††)
- Black mold, *Aspergillus niger* V. Tiegh (††)
- Gray smudge, *Diplodia natalensis* Evans (†††)
- Neck rot, *Botrytis allii* M. T. Munn (†)
- Pink root, *Fusarium malli* Taub. (†††)
- Root knot, *Caconema radicicola* (Greef) Cobb (††)
- Slimy soft rot, *Bacillus carotovorus* L. R. Jones (††)
- Smudge, *Colletotrichum circinans* (Berk.) Vogl. (†††)
- Southern blight, *Sclerotium rolfsii* Sacc. (†)

Parsley, *Petroselinum hortense* (2) (3) (4)
- Dodder, *Cuscuta* sp. (†)
- Leaf spot, *Septoria petroselini* Desm. (††)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
- Root knot, *Caconema radicicola* (Greef) Cobb (††)
- Root rot, *Corticium vagum* Berk. and Curt. (††)
- Stem rot, *Sclerotinia sclerotiorum* (Lib.) Mass. (††)

Parsnip, *Pastinaca sativa* (2) (4)
- Crown rot, *Sclerotinia sclerotiorum* (Lib.) Mass. (††)
- Leaf blight, *Septoria pastinacina* Sacc. (††)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
- Root knot, *Caconema radicicola* (Greef) Cobb (††)
- Slimy soft rot, *Bacillus carotovorus* L. R. Jones (†)
- Stem and root rot, *Corticium vagum* Berk. and Curt. (††)

Pea, English, *Pisum sativum* (2) (3) (4)
- Chlorosis, caused by too much calcium in the soil (†)
- Crown rot, *Corticium vagum* Berk. and Curt. (††)
- Leaf and pod spot, *Mycosphaerella pinodes* (Berk. and Blox.) R. E. Stone (†)
- Leaf spot, *Septoria pisi* West (†)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†)
- Powdery mildew, *Erysiphe polygoni* DC. (†††)
- Root knot, *Caconema radicicola* (Greef) Cobb (†††)
- Root rot, *Fusarium martii pisi* F. R. Jones (††)
- Stem rot, *Sclerotinia sclerotiorum* (Lib.) Mass. (†)
- Streak, *Bacillus lathyri* Manns and Taub. (†)
- Wilt, *Fusarium martii minus* Sherb. (†)

Pepper, *Capsicum annuum* (2) (3) (4)
- Anthracnose, *Glomerella cingulata* (Ston.) Spauld. and Schrenk (††)
- Bacterial wilt, *Bacterium solanacearum* EFS. (††)
- Blossom-end rot, cause unknown (††)
- Damping-off, *Sclerotinia sclerotiorum* (Lib.) Mass. (†)
- Leaf and fruit spot, *Cercospora capsici* Heald and Wolf (†††)
- Mosaic, virus (†††)
- Paper white spot of fruit, cause unknown (††)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
- Root knot, *Caconema radicicola* (Greef) Cobb (††)
- Southern blight, *Sclerotium rolfsii* Sacc. (†††)
- Stem and fruit rot, *Sclerotium bataticola* Taub. (†)
- Stem and root rot, *Corticium vagum* Berk. and Curt. (†)
- Wilt, *Fusarium annuum* L. H. Leonian (††)

Potato, Irish, *Solanum tuberosum* (2) (3) (4)
- Anthracnose, *Colletotrichum atramentarium* (Berk. and Br.) Taub. (†)
- Bacterial wilt, *Bacterium solanacearum* EFS. (†)
- Black-leg, *Bacillus carotovorus* L. R. Jones (†)
- Early blight, *Alternaria solani* (Ell. and Mart.) L. R. Jones & A. J. Grout (†)
- Curly-dwarf, virus (†)
- Hopperburn, virus (†)
- Late blight, *Phytophthora infestans* (Mont.) DeBy. (†)
- Leaf roll, virus (††)
- Leaf spot, *Cercospora solanicola* Atk. (††)
- Mosaic, virus (††)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
- Root knot, *Caconema radicicola* (Greef) Cobb (†††)
- Russet dwarf, virus (†)
- Scab, *Actinomyces scabies* (Thax.) Gues. (†††)
- Scurf and stem rot, *Corticium vagum* Berk. and Curt. (††)
- Silver scurf, *Spondylocladium atrovirens* C. O. Harz (†)
- Southern blight, *Sclerotium rolfsii* Sacc. (†††)
- Stem rot, *Sclerotinia sclerotiorum* (Lib.) Mass. (†)
- Violet root rot, *Rhizoctonia crocorum* (Pers.) DC. (†)
- Wilt, *Fusarium oxysporum* Schl. (††)
- Yellow dwarf, virus (†)

Potato, Sweet, *Ipomoea batatas* (2) (3) (4)
- Black rot, *Ceratostomella fimbriata* (Ell. and Hals.) Elliott (†††)
- Charcoal rot, *Sclerotium bataticola* Taub. (††)
- Dry rot, *Diaporthe batatatis* (Ell. and Hals.) Hart. (††)
- Java black rot, *Diplodia tubericola* (Ell. and Ev.) Taub. (††)
- Leaf spot, *Septoria bataticola* Taub. (††)
- Leaf spot, *Phyllosticta batatas* (Thuem.) Cke. (†)
- Mosaic, virus (†)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
- Pox or soil rot, *Cystospora batata* (Ell. and Hals.) J. A. Elliott (†)
- Punky rot, *Trichoderma koningi* Oud. (†)
- Root knot, *Caconema radicicola* (Greef) Cobb (†)
- Rust, *Coleosporium ipomoeae* (Schw.) Burr. (†)
- Scurf, *Monilochaetes infuscans* Ell. and Hals. (†)

Southern blight, *Sclerotium rolfsii* Sacc. (††)
Stem rot, *Corticium vagum* Berk. and Curt. (†)
Surface rot, *Fusarium oxysporum* Schl. (†)
White rust, *Albugo ipomoeae-panduranae* (Schw.) Sw. (†)
Wilt or stem rot, *Fusarium batatatis* Woll. & *F. hyperoxysporum* Woll. (††)

Radish, *Raphanus sativus* (2) (4)
Black-rot, *Bacterium campestre* (Pam.) EFS. (††)
Crown rot, *Sclerotinia sclerotiorum* (Lib.) Mass. (†)
Downy mildew, *Peronospora parasitica* (Pers.) DeBy. (††)
Leaf spot, *Cercospora cruciferarum* Ell. and Ev. (†)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
Powdery mildew, *Erysiphe polygoni* DC. (†)
Scab, *Actinomyces scabies* (Thax.) Gues. (†)
Stem rot, *Corticium vagum* Berk. and Curt. (††)
White rust, *Albugo candida* (Pers.) O. Kuntze (†††)

Rhubarb, *Rheum rhaponticum* (2)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
Southern blight, *Sclerotium rolfsii* Sacc. (†††)
Stem and foot rot, *Phytophthora parasitica rhei* G. H. Godfrey (††)
Stem rot, *Corticium vagum* Berk. and Curt. (††)

Roselle, *Hibiscus sabdariffa* (2) (3)
Crown rot, *Phytophthora terrestris* Sherb. (†)
Root rot, *Corticium vagum* Berk. and Curt. (†)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)

Rutabaga, *Brassica campestris* (2) (3)
Black leaf spot, *Alternaria brassicae* (Berk.) Sacc. (†)
Black-rot, *Bacterium campestre* (Pam.) EFS. (††)
Downy mildew, *Peronospora parasitica* (Pers.) DeBy. (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
Powdery mildew, *Erysiphe polygoni* DC. (†)
Root knot, *Caconema radicicola* (Greef) Cobb (†)
White rust, *Albugo candida* (Pers.) O. Kuntze (††)

Salsify or Vegetable-oyster, *Tragopogon porrifolius* (2)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
Root knot, *Caconema radicicola* (Greef) Cobb (†††)
Root rot, *Corticium vagum* Berk. and Curt. (††)
Slimy soft rot, *Bacillus carotovorus* L. R. Jones (††)
Southern blight, *Sclerotium rolfsii* Sacc. (††)
White rust, *Albugo tragopogonis* (DC.) S. F. Gray (†)

Shallot, *Allium ascalonicum* (2)
Pink root, *Fusarium malli* Taub. (††)
Root knot, *Caconema radicicola* (Greef) Cobb (††)

Spinach, *Spinacia oleracea* (2) (3) (4)
- Anthracnose, *Colletotrichum spinaciae* Ell. and Hals. (†)
- Black mold, *Cladosporium macrocarpum* Preuss (††)
- Downy mildew, *Peronospora effusa* (Grev.) Ces. (†††)
- Leaf spot, *Cercospora beticola* Sacc. (†)
- Leaf spot, *Heterosporium variabile* Cke. (††)
- Mosaic, virus (††)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†)
- Root knot, *Caconema radicicola* (Greef) Cobb (†)
- Root rot, *Fusarium solani* (Mart.) App. and Woll. (††)

Squash, *Cucurbita maxima;* Pumpkin, *C. pepo;* Cushaw, *C. moschata* (2) (3) (4)
- Anthracnose, *Colletotrichum lagenarium* (Pass.) Ell. and Hals. (†)
- Bacterial wilt, *Bacillus tracheiphilus* EFS. (††)
- Blossom blight, *Choanephora cucurbitarum* (Berk. and Rav.) Thax. (††)
- Charcoal rot, *Sclerotium bataticola* Taub. (†)
- Downy mildew, *Pseudoperonospora cubensis* (Berk. and Curt.) Rostew. (†††)
- Gray rot, *Diplodia natalensis* Evans (†)
- Mosaic, virus (†)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†)
- Powdery mildew, *Erysiphe cichoracearum* DC. (†††)
- Root knot, *Caconema radicicola* (Greef) Cobb (†††)
- Stem and root rot, *Corticium vagum* Berk. and Curt. (†)
- Wilt, *Fusarium cucurbitae* Taub. (††)

Swiss Chard, *Beta vulgaris cicla* (2) (3)
- Leaf spot, *Cercospora beticola* Sacc. (†††)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
- Root knot, *Caconema radicicola* (Greef) Cobb (††)
- Root rot, *Corticium vagum* Berk. and Curt. (††)
- Southern blight, *Sclerotium rolfsii* Sacc. (†††)

Tomato, *Lycopersicum esculentum* (2) (3) (4)
- Anthracnose, *Colletotrichum phomoides* (Sacc.) Chester (†)
- Bacterial canker, *Aplanobacter michiganense* EFS. (†††)
- Bacterial spot, *Bacterium vesicatorium* Doidge (†††)
- Bacterial wilt, *Bacterium solanacearum* EFS. (††)
- Blossom-end rot, non-par. (†††)
- Fruit puffing, cause unknown, (†††)
- Late blight, *Phytophthora infestans* (Mont.) DeBy. (††)
- Leaf mold, *Cladosporium fulvum* Cke. (†)
- Leaf spot, *Septoria lycopersici* Speg. (†††)
- Leaf spot and ripe rot, *Phoma destructiva* Plow. (†††)
- Mosaic, virus (††)
- Nailhead rust, *Alternaria solani* (Ell. and Mart.) L. R. Jones & A. J. Grout (†)
- Nailhead rust, *Macrosporium tomato* Cke. (†)
- Oedema, non-par. (†)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†)
- Root knot, *Caconema radicicola* (Greef) Cobb (†††)
- Slimy soft rot, *Bacillus carotovorus* L. R. Jones (†)

Soil rot and stem rot, *Corticium vagum* Berk. and Curt. (††)
Sour rot, *Oospora lactis parasitica* F. J. Pritchard and W. S. Porte (†)
Southern blight, *Sclerotium rolfsii* Sacc. (†††)
Stem rot, *Sclerotinia sclerotiorum* (Lib.) Mass. (††)
Wilt, *Fusarium lycopersici* Sacc. (†††)

Turnip, *Brassica rapa* (2) (3) (4)
Black-rot, *Bacterium campestre* (Pam.) EFS. (††)
Downy mildew, *Peronospora parasitica* (Pers.) DeBy. (††)
Drop, *Sclerotinia sclerotiorum* (Lib.) Mass. (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
Powdery mildew, *Erysiphe polygoni* DC. (††)
Root knot, *Caconema radicicola* (Greef) Cobb (††)
Southern blight, *Sclerotium rolfsii* Sacc. (††)
Stem rot, *Corticium vagum* Berk. and Curt. (††)
White rust, *Albugo candida* (Pers.) O. Kuntze (††)
Wilt or yellows, *Fusarium conglutinans* Woll. (†)

Watermelon, *Citrullus vulgaris* (2) (3) (4)
Anthracnose, *Colletotrichum lagenarium* (Pass.) Ell. and Hals. (†††)
Bacterial wilt, *Bacillus tracheiphilus* EFS. (††)
Blossom-end rot, cause unknown (†††)
Charcoal rot, *Sclerotium bataticola* Taub. (†)
Downy mildew, *Pseudoperonospora cubensis* (Berk and Curt.) Rostew. (††)
Fusarium wilt, *Fusarium niveum* EFS. (†††)
Leaf spot, *Cercospora citrullina* Cke. (†††)
Mosaic, virus (†)
Powdery mildew, *Erysiphe cichoracearum* DC. (††)
Root knot, *Caconema radicicola* (Greef) Cobb (††)
Seedling wilt, *Fusarium citrulli* Taub., *F. poolensis* Taub. (††)
Sooty mold, *Capnodium* sp. (††)
Southern blight, *Sclerotium rolfsii* Sacc. (†)
Stem end rot, *Diplodia natalensis* Evans (†††)

GROUP III

FRUITS, NUTS, AND BERRIES

Almond, *Amygdalus communis* (1)
Crown gall, *Bacterium tumefaciens* EFS. & Town. (††)
Fire blight, *Bacillus amylovorus* (Burr.) Trev. (†)
Root knot, *Caconema radicicola* (Greef) Cobb (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)

Apple, *Malus sylvestris* (1) (2) (3)
Bitter rot, and canker, *Glomerella cingulata* (Ston.) Spauld. and Schrenk (†)
Black rot, and canker, *Physalospora malorum* (Pk.) Shear (††)
Blotch canker, *Phyllosticta solitaria* Ell. and Ev. (†††)
Blue mold, *Penicillium expansum* (Lk.) Thom. (†)
Brown rot, *Sclerotinia americana* (Wormald) Norton and Ezekiel (†)
Chlorosis, caused by too much calcium in the soil (††)

Apple (concluded)
- Crown gall, *Bacterium tumefaciens* EFS. and Town. (††)
- Fire blight, *Bacillus amylovorus* (Burr.) Trev. (†††)
- Fruit blotch, *Phyllosticta solitaria* Ell. and Ev. (†††)
- Leaf spot, *Cercospora mali* Ell. and Ev. (††)
- Limb canker, *Septobasidium pseudopedicellatum* Burt. (††)
- Mistletoe, *Phoradendron flavescens* (Pursh) Nutt. (†)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††††)
- Powdery mildew, *Podosphaera oxyacanthae* (DC.) DeBy. (††)
- Root knot, *Caconema radicicola* (Greef) Cobb (††)
- Root rot, *Armillaria mellea* (Vahl) Quel. (†)
- Root rot, *Clitocybe monadelpha* (Morgan) Sacc. (††)
- Water-core, non-par. (††)

Apricot, *Prunus armeniaca* (1) (2) (3)
- Brown rot, *Sclerotinia americana* (Wormald) Norton and Ezekiel (††)
- Chlorosis, caused by too much calcium in the soil (††)
- Crown gall, *Bacterium tumefaciens* EFS. and Town. (††)
- Fire blight, *Bacillus amylovorus* (Burr.) Trev. (††)
- Leaf rust, *Tranzschelia punctata* (Pers.) Arth. (†)
- Leaf shot-hole, *Bacterium pruni* EFS. (††)
- Leaf shot-hole, *Cercospora circumscissa* Sacc. (††)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
- Root knot, *Caconema radicicola* (Greef) Cobb (††)
- Root rot, *Armillaria mellea* (Vahl) Quel. (††)
- Scab, *Cladosporium carpophilum* Thuem. (†††)
- Twig blight, *Valsa leucostoma* (Pers.) Fr. (††)

Avocado, *Persea americana* (1) (2)
- Leaf and fruit anthracnose, *Glomerella cingulata* (Ston.) Spauld. and Schrenk (††)
- Leaf spot, *Pestalozzia* sp. (†)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
- Scab, *Sphaceloma fawcettii* A. Jenkins (†)

Banana, *Musa* sp. (1) (2)
- Anthracnose, *Gloeosporium musarum* Cke. and Mass. (††)
- Root knot, *Caconema radicicola* (Greef) Cobb (†)

Cassava, *Manihot esculenta* (1) (2)
- Anthracnose, *Gloeosporium manihotis* P. Henn. (†)
- Leaf spot, *Cercospora cassavae* Ell. and Ev. (†)
- Leaf spot, *Phyllosticta mortoni* Farman (††)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)

Cherry: Sour, *Prunus cerasus;* Sweet, *P. avium* (1) (2)
- Black-knot, *Plowrightia morbosa* (Schw.) Sacc. (†)
- Brown rot, *Sclerotinia americana* (Wormald) Norton and Ezekiel (††)
- Chlorosis, caused by too much calcium in the soil (†)
- Crown gall, *Bacterium tumefaciens* EFS. and Town. (††)
- Leaf and fruit spot, *Bacterium pruni* EFS. (†††)
- Leaf shot-hole, *Cercospora circumscissa* Sacc. (†)

Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
Powdery mildew, *Podosphaera oxyacanthae* (DC.) DeBy. (†)
Root rot, *Armillaria mellea* (Vahl) Quel. (†)
Witches'-broom, *Exoascus cerasi* (Fckl.) Sadeb. (†)

Citrus spp.
Grapefruit, *C. grandis* (4)
Foot rot, cause unknown (†)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
Scab, *Sphaceloma fawcettii* A. Jenkins (††)
Seedling blight, *Sclerotium rolfsii* Sacc. (†)
Stem-end rot, *Phomopsis citri* Fawc. (††)
Stem-end rot, *Diplodia natalensis* Evans (††)
Wither-tip, *Colletotrichum gloeosporioides* Penz. (†)
Lemon, *C. limonia* (1) (2) (3)
Foot rot, cause unknown (†)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
Root rot, *Armillaria mellea* (Vahl) Quel. (†)
Wither-tip, *Colletotrichum gloeosporioides* Penz. (†)
Lime, *C. aurantifolia* (1) (2)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
Orange, *C. sinensis* (1) (3) (4)
Black rot, *Alternaria citri* N. B. Pierce (†)
Die-back or Exanthema, cause unknown (†)
Greasy spot, cause unknown (†)
Leaf spot, *Cercospora aurantia* Heald and Wolf (††)
Mottled-leaf or frenching, cause unknown (†)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
Scaly bark, also known as Psorosis, cause unknown (†)
Orange, Hardy, *C. trifoliata* (1)
Melanose, *Phomopsis citri* Fawc. (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†)
Twig-blight, *Diplodia aurantii* Catt. (†)
Orange, Satsuma, *C. nobilis unshiu* (1) (3) (4)
Black rot, *Alternaria citri* N. B. Pierce (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
Stem-end rot, *Diplodia natalensis* Ev. (††)
Stem-end rot, *Phomopsis citri* Fawc. (†††)
Wither-tip, *Colletotrichum gloeosporioides* Penz. (†)
Orange, Sour, *C. aurantium* (1)
Chlorosis, cause unknown (†)
Die-back, high water table (†)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug (†)
Scab, *Sphaceloma fawcettii* A. Jenkins (††)
Stem-end rot, *Phomopsis citri* Fawc. (†)
Wither-tip, *Colletotrichum gloeosporioides* Penz. (††)
Tangerine, *C. nobilis* (1) (3)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)

Tangerine (concluded)
- Scab, *Sphaceloma fawcettii* A. Jenkins (††)
- Wither-tip, *Colletotrichum gloeosporioides* Penz. (†)

Crab Apple, Siberian, *Malus baccata* (1)
- Blotch, *Phyllosticta solitaria* Ell. and Ev. (††)
- Fire blight, *Bacillus amylovorus* (Burr.) Trev. (††)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)

Currant, *Ribes vulgare* (2)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)

Date Palm, *Phoenix dactylifera* (1) (2)
- False smut, *Graphiola phoenicis* (Moug.) Poit. (††)
- Leaf anthracnose, *Colletotrichum gossypii* Southw. (†)
- Leaf spot, *Exosporium palmivorum* Sacc. (††)
- Leaf spot, *Pestalozzia palmarum* Cke. (††)

Dewberry, Blackberry, *Rubus* spp. (1) (2) (3) (4)
- Anthracnose, *Plectodiscella veneta* (Speg.) Burk. (†)
- Cane-blight, *Leptosphaeria coniothyrium* (Fckl.) Sacc. (†††)
- Chlorosis, caused by too much calcium in the soil (†)
- Crown gall, *Bacterium tumefaciens* EFS. and Town. (††)
- Leaf blotch, *Cercospora rubi* Sacc. (††)
- Leaf curl, virus (†)
- Leaf spot, *Cylindrosporium rubi* Ell. and Morgan (††)
- Leaf spot, *Mycosphaerella rubi* E. W. Roark (††)
- Mosaic, virus (†)
- Orange rust, *Gymnoconia interstitialis* (Schl.) Lagh. (††)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug (†)
- Powdery mildew, *Sphaerotheca humuli* (DC.) Burr. (†)
- Root rot, *Armillaria mellea* (Vahl) Quel. (†)

Fig, *Ficus carica* (1) (4)
- Anthracnose, *Glomerella cingulata* (Ston.) Spauld. and Schrenk (†)
- Black mold, *Aspergillus niger* V. Tiegh. (††)
- Crown gall, *Bacterium tumefaciens* EFS. and Town. (††)
- Die-back, *Diplodia sycina syconophila* Sacc. (††)
- Fruit canker, *Macrophoma fici* Alm. and Cam. (†)
- Leaf blight, *Rhizoctonia microsclerotia* J. Matz (††)
- Leaf rust, *Cerotelium fici* (Cast.) Arth. (†††)
- Leaf spot, *Cercospora fici* Heald and Wolf (††)
- Leaf spot, *Mycosphaerella bolleana* Hig. (††)
- Limb blight, *Corticium laetum* Karst. (†)
- Limb canker, *Sclerotinia sclerotiorum* (Lib.) Mass. (†)
- Limb canker, *Tubercularia fici* Edg. (†)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††††)
- Root knot, *Caconema radicicola* (Greef) Cobb (†††)
- Soft rot, *Rhizopus nigricans* Ehr. (†)
- Souring of fruit, *Oospora* sp. (†)

Gooseberry, *Ribes grossulariae* (2)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
- Powdery mildew, *Sphaerotheca mors-uvae* (Schw.) Berk. and Curt. (†)

Grape, *Vitis* spp. (1) (2) (3) (4)
- Black rot, *Guignardia bidwellii* (Ell.) Viala and Ravaz (†††)
- Chlorosis, caused by too much calcium in the soil (††)
- Crown gall, *Bacterium tumefaciens* EFS. and Town. (†††)
- Downy mildew, *Plasmopara viticola* (Berk. and Curt.) Berl. and DeToni (††)
- Leaf blotch, *Briosia ampelophaga* Cav. (††)
- Leaf spot, *Cercospora viticola* (Ces.) Sacc. (††)
- Leaf spot, *Coniothyrium diplodiella* (Speg.) Sacc. (††)
- Leaf spot, *Isariopsis clavispora* (Berk. and Curt.) Sacc. (†)
- Leaf spot, *Septoria ampelina* Berk. and Curt. (†)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
- Powdery mildew, *Uncinula necator* (Schw.) Burr. (††)
- Ripe-rot, *Glomerella cingulata* (Ston.) Spauld. and Schrenk (†)
- Root knot, *Caconema radicicola* (Greef) Cobb (††)
- Root rot, *Armillaria mellea* (Vahl) Quel. (†)
- Root rot, *Clitocybe monadelpha* (Morgan) Sacc. (†)

Guava, *Psidium guajava* (1) (2)
- Anthracnose, *Glomerella cingulata* (Ston.) Spauld. and Schrenk (†)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)

Jujube, *Zizyphus jujuba* Mill (1) (2)
- Anthracnose, *Glomerella cingulata* (Ston.) Spauld. and Schrenk (†)
- Black rot, *Diplodia* sp. (†)
- Cracked fruit, caused by growth cracks (††)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)

Loquat, *Eriobotrya japonica* (1) (2)
- Fire blight, *Bacillus amylovorus* (Burr.) Trev. (†)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)

Mango, *Mangifera indica* (1) (2)
- Anthracnose, *Glomerella cingulata* (Ston.) Spauld. and Schrenk (†)
- Leaf spot, *Phyllosticta mortoni* Fairman (†)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)

Nectarine, *Amygdalus persica nectarina* (1) (2)
- Brown rot, *Sclerotinia americana* (Wormald) Norton and Ezekiel (††)
- Leaf curl, *Exoascus deformans* (Berk.) Fckl. (††)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
- Root rot, *Armillaria mellea* (Vahl) Quel. (†)
- Scab, *Cladosporium carpophilum* Thuem. (††)

Olive, *Olea europaea* (1) (2)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
- Root rot, *Armillaria mellea* (Vahl) Quel. (†)

Papaw, *Asimina triloba* (1) (2)
- Leaf spot, *Cercospora asiminae* Ell. and Kellerm. (††)
- Leaf spot, *Phyllosticta asiminae* Ell. and Kellerm. (††)
- Leaf spot, *Septoria asiminae* Ell. and Ev. (††)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
- Sooty mold, *Capnodium fuligo* B. and Desm. (†††)

Papaya, *Carica papaya* (1) (2)
- Anthracnose, *Colletotrichum falcatum* Went. (†)
- Anthracnose, *Gloeosporium papayae* Henn. (†)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
- Powdery mildew, *Oidium caricae* F. Noack (†)
- Root knot, *Caconema radicicola* (Greef) Cobb (††)
- Root rot, *Pythium debaryanum* Hesse (†)
- Rust, *Pucciniopsis caricae* Earle (†)

Peach, *Amygdalus persica* (1) (2) (3) (4)
- Bacterial spot of leaf and fruit, *Bacterium pruni* EFS. (†††)
- Brown rot, *Sclerotinia americana* (Wormald) Norton and Ezekiel (†††)
- Chlorosis, caused by too much calcium in the soil (††)
- Crown gall, *Bacterium tumefaciens* EFS. and Town. (†††)
- Die-back, *Valsa leucostoma* (Pers.) Fr. (††)
- Frosty mildew, *Cercosporella persicae* Sacc. (††)
- Leaf curl, *Exoascus deformans* (Berk.) Fckl. (††)
- Leaf rust, *Tranzschelia punctata* (Pers.) Arth. (††)
- Mosaic, virus (†)
- Phoney peach, root virus (†)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
- Powdery mildew, *Podosphaera oxyacanthae* (DC.) DeBy. (††)
- Powdery mildew, *Sphaerotheca pannosa* (Wallr.) Lev. (††)
- Root knot, *Caconema radicicola* (Greef) Cobb (†††)
- Root rot, *Armillaria mellea* (Vahl) Quel. (†)
- Scab, *Cladosporium carpophilum* Thuem. (†††)
- Seedling blight, *Sclerotium rolfsii* Sacc. (†)
- Shot-hole, *Cercospora circumscissa* Sacc. (†)

Pear, *Pyrus communis* (1) (2) (3) (4)
- Ashy leaf spot, *Mycosphaerella sentina* (Fr.) Schroet. (†)
- Bitter rot, *Glomerella cingulata* (Ston.) Spauld. and Schrenk (†)
- Black rot, *Physalospora malorum* (Pk.) Shear (†)
- Blue mold, *Penicillium expansum* (Lk.) Thom. (†)
- Brown rot, *Sclerotinia americana* (Wormald) Norton and Ezekiel (††)
- Chlorosis, caused by too much calcium in the soil (††)
- Crown gall, *Bacterium tumefaciens* EFS. and Town. (††)
- Fire blight, *Bacillus amylovorus* (Burr.) Trev. (†††)
- Flyspeck, *Leptothyrium carpophilum* Pass. (†)
- Leaf blight, *Corticium stevensii* Burt (†)
- Leaf spot, *Cercospora minima* Tr. and Earle (†)
- Leaf spot, *Hendersonia foliorum* Fckl. (††)
- Mistletoe, *Phoradendron flavescens* (Pursh) Nutt. (†)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)

Root rot, *Armillaria mellea* (Vahl) Quel. (†)
Rust, *Gymnosporangium germinale* Kern I (†)
Stem canker, *Septobasidium pseudopedicellatum* Burt (†)

Pecan, *Hicoria pecan* (1) (2) (3) (4)
Anthracnose, *Glomerella cingulata* (Ston.) Spauld. and Schrenk (†)
Brown leaf-spot, *Cercospora fusca* (Heald and Wolf) F. V. Rand (††)
Crown gall, *Bacterium tumefaciens* EFS. and Town. (††)
Die-back, *Botryosphaeria berengiana* DeNot. (†††)
Kernel-spot, caused by southern stinkbug (*Nezara viridula* L.) (†††)
Leaf spot, *Microstroma juglandis* (Bereng.) Sacc. (††)
Leaf spot, *Septoria caryae* Ell. and Ev. (††)
Mistletoe, *Phoradendron flavescens* (Pursh) Nutt. (†)
Nursery blight, *Phyllosticta caryae* Pk. (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
Powdery mildew, *Microsphaera alni* (Wallr.) Wint. (††)
Root knot, *Caconema radicicola* (Greef) Cobb (††)
Rosette, caused by iron deficiency (††)
Scab, *Fusicladium effusum* Wint. (††)

Persimmon: Common, *Diospyros virginiana* (2); Japanese, *D. kaki* (1) (2)
Anthracnose, *Gloeosporium diospyri* Ell. and Ev. (†)
Black rot, *Physalospora malorum* (Pk.) Shear (†)
Chlorosis, caused by too much calcium in the soil (††)
Fruit spot, *Macrophoma diospyri* Earle (††)
Leaf spot, *Cercospora diospyri* Thuem. (††)
Leaf spot, *Cercospora fuliginosa* Ell. and Kell. (††)
Leaf spot, *Phyllosticta biformis* Heald and Wolf (††)
Mistletoe, *Phoradendron flavescens* (Pursh) Nutt. (†)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
Powdery mildew, *Podosphaera oxyacanthae* (DC.) DeBy. (†)
Root knot, *Caconema radicicola* (Greef) Cobb (††)

Pistache, *Pistacia chinensis, P. mexicana, P. vera* (1)
Leaf blight, *Corticium stevensii* (Noack) Burt (†)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)

Plum and Prune, *Prunus* spp. (1) (2) (3) (4); Plum, American Wild, *P. americana* (2)
Black-knot, *Plowrightia morbosa* (Schw.) Sacc. (††)
Black spot, *Bacterium pruni* EFS. (††)
Blotch, *Phyllosticta congesta* Heald and Wolf (†††)
Brown rot, *Sclerotinia americana* (Wormald) Norton and Ezekiel (††)
Crown gall, *Bacterium tumefaciens* EFS. and Town. (††)
Fire blight, *Bacillus amylovorus* (Burr.) Trev. (†)
Limb canker, *Septobasidium retiforme* (Berk. and Curt.) Pat. (†)
Mistletoe, *Phoradendron flavescens* (Pursh) Nutt. (†)
Plum pockets, *Exoascus pruni* (Berk.) Fckl. (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
Root knot, *Caconema radicicola* (Greef) Cobb (††)

Plum and Prune (concluded)
Root rot, *Armillaria mellea* (Vahl) Quel. (†)
Rust, *Tranzschelia punctata* (Pers.) Arth. (††)

Quince, *Cydonia oblonga* (1) (2)
Bitter rot, *Glomerella cingulata* (Ston.) Spauld. and Schrenk (†)
Black rot, *Physalospora malorum* (Pk.) Shear (†)
Brown rot, *Sclerotinia americana* (Wormald) Norton and Ezekiel (†)
Crown gall, *Bacterium tumefaciens* EFS. and Town. (†)
Fire blight, *Bacillus amylovorus* (Burr.) Trev. (†)
Leaf blight, *Corticium stevensii* Burt (†)
Leaf spot, *Fabraea maculata* (Lev.) Atk. (†)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
Root knot, *Caconema radicicola* (Greef) Cobb (††)

Strawberry, *Fragaria* sp. (2) (3) (4)
Black or burned root, caused by excessive alkalinity of soil (††)
Chlorosis, caused by too much calcium in the soil (††)
Crimp or leaf nematode, *Aphelenchus fragariae* Ritzema Bos (††)
Crown rot, *Sclerotium rolfsii* Sacc. (†)
Crown rot, *Sclerotinia sclerotiorum* (Lib.) Mass. (†)
Fruit rot, *Sphaeronemella fragariae* Stevens and Peterson (†)
Leaf scorch, *Diplocarpon earliana* (Ell. and Ev.) Wolf (††)
Leaf spot, *Mycosphaerella fragariae* (Tul.) Lindau (††)
Leak, *Rhizopus nigricans* Ehr. (†)
Root knot, *Caconema radicicola* (Greef) Cobb (††)
Root rot, *Rhizoctonia* sp. (†)
Slime mold, *Fuligo violacea* Pers. (†)
Stem nematode, *Tylenchus dipsaci* (Kuehn) Bast. (†)

Sugar-apple, *Annona squamosa* (1)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
Rust, *Uredo cherimoliae* Lagh. (†)
Stem blight, *Diplodia natalensis* Evans (††)

Walnut: Black, *Juglans nigra;* Japanese, *J. sieboldiana;* Persian, *J. regia* (1) (2)
Anthracnose, *Gnomonia leptostyla* (Fr.) Ces. and DeNot. (†)
Crown gall, *Bacterium tumefaciens* EFS. and Town. (††)
Leaf spot, *Phleospora multimaculans* Heald and Wolf (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
Powdery mildew, *Microsphaera alni* (Wallr.) Wint. (††)
Root rot, *Armillaria mellea* (Vahl) Quel. (†)
Stem canker, *Diplodia* sp. (†)

GROUP IV

SHADE AND FOREST TREES, ORNAMENTAL SHRUBS AND HERBACEOUS PLANTS

Abelia, Glossy, *Abelia grandiflora* (1) (2)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)

Acacia, Rose, *Robinia hispida* (1) (2)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug (†)

Acacia, Sweet, *Acacia farnesiana;* Catclaw, *A. greggii* (1) (2)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug (†)
Rust, *Ravenelia australis* Diet. and Neg. (†)
Rust, *Ravenelia siliquae* Long (†)

Alder: Black, *Alnus rubra;* Hazel, *A. rugosa;* Mountain, *A. tenuifolia* (1) (2)
Anthracnose, *Gnomonia alni* Plow. (†)
Catkin decay, *Taphrina robinsoniana* Gies. (†)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
Powdery mildew, *Microsphaera alni* (Wallr.) Wint. (††)
Rust, *Melampsoridium alni* (Thuem.) Diet. (†)
White heart-rot, *Fomes igniarius* (L.) Fr. (††)

Althea, Shrub, *Hibiscus syriacus* (1) (2)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
Root knot, *Caconema radicicola* (Greef) Cobb (††)
Rust, *Kuehneola malvicola* (Speg.) Arth. (†)

Amaranth, Blood, *Amaranthus paniculatus cruentus* (2)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
Rust, *Uredo amaranthi* (S.) B. (†)
White rust, *Cystopus bliti* (Biv.) Lev. (†)

Anemone, *Anemone japonica* (1) (2)
Rust, *Tranzschelia cohaesa* (Long) Arth. (†)

Araucaria, Brazilian, *Araucaria brasiliana* (1)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†)

Arborvitae: *Thuja occidentalis;* Oriental, *T. orientalis;* Giant, *T. plicata* (1) (2) (3)
Leaf blight, *Pestalozzia funerea* Desm. (†)
Limb blight, *Keithia thujina* E. J. Durand (†)
Nursery blight, *Phomopsis juniperovora* G. Hahn (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
Root rot, *Armillaria mellea* (Vahl) Quel. (†)

Ash, Prickly, *Zanthoxylum americanum* (1) (3)
Leaf spot, *Cercospora xanthoxyli* Cke. (†)
Rust, *Aecidium xanthoxyli* Pk. (†††)
Sooty mold, *Fumago vagans* Fr. (†)
Stem canker, *Diplodia natalensis* Evans (†)

Ash: White, *Fraxinus americana;* Water, *F. caroliniana;* Green, *F. pennsylvanica* (1) (2)
Anthracnose, *Gloeosporium decipiens* Ell. and Ev. (†)

Ash (concluded)
- Leaf spot, *Cercospora fraxinites* Ell. and Ev. (††)
- Leaf spot, *Cercospora texensis* Ell. and Gall. (††)
- Leaf spot, *Cylindrosporium viridis* Ell. and Kell. (††)
- Leaf spot, *Phyllosticta viridis* Ell. and Kell. (†)
- Leaf spot, *Piggotia fraxini* Berk. and Curt. (†)
- Leaf spot, *Septoria submaculata* Wint. (†)
- Mistletoe, *Phoradendron flavescens* (Pursh) Nutt. (††)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
- Rust, *Puccinia fraxinata* (Lk.) Arth. (†)
- White heartwood rot, *Fomes fraxinophilus* Pk. (†)

Aster, China, *Callistephus chinensis* (2)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
- Root knot, *Caconema radicicola* (Greef) Cobb (†)
- Stem rot, *Corticium vagum* Berk. and Curt. (†)
- Wilt, *Fusarium conglutinans* var. *callistephi* Beach (†)
- Yellows, virus (†)

Avens, *Geum japonicum* (2)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)

Azalea, *Azalea* spp. (1) (2) (3)
- Leaf gall, *Exobasidium vaccinii* (Fckl.) Wor. (†)
- Leaf spot, *Septoria solitaris* Ell. and Ev. (††)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
- Rust, *Pucciniastrum myrtilli* (Schum.) Arth. (†)
- Stem rot, *Corticium vagum* Berk. and Curt. (††)

Bamboo, *Bambusa* sp. (1) (2)
- Root rot, *Schizophyllum multifidum* Fr. (†)
- Rust, *Puccinia melanocephala* Syd. (†)
- Stem blight, *Diplodia bambusae* Ell. and Langlois (†)

Bamboo: Japanese Timber, *Phyllostachys bambusoides;* Blackjoint, *P. nigra* (1) (2)
- Rust, *Puccinia melanocephala* Syd. (†)
- Smut, *Ustilago shiraiana* P. Henn. (†)

Barberry: Allegheny, *Berberis canadensis;* Japanese, *B. thunbergii;* Common, *B. vulgaris* (1) (2)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†)

Barberry, Box, *Berberis thunbergii minor* (1) (2)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)

Basketflower, *Centaurea americana* (1) (2)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
- Rust, *Puccinia irrequisita* H. S. Jackson (†)

Bayberry, or Southern Waxmyrtle, *Myrica cerifera* (1) (2)
Leaf spot, *Cercospora myricae* Tr. and Earle (††)
Leaf spot, *Phyllosticta myricae* Cke. (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)

Bearberry or Manzanita, *Arctostaphylos uva-ursi* (1)
Leaf curl, *Exobasidium vaccinii* (Fckl.) Wor. (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)

Beautyberry, *Callicarpa americana* (1) (2)
Leaf spot, *Cercospora callicarpae* Cke. (††)
Sooty mold, *Meliola cookeana* Speg. (††)

Beech, *Fagus grandifolia* (1) (2) (3)
Anthracnose, *Gloeosporium fagi* (Desm.) Ell. and Ev. (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
Powdery mildew, *Microsphaera alni* (Wallr.) Wint. (†)
White-streaked rot, *Fomes applanatus* (Pers.) Wallr. (†)

Begonia, *Begonia* sp. (1) (2)
Crown gall, *Bacterium tumefaciens* EFS. and Town. (†)
Leaf spot, *Cercospora* sp. (†)
Root knot, *Caconema radicicola* (Greef) Cobb (†††)

Birch: White, *Betula alba;* Sweet, *B. lenta;* Yellow, *B. lutea* (1) (2) River, *B. nigra* (1) (2) (3)
Anthracnose, *Gloeosporium betularum* Ell. and Mart. (††)
Mistletoe, *Phoradendron flavescens* (Pursh) Nutt. (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
Powdery mildew, *Phyllactinia corylea* (Pers.) Karst. (†)
Powdery sapwood rot, *Polyporus betulinus* (Bull.) Fr. (†)
Rust, *Melampsoridium betulae* (Schum.) Arth. (†)

Bittersweet, *Celastrus scandens* (1) (2)
Leaf spot, *Ramularia celastri* Ell. and Mart. (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
Powdery mildew, *Phyllactinia corylea* (Pers.) Karst. (††)
Twig blight, *Diplodia celastri* Cke. (††)

Bluebell, Texas, *Eustoma russellianum* (2) (3)
Root rot, *Fusarium solani* (Mart.) App. and Woll. (†††)
Stem blight, *Sclerophoma eustomonis* Taub. (†††)

Box, *Buxus sempervirens* (1) (2)
Leaf blight, *Macrophoma candollei* (Berk. and Br.) Berl. and Vogl. (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)

Boxelder: *Acer negundo;* California, *A. negundo californicum* (1) (2)
Leaf blight, *Gloeosporium negundinis* Ell. and Ev. (†)
Leaf spot, *Phyllosticta arida* Earle (†)
Leaf spot, *Septoria marginata* Heald and Wolf (††)

Boxelder (concluded)
Leaf spot, *Septogloeum acerinum* (Pass.) Sacc. (†)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
Red stain, *Fusarium negundi* Sherb. (†)

Bridalwreath, *Spiraea prunifolia* (1) (2)
Fire blight, *Bacillus amylovorus* (Burr.) Trev. (†)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
Powdery mildew, *Sphaerotheca humuli* (DC.) Burr. (††)

Buckeye: California, *Aesculus californica;* Ohio, *A. glabra leucodermis;* Yellow, *A. octandra;* Red, *A. pavia* (1) (2) (3)
Anthracnose, *Gloeosporium carpogenum* Cke. (†)
Leaf blotch, *Guignardia aesculi* (Pk.) V. B. Stewart (†)
Leaf spot, *Phyllosticta aesculicola* Sacc. (†)
Mistletoe, *Phoradendron villosum* Nutt. (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
Powdery mildew, *Phyllactinia corylea* (Pers.) Karst. (††)
Witches'-broom, *Exoascus aesculi* (Ell. and Ev.) F. Patterson (†)

Buckthorn: Carolina, *Rhamnus caroliniana;* Cascara, *R. purshiana* (1) (2) (3)
Crown rust, *Puccinia coronata* Cda. (††)
Leaf spot, *Cercospora rhamni* Fckl. (†)
Leaf spot, *Septoria blasdalei* Sacc. and Syd. (†)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)

Buffaloberry, Yellow, *Shepherdia canadensis xanthocarpa* (1) (2)
Powdery mildew, *Sphaerotheca humuli* (DC.) Burr. (†)

Burningbush, Evergreen, *Euonymus japonicus* (1) (2) (3)
Anthracnose, *Colletotrichum griseum* Heald and Wolf (††)
Crown gall, *Bacterium tumefaciens* EFS. and Town. (†)
Leaf spot, *Cercospora destructiva* Rav. (†)
Leaf spot, *Exosporium concentricum* Heald and Wolf (††)
Leaf spot, *Phyllosticta pallens* Ell. and Ev. (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
Powdery mildew, *Microsphaera alni* (Wallr.) Wint. (†)

Butterflybush, *Buddleia* sp. (1) (2)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
Root knot, *Caconema radicicola* (Greef) Cobb (††)

Buttonbush, *Cephalanthus occidentalis* (1) (2)
Leaf spot, *Ascochyta cephalanthi* Ell. and Ev. (†)
Leaf spot, *Cercospora perniciosa* Heald and Wolf (††)
Leaf spot, *Pestalozzia funerea* Desm. (†)
Leaf spot, *Phyllosticta cephalanthi* Tharp (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
Sooty mold, *Capnodium elongatum* B. and Desm. (††)

Cactus: *Acanthocereus* spp.; *Ancistrocactus* spp.; *Ariocarpus* spp.; *Coryphantha* spp.; *Dolichothele* spp.; *Echinocactus* spp.; *Echinocereus* spp.; *Echinomastus* spp.; *Epithelantha* spp.; *Escobaria* spp.; *Ferocactus* spp.; *Hamatocactus* spp.; *Lophophora* spp.; *Neobesseya* spp.; *Neolloydia* spp.; *Neomammillaria* spp.; *Opuntia* spp.; *Penicereus* spp.; *Thelocactus* spp.; *Wilcoxia* spp.
- Anthracnose, *Sphaerella opuntiae* (E. and E.) Wolf (†††)
- Black spot, *Perisporium wrightii* B. and C. (†††)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
- Slimy soft rot, *Bacillus carotovorus* L. R. Jones (†††)
- Sunscald, *Hendersonia opuntiae* E. and E. (†††)

Calendula, *Calendula officinalis* (2)
- Mosaic, virus (††)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
- Root knot, *Caconema radicicola* (Greef) Cobb (††)
- Southern blight, *Sclerotium rolfsii* Sacc. (††)
- Stem and root rot, *Corticium vagum* Berk. and Curt. (††)

Camphor-tree, *Cinnamomum camphora* (1) (2)
- Anthracnose, *Gloeosporium camphorae* Sacc. (††)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
- Stem canker, *Diplodia natalensis* Evans (††)

Canna, *Canna indica* (1) (2)
- Southern blight, *Sclerotium rolfsii* Sacc. (†)

Cape-jasmine, *Gardenia florida* (1) (2)
- Chlorosis, caused by too much calcium in the soil (†)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
- Sooty mold, *Capnodium* sp. (†)

Carnation, *Dianthus caryophyllus* (1) (2) (3); Sweet William, *D. barbatus* (1) (2)
- Anthracnose, *Volutella dianthi* (Hals.) Atk. (†)
- Leaf spot, *Heterosporium echinulatum* (Berk.) Cke. (††)
- Leaf spot, *Septoria dianthi* Desm. (††)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
- Root knot, *Caconema radicicola* (Greef) Cobb (†††)
- Rust, *Uromyces carophyllinus* (Schrank) Wint. (†††)
- Stem rot, *Corticium vagum* Berk. and Curt. (††)

Castor-bean, *Ricinus communis* (2)
- Crown gall, *Bacterium tumefaciens* EFS. and Town. (†)
- Gray mold, *Sclerotinia ricini* G. H. Godfrey (†)
- Leaf spot, *Cercospora ricinella* Sacc. (†)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
- Stem and root rot, *Corticium vagum* Berk. and Curt. (†)

Catalpa, *Catalpa speciosa* (1) (2) (3)
- Leaf spot, *Cercospora catalpae* Wint. (††)
- Leaf spot, *Macrosporium catalpae* Ell. and Mart. (††)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
- Powdery mildew, *Microsphaera alni vaccinii* (Schw.) Salm. (††)
- Root knot, *Caconema radicicola* (Greef) Cobb (†)

Cedar: Alaska, or Nootka Cypress, *Chamaecyparis nootkatensis* (1); White, *C. thyoides* (1)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)

Cedar, Incense, *Libocedrus decurrens* (1)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)

Cedar: Mountain, *Juniperus mexicana;* Red, *J. virginiana* (1) (2) (3) (4)
- Brown fibrous rot, *Fomes texanus* (Murr.) Hedgc. and Long (†)
- Cedar rust, *Gymnosporangium exiguum* Kern (†)
- Nursery blight, *Phomopsis juniperovora* G. Hahn (†††)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†)
- Whitening or stem blight, *Cyanospora albicedrae* Heald and Wolf (††)
- Yellow pocket rot, *Fomes earlei* (Murr.) Sacc. and D. Sacc. (††)

Centuryplant, *Agave americana* (1) (2)
- Anthracnose, *Colletotrichum agaves* Cav. (††)
- Leaf spot, *Stagonospora gigantea* Heald and Wolf (†††)

Cherry: Black, *Prunus serotina* (1) (2) (3); Chokecherry, *P. virginiana, P. demissa* (2) (3)
- Black-knot, *Plowrightia morbosa* (Schw.) Sacc. (†)
- Brown rot, *Sclerotinia americana* (Wormald) Norton and Ezekiel (††)
- Chlorosis, caused by too much calcium in the soil (†)
- Leaf curl, *Exoascus pruni* Fckl. (††)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
- Rust, *Tranzschelia punctata* (Pers.) Arth. (†)
- Witches'-broom, *Exoascus cerasi* (Fckl.) Sadeb. (†)
- Witches'-broom, *Exoascus pruni* Fckl. (†)

Chestnut: *Castanea dentata;* Japanese, *C. japonica;* Spanish, *C. sativa* (1)
- Leaf spot, *Phyllosticta castanea* Ell. and Ev. (††)
- Leaf spot, *Phyllosticta fusispora* Ell. and Ev. (††)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††††)
- Powdery mildew, *Microsphaera alni* (Wallr.) Wint. (†)
- Powdery mildew, *Phyllactinia corylea* (Pers.) Karst. (†)

Chinaberry: *Melia azedarach;* Umbrella, *M. azedarach umbraculiformis* (1) (2)
- Leaf spot, *Cercospora meliae* Ell. and Ev. (†)

Leaf spot, *Phyllosticta meliae* Ell. and Ev. (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††††)

Chinquapin, *Castanea pumila* (1) (2)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
Powdery mildew, *Microsphaera alni* (Wallr.) Wint. (†)

Chokeberry, *Aronia* spp. (1) (2)
Fire blight, *Bacillus amylovorus* (Burr.) Trev. (†)
Leaf spot, *Cercospora mali* Ell. and Ev. (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
Rust, *Gymnosporangium germinale* (Schw.) Kern (†)

Chrysanthemum, *Chrysanthemum* sp. (1) (2)
Chlorosis, caused by too much calcium in the soil (†)
Leaf spot, *Cercospora chrysanthemi* Heald and Wolf (†††)
Leaf spot, *Cylindrosporium chrysanthemi* Ell. and Dearn. (††)
Leaf spot, *Septoria chrysanthemella* Cav. (†)
Mosaic, virus (†)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
Powdery mildew, *Erysiphe cichoracearum* DC. (†††)
Root knot, *Caconema radicicola* (Greef) Cobb (†††)
Rust, *Puccinia chrysanthemi* Roze (†††)
Stem and root rot, *Corticium vagum* Berk. and Curt. (††)

Clematis or Virgins-bower, *Clematis* sp. (1) (2)
Crown gall, *Bacterium tumefaciens* EFS. and Town. (†)
Leaf blight, *Phleospora adusta* Heald and Wolf (††)
Leaf spot, *Cercospora rubigo* Cke. and Hark. (††)
Leaf spot, *Cercospora squalidula* Pk. (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
Powdery mildew, *Erysiphe polygoni* DC. (††)
Root knot, *Caconema radicicola* (Greef) Cobb (††)
Rust, *Puccinia clematidis* (DC.) Lagh. (†)

Columbine, *Aquilegia* spp. (2)
Anthracnose, *Gloeosporium aquilegiae* Thuem. (††)
Crown rot, *Sclerotinia sclerotiorum* (Lib.) Mass. (†)
Powdery mildew, *Erysiphe polygoni* DC. (†)
Southern blight, *Sclerotium rolfsii* Sacc. (††)

Coneflower, *Rudbeckia laciniata* (2)
Leaf spot, *Phyllosticta rudbeckiae* Ell. and Ev. (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
Rust, *Uromyces rudbeckiae* Arth. and Holw. (†)

Coraltree, *Erythrina crista-galli* (1) (2)
Leaf spot, *Cercospora erythrinae* Ell. and Ev. (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)

Cosmos: Common, *Cosmos bipinnatus;* Yellow, *C. sulphureus* (2)
- Leaf and stem blight, *Phomopsis stewartii* Pk. (††)
- Leaf scorch, virus (?) (†)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
- Powdery mildew, *Erysiphe cichoracearum* DC. (††)
- Root and stem rot, *Corticium vagum* Berk. and Curt. (†††)

Cotoneaster: Pekin, *Cotoneaster acutifolia;* Spreading, *C. divaricata;* Rock, *C. horizontalis;* Silverleaf, *C. pannosa* (1) (2)
- Fireblight, *Bacillus amylovorus* (Burr.) Trev. (††)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
- Twig blight, *Diplodia* sp. (††)

Cottonwood: Smoothbark, *Populus acuminata;* Carolina, *P. angulata;* Narrowleaf, *P. angustifolia;* Southern, *P. deltoides* (1) (2) (3)
- Crown gall, *Bacterium tumefaciens* EFS. and Town. (††)
- Leaf spot, *Cercospora populina* Ell. and Ev. (††)
- Leaf spot, *Septoria populicola* Pk. (††)
- Mistletoe, *Phoradendron flavescens* (Pursh) Nutt. (††)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††††)
- Powdery mildew, *Uncinula salicis* (DC.) Wint. (†)
- Rust, *Melampsora larici-populina* Kleb. (††)
- Rust, *Melampsora medusae* Thuem. (††)
- Stem canker, *Cytospora chrysosperma* (Pers.) Fr. (††)
- White heart-rot, *Fomes igniarius* (L.) Fr. (†)
- White-streaked rot, *Fomes applanatus* (Pers.) Wallr. (†)

Crapemyrtle, *Lagerstroemia indica* (1) (2)
- Leaf spot, *Cercospora lythracearum* Heald and Wolf (††)
- Leaf spot, *Phyllosticta lagerstroemiae* Ell. and Ev. (††)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)

Creeper: Peppervine, *Ampelopsis arborea;* Virginia, *A. quinquefolia;* Japanese or Boston Ivy, *A. tricuspidata* (1) (2)
- Black rot, *Guignardia bidwellii* (Ell.) Viala and Ravaz (†††)
- Downy mildew, *Plasmopara viticola* (Berk. and Curt.) Berl. and DeToni (†)
- Leaf spot, *Cercospora arboriae* Tharp (††)
- Leaf spot, *Cercospora viticola* (Ces.) Sacc. (††)
- Leaf spot, *Phyllosticta viticola* (Berk. and Curt.) Thuem. (††)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
- Powdery mildew, *Uncinula necator* (Schw.) Burr. (††)

Cycas, Sago, *Cycas revoluta* (1) (2)
- Leaf spot, *Ascochyta cycadina* G. Scalia (†††)

Cyclamen, Common, *Cyclamen persicum giganteum* (1) (2)
- Anthracnose, *Glomerella cingulata* (Ston.) Spauld. and Schrenk (†)
- Leaf spot, *Phyllosticta cyclaminicola* Trel. (††)
- Root knot, *Caconema radicicola* (Greef) Cobb (†††)

Cypress, *Taxodium distichum* (1) (2) (3)
Leaf spot, *Pestalozzia funerea* Desm. (††)
Pecky heartwood rot, *Fomes geotropus* Cke. (†)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)

Cypress: Arizona, *Cupressus arizonica;* Smooth, *C. glabra;* Italian, *C. sempervirens* (1) (2) (3)
Nursery blight, *Phomopsis juniperovora* Hahn (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)

Cypress, Summer, *Kochia scoparia* and *K. trichophylla* (1) (2)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
Rust, *Puccinia subnitens* Diet. I (†)
Stem and root rot, *Corticium vagum* Berk. and Curt. (††)

Cypressvine, *Quamoclit pinnata* (2)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)

Dahlia, *Dahlia* sp. (2)
Mosaic, virus (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††††)
Powdery mildew, *Erysiphe cichoracearum* DC. (††)
Root knot, *Caconema radicicola* (Greef) Cobb (†††)
Southern blight, *Sclerotium rolfsii* Sacc. (†††)
Stem and root rot, *Corticium vagum* Berk. and Curt. (†††)

Daylily, Orange, *Hemerocallis aurantiaca* (2)
Leaf spot, *Cercospora hemerocallis* L. R. Tehon (††)
Leaf spot, *Heterosporium gracile* Sacc. (††)

Deutzia: Common, *Deutzia* sp.; Slender, *D. gracilis;* Lemoine's, *D. lemoinei* (1) (2)
Leaf spot, *Cercospora deutziae* Ell. and Ev. (††)
Leaf spot, *Phyllosticta deutziae* Ell. and Ev. (††)
Root knot, *Caconema radicicola* (Greef) Cobb (†)

Devils-walkingstick, *Aralia spinosa* (1) (2)
Leaf spot, *Cercospora atromaculans* Ell. and Ev. (†)
Leaf spot, *Phyllosticta araliae* Ell. and Ev. (†)
Leaf spot, *Phyllosticta everhartii* Sacc. and Syd. (†)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
Root rot, *Corticium vagum* Berk. and Curt. (††)

Dogwood: Tatarian, *Cornus alba* (1) (2); Silky, *C. ammonum* (1) (2); Roughleaf, *C. asperifolia* (1) (2); Flowering, *C. florida* (1) (2) (3); Bloodtwig, *C. sanguinea* (1) (2)
Leaf spot, *Cercospora cornicola* Tr. and Earle (††)
Leaf spot, *Septoria cornicola* Desm. (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††††)
Powdery mildew, *Phyllactinia corylea* (Pers.) Karst. (†)
Sooty mold, *Dimerosporium pulchrum* Sacc. (††)

Ebony, Texas, *Pithecolobium flexicaule* (1) (3) (4)
Anthracnose, *Colletotrichum erythrinae* Ell. and Ev. (†)
Leaf spot, *Pestalozzia funerea* Desm. (†)
Leaf spot, *Phyllosticta pithecolobii* E. Young (††)
Rust, *Ravenelia gracilis* Arth. (†)
Rust, *Ravenelia pithecolobii* Arth. (†)

Elder: American, *Sambucus canadensis;* European, *S. nigra;* Albino, *S. pubens leucocarpa* (1) (2)
Anthracnose, *Gloeosporium lineum* Sacc. (†)
Leaf spot, *Cercospora catenospora* Atk. (††)
Leaf spot, *Septoria sambucina* Pk. (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
Powdery mildew, *Microsphaera alni* (Wallr.) Wint. (††)
Violet root rot, *Rhizoctonia crocorum* (Pers.) DC. (††)

Elephants-ear, *Colocasia esculenta* (2)
Root knot, *Caconema radicicola* (Greef) Cobb (††)
Southern blight, *Sclerotium rolfsii* Sacc. (†††)

Elm: Winged, *Ulmus alata;* American, *U. americana;* Cedar, *U. crassifolia;* Red or Slippery, *U. fulva;* Chinese, *U. parvifolia* (1) (2) (3)
Anthracnose, *Gnomonia ulmea* (Sacc.) Thuem. (††)
Leaf spot, *Cercospora sphaeriaeformis* Cke. (††)
Leaf spot, *Cylindrosporium tenuisporum* Heald and Wolf (†††)
Leaf spot, *Phyllosticta erratica* Ell. and Ev. (†)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
Powdery mildew, *Phyllactinia corylea* (Pers.) Karst. (††)
Root knot, *Caconema radicicola* (Greef) Cobb (†)
Twig blight, *Coniothyrium ulmi* Tharp (††)

Fir, Douglas, *Pseudotsuga taxifolia* and *P. douglasii* (1) (2) (3)
Damping-off, *Corticium vagum* Berk. and Curt. (†)
Mistletoe, *Phoradendron flavescens* (Pursh) Nutt. (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)

Four-o'clock, *Mirabilis jalapa* (2)
Leaf spot, *Cercospora mirabilis* Tharp (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
White rust, *Albugo platensis* (Speg.) Sw. (††)

Foxglove, *Digitalis purpurea* (1) (2)
Leaf spot, *Phyllosticta digitalis* A. Bellynck (†)
Southern blight, *Sclerotium rolfsii* Sacc. (††)

Fringetree, White, *Chionanthus virginica* (1) (2)
Leaf spot, *Phyllosticta chionanthi* Thuem. (††)
Leaf spot, *Septoria eleospora* Sacc. (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)

Gaillardia, *Gaillardia aristata* (2)
Leaf spot, *Septoria gaillardiae* Ell. and Ev. (††)

Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
Powdery mildew, *Erysiphe cichoracearum* DC. (††)

Gaura, *Gaura lindheimeri* and *G. parviflora* (1) (2)
Leaf spot, *Septoria gaurina* Ell. and Kellerm. (†)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
Powdery mildew, *Erysiphe polygoni* DC. (†)
Rust, *Aecidium gaurae* Ell. and Ev. (†)

Geranium, *Pelargonium graveolens* and *P. peltatum* (2)
Bacterial blight, *Bacterium erodii* I. M. Lewis (†††)
Chlorosis, caused by too much calcium in the soil (†)
Leaf spot, *Cercospora brunkii* Ell. and Gall. (††)

Gladiolus, *Gladiolus* sp. (1) (2) (3)
Bacterial blight, *Bacterium gummisudans* McC. (††)
Chlorosis, caused by too much calcium in the soil (†)
Dry rot, *Sclerotium gladioli* Massey (†)
Fusarium rot, *Fusarium oxysporum* (Schl.) var. *gladioli* Massey (††)
Leaf spot and corm rot, *Phyllosticta gladioli* Ell. and Ev. (††)
Leaf spot, *Septoria gladioli* Pass. (†††)
Moist rot, *Pythium debaryanum* Hesse (††)
Mosaic, virus (††)
Penicillium rot, *Penicillium gladioli* Machacek (††)
Scab, *Bacterium marginatum* McC. (†††)
Stem and root rot, *Corticium vagum* Berk. and Curt. (††)

Goldenbell, *Forsythia* sp. (1) (2)
Crown gall, *Bacterium tumefaciens* EFS. and Town. (†)
Leaf spot, *Phyllosticta terminalis* Ell. and Mart. (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
Root knot, *Caconema radicicola* (Greef) Cobb (††)

Goldenseal, *Hydrastis canadensis* (2)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
Root knot, *Caconema radicicola* (Greef) Cobb (††)

Grass, Carpet Bentgrass, *Agrostis stolonifera* (2) (in lawns)
Leaf spot, *Helminthosporium giganteum* Heald and Wolf (††)
Root rot, *Corticium vagum* Berk. and Curt. (††)

Gum: Cotton, *Nyssa aquatica;* Black, *N. sylvatica* (1) (2)
Leaf spot, *Phyllosticta nyssae* Cke. (†)
Mistletoe, *Phoradendron flavescens* (Pursh) Nutt. (†)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
Rust, *Aplopsora nyssae* (Ell. and Tracy) E. B. Mains (†)

Gum, Elastic (Chittam Wood), *Bumelia lanuginosa* (1) (2)
Leaf spot, *Cercospora lanuginosa* Heald and Wolf (††)
Leaf spot, *Phyllosticta bumeliifolia* Heald and Wolf (††)
Leaf spot, *Septoria bumeliae* Sacc. (†)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)

Gum, Sweet or Red, *Liquidambar styraciflua* (1) (4)
- Leaf spot, *Cercospora liquidambaris* Cke. and Ell. (†)
- Leaf spot, *Septoria liquidambaris* Cke. and Ell. (†)
- Mistletoe, *Phoradendron flavescens* (Pursh) Nutt. (††)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)

Hackberry: Southern, or Sugarberry, *Celtis mississippiensis;* Rough-leaved, *C. occidentalis crassifolia* (1) (2) (3)
- Crown rot, *Thelephora retiformis* B. and C. (††)
- Leaf blight, *Cylindrosporium defoliatum* Heald and Wolf (†††)
- Leaf spot, *Cylindrosporium celtidis* Earle (††)
- Leaf spot, *Phyllosticta celtidis* Ell. and Kell. (††)
- Mistletoe, *Phoradendron flavescens* (Pursh) Nutt. (††††)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†)
- Powdery mildew, *Uncinula polychaeta* (Berk. and Curt.) Ell. (†)

Haw, Rusty Black, *Viburnum rufidulum* (1) (4)
- Leaf spot, *Helminthosporium beaumonti* Sacc. (†)
- Leaf spot, *Hendersonia foliorum* Fckl. (††)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
- Powdery mildew, *Microsphaera alni* (Wallr.) Wint. (†)

Hawthorn, Red, White, *Crataegus* spp. (1) (4)
- Fire blight, *Bacillus amylovorus* (Burr.) Trev. (††)
- Leaf spot, *Cercospora crataegi* Heald and Wolf (††)
- Leaf spot, *Hendersonia foliorum* Fckl. (†)
- Leaf spot, *Phyllosticta crataegi* (Cke.) Sacc. (††)
- Mistletoe, *Phoradendron flavescens* (Pursh) Nutt. (††)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
- Rust, *Gymnosporangium exiguum* Kern (†††)
- Rust, *Gymnosporangium trachysorum* Kern (††)

Hazelnut or Filbert, *Corylus* sp. (1)
- Leaf spot, *Phyllosticta coryli* West. (††)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)

Hemlock, *Tsuga diversifolia* (2)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
- Sooty mold, *Dimerosporium tsugae* Dearn. (††)

Hickory: White or Mockernut, *Hicoria alba;* Black, *H. buckleyi;* Bitternut or Pignut, *H. cordiformis;* Shellbark or Scaly-bark, *H. ovata* (1) (2) (3)
- Crown gall, *Bacterium tumefaciens* EFS. and Town. (†)
- Leaf spot, *Phyllosticta caryae* Pk. (††)
- Leaf spot, *Septoria hicoriae* Tharp (††)
- Mistletoe, *Phoradendron flavescens* (Pursh) Nutt. (††)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†)
- Powdery mildew, *Microsphaera alni* (Wallr.) Wint. (††)
- Root rot, *Armillaria mellea* (Vahl) Quel. (††)
- Scab, *Fusicladium effusum* Wint. (††)

Holly, American, *Ilex opaca* (1) (2) (3)
Leaf spot, *Cercospora ilicicola* Maub. (††)
Leaf spot, *Cercospora pulvinula* Cke. and Ell. (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†)
Tar-spot, *Rhytisma curtisii* Berk. and Rav. (†)

Hollygrape, *Mahonia* spp. (1) (2)
Rust, *Puccinia oxalidis* Diet. and Ell. (†)

Hollyhock, *Althaea rosea* (2)
Anthracnose, *Colletotrichum malvarum* (Braun and Casp.) E. A. Southworth (†)
Leaf blight, *Rhizoctonia microsclerotia* Matz (†)
Leaf spot, *Cercospora althaeina* Sacc. (†††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††††)
Root knot, *Caconema radicicola* (Greef) Cobb (†††)
Rust, *Micropuccinia heterospora* (Berk. and Curt.) Arth. (††)

Honeysuckle, *Lonicera* spp. (2)
Crown gall, *Bacterium tumefaciens* EFS. and Town. (†)
Leaf spot, *Cercospora varia* Pk. (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
Powdery mildew, *Microsphaera alni* (Wallr.) Wint. (†)

Honeysuckle, Bush, *Diervilla rivularis* (2)
Leaf spot, *Cercospora diervillae* Ell. and Ev. (††)
Leaf spot, *Cercospora weigeliae* Ell. and Ev. (††)
Leaf spot, *Pestalozzia syringae* Oud. (†)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)

Hoptree or Wafer Ash, *Ptelea trifoliata* (1) (2)
Leaf spot, *Cercospora afflata* Wint. (†)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
Rust, *Puccinia windsoriae* Schw. (†)

Hornbeam, American or Blue Beech, *Carpinus caroliniana* (1) (2) (3)
Blight, *Fracchiaea callista* (Berk. and Curt.) Sacc. (†)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
Powdery mildew, *Microsphaera alni* (Wallr.) Wint. (†)
Powdery mildew, *Phyllactinia corylea* (Pers.) Karst. (†)

Horsechestnut, *Aesculus hippocastanum* (1) (2)
Anthracnose, *Glomerella cingulata* (Ston.) Spauld. and Schrenk (†)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)

Huckleberry, Tree, or Sparkleberry, *Vaccinium arboreum* (2)
Leaf spot, *Phyllosticta vaccinii* Earle (†)
Leaf spot, *Septoria albopunctata* Cke. (†)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
Tar-spot, *Rhytisma vaccinii* (S.) Fr. (††)

Hyacinth, Common, *Hyacinthus orientalis* (2)
Bulb rot, *Fusarium bulbigenum* Cke. and Mass. (††)
Mosaic, virus (†)
Yellow disease, *Bacterium hyacinthi* J. H. Wakker (††)

Hydrangea, *Hydrangea* sp. (1) (2)
Leaf spot, *Cercospora hydrangeana* Tharp (††)
Leaf spot, *Phyllosticta hydrangeae* Ell. and Ev. (††)
Leaf spot, *Septoria hydrangeae* Bizz. (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
Root knot, *Caconema radicicola* (Greef) Cobb (†)

Indigo, *Indigofera tinctoria* (1) (2)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†)
Rust, *Ravenelia laevis* Diet. and Holw. (†)
Rust, *Uromyces indigoferae* Diet. and Holw. (†)

Iris, *Iris* spp. (2)
Leaf spot, *Didymellina iridis* (Desm.) Hoehn (†††)
Leaf spot, *Didymellina macrospora* Kleb. (††)
Leaf spot, *Macrosporium iridis* Cke. and Ell. (††)
Leaf spot, *Scolecotrichum punctulatum* Tr. and Earle (††)
Mosaic, virus (†)
Rhizome rot, *Bacterium iridis* Van Hall (††)
Slimy soft rot, *Bacillus carotovorus* L. R. Jones (††)
Southern blight, *Sclerotium rolfsii* Sacc. (††)
Stem rot, *Sclerotinia sclerotiorum* (Lib.) Mass. (†)

Ironwood or Hophornbeam, *Ostrya virginiana* (1) (2)
Leaf spot, *Taphrina virginica* Seym. and Sadeb. (†)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
Powdery mildew, *Phyllactinia corylea* (Pers.) Karst. (†)

Ivy, English, *Hedera helix* (1) (2)
Anthracnose, *Glomerella cingulata* (Ston.) Spauld. and Schrenk (††)
Leaf spot, *Phyllosticta concentrica* Sacc. (††)
Leaf spot, *Ramularia hedericola* Heald and Wolf (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)

Jessamine, Carolina, *Gelsemium sempervirens* (1) (2)
Leaf spot, *Phyllosticta gelsemii* Ell. and Ev. (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
Sooty mold, *Capnodium grandisporum* Ell. and Martin (††)

Juneberry, Garden or Serviceberry, *Amelanchier alnifolia pumila* (1) (2)
Fire blight, *Bacillus amylovorus* (Burr.) Trev. (†)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
Rust, *Gymnosporangium nidus-avis* Thax. (†)

Juniper: Chinese, *Juniperus chinensis;* Common, *J. communis* (1) (2) (3)
Limb blight, *Phomopsis juniperovora* G. Hahn (†††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)

Kerria, Silver, *Kerria japonica argenteovariegata* (1) (2)
Twig blight, *Phoma japonica* Sacc. (†)
Leaf spot, *Cylindrosporium kerriae* V. B. Stewart (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)

Larch, American, *Larix laricina* (1) (2)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)

Larkspur, *Delphinium* spp. (2)
Leaf spot, *Bacterium delphinii* (EFS.) Bryan (†)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
Southern blight, *Sclerotium rolfsii* Sacc. (††)
Stem and root rot, *Corticium vagum* Berk. and Curt. (††)

Laurel, Mountain, *Kalmia latifolia* (1) (2)
Leaf spot, *Cercospora sparsa* Cke. (†)
Leaf spot, *Pestalozzia kalmicola* Ell. and Ev. (†)
Leaf spot, *Phyllosticta kalmicola* (Schw.) Ell. and Ev. (††)
Leaf spot, *Septoria angustifolia* Ell. and Ev. (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)

Lilac: Persian, *Syringa persica;* Common, *S. vulgaris* (1) (2)
Bacterial blight, *Bacterium syringae* (Van Hall) EFS. (††)
Leaf spot, *Cercospora lilacis* (Desm.) Sacc. (†)
Leaf spot, *Cercospora macromaculans* Heald and Wolf (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††††)
Powdery mildew, *Microsphaera alni* (Wallr.) Wint. (††)

Lily, *Lilium* spp. (2)
Crown rot, *Sclerotinia sclerotiorum* (Lib.) Mass. (†)
Stem rot, *Corticium vagum* Berk. and Curt. (†)

Lily, Belladonna, *Amaryllis belladonna* (2)
Leaf spot, *Cercospora amaryllidis* Ell. and Ev. (††)
Leaf spot, *Phyllosticta hymenocallidis* Seaver (††)
Southern blight, *Sclerotium rolfsii* Sacc. (†)

Lily, Common Calla, *Zantedeschia aethiopica* (2)
Slimy soft rot, *Bacillus aroidae* Town. (††)

Linden, American or Basswood, *Tilia americana* (1) (2) (4)
  Anthracnose, *Gloeosporium tiliae* Oud. (†)
  Mistletoe, *Phoradendron flavescens* (Pursh) Nutt. (††)
  Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
  White sapwood rot, *Hydnum septentrionale* Fr. (†)

Loblolly-bay, *Gordonia lasiantha* (1) (2)
  Leaf spot, *Phyllosticta gordoniae* Ell. and Mart. (††)
  Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug (†)

Locust, Black, *Robinia pseudo-acacia* (1) (2) (3)
  Chlorosis, caused by too much calcium in the soil (†††)
  Heartwood rot, *Polyporus obtusus* Berk. (†)
  Leaf spot, *Cylindrosporium solitarium* Heald and Wolf (†††)
  Mistletoe, *Phoradendron flavescens* (Pursh) Nutt. (††)
  Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††††)

Locust: Water, *Gleditsia aquatica;* Honey, *G. triacanthos* (1) (2) (3)
  Chlorosis, caused by too much calcium in the soil (†††)
  Leaf spot, *Cercospora olivacea* (Berk. and Rav.) Ell. (††)
  Mistletoe, *Phoradendron flavescens* (Pursh) Nutt. (††)
  Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††††)

Lupine, Sundial, *Lupinus perennis* (2)
  Crown rot, *Sclerotinia sclerotiorum* (Lib.) Mass. (††)
  Leaf spot, *Cercospora longispora* Pk. (††)
  Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†)

Maackia: Amur, *Maackia amurensis;* Chinese, *M. hupehensis* (1) (2)
  Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)

Madrone, *Arbutus menziesii* (1)
  Black spot, *Rhytisma arbuti* Phill. (††)
  Leaf gall, *Exobasidium vaccinii* (Fckl.) Wor. (††)
  Leaf spot, *Ascochyta hanseni* Ell. and Ev. (†)
  Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
  Stem blight, *Diplodia maculata* Cke. and Hark. (†)

Magnolia, *Magnolia grandiflora* (1) (2) (3) (4); Sweet Bay, *M. virginiana australis* (1) (2) (3)
  Leaf blotch, *Cladosporium fasciculatum* Cda. (††)
  Leaf spot, *Coniothyrium olivaceum grandiflorae* Sacc. (††)
  Leaf spot, *Septoria magnoliae* Cke. (††)
  Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
  Sooty mold, *Dimerosporium magnoliae* Tr. and Earle (††)

Maidenhair-tree, *Ginkgo biloba* (1) (2)
  Anthracnose, *Glomerella cingulata* (Ston.) Spauld. and Schrenk (†)
  Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††††)

Maple: Amur, *Acer ginnala;* Black, *A. nigrum;* Japanese, *A. palmatum;* Norway, *A. platanoides;* Sycamore, *A. pseudoplatanus;* Red, *A. rubrum;* Sugar, *A. saccharum;* Silver, *A. saccharinum;* Mountain, *A. spicatum* (1) (2)
- Chlorosis, caused by too much calcium in the soil (†††)
- Leaf spot, *Phleospora aceris* (Lib.) Sacc. (††)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
- Powdery mildew, *Uncinula circinata* Cke. and Pk. (†)
- Root rot, *Armillaria mellea* (Vahl) Quel. (†)
- Tar-spot, *Rhytisma acerinum* (Pers.) Fr. (†)

Marigold: African, *Tagetes erecta;* French, *T. patula* (2)
- Stem and root rot, *Corticium vagum* Berk. and Curt. (†††)

Mesquite, *Prosopis juliflora* (2) (4)
- Anthracnose, *Gloeosporium leguminum* Cke. (††)
- Ball moss, *Tillandsia recurvata* L. (††)
- Blight, *Scleropycnium aureum* Heald and Lewis (††)
- Heart rot, *Fomes rimosus* Berk. (††)
- Heart rot, *Polyporus texanus* (Murrill) Sacc. and Trott. (††)
- Heart rot, *Polystictus lindheimeri* B. and C. (††)
- Heart rot, *Schizophyllum commune* Fr. (††)
- Leaf spot, *Cercospora prosopidis* Heald and Wolf (††)
- Leaf spot, *Phyllosticta juliflora* Ell. and Barth. (††)
- Mistletoe, *Phoradendron californicum* Nutt. (†)
- Mistletoe, *Phoradendron flavescens* (Pursh) Nutt. (†)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†)
- Rust, *Neoravenelia holwayi* (Diet.) Long (†)
- Rust, *Ravenelia arizonica* Ell. and Ev. (†)

Mignonette, *Reseda odorata* (2)
- Root rot, *Corticium vagum* Berk. and Curt. (†)

Mimosa, *Leucaena greggii* (1) (2)
- Rust, *Ravenelia leucaenae* Long (†)

Mint, *Mentha arvensis* (2)
- Leaf spot, *Cercospora menthicola* Tehon and Daniels (†)
- Powdery mildew, *Erysiphe polygoni* DC. (†)
- Rust, *Puccinia menthae* Pers. var. *americana* Pk. (†)

Mockorange, *Philadelphus* spp. (1) (2)
- Leaf spot, *Cercospora angulata* Wint. (†)
- Leaf spot, *Septoria philadelphi* Ell. and Ev. (†)
- Limb blight, *Diplodia microspora* B. and C. (†)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)

Monkshood, Chinese, *Aconitum chinense* (1) (2)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†)
- Powdery mildew, *Erysiphe polygoni* DC. (††)
- Rust, *Uromyces aconiti* Fckl. (†)

Mountain-ash, *Sorbus* sp. (1) (2)
Fire blight, *Bacillus amylovorus* (Burr.) Trev. (†)
Leaf spot, *Phyllosticta sorbi* West. (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
Stem canker, *Physalospora malorum* (Pk.) Shear (†)

Mulberry: White, *Morus alba;* Russian, *M. alba tatarica;* Black, *M. nigra;* Red, *M. rubra* (1) (2) (3)
Blight, *Bacterium mori* (Boyer and Lambert) EFS. (†††)
Leaf spot, *Cercospora missouriensis* Wint. (†††)
Leaf spot, *Cercosporella mori* Pk. (†††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
Pop-corn disease or fruit swelling, *Sclerotinia carunculoides* E. A. Siegler & A. Jenkins (†)
Twig blight, *Myxosporium diedickei* Syd. (††)

Nandina, *Nandina domestica* (1) (2)
Anthracnose, *Glomerella cingulata* (Ston.) Spauld. and Schrenk (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)

Narcissus, Jonquil, *Narcissus* sp. (2)
Leaf spot, *Hendersonia curtisii* B. (†)
Mosaic, virus (†)

Nasturtium, *Tropaeolum majus* (2)
Bacterial blight, *Bacterium aptatum* N. Brown and Jamieson (††)
Bacterial wilt, *Bacterium solanacearum* EFS. (††)
Leaf spot, *Cercospora tropaeoli* Atk. (†)
Root knot, *Caconema radicicola* (Greef) Cobb (†)

Ninebark, Goldleaf, *Physocarpus opulifolius luteus* (2)
Anthracnose, *Gloeosporium neilliae* Hark. (†)
Leaf spot, *Marssonia neilliae* Hark. (†)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)

Oak: White, *Quercus alba;* Daimyo, *Q. dentata;* Durand White, *Q. durandii;* Emory, *Q. emoryi;* Overcup, *Q. lyrata;* Burr, *Q. macrocarpa;* Black Jack, *Q. marilandica;* Shin, *Q. mobriana;* Mongolian, *Q. mongolica;* Chinquapin, *Q. muhlenbergii;* Water or Pin, *Q. nigra;* Pin, *Q. palustris;* Willow, *Q. phellos;* Swamp Chestnut, Basket or Cow, *Q. prinus;* Southern Red, *Q. rubra;* Spotted, *Q. shumardii;* Post, *Q. stellata;* Texas Red, *Q. texana;* Black, *Q. velutina* (1) (2) (3) (4)
Blister leaf, *Taphrina coerulescens* (Mont. and Desm.) Tul. (††)
Honeycomb heart rot, *Stereum subpileatum* Berk. and Curt. (†)
Large leaf spot, *Monochaetia desmazierii* Sacc. (††)
Leaf spot, *Leptothyrium dryinum* Sacc. (††)
Leaf spot, *Marssonia quercus* Pk. (††)
Mistletoe, *Phoradendron flavescens* (Pursh) Nutt. (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
Root rot, *Armillaria mellea* (Vahl) Quel. (††)

Rust, *Cronartium strobilinum* (Arth.) Hedgc. and Hahn (†)
Tar-spot, *Rhytisma erythrosporum* Berk. and Curt. (†)
Twig blight, *Diplodia longispora* Cke. and Ell. (†)
White pocket rot, *Polyporus rheades* Fr. (†)
White wood rot, *Polyporus berkeleyi* Fr. (††)

Oak, Live, *Quercus virginiana* (1) (2) (3) (4)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†)
Other diseases, same as for other oaks

Oleander, *Nerium oleander* (1) (2) (3)
Leaf spot, *Cercospora neriella* Sacc. (††)
Leaf spot, *Macrosporium nerii* Cke. (†)
Leaf spot, *Phyllosticta nerii* West. (†)
Leaf spot, *Septoria oleandrina* Sacc. (†)
Limb gall, *Bacterium savastanoi* EFS. (†)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)

Olive, Russian, *Elaeagnus angustifolia* (1) (2)
Leaf spot, *Cercospora elaeagni* Heald and Wolf (†††)
Leaf spot, *Septoria argyraea* Sacc. (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)

Osage-orange, *Toxylon pomiferum* (1) (2) (3)
Cottony leaf spot, *Ovularia maclurae* Ell. and A. B. Langlois (††)
Mistletoe, *Phoradendron flavescens* (Pursh) Nutt. (†)
Rust, *Cerotelium fici* (Cast.) Arth. (†)

Osmanthus, Silver, *Osmanthus aquifolium argenteus* (2)
Leaf spot, *Phyllosticta oleae* Ell. and Mart. (††)
Leaf spot, *Phyllosticta sinuosa* Ell. and Mart. (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
Sooty mold, *Capnodium elongatum* B. and Desm. (†)
Sooty mold, *Fumago salicina* (P. and Fr.) Tul. (†)

Pagoda Tree, *Sophora japonica* (1) (2)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)

Pansy, *Viola tricolor* and *V. cornuta* (2)
Leaf spot, *Cercospora violae* Sacc. (††)
Root knot, *Caconema radicicola* (Greef) Cobb (†††)

Parkinsonia, *Parkinsonia aculeata* (1) (2)
Leaf spot, *Cylindrosporium parkinsoniae* Heald (††)
Leaf spot, *Phyllosticta parkinsoniae* Ell. and Ev. (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
Sooty mold, *Dimerosporium parkinsoniae* Heald and Wolf (††)

Peony, *Paeonia* spp. (2)
Leaf mold, *Cladosporium paeoniae* Pass. (†)
Leaf and stem blight, *Botrytis paeoniae* Oud. (††)
Mosaic, virus (†)

Peony (concluded)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††††)
- Root knot, *Caconema radicicola* (Greef) Cobb (††)
- Stem and root rot, *Corticium vagum* Berk. and Curt. (††)

Peppertree: California, *Schinus molle;* Brazilian, *S. terebinthifolius* (1) (2) (3)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
- Root knot, *Caconema radicicola* (Greef) Cobb (†)
- Root rot, *Armillaria mellea* (Vahl) Quel. (††)

Petunia, *Petunia hybrida* (2)
- Black stalk-rot, *Macrosporium sarcinula parasiticum* Thüem. (†)
- Leaf spot, *Ascochyta petuniae* Speg. (†)
- Mosaic, virus (†)
- Root knot, *Caconema radicicola* (Greef) Cobb (††)
- Stem and root rot, *Corticium vagum* Berk. and Curt. (††)

Phlox, *Phlox* spp. (2)
- Leaf spot, *Ascochyta phlogis phlogina* Fairman (†)
- Leaf spot, *Septoria divaricata* E. and E. (†)
- Powdery mildew, *Erysiphe cichoracearum* DC. (††)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†)
- Root knot, *Caconema radicicola* (Greef) Cobb (††)
- Rust, *Uromyces polemonii* (Pk.) Arth. (†)
- Southern blight, *Sclerotium rolfsii* Sacc. (†)

Photinia: Christmasberry, *Photinia arbutifolia;* Low, *P. serrulata* (1) (2)
- Leaf spot, *Cercospora heteromeles* Hark. (†)
- Leaf spot, *Phyllosticta heteromeles* Cke. and Hark. (†)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
- Scab, *Fusicladium photinicola* R. L. McClain (††)

Pine: Shortleaf, *Pinus echinata;* Pinon, *P. edulis;* Limber, *P. flexilis;* Longleaf, *P. palustris;* Western Yellow, *P. ponderosa;* Mexican White, *P. strobiformis;* Loblolly, *P. taeda* (1) (2) (4)
- Brown pocket rot, *Fomes roseus* (Alb. and Schw.) Fr. (††)
- Brown crumbly rot, *Fomes pinicola* Fr. (††)
- Damping-off, *Corticium vagum* Berk. and Curt. (††)
- Damping-off, *Pythium debaryanum* Hesse (††)
- Mistletoe, *Razoumofskya campylopoda* (Engelm.) Piper (†)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
- Red rot, *Polyporus ellisianus* (Murr.) Long (††)
- Rust, *Coleosporium carneum* (Bosc) Jack. (†)
- Rust, *Coleosporium delicatulum* (Arth. and Kern) Hedgc. and Long (†)
- Rust, *Coleosporium ipomoeae* (Schw.) Burr. (†)
- Rust, *Coleosporium terebinthinaceae* (Schw.) Arth. (†)
- Rust, *Cronartium fusiforme* (Pk.) Hedgc. and Hunt (†)

Pine, Cypress, *Callitris rhomboidea* and *C. robusta* (1)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)

Pittosporum, *Pittosporum* sp. (1) (2)
Chlorosis, caused by too much calcium in the soil (†)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
Southern blight, *Sclerotium rolfsii* Sacc. (††)

Poinsettia, *Poinsettia pulcherrima* (1) (2)
Leaf spot, *Cercospora pulcherrimae* Tharp (††)
Leaf spot, *Cercospora pulcherrimae* var. *minima* Tharp (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
Rust, *Uromyces proeminens* Pass. (††)
Stem and root rot, *Corticium vagum* Berk. and Curt. (††)

Pomegranate, *Punica granatum* (1) (2)
Blotch, *Mycosphaerella lythracearum* Wolf (††)
Fruit rot, *Sterigmatocystis castanea* F. Patterson (††)
Leaf spot, *Cercospora lythracearum* Heald and Wolf (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†)
Root knot, *Caconema radicicola* (Greef) Cobb (†)

Poppy, California, *Eschscholtzia californica* (2)
Bacterial blight, *Bacterium papavericola* Bryan and McW. (†)
Root knot, *Caconema radicicola* (Greef) Cobb. (††)

Primrose: Evening or Sundrops, *Oenothera drummondii;* Evening Ozark, *O. missouriensis* (2)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)

Primrose, Showy, *Primula obconica superba* (2)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
Root knot, *Caconema radicicola* (Greef) Cobb (†)

Princess Tree, Royal, *Paulownia tomentosa* (1) (2)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)

Privet, *Ligustrum* spp. (1) (2) (3)
Anthracnose, *Glomerella cingulata* (Ston.) Spauld. and Schrenk (††)
Crown gall, *Bacterium tumefaciens* EFS. and Town. (†)
Leaf spot, *Cercospora adusta* Heald and Wolf (††)
Leaf spot, *Cercospora ligustri* Roum. (†)
Leaf spot, *Exosporium concentricum* Heald and Wolf (†††)
Leaf spot, *Phyllosticta ovalifolii* Brun. (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
Root knot, *Caconema radicicola* (Greef) Cobb (†)
Root rot, *Armillaria mellea* (Vahl) Quel. (†)

Privet, Swamp, *Forestiera acuminata* (1) (4)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
Powdery mildew, *Microsphaera alni* (DC.) Wint. (††)
Rust, *Coleosporium minutum* Hedgc. and Hunt (†)
Rust, *Puccinia fraxinata* Arth. I (†)

Quince, Flowering, *Cydonia japonica* (1) (2)
- Fire blight, *Bacillus amylovorus* (Burr.) Trev. (††)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)

Redbud: *Cercis canadensis;* California, *C. occidentalis* (1) (2) (3) (4)
- Leaf spot, *Cercospora cercidicola* Ell. (††)
- Leaf spot, *Phyllosticta siliquastri* Sacc. (††)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)

Redwood: Weeping Giant, *Sequoia gigantea pendulata;* Blue, *S. sempervirens glauca* (1) (2)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)

Rhododendron, *Rhododendron* sp. (1) (2)
- Bloom blight, *Sporocybe azaleae* (Pk.) Sacc. (†)
- Leaf spot, *Hendersonia concentrica* Ell. and Ev. (††)
- Leaf spot, *Lophodermium rhododendri* (S.) Pk. (†)
- Leaf spot, *Pestalozzia funerea* Desm. (†)
- Leaf spot, *Phyllosticta maxima* Ell. and Ev. (†)
- Leaf spot, *Septoria rhododendri* Cke. (†)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
- Rust, *Melampsoropsis roanensis* Arth. (†)

Rose: *Rosa* spp. (1) (2) (3); Meadow, *R. blanda* (1) (3); Pasture, *R. humilis* (1) (3)
- Black rot canker, *Physalospora malorum* (Pk.) Shear (†)
- Bloom blight, *Discosia artocreas* (Tode) Fr. (††)
- Blossom rot, *Botrytis cinerea* Auct. (†)
- Canker, *Diaporthe umbrina* A. Jenkins (†††)
- Chlorosis, caused by too much calcium in the soil (††)
- Crown canker, *Cylindrocladium scoparium* Morg. (††)
- Crown gall, *Bacterium tumefaciens* EFS. and Town. (††)
- Die-back, *Leptosphaeria coniothyrium* (Fckl.) Sacc. (†††)
- Leaf blight, *Dicoccum rosae* Bon. (††)
- Leaf blotch, *Diplocarpon rosae* Wolf (†††)
- Leaf spot, *Cercospora rosigena* Tharp (††)
- Leaf spot, *Phyllosticta rosae* Desm. (††)
- Mosaic, virus (†)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
- Powdery mildew, *Sphaerotheca humuli* (DC.) Burr. (†††)
- Root knot, *Caconema radicicola* (Greef) Cobb (†††)
- Root rot, *Armillaria mellea* (Vahl) Quel. (†)
- Rust, *Phragmidium disciflorum* (Tode) G. F. James (††)
- Rust, *Phragmidium speciosum* Cke. (††)
- Rust, *Phragmidium subcorticinum* (Schrank) Wint. (††)
- Stem canker, *Coniothyrium rosarum* Cke. and Hark. (†††)
- Twig blight, *Diplodia natalensis* Evans (††)
- Twig blight, *Gloeosporium rosae* Hals. (††)

Salvia, Autumn, *Salvia greggi alba* (2)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†)
- Rust, *Puccinia menthae* P. (††)

Sapodilla Vine, *Achras sapota* (1) (2)
Limb gall, *Pestalozzia scirrofaciens* N. Brown (†)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)

Sassafras, *Sassafras variifolium* (1) (3)
Anthracnose, *Glomerella cingulata* (Ston.) Spauld. and Schrenk (†)
Mistletoe, *Phoradendron flavescens* (Pursh) Nutt. (†)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)

Silktassel-bush, *Garrya elliptica* (1) (2)
Leaf spot, *Cercospora garryae* Hark. (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)

Snapdragon, *Antirrhinum majus* (2) (3)
Anthracnose, *Colletotrichum antirrhini* Stev. (†)
Leaf spot, *Phyllosticta antirrhini* Syd. (††)
Root knot, *Caconema radicicola* (Greef) Cobb (†††)
Rust, *Puccinia antirrhini* Diet. and Holw. (†††)
Southern blight, *Sclerotium rolfsii* Sacc. (††)
Stem and root rot, *Corticium vagum* Berk and Curt. (††)

Snowberry, *Symphoricarpos* sp. (1) (2)
Powdery mildew, *Microsphaera diffusa* Cke. and Pk. (†††)
Violet root rot, *Rhizoctonia crocorum* (Pers.) DC. (††)

Soapberry or Wild China, *Sapindus drummondi* (1) (3)
Anthracnose, *Glomerella cingulata* (Ston.) Spauld. and Schrenk (†)
Leaf blight, *Cylindrosporium griseum* Heald and Wolf (††)
Mistletoe, *Phoradendron flavescens* (Pursh) Nutt. (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††††)
Powdery mildew, *Uncinula circinata* Cke. and Pk. (†)

Sourwood, *Oxydendrum arboreum* (1) (2)
Leaf spot, *Cercospora oxydendri* Tr. and Earle (††)
Leaf spot, *Phyllosticta oxydendri* Ell. and Ev. (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)

Spicebush, *Benzoin aestivale* (2) (3)
Leaf spot, *Phyllosticta linderae* Ell. and Ev. (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)

Spirea, Vanhoutte, *Spiraea vanhouttei* (2)
Chlorosis, caused by too much calcium in the soil (†)
Fire blight, *Bacillus amylovorus* (Burr.) Trev. (†)
Leaf spot, *Septoria salicifolia* (Trel.) Ell. and Ev. (†)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)

Spruce: White, *Picea canadensis;* Engelmann, *P. engelmanni* (1) (2)
Brown crumbly rot, *Fomes pinicola* Fr. (†)
Brown pocket rot, *Fomes roseus* (Alb. and Schw.) Fr. (†)
Damping-off, *Corticium vagum* Berk. and Curt. (†)

Spruce (concluded)
Damping-off, *Pythium debaryanum* Hesse (†)
Mistletoe, *Razoumofskya douglasii microcarpa* Engelm. (†)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)

Stock, Common, *Matthiola incana* (2)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
Root knot, *Caconema radicicola* (Greef) Cobb (††)
Stem and root rot, *Corticium vagum* Berk. and Curt. (††)

Sumac: Shining, *Rhus copallina;* Smoketree, *R. cotinus;* Smooth, *R. glabra;* Lemonade, *R. trilobata;* Staghorn, *R. typhina* (1) (2)
Leaf curl, *Exoascus purpurascens* (Ell. and Ev.) Sadeb. (†)
Leaf spot, *Cercospora copallina* Cke. (††)
Leaf spot, *Cercospora rhoina* Cke. and Ell. (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)

Summersweet, *Clethra alnifolia* (1) (2)
Leaf spot, *Phyllosticta clethricola* Ell. and Martin (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)

Sweetleaf or Horse Sugar, *Symplocos tinctoria* (1) (2)
Leaf spot, *Exobasidium symploci* Ell. and Martin (†)
Leaf spot, *Septoria symploci* Ell. and Martin (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)

Sweet Pea, *Lathyrus odoratus* (2) (3)
Anthracnose, *Glomerella cingulata* (Ston.) Spauld. and Schrenk (†)
Fasciation, caused by *Corticium vagum* Berk. and Curt. (†)
Mosaic, virus (†)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†)
Powdery mildew, *Erysiphe polygoni* DC. (†††)
Root knot, *Caconema radicicola* (Greef) Cobb (†††)
Southern blight, *Sclerotium rolfsii* Sacc. (†)
Stem rot, *Fusarium lathyri* Taub. (††)
Stem and root rot, *Corticium vagum* Berk. and Curt. (†††)
Streak, *Bacillus lathyri* Manns and Taub. (†††)
White blight, *Erostrotheca multiformis* Mart. and Charles (†)

Sycamore, *Platanus occidentalis* (1) (2) (3)
Anthracnose, *Gnomonia veneta* (Sacc. and Speg.) Kleb. (††)
Leaf blight, *Phleospora multimaculans* Heald and Wolf (††)
Leaf spot, *Cercospora platanicola* Ell. and Ev. (††)
Leaf spot, *Septoria platanifolia* Cke. (††)
Mistletoe, *Phoradendron flavescens* (Pursh) Nutt. (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†)
Root rot, *Armillaria mellea* (Vahl) Quel. (††)

Tallowtree, Chinese, *Sapium sebiferum* (1) (2)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)

Tamarix, French, *Tamarix gallica* (1) (2)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)

Teosinte, *Euchlaena mexicana* (1) (2)
Leaf spot, *Helminthosporium turcicum* Pass. (††)
Rust, *Puccinia sorghi* Schw. (†)
Smut, *Ustilago zeae* (Beckm.) Ung. (†)

Treemallow, *Lavatera arborea* (1) (2)
Anthracnose, *Colletotrichum malvarum* A. Braun and Casp. (†)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)

Tree-of-heaven, *Ailanthus glandulosa* (1) (2)
Anthracnose, *Gloeosporium ailanthi* Dearness and Barthol. (††)
Leaf spot, *Cercospora glandulosa* Ell. and Kell. (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
Stem blight, *Diplodia ailanthi* Cke. (†)
Stem blight, *Phoma ailanthi* Sacc. (†)

Trumpetcreeper, *Bignonia radicans* (1) (2)
Leaf spot, *Cercospora pallida* Ell. and Ev. (††)
Leaf spot, *Cercospora sordida* Sacc. (††)
Leaf spot, *Septoria tecomae* Ell. and Ev. (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
Powdery mildew, *Microsphaera alni* (Wallr.) Wint. (††)
Sooty mold, *Dimerosporium tropicale* Speg. (††)

Tulip, *Tulipa* sp. (2)
Blight, *Botrytis tulipae* (Lib.) E. F. Hopkins (†)

Tuliptree, *Liriodendron tulipifera* (1) (2)
Anthracnose, *Gloeosporium liriodendri* Ell. and Ev. (††)
Leaf spot, *Phyllosticta liriodendrica* Sacc. (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
Tar-spot, *Rhytisma liriodendri* Wallr. (†)

Viburnum, Common, *Viburnum opulus sterile* (1) (2)
Leaf spot, *Helminthosporium beaumonti* Sacc. (††)
Leaf spot, *Hendersonia foliorum* Fckl. (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)
Powdery mildew, *Microsphaera alni* (Wallr.) Wint. (††)

Violet, *Viola odorata* (2)
Leaf spot, *Alternaria violae* Gall. and P. H. Dorsett (†††)
Leaf spot, *Cercospora violae* Sacc. (††)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†)
Root knot, *Caconema radicicola* (Greef) Cobb (††)
Root rot, *Corticium vagum* Berk. and Curt. (††)
Southern blight, *Sclerotium rolfsii* Sacc. (†)

Vitex or Chaste-tree, *Vitex agnus-castus; V. negundo; V. negundo incisa* (1) (2)
    Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)

Wandering-Jew, *Tradescantia fluminensis* (2)
    Root knot, *Caconema radicicola* (Greef) Cobb (†)

Weigela, Japanese, *Weigela japonica* (1) (2)
    Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)

Willow, Black, *Salix nigra* (1) (2) (3)
    Crown gall, *Bacterium tumefaciens* EFS. and Town. (††)
    Leaf spot, *Cercospora salicina* Ell. and Ev. (††)
    Mistletoe, *Phoradendron flavescens* (Pursh) Nutt. (†)
    Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†††)
    Powdery mildew, *Uncinula salicis* (DC.) Wint. (†)
    Rust, *Melampsora americana* Arth. (††)
    Rust, *Melampsora bigelowii* Thuem. (†)
    Tar-spot, *Rhytisma salicinum* Fr. (†)

Willow, Desert, *Chilopsis linearis* (1) (2) (3)
    Leaf spot, *Phyllosticta erysiphoides* Sacc. (†)
    Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)

Winterberry, Common, *Ilex verticillata* (1) (2)
    Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†)

Wisteria, American, *Wisteria frutescens* (1) (2)
    Leaf spot, *Phyllosticta wistariae* Sacc. (††)
    Leaf spot, *Septoria wistariae* Tharp (††)
    Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (††)

Yaupon, *Ilex decidua; I. vomitoria* (1) (2) (4)
    Leaf spot, *Cercospora ilicis* Ell. (†)
    Leaf spot, *Phyllosticta concomitans* Ell. and Ev. (†)
    Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug. (†)

Yucca, Common, *Yucca filamentosa* (1) (2) (3)
    Leaf spot, *Cercospora concentrica* Cke. and Ell. (†††)
    Leaf spot, *Coniothyrium concentricum* (Desm.) Sacc. (††)

Zinnia, *Zinnia elegans* (2)
    Fusarium wilt, *Fusarium* sp. (††)
    Leaf spot, *Cercospora atricincta* Heald and Wolf (†††)
    Leaf spot, *Cercospora zinniae* Ell. and Mart. (††)
    Powdery mildew, *Erysiphe cichoracearum* DC. (†††)
    Stem and root rot, *Corticium vagum* Berk. and Curt. (†††)

GROUP V

NON-CULTIVATED HERBACEOUS AND WOODY PLANTS

(Except Trees and Shrubs)

Adder's Tongue or White Troutlily, *Erythronium albidum.*
Blight, *Sclerotinia erythroniae* Whetzel
Rust, *Teleutospora heteroderma* (Syd.) Arth. and Bisby
Smut, *Ustilago erythronii* G. W. Clinton

Agrimony: Tall Hairy, *Agrimonia gryposepala;* Soft, *A. mollis;* Small-flowered, *A. parviflora.*
Downy mildew, *Peronospora potentillae* DeBy.
Leaf spot, *Phyllosticta decidua* Ell. and Kell.
Leaf spot, *Septoria agrimoniae* Roum.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Rust, *Caeoma* (*Uredo*) *agrimoniae* S.
Stem blight, *Phoma herbarum* Westd.

Anacahuita, *Cordia boissieri*
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Sooty mold, *Fumago vagans* Fr.

Angelica, *Angelica villosa*
Leaf spot, *Cercospora thaspi* Ell. and Ev.
Leaf spot, *Septoria dearnessii* Ell. and Ev.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Rust, *Bullaria bullata* (Schrt.) Arth.

Angel's Trumpet: *Acleisanthes berlandieri; A. longiflora*
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Apple-of-Peru, *Nicandra physalodes*
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Arrowleaf or Water Potato, *Sagittaria lancifolia*
Anthracnose, *Gloeosporium confluens* Ell. and Dearness
Leaf spot, *Cercospora sagittariae* Ell. and Kell.
Leaf spot, *Epicoccum vulgare* Cda.
Rust, *Uredo sagittariae* Westd.

Aster: Frost, *Aster ericoides;* White, *A. exiguus; A. exilis;* Starved, *A. lateriflorus;* Dense-flowered, *A. multiflorus;* Aromatic, *A. oblongifolius;* Showy Blue, *A. patens; A. spinosus;* Corymbed, *A. umbellatus*
Leaf spot, *Cercospora asterata* Atk.
Leaf spot, *Phyllosticta astericola* Ell. and Ev.
Leaf spot, *Ramularia asteris* (Phil. and Plowr.) Bubak.
Leaf spot, *Ramularia macrospora asteris* Trelease
Leaf spot, *Septoria atropurpurea* Pk.
Leaf spot, *Septoria solidaginicola* Pk.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Powdery mildew, *Erysiphe cichoracearum* DC.
Rust, *Coleosporium solidaginis* Thm.

Asters, Baby, *Chaetopappa asteroides*
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Avens, White, *Geum canadense*
Downy mildew, *Peronospora potentillae* DeBy.
Leaf spot, *Phyllosticta decidua* Ell. and Kell.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Baby Blue-eyes, *Nemophila phacelioides*
Powdery mildew, *Erysiphe cichoracearum* DC.

Baby's Breath or Bluets: *Houstonia angustifolia; H. humifusa; H. minor*
Downy mildew, *Peronospora seymourii* Burrill
Leaf spot, *Septoria galiorum* Ell.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Bank Hyacinth or Pickerel Weed, *Pontedaria cordata*
Leaf spot, *Cercospora pontederiae* Ell. and Dearness
Leaf spot, *Mycosphaerella pontederiae* (Pk.) House
Rust, *Uromyces pontederiae* Gerard

Barnyard Grass, *Echinochloa crus-galli*
Foot rot, *Colletotrichum graminicolum* (Ces.) G. W. Wilson
Leaf spot, *Helminthosporium monoceras* Drechsler
Smut, *Sphacelotheca diplospora* (Ell. and Ev.) G. P. Clinton

Basket Grass: *Nolina lindheimeri; N. microcarpa; N. texana*
Smut, *Tolyposporella nolinae* G. P. Clinton

Beach Weed, *Salicornia perennis*
Leaf spot, *Pleospora salsolae* Fckl.
Rust, *Uromyces peckianus* Farl. I

Bear-grass or Adam's Needles: *Yucca rupicola; Y. tenuistyla*
Anthracnose, *Gloeosporium yuccigenum* Ell. and Ev.
Blight, *Diplodia circinans* B. and Br.
Leaf spot, *Coniothyrium concentricum* (Desm.) Sacc.
Leaf spot, *Cylindrosporium angustifolium* Ell. and Kell.
Leaf spot, *Kellermania yuccigena* Ell. and Ev.

Bergamot, Wild, *Monarda mollis*
Root rot, *Corticium vagum* Berk. and Curt.
Rust, *Puccinia menthae* P., var. *americana* Pk.

Bindweed: Field, *Convolvulus arvensis;* Gray, *C. hermannioides;* Hedge, *C. sepium*
Leaf spot, *Septoria convolvuli* Desm.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Root rot, *Corticium vagum* Berk. and Curt.
Rust, *Aecidium calystegiae* Cast.
Stem blight, *Diplodia convolvuli* Dearness and House
White rust, *Albugo ipomoeae-panduranae* (Farl.) Swingle

Bird Pepper, *Capsicum baccatum*
Anthracnose, *Gloeosporium piperatum* Ell. and Ev.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Bird's Nest or Queen Anne's Lace, *Daucus pusillus*
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Bitterweed, *Helenium tenuifolium*
Leaf spot, *Metasphaeria sanguinea* Ell. and Ev.
Leaf spot, *Septoria helenii* Ell. and Ev.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Powdery mildew, *Erysiphe cichoracearum* DC.

Black-eyed Susan, *Rudbeckia triloba*
Downy mildew, *Rhysotheca halstedii* (Farl.) G. W. Wilson
Leaf spot, *Cercospora tabacina* Ell. and Ev.
Leaf spot, *Septoria rudbeckiae* Ell. and Halsted
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Bladder-pod, or Pop-weed: *Lesquerella lasiocarpa; L. polyantha; L. recurvata*
Leaf spot, *Helminthosporium nanum* Nees.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Stem blight, *Phoma punctiformis* Desm.

Blazing Star, Prairie, *Liatris pycnostachya*
Leaf spot, *Septoria liatridis* Ell. and Davis
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Rust, *Coleosporium laciniariae* Arth.

Bloodroot, *Sanguinaria canadensis*
Anthracnose, *Gloeosporium sanguinariae* Ell. and Ev.
Leaf spot, *Cercospora sanguinariae* Pk.
Leaf spot, *Phyllosticta sanguinariae* Wint.

Bluebonnet, *Lupinus texensis*
Anthracnose, *Gloeosporium lupinicola* Dearness
Crown rot and damping-off, *Pythium debaryanum* Hesse, and *Corticium vagum* Berk. and Curt.
Leaf spot, *Cercospora texensis* Tharp.
Leaf spot, *Ramularia lupini* J. J. Davis
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Southern blight, *Sclerotium rolfsii* Sacc.

Blue-eyed Grass: Narrow-leaved, *Sisyrinchium angustifolium;* Dwarf, *S. minus; S. varians*
Leaf spot, *Vermicularia affinis* Sacc. and Briard.
Rust, *Aecidium residuum* Arth.
Rust, *Uromyces probus* Arth.
Rust, *Uredo nominata* Arth.

Blue Flag, *Iris versicolor*
Leaf spot, *Asteroma venulosum* (Wallr.) Fckl.
Leaf spot, *Cylindrosporium iridis* Ell. and Halsted
Leaf spot, *Didymellina iridis* (Desm.) Hoehn
Leaf spot, *Phyllosticta iridis* Ell. and Martin
Leaf spot, *Sphaeria iridis* S.

Blue Thistle: *Eryngium diffusum; E. leavenworthii*
Leaf spot, *Cylindrosporium eryngii* Ell. and Kell.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Blue Weed, *Helianthus ciliaris*
Leaf spot, *Septoria helianthi* Ell. and Kell.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Rust, *Puccinia massalis* Arth.

Brookweed, *Samolus cuneatus*
Leaf spot, *Septoria conspicua* Ell. and Ev.

Broomweed, *Gutierrezia texana*
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Powdery mildew, *Erysiphe cichoracearum* DC.
Stem blight, *Diplodina coloradensis* Ell. and Ev.

Bull Nettle, *Jatropha (Cnidosculus) texana*
Leaf spot, *Septoria jatrophae* Heald and Wolf
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Bur Cucumber, *Cyclanthera dissecta*
Anthracnose, *Colletotrichum lagenarium* (Pass.) Ell. and Halsted

Burdock: Great, *Arctium lappa;* Common, *A. minus*
Anthracnose, *Gloeosporium lappae* Dearness and House
Leaf spot, *Cercospora arcti-ambrosiae* Halsted
Leaf spot, *Phlyctaena arcuata* Berk.
Leaf spot, *Phyllosticta lappae* Sacc.
Leaf spot, *Sphaeropsis lappae* Ell. and Ev.
Leaf and stem blight, *Phomopsis arctii* (Lasch) Trav.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Powdery mildew, *Erysiphe cichoracearum* DC.

Bur-head or Mud Babies, *Echinodorus cordifolius*
Smut, *Burrillia echinodori* G. P. Clinton

Bur Seed, *Lappula echinata*
Downy mildew, *Peronospora echinospermi* Swingle
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Rust, *Micropuccinia mertensiae* (Pk.) Arth. and Jackson

Butter and Eggs, *Linaria vulgaris*
Anthracnose, *Colletotrichum vermicularioides* Halsted
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Southern blight, *Sclerotium rolfsii* Sacc.
Stem blight, *Phoma linariae* Dearness and House

Buttercup, Creeping, *Ranunculus repens*
Leaf spot, *Ovularia decipiens* Sacc.
Leaf spot, *Ramularia decipiens* Ell. and Ev.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Powdery mildew, *Erysiphe polygoni* DC.
Rust, *Puccinia clematidis* Lagerh. I.

Butterfly-weed, *Asclepias tuberosa*
Leaf spot, *Cercospora asclepiadorae* Ell. and Kell.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Rust, *Puccinia jamesiana* Arth. I.

Calico Bush, *Lantana horrida*
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Camomile: Corn, *Anthemis arvensis;* Dog-fennel, *A. cotula*
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Camphor Plant, *Heterotheca subaxillaris*
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Root rot, *Corticium vagum* Berk. and Curt.

Candlewood, *Fouquiera spendens*
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Candytuft, Wild, *Valerianella stenocarpa*
Leaf spot, *Septoria valerianellae* L. E. Miles
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Cardinal Feather: *Acalypha lindheimeri; A. radians*
Leaf spot, *Cercospora acalypharum* Tharp
Leaf spot, *Ramularia acalyphae* Tharp
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Cardinal Flower: *Lobelia inflata; L. puberula; L. splendens*
Leaf spot, *Cercospora effusa* (B. and C.) Ell. and Ev.
Leaf spot, *Cercospora lobeliae* Kell. and Swingle
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Carpetweed, or Indian Chickweed, *Mollugo verticillata*
Leaf spot, *Cercospora molluginia* Halsted
Leaf spot, *Phyllosticta molluginis* Ell. and Halsted
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Root rot, *Corticium vagum* Berk. and Curt.
Southern blight, *Sclerotium rolfsii* Sacc.

Cat-brier, *Smilax bona-nox*
- Leaf spot, *Cercospora mississippiensis* Tracy and Earle
- Leaf spot, *Diplodia smilacina* B.
- Leaf spot, *Phyllosticta smilacis* Ell. and Martin
- Rust, *Puccinia smilacis* S.

Catchfly: Forked, *Silene dichotoma;* Night-flowering, *S. noctiflora;* Sleepy, *S. antirrhina*
- Downy mildew, *Peronospora silenes* Wilson
- Leaf spot, *Phyllosticta silenes* Pk.
- Leaf spot, *Septoria noctiflorae* Ell. and Kell.
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
- Rust, *Puccinia subnitens* Diet.
- Smut, *Ustilago violacea* (P.) Fckl.

Catnip, *Nepeta cataria*
- Leaf spot, *Cercospora nepetae* Tehon
- Leaf spot, *Septoria nepetae* Ell. and Ev.
- Root rot, *Corticium vagum* Berk. and Curt.
- Southern blight, *Sclerotium rolfsii* Sacc.

Cattail, *Typha latifolia*
- Foot rot, *Phoma orthosticta* Ell. and Ev.
- Foot rot, *Phoma typhicola* Oud.
- Leaf spot, *Cladosporium typharum* Desm.
- Leaf spot, *Epicoccum scabrum* Cda.
- Leaf spot, *Leptosphaeria luctuosa* Neissl.
- Leaf spot, *Phyllosticta typhina* Sacc. and Malbr.
- Leaf spot, *Stagonospora typhoidearum* (Desm.) Sacc.

Celandine, *Chelidonium majus*
- Leaf spot, *Septoria chelidonii* Desm.
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Celestials or Wild Iris, *Nemastylis acuta*
- Leaf spot, *Cercospora amaryllidis* Ell. and Ev.

Chaparral: *Lippia lycioides;* Turkey Tangle, *L. nodiflora*
- Leaf spot, *Cercospora lippiae* Ell. and Ev.
- Leaf spot, *Cylindrosporium lippiae* Heald and Wolf
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Chaparral Berry, *Berberis trifoliolata*
- Anthracnose, *Gloeosporium berberidis* Cke.
- Leaf spot, *Stagonospora berberidina* Sacc.
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
- Sooty mold, *Fumago vagans* Fr.

Charlock, *Brassica arvensis*
- Downy mildew, *Peronospora parasitica* (P.) Fr.
- Leaf spot, *Cercospora bloxami* Berk. and Br.
- Root rot, *Corticium vagum* Berk. and Curt.
- White rust, *Albugo candida* (P. ex Lev.) O. Kuntze

Chess or Cheat: *Bromus secalinus;* Soft, *B. hordcaceus*
Anthracnose, *Colletotrichum graminicolum* (Ces.) G. W. Wilson
Leaf spot, *Septoria bromi* Sacc.
Smut, *Ustilago bromivora* (Tul.) Fisch. Wald.

Chickweed: Powder-horn, *Cerastium brackypodium; C. longipedunculatum; C. viscosum;* Large Mouse-ear, *C. vulgatum*
Leafspot, *Septoria cerastii* Rob. and Desm.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Root rot, *Corticium vagum* Berk. and Curt.
Southern blight, *Sclerotium rolfsii* Sacc.
Stem blight, *Phoma herbarum* Westd.

Chickweed: Common, *Stellaria media; S. nuttallii*
Leaf blister, *Synchytrium stellariae* Fckl.
Leaf spot, *Septoria stellariae* Rob.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Rust, *Puccinia subnitens* Diet.
Smut, *Entyloma alsines* Halsted

Chicory, Wild, *Cichorium intybus*
Crown rot, *Sclerotinia sclerotiorum* (Lib.) Mass.
Leaf spot, *Cercospora cichorii* J. J. Davis
Leaf spot, *Ramularia cichorii* Dearness and House
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Rust, *Bullaria hieracii* (Mart.) Arth.
Southern blight, *Sclerotium rolfsii* Sacc.

Cinquefoil: Silvery, *Potentilla argentea;* Rough, *P. monspeliensis*
Anthracnose, *Gloeosporium potentillae* (Desm.) Oud.
Downy mildew, *Peronospora potentillae* DeBy.
Leaf blister, *Synchytrium aureum* Schrt.
Leaf curl, *Taphrina potentillae* (Farl.) Johans.
Leaf spot, *Ramularia arvensis* Sacc.
Leaf and stem blight, *Physalospora potentillae* Rostr.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Powdery mildew, *Sphaerotheca humuli* (DC.) Burrill
Root rot, *Corticium vagum* Berk. and Curt.
Rust, *Phragmidium potentillae* (P.) Karst.
Stem blight, *Phoma potentillica* Allescher.

Clematis: Scarlet, *Clematis coccinea;* Goat's Beard, *C. drummondii;* Mountain, *C. ligusticifolia; C. reticulata*
Leaf spot, *Ramularia clematidis* Dearness and Barthol.
Leaf spot, *Sphaerella applanata* Ell. and Ev.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Rust, *Puccinia clematidis* Lagerh. I.

Climbing Buckwheat: *Polygonum scandens;* Wild Buckwheat, *P. convolvulus*
Leaf spot, *Cercospora polygonacea* Ell. and Ev.

Climbing Buckwheat (concluded)
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
- Powdery mildew, *Erysiphe polygoni* DC.
- Rust, *Puccinia polygoni-amphibii* P.
- Smut, *Ustilago anomala* J. Kunze
- Stem blight, *Septoria polygonorum* Desm.

Clover, Bush, *Lespedeza prairea*
- Leaf spot, *Cercospora flagellifera* Atk.
- Leaf spot, *Cercospora latens* Ell. and Ev.
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Clover, Hop, *Trifolium procumbens*
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
- Rust, *Puccinia oblonga* (Vize) Arth.

Cockle, *Grostemma githago*
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Cocklebur: American, *Xanthium canadensis;* Common, *X. commune;* Spiny, *X. spinosum*
- Anthracnose, *Collectotrichum xanthii* Halsted
- Leaf spot, *Cercospora xanthicola* Heald and Wolf
- Leaf spot, *Rhabdospora xanthii* Pk.
- Leaf spot, *Vermicularia dematium* (P.) Fr.
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
- Rust, *Micropuccinia xanthi* (S.) Arth. and Jackson

Coffee Bean, *Sesbania macrocarpa*
- Leaf spot, *Cercospora glotidiicola* Tracy and Earle
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Common Wood Sage or Germander, *Teucrium canadense*
- Leaf spot, *Phyllosticta decidua* Ell. and Kell.

Coral Bean, *Erythrina herbacea*
- Leaf spot, *Cercospora erythrinae* Ell. and Ev.
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Corydalis, Golden or Scrambled Eggs: *Capnoides curvisiliquum; C. micrantha*
- Downy mildew, *Peronospora corydalis* DeBy.
- Leaf spot, *Septoria corydalis* Ell. and Davis

Cotton Weed, *Froelichia drummondii*
- Leaf spot, *Cercospora crassoides* J. J. Davis
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Couch Grass, *Agropyron repens*
Anthracnose, *Colletotrichum graminicolum* (Ces.) G. W. Wilson
Leaf spot, *Septoria agropyri* Ell. and Ev.
Powdery mildew, *Erysiphe graminis* DC.
Smut, *Tilletia striiformis* (Westd.) Wint.
Stem blight, *Helminthosporium giganteum* Heald and Wolf

Cow-itch Vine, *Cissus incisa*
Leaf spot, *Cercospora arboriae* Tharp
Leaf spot, *Phyllosticta cissicola* Speg.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Cow Lily, *Nymphaea microcarpa*
Leaf spot, *Phyllosticta nymphaeacea* Ell. and Ev.
Smut, *Entyloma nymphaeae* (Cunningh.) Setchell

Cow Parsnip, *Heracleum lanatum*
Leaf spot, *Cylindrosporium heraclei* Ell. and Ev.
Leaf spot, *Phyllosticta heraclei* Ell. and Dearness
Leaf spot, *Ramularia heraclei* (Oud.) Sacc.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Stem blight, *Phoma heraclei* Earle

Cowslip, American, *Dodecatheon meadia*
Leaf spot, *Phyllosticta dodecathei* Trelease

Crab Grass: Small, *Digitaria* (*Syntherisma*) *humifusa;* Large, *D. sanguinalis*
Leaf spot, *Piricularia oryzae* Cav.
Leaf spot, *Septoria graminum* Desm.

Cranesbill, Carolina, *Geranium carolinianum*
Downy mildew, *Peronospora geranii* Pk.
Leaf spot, *Phyllosticta geranii* Ell. and Ev.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Rust, *Aecidium geraniatum* Lk.

Creeping Cucumber, *Melothria pendula*
Downy mildew, *Plasmopara cubensis* (B. and C.) J. E. Humphrey
Rust, *Puccinia melothriae* F. L. Stevens

Croton: Woolly, *Croton capitatus;* Shrubby, *C. fruiticulosus;* Mexican Tea, *C. monanthogynus;* Gulf, *C. punctatus;* Sand, *C. texensis*
Leaf spot, *Cercospora capitati* Tharp
Leaf spot, *Cercospora crotonis* Ell. and Ev.
Leaf spot, *Cercospora maritima* Tracy and Earle
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Rust, *Bubakia crotonis* (Burrill) Arth.

Crowfoot: *Ranunculus fascicularis; R. macranthus; R. sceleratus*
Rust, *Uromyces alopecuri* Seym.

Crowpoison, False Garlic or Scentless Wild Onion, *Nothoscordum bivalve*
Rust, *Uromyces nothoscordi* Syd.

Cudweed: *Gnaphalium falcatum; G. wrightii*
Leaf spot, *Cercospora gnaphaliacea* Cke.
Leaf spot, *Cercospora gnaphalii* Hark.
Leaf spot, *Cylindrosporium gnaphalicola* Atk.
Leaf spot, *Septoria cercosperma* Rostr.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Stem canker, *Phoma erysiphoides* Ell. and Ev.

Culver's Root, *Leptandra (Veronica) virginica*
Leaf spot, *Phyllosticta decidua* Ell. and Kell.
Leaf spot, *Ramularia veronicae* Fckl.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Root rot, *Corticium vagum* Berk. and Curt.
Rust, *Micropuccinia veronicarum* (DC.) Arth. and Jackson

Dandelion, *Taraxacum officinale*
Leaf spot, *Ramularia lineola* Pk.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Darnel, Poison, *Lolium temulentum*
Anthracnose, *Colletotrichum graminicolum* (Ces.) G. W. Wilson
Stem rust, *Puccinia graminis* P.

Dayflower, Virginia or Dew Flower,*Commelina angustifolia*
Anthracnose, *Colletrotrichum commelinae* Ell. and Ev.
Leaf spot, *Mycosphaerella tetraspora* Seaver
Leaf spot, *Phyllosticta commelinicola* Young
Rust, *Uromyces commelinae* Cke.

Dead Nettle or Henbit, *Lamium amplexicaule*
Downy mildew, *Peronospora lamii* A. Braun
Root rot, *Corticium vagum* Berk. and Curt.

Devil's Bouquet, *Nyctaginia capitata*
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
White rust, *Albugo platensis* (Speg.) Swingle

Devil's Elbow, *Forestiera pubescens*
Powdery mildew, *Microsphaera alni* (DC.) Wint.

Dock: Pale, *Rumex altissimus;* Bitter, *R. obtusifolius*
Anthracnose, *Gloeosporium rumicis* Ell. and Ev.
Leaf spot, *Cercospora rumicis* Ell. and Langlois
Leaf spot, *Macrosporium commune* Rabh.
Leaf spot, *Ramularia circumfusa* Ell. and Ev.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Dragonhead Mint, *Dracocephalum parviflorum*
Leaf spot, *Phyllosticta dracocephali* Dearness and Bisby
Leaf spot, *Septoria dracocephali* Thm.
Southern blight, *Sclerotium rolfsii* Sacc.

Duckweed, *Lemna minor*
Root rot, *Corticium vagum* Berk. and Curt.

Encelia, *Encelia calva*
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Everlasting Sweetlife, *Gnaphalium polycephalum*
Leaf spot, *Cercospora gnaphaliacea* Cke.
Leaf spot, *Cylindrosporium gnaphalicola* Atk.
Leaf spot, *Septoria cercosperma* Rostr.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Rust, *Puccinia gnaphaliata* (Arth.) Arth. and Bisby
Smut, *Entyloma compositarum* Farl.
Stem blight, *Phoma erysiphoides* Ell. and Ev.

Eve's Necklace, *Sophora affinis*
Leaf spot, *Phyllosticta sophorae* Ell. and Ev.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Evolvulus, Silky, *Evolvulus sericeus*
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Fake Goldenrod, *Gymnosperma corymbosa*
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

False Boneset, *Kuhnia rosmarinifolia*
Leaf spot, *Pleospora compositarum* Earle
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

False Flax, *Camelina sativa*
White rust, *Albugo candida* (P. ex Lev.) O. Kuntze

False Flax, *Gilia incisa;* Golden Eye, *G. rigidula;* Texas Star, *G. rubra*
Downy mildew, *Peronospora giliae* Ell. and Ev.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Stem blight, *Diplodia leptodactyli* Earle

False Foxglove or Beard-tongue, *Pentstemon cobaea;* Scarlet-beard Foxglove, *P. murrayanus*
Leaf spot, *Cercospora pentstemonis* Ell. and Kell.
Leaf spot, *Septoria pentstemonis* Ell. and Ev.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Southern blight, *Sclerotium rolfsii* Sacc.

False Gromwell, *Onosmodium bejariense*
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

False Hyacinth, *Quamasia hyacinthina*
Smut, *Urocystis ornithogali* Korn.

False Indigo, *Amorpha fruticosa*
Leaf spot, *Cercospora passaloroides* Wint.
Leaf spot, *Diplodia amorphae* (Wallr.) Sacc.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

False Mallow, *Malvastrum americanum*
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Fireweed, *Epilobium angustifolium*
Leaf spot, *Cercospora epilobii* Schneid.
Leaf spot, *Ramularia cercosporoides* Ell. and Ev.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Rust, *Micropuccinia gigantea* (Karst.) Arth. and Jackson
Southern blight, *Sclerotium rolfsii* Sacc.

Fireweed, *Erechtites hieracifolia*
Downy mildew, *Peronospora halstedii* Farl.
Leaf spot, *Cercospora erechtitis* Atk.
Leaf spot, *Septoria erechtitis* Ell. and Ev.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Firewheel, *Gaillardia pulchella*
Leaf spot, *Septoria gaillardiae* Ell. and Ev.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Flame Flower: *Talinum lineare; T. parviflorum*
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Flax: Tall, *Linum lewisii; L. rupestre;* Wild, *L. sulcatum*
Leaf spot, *Cercospora lini* Ell. and Ev.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Root rot, *Corticium vagum* Berk. and Curt.

Fleabane: Daisy, *Erigeron annuus;* Horse-weed, *E. canadensis*
Downy mildew, *Plasmopara halstedii* (Farl.) Berl. and De Toni
Leaf spot, *Basidiophora entospora* Roze and Cornu
Leaf spot, *Cercospora griseella* Pk.
Leaf spot, *Leptothyrium dearnessii* Kabat and Bubak
Leaf spot, *Ramularia macrospora* Fres.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Powdery mildew, *Erysiphe cichoracearum* DC.
Rust, *Puccinia asterum* Kern I.

Fool's Parsley, *Aethusa cynapium*
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Frost-weed, *Helianthemum majus*
Leaf spot, *Cylindrosporium eminens* J. J. Davis
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Garlic, Wild, *Allium vineale*
Anthracnose, *Vermicularia liliacearum* Westd.
Leaf spot, *Heterosporium allii* Ell. and Martin

Gaura, *Gaura biennis*
Leaf spot, *Cercospora gaurae* Kell. and Swingle
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Geranium, Wild: *Geranium maculatum; G. texanum*
Downy mildew, *Peronospora geranii* Pk.
Leaf spot, *Cercospora geranii* Kell. and Swingle

Goldenrod: Stiff, *Solidago rigida;* Rough, *S. serotina*
Black spot, *Rhytisma solidaginis* S. Spec. Dub.
Leaf spot, *Cercospora stomatica* Ell. and Davis
Leaf spot, *Ramularia minax* J. J. Davis
Leaf spot, *Ramularia serotina* Ell. and Ev.
Leaf spot, *Septoria canadensis* Ell. and Davis
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Powdery mildew, *Erysiphe cichoracearum* DC.
Rust, *Coleosporium solidaginis* Thm.

Goosefoot, Oak-leaved, *Chenopodium glaucum*
Rust, *Puccinia subnitens* Diet. I
Smut, *Urophlyctis pulposa* (Wallr.) Schrt.

Gourd, Wild, *Cucurbita foetidissima*
Anthracnose, *Colletotrichum lagenarium* (Pass.) Ell. and Halsted
Leaf spot, *Cercospora cucurbitae* Ell. and Ev.
Powdery mildew, *Erysiphe cichoracearum* DC.

Green Lily, *Schoenocaulon drummondii*
Rust, *Puccinia atropunctum* Pk. and Clinton

Ground Nut, *Apios tuberosa*
Leaf spot, *Cercospora glaucescens* Wint.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Rust, *Aecidium falcatae* Arth.

Ground Plum, *Astragalus mexicanus*
Downy mildew, *Peronospora viciae* (B.) DeBy. var. *astragali* Sacc.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Gum, Elastic, *Bumelia lanuginosa*
Leaf spot, *Cercospora lanuginosa* Heald and Wolf
Leaf spot, *Phyllosticta bumeliifolia* Heald and Wolf
Leaf spot, *Phyllosticta curtisii* (Sacc.) Ell. and Ev.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Hawkweed: Orange, *Hieracium aurantiacum;* Mouse-eared, *H. pilosella*
Leaf spot, *Rhabdospora cercosperma* (Rostr.) Sacc.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Powdery mildew, *Erysiphe cichoracearum* DC.
Rust, *Bullaria hieracii* (Mart.) Arth.
Stem blight, *Phoma hieracii* Rostr.

Heal-all, *Prunella vulgaris*
Leaf spot, *Phyllosticta brunellae* Ell. and Ev.
Leaf spot, *Ramularia brunellae* Ell. and Ev.
Southern blight, *Sclerotium rolfsii* Sacc.

Hemp, Wild, *Cannabis sativa*
Leaf spot, *Septoria cannabina* Westd.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Southern blight, *Sclerotium rolfsii* Sacc.

Hibiscus: Wild, *Hibiscus trionum*
Leaf spot, *Cercospora althaeina* Sacc.
Leaf spot, *Phyllosticta hibiscina* Ell. and Ev.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Root rot, *Corticium vagum* Berk. and Curt.

Hoarhound, *Marrubium vulgare*
Leaf blister, *Synchytrium marrubii* Tobler
Leaf spot, *Cercospora marrubii* Tharp
Stem blight, *Diplodia herbarum* (Cda.) Lev.
Stem blight, *Phoma lanuginis* Fairman

Horsemint: *Monarda dispersa; M. fistulosa; M. lasiodonta; M. punctata*
Leaf spot, *Phyllosticta decidua* Ell. and Kell.
Leaf spot, *Ramularia brevipes* Ell. and Ev.
Rust, *Puccinia menthae* P., var *americana* Pk.
Southern blight, *Sclerotium rolfsii* Sacc.

Hound's Tongue, *Cynoglossum officinale*
Downy mildew, *Peronospora cynoglossi* Burrill
Leaf spot, *Phyllosticta decidua* Ell. and Kell.
Leaf spot, *Ramularia lappulae* J. J. Davis
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Stem blight, *Phoma cynoglossi* Dearness

Indian Blanket, *Castilleja indivisa;* Indian Paint-brush, *C. lindheimeri*
Leaf spot, *Ramularia castilleiae* Ell. and Ev.

Indian Cup, *Sarracenia flava*
Anthracnose, *Gloeosporium cinctum* B. and C.
Leaf spot, *Pestalozzia aquatica* Ell. and Ev.
Root rot, *Corticium vagum* Berk. and Curt.
Southern blight, *Sclerotium rolfsii* Sacc.

Indian Hemp: *Apocynum androsaemifolium; A. cannabinum*
Leaf spot, *Cercospora apocyni* Ell. and Kell.
Leaf spot, *Cylindrosporium apocyni* Ell. and Ev.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Indian Mallow: *Abutilon incanum;* Velvet Leaf, *A. theophrasti*
Leaf spot, *Alternaria abutilonis* Speg.
Leaf spot, *Cercospora althaeina* Sacc.
Leaf spot, *Phyllosticta althaeina* Sacc.

Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Rust, *Micropuccinia heterospora* (B. and C.) Arth. and Jackson

Indian Tobacco: *Verbesina texana; V. virginica*
Leaf spot, *Cercospora fulvella* Heald and Wolf
Leaf spot, *Phyllosticta verbesinae* Heald and Wolf
Leaf spot, *Rhysotheca halstedii* (Farl.) G. W. Wilson
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Powdery mildew, *Erysiphe cichoracearum* DC.

Indigo Bush, False, *Baptisia sphaerocarpa*
Leaf spot, *Cercospora velutina* Ell. and Kell.
Leaf spot, *Septoria baptisiae* Cke.
Leaf spot, *Sphaerella granulata* Ell. and Ev.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Stem blight, *Phoma baptisiae* Cke.

Iris, Wild, *Iris hexagona*
Leaf spot, *Didymellina iridis* (Desm.) Hoehn
Leaf spot, *Macrosporium iridicola* Ell. and Ev.
Rust, *Puccinia iridis* Rabh.

Ironweed: *Vernonia fasciculata;* Baldwin's, *V. baldwinii;* Missouri, *V. missourica*
Leaf spot, *Cercospora vernoniae* Ell. and Kell.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Rust, *Coleosporium sonchi* Auct. Amer. p. p.

Jimson Weed: *Datura meteloides; D. stramonium*
Leaf spot, *Alternaria solani* (Ell. and Martin) Jones and Grout
Leaf and stem blight, *Helminthosporium socium* Ell. and Ev.
Leaf spot, *Septoria lycopersici* Speg.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Joint Vetch, *Aeschynomene viscidula*
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Knawel, *Scleranthus annuus*
Leaf spot, *Septoria scleranthi* Desm.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Southern blight, *Sclerotium rolfsii* Sacc.

Krameria, *Krameria secundiflora*
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Rust, *Uromyces krameriae* Long

Laceflower: *Ptilimnium laciniatum; P. nuttallii*
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Lady's-thumb, *Polygonum persicaria*
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
- Rust, *Puccinia polygoni-amphibii* P.

Lamb's-quarters or Pigweed, *Chenopodium album*
- Leaf spot, *Cercospora chenopodii* Fres.
- Leaf spot, *Macrosporium amaranthi* Pk.
- Leaf spot, *Ramularia dubia* Riess.
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
- Rust, *Puccinia subnitens* Diet. I

Larkspur, Wild: *Delphinium carolinianum; D. consolida; D. stathisagria*
- Blight, *Sclerotium delphinii* Welch
- Crown rot, *Sclerotinia sclerotiorum* (Lib.) Mass.
- Leaf spot, *Cercospora delphinii* Thm.
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
- Root rot, *Corticium vagum* Berk. and Curt.
- Rust, *Micropuccinia delphinii* (Diet. and Holw.) Arth. and Jackson
- Southern blight, *Sclerotium rolfsii* Sacc.
- Stem blight, *Phoma delphiniicola* Tracy and Earle

Lettuce: Wild, *Lactuca canadensis; L. ludoviciana;* Prickly, *L. scariola*
- Downy mildew, *Bremia lactucae* Regel.
- Leaf spot, *Alternaria sonchi* J. J. Davis
- Leaf spot, *Asteroma lactucae* J. J. Davis
- Leaf spot, *Calosphaeria herbicola* Ell. and Ev.
- Leaf spot, *Phyllosticta lactucae* Atk.
- Leaf spot, *Pleospora lactucicola* Ell. and Ev.
- Leaf spot, *Septoria unicolor* Wint.
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
- Powdery mildew, *Erysiphe cichoracearum* DC.
- Smut, *Entyloma compositarum* Farl.
- Southern blight, *Sclerotium rolfsii* Sacc.

Lobelia, Great, *Lobelia siphilitica*
- Leaf spot, *Cercospora effusa* (B. and C.) Ell.
- Leaf spot, *Septoria lobeliae* Pk.
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Loco Weed, *Astragalus mollissimus*
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
- Rust, *Uromyces punctatus* Schrt.

Loosestrife, Fringed, *Steironema ciliatum*
- Leaf spot, *Phyllosticta decidua* Ell. and Kell
- Leaf spot, *Septoria conspicua* Ell. and Martin
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
- Rust, *Puccinia distichlidis* Ell. and Ev.

Lotus, *Nelumbo lutea*
- Leaf spot, *Cercospora nelumbonis* Tharp
- Leaf spot, *Macrosporium nelumbii* Ell. and Ev.

Mallow: Small-flowered, *Malva parviflora;* Common, or Cheeses, *M. rotundifolia*
- Leaf spot, *Cercospora althaeina* Sacc.
- Leaf spot, *Septoria destruens* Auct. Amer.
- Leaf spot, *Septoria malvicola* Ell. and Martin
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
- Rust, *Micropuccinia heterospora* (B. and C.) Arth. and Jackson

Marguerites: *Aphanostephus humilis; A. skirrobasis*
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Marsh Elder, *Iva xanthifolia*
- Leaf spot, *Basidiophora kellermanii* (Ell. and Halsted) G. W. Wilson var. *paupercula* Pk.
- Leaf spot, *Heterosporium tuberculans* Ell. and Ev.
- Leaf spot, *Phyllosticta ivicola* Ell. and Ev.
- Leaf spot, *Physalospora arthuriana* Sacc.
- Leaf spot, *Septoria ivicola* Ell. and Ev.
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

May Apple, *Podophyllum peltatum*
- Anthracnose, *Glomerella cingulata* (Ston.) Spauld. and Schrenk
- Leaf spot, *Macrosporium podophylli* Ell. and Ev.
- Leaf spot, *Vermicularia podophylli* Ell. and Dearness
- Rust, *Puccinia podophylli* S.

Meadow Salsify, *Tragopogon pratensis*
- Downy mildew, *Erysiphe cichoracearum* DC.
- Leaf spot, *Cercospora tragopogonis* Ell. and Ev.
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
- Root rot, *Corticium vagum* Berk. and Curt.
- White rust, *Albugo tragopogonis* (P.) ex S. F. Gray

Medick, Black, *Medicago lupulina*
- Anthracnose, *Gloeosporium medicaginis* (Rob. and Desm.) Ell. and Kell.
- Leaf spot, *Cercospora medicaginis* Ell. and Ev.
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
- Rust, *Uromyces medicaginis* Pass.
- Stem blight, *Septoria medicaginis* Rob. and Desm.

Menodora, *Menodora heterophylla*
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Mexican Mallow, *Hermannia texana*
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Mexican Persimmon, *Brayodendron texanum*
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Mexican Tea or Wormseed, *Chenopodium ambrosioides*
Leaf spot, *Cercospora anthelmintica* Atk.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Mexican Thistle: *Argemone alba; A. mexicana; A. platyceras; A. rosea*
Anthracnose, *Gloeosporium argemonis* Ell. and Ev.
Downy mildew, *Peronospora arborescens* (B.) DeBy.
Leaf spot, *Alternaria lancipes* Ell. and Ev.
Leaf spot, *Septoria argemones* Tharp
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Milkweed, *Acerates viridiflora*
Leaf spot, *Cercospora briareus* Ell. and Ev.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Milkweed: Common, *Asclepias syriaca;* Whorled, *A. verticillata*
Leaf spot, *Cercospora asclepiadis* Ell.
Leaf spot, *Septoria cryptotaeniae* Ell. and Ev.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Root rot, *Corticium vagum* Berk. and Curt.
Rust, *Aecidium jamesianum* Pk.
Stem blight, *Phoma asclepiadea* Ell. and Ev.
Stem blight, *Vermicularia compacta* C. and E.

Milkweed, Star, *Vincetoxicum biflorum*
Downy mildew, *Plasmopora vincetoxici* Ell. and Ev.
Leaf spot, *Cercospora vincetoxici* Ell. and Ev.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Rust, *Micropuccinia obliqua* (B. and C.) Arth. and Jackson

Mist-flower: *Eupatorium ageratifolium; E. coelestinum*
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Mitrewort, *Cynoctonum mitreola*
Leaf spot, *Cercospora torta* Tracy and Earle
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Mockorange, Wild, *Philadelphus serpyllifolius*
Leaf spot, *Ramularia philadelphi* Sacc.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Moneywort, *Lysimachia nummularia*
Leaf spot, *Septoria conspicua* Ell. and Martin
Leaf spot, *Ramularia lysimachiae* Thm.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Rust, *Puccinia lysimachiae* Kern I

Morning Glory: Wild Blue, *Ipomoea hederacea;* Bush, *I. leptophylla;* White-flowered, *I. littoralis;* Purple-flowered, *I. pescaprae*
- Leaf spot, *Cercospora ipomoeae* Wint.
- Leaf spot, *Phyllosticta ipomoeae* Ell. and Kell.
- Leaf spot, *Septoria convolvuli* Desm.
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
- Rust, *Coleosporium ipomoeae* Burrill
- White rust, *Albugo ipomoeae-panduranae* (Farl.) Swingle
- Wilt, *Fusarium batatatis* Wollenw.
- Wilt, *Fusarium hyperoxysporum* Wollenw.

Motherwort, *Leonurus cardiaca*
- Leaf spot, *Dinemasporium hispidulum* (Schrad.) M. A. Curtis
- Leaf spot, *Helotium fumosum* Ell. and Ev.
- Leaf spot, *Phyllosticta decidua* Ell. and Kell.

Mountain Daisy, *Melampodium cinereum*
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Mountain Mint, *Pycanthemum flexuosum*
- Rust, *Puccinia menthae* P., var. *americana* Pk.

Mullein: Moth, *Verbascum blattaria;* Common, *V. thapsus*
- Leaf spot, *Cercospora verbasicola* Ell. and Ev.
- Leaf spot, *Phyllosticta verbasci* Sacc.
- Leaf spot, *Ramularia variabilis* Fckl.
- Leaf spot, *Septoria verbascicola* B. and C.
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
- Stem blight, *Phoma thapsi* Ell. and Ev.

Mustard, Wild, *Brassica alba*
- Downy mildew, *Peronospora parasitica* (P.) Fr.
- White rust, *Albugo candida* (P. ex Lev.) O. Kuntze

Nigger Weed: *Sphaeralcea angustifolia;* Pompadour Mallow, *S. cuspidata; S. lindheimeri*
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
- Rust, *Aecidium sphaeralceae* Ell. and Ev.

Nightshade: Purple, *Solanum eleagnifolium;* Black, *S. nigrum;* Beaked, *S. rostratum;* White, *S. triquetrum*
- Anthracnose, *Colletotrichum atramentarium* (B. and Br.) Taub.
- Crown rot, *Sclerotinia sclerotiorum* (Lib.) Mass.
- Leaf spot, *Alternaria solani* (Ell. and Martin) Jones and Grout
- Leaf spot, *Cercospora carolinensis* Tharp
- Leaf spot, *Cercospora nigri* Tharp
- Leaf spot, *Macrophoma subconica* Ell. and Ev.
- Leaf spot, *Phyllosticta decidua* Ell. and Kell.
- Leaf spot, *Phyllosticta dulcamarae* Sacc.
- Leaf spot, *Septoria lycopersici* (Speg.) Sacc.
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
- Root rot, *Corticium vagum* Berk. and Curt.

Nightshade (concluded)
- Root rot, *Pythium debaryanum* Hesse
- Southern blight, *Sclerotium rolfsii* Sacc.
- Stem blight, *Diplodia dulcamarae* Fckl.
- Stem blight, *Diplodia natalensis* Evans

Nutgrass, *Cyperus esculentus*
- Rust, *Puccinia cyperi* Arth.

Oats, Wild, *Avena fatua*
- Smut, *Ustilago levis* (Kell. and Swingle) Magn.
- Stem rust, *Puccinia graminis* Pers.

Onion, Wild, *Allium canadense*
- Leaf spot, *Heterosporium allii* Ell. and Martin
- Pink root, *Fusarium malli* Taub.
- Rust, *Puccinia sporoboli* (Ell. and Ev.) Arth. I.

Orache: Halberd-leaved, *Atriplex hastata;* Spreading, *A. patula*
- Downy mildew, *Peronospora effusa* (Grev.) Rabh.
- Leaf spot, *Cercospora chenopodii* Fres.
- Leaf spot, *Septoria atriplicis* (Westd.) Fckl.
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
- Rust, *Puccinia subnitens* Diet. I
- Smut, *Urophlyctis pulposa* (Wallr.) Schrt.

Ox-eye Daisy, *Chrysanthemum leucanthemum* var. *pinnatifidum*
- Crown rot, *Sclerotinia sclerotiorum* (Lib.) Mass.
- Leaf spot, *Cylindrosporium chrysanthemi* Ell. and Dearness
- Leaf spot, *Septoria chrysanthemi* Halsted
- Leaf spot, *Septoria herbarum* B. and C.
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
- Sooty mold, *Fumago vagans* Fr.
- Southern blight, *Sclerotium rolfsii* Sacc.
- Stem blight, *Phoma herbarum* Westd.

Parsnip, Wild, *Pastinaca sativa*
- Crown rot, *Sclerotinia sclerotiorum* (Lib.) Mass.
- Leaf spot, *Cercospora apii* Fres. var. *pastinacae* Sacc.
- Leaf spot, *Cylindrosporium crescentum* Barthol.
- Leaf spot, *Ramularia pastinacae* (Karst.) Lindr. and Vestergren.
- Leaf spot, *Septoria pastinacina* Sacc.
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
- Root rot, *Corticium vagum* Berk. and Curt.
- Stem blight, *Phoma nebulosa* (P.) Mont.

Partridge Pea, *Cassia chamaecrista*
- Leaf spot, *Septoria cassiicola* Kell. and Swingle
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
- Powdery mildew, *Erysiphe polygoni* DC.
- Rust, *Aecidium chamicristae* Arth.
- Rust, *Ravenelia cassiicola* Atk.

Passion Flower: *Passiflora affinis; P. incarnata;* Dwarf, *P. lutea*
Leaf spot, *Cercospora fuscovirens* Sacc.
Leaf spot, *Cercospora regalis* Tharp
Leaf spot, *Cercospora truncatella* Atk.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Pea-vine: *Dolicholus minimus; D. americanus; D. texensis*
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Pennyroyal, Hairy, *Hedeoma hispida*
Leaf spot, *Rhabdospora hedeomina* (Pk.) Sacc.
Rust, *Puccinia menthae* P., var. *americana* Pk.

Pepper-grass: Apetalous, *Lepidium apetalum;* Field, *L. campestre;* Hoary, *L. draba;* Golden, *L. sativum;* Wild, *L. virginicum*
Damping-off, *Pythium debaryanum* Hesse
Downy mildew, *Peronospora parasitica* (P.) Fr.
Leaf spot, *Pleospora lepidiicola* Earle
Leaf spot, *Septoria lepidiicola* Ell. and Martin
Root rot, *Corticium vagum* Berk. and Curt.
Rust, *Puccinia subnitens* Diet. I
White rust, *Albugo candida* (P. ex Lev.) O. Kuntze

Phanerotaenia, *Phanerotaenia texana*
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Pigeon Grass: *Setaria glauca; S. viridis*
Leaf spot, *Cercospora setariae* Atk.
Leaf spot, *Piricularia grisea* (Cke.) Sacc.
Smut, *Ustilago neglecta* Niessl

Pigweed: Green, *Amaranthus hybridus;* Rough, *A. retroflexus*
Anthracnose, *Gloeosporium amaranthicola* Dearness
Leaf spot, *Alternaria solani* (Ell. and Martin) Jones and Grout
Leaf spot, *Phyllosticta amaranthi* Ell. and Kell.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Root rot, *Corticium vagum* Berk. and Curt.
Rust, *Puccinia subnitens* Diet. I
Stem rot, *Phoma longissima* (P. ex Fr.) Westd.
White rust, *Albugo amaranthi* (S.) O. Kuntze

Pigweed, Winged, *Cycloloma atriplicifolium*
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Pin Clover: *Erodium cicutarium;* Stork's Bill, *E. texanum*
Leaf blister, *Synchytrium papillatum* Farl.
Root rot, *Corticium vagum* Berk. and Curt.
Southern blight, *Sclerotium rolfsii* Sacc.

Plantain: Large-bracted, *Plantago aristata;* Sand, *P. arvenaria;* Narrow-leaved, *P. lanceolata*
Downy mildew, *Peronospora plantaginis* Underw.
Leaf spot, *Septoria inconspicua* B. and C.

Plantain (concluded)
- Leaf spot, *Ramularia plantaginis* Ell. and Martin
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
- Powdery mildew, *Erysiphe cichoracearum* DC.
- Root rot, *Corticium vagum* Berk. and Curt.
- Rust, *Uromyces seditiosus* Kern I
- Rust, *Puccinia subnitens* Diet. I

Plantain, Tuberous Indian, *Cacalia tuberosa*
- Leaf spot, *Septoria cacaliae* Ell. and Kell.

Poison Hemlock, or Spotted Cowbane, *Conium maculatum*
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Poison Ivy, *Rhus toxicodendron*
- Leaf spot, *Cercospora toxicodendri* Ell.
- Leaf spot, *Cylindrosporium toxicodendri* (Ell. and Martin) Ell. and Ev.
- Leaf spot, *Exosporium pallidum* Ell. and Ev.
- Leaf spot, *Phyllosticta rhoicola* Ell. and Ev.
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
- Rust, *Pileolaria toxicodendri* (B. and Rav.) Arth.

Poke-berry, *Rivina humilis*
- Leaf spot, *Cercospora flagellaris* Ell and Martin
- Leaf spot, *Septoria rivinae* Pat.
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Pokeweed, *Phytolacca decandra*
- Leaf spot, *Dendryphium nodulosum* Sacc.
- Leaf spot, *Phlyctaena septorioides* Sacc.
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
- Root rot, *Corticium vagum* Berk. and Curt.
- Stem blight, *Phoma apocrypta* Ell and Ev.

Polypteris, *Polypteris texana*
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Poppy Mallow, *Callirhoe involucrata*
- Anthracnose, *Vermicularia sparsipila* Ell. and Kell.
- Leaf spot, *Cercospora althaeina* Sacc.
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
- Rust, *Puccinia hibisciatum* (Kell.) Arth. I

Poverty-weed, *Filago nivea*
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Powder Puffs, *Centaurea americana*
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Prairie clover: *Petalostemon obovatus; P. stanfieldii;* Purple, *P. purpureum.*
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Rust, *Aecidium petalostemonis* Kell. and Carl.

Prairie or Rain Lily, *Cooperia pedunculata*
Leaf spot, *Cercospora amaryllidis* Ell. and Ev.
Rust, *Puccinia cooperiae* Long

Prickly Pear: *Opuntia leptocaulis; O. lindheimeri*
Anthracnose, *Sphaerella opuntiae* (E. and E.) Wolf
Leaf spot, *Perisporium wrightii* B. and C.
Pad spot, *Phoma mamillariae* Ell. and Ev.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Sunscald, or scorch, *Hendersonia opuntiae* Ell. and Ev.

Primrose, Yellow Evening, *Oenothera laciniata*
Leaf spot, *Septoria oenotherae* Westd.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Root rot, *Corticium vagum* Berk. and Curt.

Puccoon, *Lithospermum linearifolium*
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Puncture Plant, *Tribulus terrestris*
Root rot, *Corticium vagum* Berk. and Curt.

Purslane: *Portulaca grandiflora; P. oleracea; P. pilosa*
Anthracnose, *Vermicularia oblongispora* Ell. and Ev.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Root rot, *Corticium vagum* Berk. and Curt.
White rust, *Albugo portulacae* (DC.) O. Kuntze

Queen Anne's Lace or Chervil, *Chaerophyllum dasycarpum*
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Queen's Root or Queen's Delight, *Stillingia linearifolia*
Leaf spot, *Cercospora stillingiae* Ell. and Ev.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Rabbit Lettuce, *Bowlesia septentrionalis*
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Ragged Daisy, *Tetraganotheca texana*
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Ragweed: Small, *Ambrosia artemisiifolia;* Small Western, *A. psilostachya;* Giant or Bloodweed, *A. trifida*
Downy mildew, *Peronospora halstedii* Farl.

Ragweed (concluded)
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Root rot, *Corticium vagum* Berk. and Curt.
Southern blight, *Sclerotium rolfsii* Sacc.
White rust, *Albugo tragopogonis* (P.) ex S. F. Gray

Ragweed, *Parthenium hysterophorus*
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Ram's Horns or Unicorn Plant: *Martynia fragrans; M. louisiana*
Leaf spot, *Cercospora beticola* Sacc.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Rattle Box, *Crotalaria sagittalis*
Leaf spot, *Cercospora demetrioniana* Wint.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Southern blight, *Sclerotium rolfsii* Sacc.

Red Mallow, *Malvaviscus drummondii*
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Rust, *Micropuccinia heterospora* (B. and C.) Arth. and Jackson

Red Sunflower, or Purple Coneflower, *Echinacea angustifolia*
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Rock Cress: *Arabis ludoviciana; A. petiolaris*
Downy mildew, *Peronospora parasitica* (P.) Fr.
Leaf spot, *Septoria arabidis* Sacc.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
White rust, *Albugo candida* (P. ex Lev.) O. Kuntze

Rose, Wild, *Rosa bracteata*
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Rose Mallow, *Pavonia lasiopetala*
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Rose Mallow, Swamp, *Hibiscus moscheutos*
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Rust, *Puccinia hibisciatum* (Kell.) Arth. I

Rosetilla, *Franseria hookeriana*
Leaf spot, *Cercospora racemosa* Ell. and Martin
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Rust, *Puccinia franseriae* Syd.
White rust, *Albugo tragopogonis* (P.) ex. S. F. Gray

Rosin-weed, *Grindelia inuloides*
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Rosin-weed, *Silphium integrifolium*
Downy mildew, *Peronospora halstedii* Farl.
Leaf spot, *Cercospora silphii* Ell. and Ev.
Leaf spot, *Septoria silphii* Ell. and Ev.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Smut, *Entyloma compositarum* Farl.

Rush, Slender, *Juncus tenuis*
Rust, *Uromyces silphii* Arth.
Smut, *Ustilago junci* (S.) M. A. Curtis

Russian Thistle, *Salsola tragus*
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Rust, *Puccinia subnitens* Diet. I

Sage: Shrubby, *Salvia ballotaeflora;* Blue, *S. farinacea; S. lanceaefolia*
Leaf spot, *Cercospora salviicola* Tharp
Leaf spot, *Ramularia salviicola* Tharp
Rust, *Puccinia caulicola* Tracy and Gall.

Sand Bells, *Marilaunidium hispidum;* Fiddle-leaves, *M. jamaicense*
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Sandbur, *Cenchrus tribuloides*
Anthracnose, *Colletotrichum graminicolum* (Ces.) G. W. Wilson
Smut, *Ustilago cenchri* Lagerh.

Sand-dune Weed, *Sesuvium portulacastrum*
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Rust, *Puccinia subnitens* Diet. I
White rust, *Albugo trianthemae* G. W. Wilson

Sand Parsley, *Ammoselinum popei*
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Sand Verbena, *Abronia fragrans*
Downy mildew, *Peronospora oxybaphi* Ell. and Kell.
Leaf spot, *Heterosporium abroniae* Hark.

Sandwort: *Arenaria benthamii;* Thyme-leaved, *A. serpyllifolia*
Leaf spot, *Hendersonia tenella* Schrt.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Rust, *Micropuccinia arenariae* (Wint.) Arth. and Jackson
Rust, *Micropuccinia hysteriiformis* (Pk.) Arth. and Jackson
Smut, *Ustilago arenariae* Ell. and Ev.
Smut, *Ustilago violacea* (P.) Fckl.

Sarsaparilla Vine, *Cebatha* (*Cocculus*) *carolinus*
Leaf spot, *Cercospora menispermi* Ell. and Holw.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Scarlet Pea: *Cracca lindheimeri; C. thuberi*
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Scouring Rush, *Equisetum hyemale*
Anthracnose, *Mycosphaerella altera* (Pass.) House
Leaf spot, *Septoria equiseti* Desm.
Root rot, *Corticium vagum* Berk. and Curt.

Sea Blite, *Dondia fruiticosa*
Rust, *Uromyces chenopodii* Schrt.

Sea Lavender, *Limonium brasiliense*
Leaf spot, *Fusicladium staticis* Ell. and Ev.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Sea Rocket, *Cakile geniculata*
White rust, *Albugo candida* (P. ex. Lev.) O. Kuntze

Sesban, *Sesbania vesicaria*
Anthracnose, *Gloeosporium glottidi* Ell. and Martin
Leaf spot, *Phomatospora sesbaniae* (Ell. and Ev.) Sacc.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Powdery mildew, *Erysiphe polygoni* DC.
Stem blight, *Phoma clitoricarpa* (Cke.) Sacc.

Shepherd's Barometer, *Anagallis arvensis*
Leaf spot, *Septoria anagallidis* Ell. and Halsted

Shepherd's Purse, *Capsella bursa-pastoris*
Downy mildew, *Peronospora parasitica* (P.) Fr.
Leaf spot, *Cylindrosporium capsellae* Ell. and Ev.
White rust, *Albugo candida* (P. ex Lev.) O. Kuntze

Sida: Small-leaved, *Sida diffusa; S. longipes; S. physocalyx;* Prickly, *S. spinosa*
Anthracnose, *Colletotrichum malvarum* (A. Br. and Casp.) Southworth
Leaf spot, *Cercospora sidicola* Ell. and Ev.
Leaf spot, *Phyllosticta spinosa* Ell. and Kell.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Rust, *Micropuccinia heterospora* (B. and C.) Arth. and Jackson

Skull-cap, Small, *Scutellaria parvula*
Leaf spot, *Cercospora scutellariae* Ell. and Ev.
Leaf spot, *Phyllosticta verbenae* Sacc.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Root rot, *Corticium vagum* Berk. and Curt.

Sleepy Daisy, *Xanthisma texanum*
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Snail Flower, *Phacelia congesta*
Leaf spot, *Cylindrosporium phaceliae* Ell. and Ev.
Powdery mildew, *Erysiphe cichoracearum* DC.

Snake Apple, *Ibervillea lindheimeri*
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Snake Herb, *Calophanes linearis*
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Snakeroot, White, *Eupatorium urticaefolium*
Downy mildew, *Peronospora halstedii* Farl.
Leaf spot, *Septoria eupatorii* Rob.
Leaf spot, *Ramularia dispar* J. J. Davis
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Southern blight, *Sclerotium rolfsii* Sacc.

Sneezeweed, *Helenium autumnale*
Leaf spot, *Septoria helenii* Ell. and Ev.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Rust, *Puccinia helenii* Schw.
Smut, *Entyloma compositarum* Farl.

Snow-on-the-mountain, *Euphorbia marginata*
Leaf spot, *Macrosporium euphorbiae* Barthol.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Rust, *Uromyces proeminens* Pass.
Stem blight, *Sphaerella euphorbiicola* (S.) Ell. and Ev.

Soapwort or Bouncing Bet, *Saponaria officinalis*
Leaf spot, *Phyllosticta tenerrima* Ell. and Ev.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Sorrel: Tall, *Rumex acetosa;* Sheep, *R. acetosella*
Anthracnose, *Gloeosporium rumicis* Ell. and Ev.
Leaf spot, *Cercospora acetosellae* Ell.
Leaf spot, *Septoria pleosporoides* Sacc.
Root rot, *Corticium vagum* Berk. and Curt.

Sotol or Saw Yucca, *Dasylirion texanum; D. wheeleri*
Leaf spot, *Botryosphaeria dasylirii* (Pk.) Theissen and Syd.
Leaf spot, *Coniothyrium hysterioideum* Karst.

Sow Thistle: Field, *Sonchus arvensis;* Spiny-leaved, *S. asper;* Common, *S. oleraceus*
Collar rot, *Sclerotinia sclerotiorum* (Lib.) Mass.
Downy mildew, *Bremia lactucae* Regel.

Sow Thistle (concluded)
Leaf spot, *Alternaria sonchi* J. J. Davis
Leaf spot, *Septoria sonchifolia* Cke.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Speedwell: *Veronica anagallis-aquatica;* Corn, *V. arvensis;* Common, *V. officinalis;* Brooklime, *V. peregrina*
Downy mildew, *Peronospora aquatica* Gauman
Leaf spot, *Ovularia veronicae* (Fckl.) Sacc.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Smut, *Entyloma veronicae* (Wint.) Lagerh.

Spider Flower: *Polanisia trachysperma; P. uniglandulosa*
Leaf spot, *Cercospora cleomis* Ell. and Halsted
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Root rot, *Corticium vagum* Berk. and Curt.

Spider Lily, Western, *Hymenocallis occidentalis*
Anthracnose, *Gloeosporium hemerocallidis* Ell. and Ev.
Leaf spot, *Cercospora amaryllidis* Ell. and Ev.
Leaf spot, *Mycosphaerella aggregata* Earle
Leaf spot, *Phyllosticta hymenocallidis* Seaver

Spiderwort or Grass Violets, *Tradescantia humilis*
Leaf spot, *Cylindrosporium tradescantiae* Ell. and Kell.
Rust, *Uromyces commelinae* Cke.

Spring Beauty, *Claytonia virginica*
Downy mildew, *Peronospora claytoniae* Farl.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Rust, *Micropuccinia agnita* (Arth.) Arth. and Jackson

Spurge: Flowering, *Euphorbia corollata;* Cypress, *E. cyparissias;* Toothed, *E. dentata;* Leafy, *E. esula;* Spotted, *E. maculata*
Leaf spot, *Cercospora euphorbiae* Kell. and Swingle
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Rust, *Aecidium pammelii* Trel.
Rust, *Uromyces proeminens* Pass.

Spurry, *Spergula arvensis*
Leaf spot, *Macrosporium parasiticum* Thm.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Rust, *Micropuccinia arenariae* (Wint.) Arth. and Jackson
White rust, *Albugo lepigoni* (DeBy.) O. Kuntze

Squirrel-tail Grass, *Hordeum jubatum*
Leaf spot, *Septoria gramineum* Desm.
Powdery mildew, *Erysiphe graminis* DC.
Rust, *Puccinia anomala* Rostr.
Smut, *Ustilago lorentziana* Thm.

Stagger Grass or Copper Lily, *Atamosco texana*
Rust, *Puccinia cooperiae* Long

Staggerwort, *Senecio jacobaea;* Squaw-weed, *S. obovatus*
- Leaf spot, *Cercospora seneccionis* Ell. and Ev.
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
- Rust, *Aecidium jacobeae* Grev.
- Smut, *Entyloma compositarum* Farl.
- White rust, *Albugo tragopogonis* (P.) ex S. F. Gray

Star Cucumber, *Sicyos angulatus*
- Downy mildew, *Plasmopara cubensis* (B. and C.) J. E. Humphrey
- Leaf spot, *Cercospora echinocystis* Ell. and Martin
- Leaf spot, *Phyllosticta sicyna* Sacc.
- Leaf spot, *Septoria sicyi* Pk.
- Powdery mildew, *Erysiphe cichoracearum* DC.

Star Flower, *Erythraea beyrichii;* Mountain Pink, *E. calycosa*
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Star Thistle, *Centaurea solstitialis*
- Downy mildew, *Plasmopara halstedii* (Farl.) Berl. and DeToni
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
- Root rot, *Corticium vagum* Berk. and Curt.
- Rust, *Puccinia centaureae* Mart.

Stick-leaf, *Mentzelia nuda*
- Leaf spot, *Phyllosticta mentzeliae* Ell. and Kell.
- Leaf spot, *Septoria mentzeliae* Ell. and Kell.
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Stickseed, *Lappula texana*
- Downy mildew, *Peronospora echinospermi* Swingle
- Leaf spot, *Phyllosticta decidua* Ell. and Kell.
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
- Powdery mildew, *Erysiphe cichoracearum* DC.

Stinging Nettle, *Tragia nepetaefolia*
- Leaf spot, *Cercospora euphorbiicola* var. *tragiae* Tharp
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Stinging Nettle: *Urtica chamaedryoides; U. dioica;* Slender, *U. gracilis*
- Leaf spot, *Helminthosporium urticae* Pk.
- Leaf spot, *Ramularia urticae* Ces.
- Leaf spot, *Septoria urticae* Desm. and Rob.
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
- Rust, *Aecidium urticae* Schum.
- Stem blight, *Phoma nebulosa* (P. ex Fr.) B.

Stink Weed or Penny Cress, *Thlaspi arvense*
- Leaf spot, *Ramularia armoraciae* Fckl.
- Rust, *Puccinia subnitens* Diet.

Stonecrop, *Sedum nuttallianum*
- Leaf spot, *Cercospora sedi* Ell. and Ev.
- Leaf spot, *Cladosporium herbarum* (P.) ex Lk.
- Leaf spot, *Septoria sedicola* Pk.
- Root rot, *Corticium vagum* Berk. and Curt.

Sunflower, Maximilian's, *Helianthus maximiliani*
- Downy mildew, *Rhysotheca halstedii* (Farl.) G. W. Wilson
- Leaf spot, *Cercospora helianthi* Ell. and Ev.
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
- Powdery mildew, *Erysiphe cichoracearum* DC.

Tansy Mustard, *Sophia* (*Sisymbrium*) *pinnata*
- Downy mildew, *Peronospora parasitica* (P.) Fr.
- Leaf spot, *Cercospora nasturtii* Pass.
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
- Rust, *Micropuccinia holboellii* (Rostr.) Arth. and Jackson

Tar-weed, *Grindelia squarrosa*
- Leaf spot, *Ampelomyces quisqualis* Ces.
- Leaf spot, *Cercospora grindeliae* Ell. and Ev.
- Leaf spot, *Ramularia grindeliae* Ell. and Kell.
- Leaf spot, *Septoria grindeliae* Ell. and Barthol.
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
- Rust, *Aecidium grindeliae* Syd.
- Rust, *Micropuccinia grindeliae* (Pk.) Arth. and Jackson
- Stem blight, *Phoma leptospora* Sacc.

Teasel, Common, *Dipsacus sylvestris*
- Crown rot, *Sclerotinia sclerotiorum* (Lib.) Mass.
- Leaf spot, *Cercospora elongata* Pk.
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
- Southern blight, *Sclerotium rolfsii* Sacc.
- Stem blight, *Phoma oleracea* Sacc. var. *dipsaci* Sacc.

Texas Star, *Sabbatia campestris*
- Leaf spot, *Cercospora sabbatiae* Ell. and Ev.

Texas Star, Blue, *Amsonia texana*
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Texas Star Daisy, *Lindheimera texana*
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Thistle: Canada, *Cirsium arvense;* Woolly, *C. canescens;* Roadside, *C. discolor;* Bull, *C. lanceolatum.*
- Leaf spot, *Cercospora kansensis* Syd.
- Leaf spot, *Septoria cirsii* Niessl.
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
- Powdery mildew, *Erysiphe cichoracearum* DC.
- Southern blight, *Sclerotium rolfsii* Sacc.
- White rust, *Albugo tragopogonis* (P.) ex S. F. Gray

Three-seeded Mercury, *Acalypha virginica*
Downy mildew, *Peronospora euphorbiae* J. J. Davis
Leaf blight, *Volutella acalyphae* Atk.
Leaf blister, *Synchytrium aureum* Schrt.
Leaf spot, *Cercospora acalyphae* Pk.
Leaf spot, *Ramularia acalyphae* Tharp.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Root rot, *Corticium vagum* Berk. and Curt.

Thoroughwort, Late-flowering, *Eupatorium serotinum*
Leaf spot, *Septoria eupatorii* Rob.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Rust, *Aecidium compositarum*, var. *eupatorii* (S.) B.

Tickseed: Nodding Bur, *Bidens cernua;* Leafy-bracted, *B. comosa;* Purple-stemmed, *B. connata*
Downy mildew, *Peronospora halstedii* Farl.
Leaf spot, *Cercospora umbrata* Ell. and Holw.
Leaf spot, *Ramularia concomitans* Ell. and Holw.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Powdery mildew, *Sphaerotheca humuli* (DC.) Burrill
Rust, *Puccinia obtectum* Pk. I
Smut, *Entyloma compositarum* Farl.

Tickweed: *Coreopsis cardaminefolia; C. crassifolia; C. drummondii*
Leaf spot, *Septoria coreopsidis* J. J. Davis
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Root rot, *Corticium vagum* Berk. and Curt.

Toad-flax, Blue, *Linaria texana*
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Treemallow, *Lavatera trimestris*
Anthracnose, *Colletotrichum malvarum* (A. Br. and Casp.) Southworth
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Root rot, *Corticium vagum* Berk. and Curt.

Trefoil, Tick or Jointed Clover: *Meibomia (Desmodium) canadensis; M. paniculata; M. wrightii*
Anthracnose, *Vermicularia herbarum* Westd.
Leaf blister, *Synchytrium decipiens* Farl.
Leaf spot, *Isthmospora glabra* F. L. Stevens
Leaf spot, *Phyllosticta desmodiiphila* Speg.
Leaf spot, *Ramularia desmodii* Cke.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Powdery mildew, *Erysiphe polygoni* DC.
Rust, *Caeomurus hedysari-paniculati* (S.) Arth.
Southern blight, *Sclerotium rolfsii* Sacc.

Tumble Weed, *Amaranthus graecizans*
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Root rot, *Corticium vagum* Berk. and Curt.
Rust, *Puccinia subnitens* Diet. I
White rust, *Albugo bliti* (Biv.) Lev.

Umbrella-wort: *Allionia alba; A. aggregata; A. linearis; A. nyctaginia*
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Rust, *Puccinia subnitens* Diet. I
White rust, *Albugo platensis* (Speg.) Swingle

Umbrella-wort: Hairy, *Oxybaphus hirsutus;* Heart-leaved, *O. nyctagineus*
Leaf spot, *Cercospora oxybaphi* Ell. and Halsted
Leaf spot, *Heterosporium oxybaphi* Patterson
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Velvet Mallow, *Wissadula holosericea*
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Venus' Looking-glass: *Specularia coloradoensis; S. perfoliata*
Leaf spot, *Septoria speculariae* B. and C.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Verbena: Wild, *Verbena bipinnatifida; V. ciliata;* Blue, *V. hastata;* Vervain, Narrow-leaved, *V. angustifolia; V. officinalis;* Hoary, *V. stricta;* Nettle-leaved, *V. urticaefolia*
Leaf spot, *Cercospora verbenicola* Ell. and Ev.
Leaf spot, *Phyllosticta texensis* Seaver
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Powdery mildew, *Erysiphe cichoracearum* DC.

Vetch, Wild, *Vicia leavenworthii*
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Vetchling, *Lathyrus pusillus*
Root rot, *Corticium vagum* Berk. and Curt.
Southern blight, *Sclerotium rolfsii* Sacc.

Viguiera, *Viguiera helinthoides*
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Virginia Creeper, Texas, *Parthenocissus (Ampelopsis) heptaphylla*
Black rot, *Guignardia bidwellii* (Ell.) Viala and Ravaz
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Wallflower, *Cheirinia arkansana*
Root rot, *Corticium vagum* Berk. and Curt.
White rust, *Albugo candida* (P. ex Lev.) O. Kuntze

Water Cress, *Radicula nasturtium-aquaticum*
Crown canker, *Pythium debaryanum* Hesse
Leaf spot, *Cercospora nasturtii* Pass.
Root rot, *Corticium vagum* Berk. and Curt.
Rust, *Puccinia subnitens* Diet. I

Water Hemlock or Beaver Poison, *Cicuta maculata*
Leaf spot, *Cylindrosporium cicutae* Ell. and Ev.
Leaf spot, *Helminthosporium interseminatum* B. and Rav.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Rust, *Uromyces scirpi* Burrill

Water Hemp: Western, *Acnida tuberculata*
Leaf spot, *Phyllosticta amaranthi* Ell. and Kell.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
White rust, *Albugo amaranthi* (S.) O. Kuntze

Water Lily, *Castalia elegans*
Leaf spot, *Cercospora nymphaeae* Ell. and Ev.
Leaf spot, *Phyllosticta fatiscens* Pk.
Smut, *Entyloma castaliae* Holw.

Water Primrose, *Jussiaea diffusa;* Willow Primrose, *J. suffruticosa*
Anthracnose, *Colletotrichum jussiaeae* Earle
Leaf spot, *Cercospora jussiaeae* Atk.
Leaf spot, *Septoria jussiaeae* Ell. and Kell.

Water Smartweed: *Polygonum acre; P. lapathifolium*
Leaf spot, *Cercospora avicularis* Wint.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Rust, *Uredo polygonorum* DC.
Smut, *Ustilago utriculosa* (Nees) Tul.

Water Willow, *Dianthera americana*
Leaf spot, *Cercospora diantherae* Ell. and Kell.

Wheat Thief, *Lithospermum arvense*
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Powdery mildew, *Erysiphe cichoracearum* DC.
Rust, *Aecidium onosmodii* Arth.

White Campion, *Lychnis alba*
Leaf spot, *Phyllosticta lychnidis* (Fr.) Ell. and Ev.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Rust, *Uromyces verruculosus* Schrt.
Southern blight, *Sclerotium rolfsii* Sacc.

White or Zygadenus Lily, *Zygadenus nuttallii*
Rust, *Puccinia atropuncta* Pk. and Clinton
Rust, *Uromyces zygadeni* Pk.

Wild Alfalfa: *Psoralea floribunda;* Brown-flowered, *P. rhombifolia*
Leaf spot, *Cercospora latens* Ell. and Ev.
Leaf spot, *Ramularia psoraleae* Ell. and Ev.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Wild Alyssum: *Draba cuneifolia; D. platycarpa*
Downy mildew, *Peronospora parasitica* (P.) Fr.

Wild Buckwheat: *Eriogonum annuum; E. longifolium; E. multiflorum*
Leaf spot, *Cercospora eriogoni* Ell. and Ev.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Powdery mildew, *Erysiphe cichoracearum* DC.
Rust, *Uromyces intricatus* Cke.

Wild Mercury, *Ditaxis (Argythamnia) mercurialina*
Leaf spot, *Cercospora argithamniae* Dearness and House
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Wild Pea, *Bradburya virginiana*
Leaf spot, *Cercospora bradburyae* E. Young
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Wild Senna, *Cassia marilandica*
Leaf spot, *Cercospora atromaculans* Ell. and Ev.
Leaf spot, *Cercospora nigricans* Cke.
Leaf spot, *Cercospora simulata* Ell. and Ev.
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Stem blight, *Ramularia cassiicola* (Ell. and Kell.) Heald and Wolf

Wild Tuberose or Spice Lily, *Manfreda maculosa*
Leaf spot, *Cercospora amaryllidis* Ell. and Ev.
Leaf spot, *Phyllosticta hymenocallidis* Seaver
Rust, *Aecidium modestum* Arth.

Wine Cup, *Callirhoe digitata*
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
Rust, *Aecidium roestelioides* Ell. and Ev.

Wine Flower: *Boerhaavia decumbens;* Boerhaavia, *B. erecta*
Leaf spot, *Ascochyta boerhaaviae* Tharp
Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
White rust, *Albugo platensis* (Speg.) Swingle

Winter Cress, *Barbarea vulgaris*
Downy mildew, *Peronospora parasitica* (P.) Fr.
Leaf spot, *Ramularia barbareae* Pk.
Southern blight, *Sclerotium rolfsii* Sacc.
White rust, *Albugo candida* (P. ex Lev.) O. Kuntze

Wood Sorrel: *Oxalis corniculata;* Sour Grass, *O. drummondii; O. stricta*
Leaf spot, *Phyllosticta oxalidis* Sacc.
Rust, *Puccinia sorghi* Schw.
Smut, *Ustilago oxalidis* Ell. and Tracy

Wood Violet, *Anemone decapetala*
Rust, *Tranzschelia cohaesa* (Long) Arth.
Smut, *Urocystis anemones* (P.) Wint.

Wormwood, *Artemisia biennis*
- Leaf blister, *Synchytrium aureum* Schrt.
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
- Powdery mildew, *Erysiphe cichoracearum* DC.
- White rust, *Albugo tragopogonis* (P.) ex S. F. Gray

Yarrow or Milfoil, *Achillea millefolium*
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.
- Root rot, *Corticium vagum* Berk. and Curt.
- Rust, *Micropuccinia millefolii* (Fckl.) Arth. and Jackson
- Stem blight, *Phoma erysiphoides* Ell. and Ev.

Yellow Daisy, *Tetraneuris linearifolia*
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

Zornia, Four-leaved, *Zornia bracteata*
- Phymatotrichum root rot, *Phymatotrichum omnivorum* (Shear) Dug.

PROCEEDINGS

of the

TEXAS ACADEMY OF SCIENCE

Annual Meeting, November 11, 12, 1932

The annual meeting of the members of the Texas Academy of Science was held at Rice Institute, Houston, Texas, Friday and Saturday, November 11 and 12, 1932, Dr. H. Y. Benedict, President, presiding either in person or by a representative. New members were elected; five old members elevated to the rank of Fellow and the officers for the coming year were elected. A program of excellent papers in five sections was enjoyed during the two days. After the general meeting the Executive Committee held a business session.

Officers elected for 1932-1933.—E. N. Jones, president; F. B. Plummer, executive vice-president; H. A. Wilson, vice-president, section 1; F. B. Isely, vice-president, section 2; Col. M. L. Crimmins, vice-president, section 3; H. B. Parks, secretary-treasurer; S. W. Bilsing, representative to A.A.A.S. Council.

Fellows elected.—Albert J. Kirn; Dr. J. J. Taubenhaus; Avery B. Cushing; William Alonzo James; Dr. E. H. Sellards.

Report of the Treasurer.—The following report for the period from November 27, 1931, to October 31, 1932, was presented:

RECEIPTS

Cash brought forward	$116.22
Membership fees from A.A.A.S.	51.00
Fees and dues received	106.00
Donation	10.00
Sale of old publications	58.95
	$342.17

EXPENDITURES

Postage	$ 33.00
Stationery	47.00
Printing	28.20
Expenses of annual meeting	7.50
	$115.70

STATEMENT

Total receipts	$342.17
Total expenses	115.70
Amount on hand	$226.47

Report of the Auditing Committee.—We have examined this account and have found this report correct.

Donald C. Barton
M. A. Stewart

Papers presented.—Following the precedent set in Volume XV the names of papers given at the Annual Meeting are recorded here. Of these papers some will be printed by other organizations and some by the Academy. The Committee on Publications will select from the material in their hands those papers which will appear in the future numbers of the Transactions.

BOTANICAL SCIENCES

Further Study on Barriers to Prevent the Spread of Phymatotrichum Root-rot, by J. J. Taubenhaus and Walter N. Ezekiel.
Structure and Development of Strands and Sclerotia of Root-rot, by C. H. Rogers.
Cotton Variety Tests in the Differentiation of Two Wilt Diseases, by W. N. Ezekiel and J. J. Taubenhaus.
Progress Notes on the Study of the Water Requirement of Cotton Plants on Lufkin Very Fine Sandy Loam, under Field Conditions, by L. B. Jones.
Effect of Ecological Conditions on Injury by the Cotton Flea Hopper, by F. L. Thomas.
Some Studies on Cotton Seed, by M. K. Thornton, Jr.
Our Present Knowledge of Tomato Puffing, by J. J. Taubenhaus and Walter N. Ezekiel.
Vegetation of a Blackland Hillside, by Simon E. Wolff.
Effect of Oil Sprays on Carbohydrate Manufacture in Citrus Leaves, by J. B. Corns.
Inheritance of Color Pigments in Cotton, by W. R. Horlacher and D. T. Killough.

GEOLOGICAL SCIENCES

Big Springs of Texas, by R. E. Ryan.
An Illustrated Lecture on Salt Domes and Gulf Coast Oil Fields, by Marcus Hanna.
A Cretaceous Ammonite with an Anomalous Suture Pattern, by Gayle Scott.
Relation of Texas Soils to Geological Formations, by W. T. Carter.
Some Graptolites from the Ordovician "Unnamed Shale" of Marathon Basin, by George D. Harris.
Leaves of Geologic History from the Topography around Houston, by Donald C. Barton.
Progress in Geologic Mapping in Texas, by E. H. Sellards.
Some Comments on the Pennsylvania Tillite of Brewster County, by Frank Carney.
Recovery of Types of Important Cretaceous Fossils, by W. S. Adkins.
Alkali Lakes of the Llano Estacado, by C. L. Baker.
Interesting Beach Deposits in the Tertiary Formations of the Gulf Coast, by F. B. Plummer.
Metallic Minerals of the Winfield Salt Dome, Louisiana, by V. E. Barnes.
New Plants of the Eocene of Texas, by O. M. Ball.
Notes on Geology of Webb County, by J. T. Lonsdale.
General Faunal Aspects of the Travis Peak Formation, by Robert H. Cuyler.
Mica of the Coastal Plain, by H. Gordon Damon.
Is There a Deposit of Volcanic Ash in North-central Texas, by Augusta Hassloch Kemp.
Notes on a Brackish-Water and a Marine Fauna from the Catahoula Formation, Fayette County, Texas, by Leslie Bowling.

MENTAL AND RELATED SCIENCES

In and Into Long Canyon, by M. L. Crimmins.
Recent Researches in Archeology and Indian Mounds along the Gulf Coast, J. E. Pearce.
Some Dynamic Consequences of the Industrial Revolution, by Elmer H. Johnson.

Public Utilities, An Expanding Category, by A. S. Long.
Organic Evidences Accompanying Behavior as Criteria of Specific Emotions, by J. Dewitt Davis.
Comparison of the Texas Academy with other State Academies, by S. W. Bilsing.
Science Clubs and the Junior Academy of Science, by Clyde T. Reed.

PHYSICAL AND CHEMICAL SCIENCES

The New McDonald Observatory to be Erected in Davis Mountains, by H. Y. Benedict.
A Polarimetric Test of Sugar Content of Grapefruit and its Correlation with the Sugar-Acid Ratio, by H. A. Hodges.
Reverberation Time Bridge, by G. R. Tatum.
A Large Cobalt Steel Permanent Magnet, by H. A. Wilson.
Effects of Storage on Vitamin A Contents of Dried Foods, by G. S. Fraps.
Use of the Micro-Micrometer for Measuring Megnestostriction, by R. L. Peurifoy.
Measurements of the Propagation Characteristics of Electric Wave Filters, by A. W. Straiton.
Rotation of the Positive Column in a Radical Magnetic Field and Determination of Ionic Velocities, by Sidon Harris.
Airplane Cosmic Ray Measurements, by L. M. Mott Smith and L. C. Howe.

ZOOLOGICAL SCIENCES W

Some Factors Affecting the Lethal Point of Suffocation in Phrynowoma, by G. E. Potter.
Notes on Rhopalocera, of Texas, by H. B. Parks.
Banded Gecko and Some Measurements of the Rate of Tail Regeneration in this Lizard, by Stanley Mulaik.
Fleas of Texas and Their Economic Importance, by M. A. Stewart.
Study of the Animal Communities of a Restricted Area of the Sea Bottom in the San Juan Channel, by John H. Swanson.
Human Side of Bees, by Don O. Beard.
New Treatment for the Bites of Our Poisonous Snakes, by Karl Bleyl.
Circulatory System of Gambusia patruelis speciosa, by Ammon Medlen.
Student Genetical Studies, by E. N. Jones.
Genetical Views of the Origin of Life, by Edgar Altenberg.

LIFE FELLOWS

Bailey, James R., University of Texas, Austin, Texas.
Benedict, H. Y., University of Texas, Austin, Texas.
Clark, James F., Texas Land Office, Austin, Texas.
*Dumble, E. T.
*Everhart, Edgar
*Halley, R. B.
*Halsted, G. B.
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*Macfarlane, Alexander
*Nagle, J. C.
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Taylor, T. U., University of Texas, Austin, Texas.
Thompson, R. A., 3310 Drexel Drive, Dallas, Texas.
*Streeruwitz, W. von

*Deceased

FELLOWS

Adkins, W. S., Bureau of Economic Geology, University of Texas, Austin, Texas.
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CONTENTS

ILLUSTRATIONS

Counties in which collections of land and fresh-water shells have been made. The two small stipled counties are: 1, Somervell County; 2, Rockwall County.

LAND AND FRESH-WATER SNAILS OF TEXAS

By JOHN K. STRECKER, JR.[1]

Family HELICINIDAE

HELICINA CHRYSOCHEILA A. Binney

Helicina chrysocheila, Singley, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 311.

Said by W. G. Binney to occur in Texas, near the mouth of the Rio Grande. Pilsbry and Johnson in their catalogue of North American snails repeat this statement, but no other information is available.

HELICINA ORBICULATA Say

Pl. III, figs. 15, 16

Helicina orbiculata, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 311.

This includes the form *H. orbiculata* var. *tropica* Jan, which Pilsbry regards as an ill-defined race.

Galveston, Galveston County; Corpus Christi, Nueces County (Singley). El Paso, El Paso County (Askew (Singley)). Victoria, Victoria County (Mitchell). Ellis County (Cheatum and Burt). Laneport, Williamson County; Pecos, Devils, and Nueces river drift; east of Brackettville, Kinney County; Dekalb and Bowie counties (Ferriss). Fort Clark, Kinney County; Fort Worth, Tarrant County (Mearns (Dall)). Cibilo River in Wilson County (Johnson and Strecker). Helotes, Bexar County; New Braunfels, Comal County; San Marcos, Hays County; Dallas, Dallas County; Waco, McLennan County; Burnet, Burnet County; Austin, Travis County; Rosebud, Falls County; Matagorda Peninsula and Palacios, Matagorda County; Refugio, Refugio County; Glen Rose, Somervell County (Strecker). San Antonio, Bexar County; Hondo, Medina County; Del Rio, Devils River, High Bridge over Pecos River, Val Verde County (Pilsbry). Live Oak County (Vanatta).

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[1] This paper is published from a manuscript completed by Mr. John Kern Strecker, Jr., Curator of Baylor University Museum, previous to his death on January 9, 1933. Except for editing and the addition of species reported from the Davis Mountains area by E. P. Cheatum in 1935, the material is as prepared by Mr. Strecker. Grateful acknowledgments are extended by the editor to Henry A. Pilsbry, H. A. Rehder, T. D. A. Cockerell, E. P. Cheatum, Frank Collins Baker, M. L. Thompson, and G. D. Hanna for aid in checking some of the names and references.

No attempt has been made by the author to offer to the reader complete synonymies. For those species named from Texas localities reference to the original paper has been made. A few references to papers that present helpful illustrations of Texas species have been included. Because Singley's lists in the Fourth Annual Report of the Geological Survey of Texas in 1893 are classic and constitute a starting point in any compilation of recorded occurrences of species in Texas, these are presented in the synonymies.—Editor, Texas Academy of Science.

Family HELICIDAE

HELIX ASPERA Müller

Pl. II, figs. 11, 12

Two small local colonies in Waco, McLennan County. The members of these colonies have so far not wandered any great distance from their original neighborhoods.

HELIX LACTEA Müller

Pl. II, figs. 5, 6

I have specimens that were reared in local snaileries in Waco. This snail, like *H. aspera,* is not confined, and it is merely a matter of a short time before it becomes more widely distributed.

HELIX VERMICULATA Müller

Pl. II, figs. 7, 8

Introduced at Waco, McLennan County; now widespread and abundant. The first colony of which I have knowledge was established near Cameron Park in the northeastern part of the city. Another colony established by Tony Gooch on South Seventh Street has already spread as far west as Tenth Street and five blocks southward to Speight Avenue. Another healthy colony is scattered along Fort Avenue in the northwestern part of Waco. In some of these places the snails are so abundant that they can be collected by the hundreds.

HUMBOLDTIANA CHISOSENSIS Pilsbry

Humboldtiana chisosensis Pilsbry, 1927, Proc. Acad. Nat. Sci. Philadelphia, vol. 79, pp. 182–184, pl. 12, figs. 7, 8, pl. 14, fig. 8.

In Chisos Mountains, Brewster County, this species occurs in rock slides on steep slopes and in recesses of the crags along the summit (type locality) to the left of Naill's ranch house (Pilsbry and Ferriss, Nov. 23–25, 1923); also at "Lost Mine Peak" near Moss Well (Morgan Hebard (Pilsbry)).

HUMBOLDTIANA FERRISSIANA Pilsbry

Humboldtiana ferrissiana Pilsbry, 1928, Nautilus, vol. 41, p. 82.

Type locality at Mitre Peak in Davis Mountains, Pecos County.

HUMBOLDTIANA HUMBOLDTIANA (Valenciennes)

Helix (Pomatia) humboldtiana, Stearns, 1891, Proc. U. S. Nat. Mus., vol. 14, p. 96.

Helix humboldtiana, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 304.

Lysinoe humboldtiana, Pilsbry and Johnson Catalogue, 1898.

Altuda, Brewster Co. (Stearns); single specimen found in soil thrown out by a prairie dog; elevation 5,000 feet (Stearns (Singley)).

HUMBOLDTIANA TEXANA Pilsbry

Humboldtiana texana Pilsbry, 1927, Proc. Acad. Nat. Sci. Philadelphia, vol. 79, pp. 179–182, pl. 12, figs. 9–11, pl. 14, fig. 5.

Type locality in Brewster County along the Marathon-Sanderson highway 15 to 20 miles east of Marathon at Housetop Mountain; occurs also about 25 miles east of Marathon and on the south side of valley near water tank about 34 miles east (all collected by James H. Ferriss).

HUMBOLDTIANA CHEATUMI Pilsbry

Small canyon tributary to Limpia Canyon about five miles north of Fort Davis, Jeff Davis County (Cheatum).

HUMBOLDTIANA ULTIMA Pilsbry

Humboldtiana ultima Pilsbry, 1927, Proc. Acad. Nat. Sci. Philadelphia, vol. 79, pp. 184–186, pl. 12, figs. 12–14; pl. 13, fig. 4.

This species was described from the canyons high in Guadalupe Mountains southeast of Orange, New Mexico. It probably ranges into Texas, as Pilsbry infers that the type locality is near the boundary between the two states.

HUMBOLDTIANA PALMERI Clench and Rehder

Humboldtiana palmeri Clench and Rehder, 1930, Nautilus, vol. 44, p. 12, pl. 2, figs. 1–4.

The type locality is Livermore Peak in Davis Mountains, Jeff Davis County.

VALLONIA COSTATA (Müller)

Eight miles southeast Aspermont, Stonewall County; North Fork Little Wichita River south of Dundee, Archer County (Case (Walker)).

VALLONIA GRACILICOSTA Reinhard

Vallonia gracilicostata Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 5, p. 189.

Helix gracilicosta, Singley, 1893, Idem, pt. 10, p. 307.

Amarillo, Potter County (Henderson). Swisher County (Cummins (Singley)). Pleistocene.

VALLONIA PERSPECTIVA Sterki

Drift from Pecos, Devils, and Nueces rivers (Ferriss). Amarillo, Potter County (Henderson).

VALLONIA PULCHELLA (Müller)

Laneport (Ferriss), Williamson County.

VALLONIA EXCENTRICA Sterki

Under boards in a vacant lot in Galveston, Galveston County (Pilsbry).

PRATICOLELLA BERLANDIERIANA (Moricand)

Pl. III, figs. 11, 12

Helix berlandieriana, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 304.

Anderson, Austin, Bexar, Brazos, Caldwell, Cameron, Comal, Duval, Fort Bend, Galveston, Gillespie, Goliad, Gonzales, Hays, Hidalgo, Kendall, Lampasas, Lee, Milam, Nueces, Travis, Waller, Washington, and Williamson counties (Singley). Harris County (Askew (Singley)). Palacios and Matagorda Peninsula, Matagorda County; McLennan County (Strecker). Live Oak County (Vanatta). Jackson and Victoria counties (Mitchell). San Benito, Cameron County (Cockerell). Wilson County (Johnson and Strecker). Bosque County (Pilsbry). Dallas County (Cheatum and Burt).

PRATICOLELLA GRISEOLA (Pfeiffer)

Helix griseola, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 304.

Brownsville and other localities in Cameron County, Edinburg, Hidalgo County (Strecker collection). In addition to the above two counties Singley lists this shell from Duval County and in these three records he was correct. All the other counties he mentions for *P. griseola* are no doubt based on *P. berlandieriana.*

POLYGYRA CEREOLA (Muhlfeldt) var. FEBIGERI (Bland)

Helix febigeri, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 307.

Galveston and Virginia Point, Galveston County (Singley). Matagorda Peninsula, Matagorda County (Strecker).

POLYGYRA UVULIFERA (Shuttleworth)

Helix uvulifera, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 305.

Recorded from Corpus Christi by Binney. It is doubtful whether this shell is a native of Texas. Singley was unable to find it at Corpus Christi and in other localities where he was told that he would be likely to find it.

POLYGYRA AURIFORMIS (Bland)

Helix auriformis, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 306.

Quarantine Island, off Aransas Pass, Aransas County (Roy Quillin, Strecker collection). Galveston County (Ferriss). New Braunfels, Comal County (Strecker). Calhoun County (Hubbard (Pilsbry)). Comal, Bastrop, and Burleson counties (Singley). Austin, Travis County; San Antonio, Bexar County (Pilsbry).

POLYGYRA ESPILOCA Ravenal

Helix espiloca, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 306.

Indianola, Calhoun County (Binney (Singley)). Matagorda Peninsula, Matagorda County (Strecker).

POLYGYRA PUSTULA (Férussac)

Helix pustula, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 306.

Recorded from Texas by Binney, but doubtless in error.

POLYGYRA LEPORINA (Gould)

Helix leporina, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 306.

Matagorda Peninsula, Matagorda County (Strecker). Mt. Pleasant, Titus County (Ferriss). Anderson, Lee, Fort Bend, and Washington counties (Singley).

POLYGYRA DORFEUILLIANA (Lea)

Pl. III, figs. 9, 10

Helix dorfeuilliana, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 306.

McLennan County (Bland, Strecker, and Williams). Tarrant and Grayson counties (Askew (Singley)). Burleson and Brazos counties (Singley). Cooke County (Ragsdale (Singley)). Galveston, Galveston County (Pilsbry). Matagorda Peninsula, Matagorda County (Strecker). Naples, Morris County (Ferriss). Bowie and DeKalb counties; Dallas, Dallas County; Waco, McLennan County; Fort Worth, Tarrant County (Pilsbry and Ferriss).

POLYGYRA DORFEUILLIANA (Lea) var. SAMPSONI Wetherby

Waco, McLennan County (Strecker); identified by Bryant Walker. In the Pilsbry and Johnson catalogue this species is listed as Texan, but I do not recall seeing any specific localities listed for it.

POLYGYRA MOOREANA (W. G. Binney)

Polygyra mooreana, W. G. Binney, 1885, U. S. Nat. Mus. Bull. 28, p. 370, fig. 405.

Helix mooreana, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 306.

Polygyra mooreana, Pilsbry and Ferriss, 1906, Proc. Acad. Nat. Sci. Philadelphia, vol. 58, p. 129, pl. 5, figs. 4–10.

Abundant and widely distributed. Williamson and Wharton counties (Walker (Singley)). Lampasas County (Mrs. Sinks (Singley)). Burnet County (Cummins (Singley)). Lee, Brazos, Burleson, Washington, Austin, Waller, Fort Bend, Fayette, Anderson, Bastrop, Travis, Comal, Bexar, Nueces, Webb, Starr, and Hidalgo counties (Singley). Wilson County (Johnson and Strecker). McLennan County; Helotes, Bexar County; New Braunfels, Comal County; Palacios, Matagorda Peninsula, Matagorda County (Strecker). Dallas County (Cheatum and Burt).

POLYGYRA MOOREANA (W. G. Binney) var. THOLUS (W. G. Binney)

Helix mooreana var. *tholus,* Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 306.

Polygyra mooreana tholus, Pilsbry and Ferriss, 1906, Proc. Acad. Nat. Hist. Philadelphia, vol. 58, p. 130, pl. 5, figs. 1–3.

Brazos and Fort Bend counties (Singley). Washington County (Pilsbry). Galveston County (Ferriss). Calhoun County (Hubbard specimens in Academy of Natural Sciences of Philadelphia).

POLYGYRA BICRURUS (Pfeiffer)

Brownsville and the mouth of Rio Grande (Pilsbry). A Mexican species. Specimens from "Texas" collected by A. D. Brown are in the Academy of Natural Sciences of Philadelphia.

POLYGYRA VENTROSULA (Pfeiffer)

Helix ventrosula, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 307.

A species of northwestern Mexico, reported from Texas by Binney. Listed in the Pilsbry and Johnson catalogue, but Vanatta of the Academy of Natural Sciences of Philadelphia informs me that that institution has no Texas specimens of this species nor of the following variety.

POLYGYRA VENTROSULA (Pfeiffer) var. HINDSI Pfeiffer

Polygyra hindsi, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 307.

Southern Texas, according to Binney. Singley reported specimens of Pliocene age from the Galveston artesian well.

POLYGYRA MATERMONTANA Pilsbry

Texas (Pilsbry). Two specimens labeled "Texas" and collected by A. B. Brown are in the collection of the Philadelphia Academy of Natural Sciences.

POLYGYRA RICHARDSONI von Martens

Specimens from "Texas" collected by J. S. Phillips are in the Academy of Natural Sciences of Philadelphia.

POLYGYRA TEXASIANA (Moricand)

Pl. III, figs. 7, 8

Helix texasiana Moricand, 1833, Mém. Soc. Phys. Hist. Nat. Géneve, vol. 6, p. 538, pl. 1, fig. 2.

Helix texasiana (pars), Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 306.

Polygyra texasiana, Pilsbry and Ferriss, 1906, Proc. Acad. Nat. Sci. Philadelphia, vol. 58, p. 128, pl. 5, figs. 16–20.

Polygyra texasiana var. *tillsandsiae* Cockerell, 1917, Nautilus, vol. 31, p. 36. (Type locality at San Benito, Cameron County.)

Ranges over most of Texas. Lee, Washington, Robertson, Burleson, Waller, Austin, Fort Bend, Travis, Hays, Comal, Bexar, Frio, Nueces, Webb, Hidalgo, and Uvalde counties (Singley). Dallas, Dallas County; Waco, McLennan County; Chilton, Cedar, and Big Deer creeks, Falls County; Palacios, Matagorda Peninsula, Matagorda County (Strecker). Cibolo Creek, Wilson County (Johnson and Strecker). Ellis County (Cheatum and Burt). North Fork Little Wichita River south of Dundee, Archer County; Double Mountain Fork Brazos River eight miles southeast of Aspermont, Stonewall County (Case (Walker)). Fort Worth, Tarrant County (Mearns (Dall)). Live Oak County (Vanatta). Laneport, Williamson County (Ferriss). San Benito, Cameron County (Cockerell). Jackson and Victoria counties (Mitchell). Lampasas County (Mrs. Sinks (Singley)). Cooke County (Ragsdale (Singley)). Burnet County (Cummins (Singley)). Hill, Hunt, and Kaufman counties (Askew (Singley).

POLYGYRA TEXASIANA (Moricand) var. TEXASENSIS Pilsbry

Helix texasiana (pars), Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 5, p. 189, pt. 10, p. 306.

Polygyra texasensis Pilsbry, 1902, Nautilus, vol. 16, p. 31.

Polygyra texasiana var. *texasensis,* Pilsbry and Ferriss, 1906, Proc. Acad. Nat. Sci. Philadelphia, vol. 58, p. 129, pl. 5, figs. 11, 12.

Polygyra texasiana hyperolia Pilsbry and Ferriss, 1906, Idem, p. 128, pl. 5, figs. 13–15. (Type locality is the high land west of Devils River.)

The type locality for this variety is Colorado City, Mitchell County (Ferriss). Sanderson, Terrell County (Strecker collection). Alpine, Brewster County; Langtry, mouth of Pecos River, Val Verde County; Devils River; east of Brackettville, Kinney County; Nueces River (Ferriss). Reeves and Ward counties (Askew (Singley as *P. texasiana)).* Fort Clark, Kinney County (Mearns, as *P. texasiana).*

POLYGYRA TRIODONTOIDES (Bland)

Polygyra triodontoides, W. G. Binney, 1885, U. S. Nat. Mus. Bull. 28, p. 370, fig. 404.

Helix triodontoides, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 306.

Lafitte's Cove on Galveston Island, and the mainland, Galveston County (Singley). Jefferson County (Kennedy (Singley)). Corpus Christi, Nueces County; Dewitt County (Binney). (T. D. A .Cockerell records this species from Roswell, New Mexico, but Dr. Pilsbry who has examined Cockerell's specimens, says that they are *P. texasiana* var. *texasensis* Pilsbry.)

POLYGYRA LATISPIRA Pilsbry

Western Texas (Pilsbry). Two specimens collected by Dr. Horatio C. Weed from the Big Bend of the Rio Grande, Brewster County, Texas, are in the collection of the Academy of Natural Sciences of Philadelphia.

POLYGYRA ARIADNAE (Pfeiffer)

Helix ariadnae, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 307.

Texas, on the Rio Grande, according to Binney (Pilsbry and Johnson catalogue).

POLYGYRA HIPPOCREPIS (Pfeiffer)

Helix hippocrepis, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 307.

Known only from New Braunfels, Comal County, where it has been collected by Singley, Askew, Mitchell, Pilsbry, Strecker, and others.

POLYGYRA FALLAX (Say)

Helix fallax, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 305.

Texas (Binney); an extremely doubtful record.

POLYGYRA VULTUOSA (Gould)

Helix vultuosa, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 305.

Twenty miles north of Beaumont, Jefferson County (Wetherby). Smith and Wood counties (Askew (Singley)). Anderson County (Singley).

POLYGYRA VULTUOSA (Gould) var. HENRIETTAE (Mazyck)

Helix vultuosa var. *henriettae,* Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 305.

Angelina County (Askew (Singley)). Lee and Robertson counties (Singley).

POLYGYRA VULTUOSA (Gould) var. COPEI Wetherby

Helix vultuosa var. *copei,* Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 305.

Hardin County (Pilsbry). Harris County (Askew (Singley)). Lee, Robertson, Anderson, and Galveston counties (Singley).

POLYGYRA VULTUOSA (Gould) var. CRAGINI (Call)

Helix vultuosa var. *cragini,* Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 305.

Wood County (Singley). Naples, Morris County (Ferriss).

POLYGYRA INFLECTA (Say)

Helix inflecta, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 305.

Recorded by Binney from Texas, no definite locality. It occurs in Oklahoma, Arkansas, and Missouri and may have entered northern Texas.

POLYGYRA ALBOLABRIS (Say)

Helix albolabris, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 305.

Daingerfield, Morris County (McDaniell (Singley)). Tyler, Smith County, introduced (Askew (Singley)). Ellis County (Cheatum and Burt).

POLYGYRA ROEMERI (Pfeiffer)

Pl. III, figs. 17, 18

Helix roemeri, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 305.

Goeth's ranch, 12 miles from San Antonio, Bexar County (Quillin). Falls, McLennan, Coryell, Oglesby, and Robertson counties (Strecker). Fort Worth, Tarrant County (Mearns (Dall)). Ellis County (Cheatum and Burt). Tarrant County (Askew (Singley)). Falls, Brazos, and Milam counties (Kennedy (Singley)). Lampasas County (Mrs. Sinks (Singley)). Burnet County (Cummins (Singley)). Travis, Bexar, Comal, Hays, and Dallas counties (Singley).

POLYGYRA CLAUSA (Say)

Dallas County (Cheatum and Burt).

POLYGYRA THYROIDES (Say)

Helix thyroides, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 304.

San Marcos, Hays County (Pilsbry and Ferriss, Strecker). Smithville, Bastrop County; DeKalb, Bowie County (Ferriss). Jefferson County (Kennedy (Singley)). Ellis County (Cheatum and Burt). Jackson and Victoria counties (Mitchell).

POLYGYRA THYROIDES (Say) var. BUCCULENTA (Gould)

Helix thyroides var. *bucculenta,* Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 304.

Harris, Gonzales, and Grayson counties (Askew (Singley)). Collin and San Jacinto counties (Ragsdale (Singley)). Lee, Washington, Robertson, Waller, Fort Bend, Anderson, and Caldwell counties (Singley).

POLYGYRA MONODON (Rackett)

Helix monodon, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 5, p. 189, pt. 10, p. 305.

Hardeman County (Cummins (Singley)). Pleistocene. San Antonio, Bexar County (Pilsbry). Dallas County (Cheatum and Burt).

POLYGYRA FRATERNA (Say)

Helix monodon var. *fraterna,* Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 305.

New Braunfels, Comal County (Pilsbry and Ferriss, Singley, Strecker). Austin, Travis County (Pilsbry). Ellis County (Cheatum and Burt). McLennan County (Strecker). Wood and Gonzales counties (Askew (Singley)). Cooke County (Ragsdale (Singley)). Jefferson and Milam counties (Kennedy (Singley)). Bexar, Burleson, Brazos, and Fort Bend counties (Singley). Dallas County (Cheatum and Burt).

POLYGYRA FRATERNA (Say) var. ALICIAE (Pilsbry)

Gainesville, Cooke County; Cass County (Ragsdale). Wood County (R. Walton (Pilsbry)). DeKalb, Bowie County; Mt. Pleasant, Titus County; Naples, Morris County (Ferriss).

POLYGYRA FRATERNA (Say) var. FRIERSONI (Pilsbry)

Fayette County (Pilsbry). DeKalb, Bowie County (Ferriss). Sulphur River, Bowie County (Strecker and Williams). Matagorda Peninsula, Matagorda County (Strecker).

THYSANOPHORA INCRUSTATA (Poey)

Patula incrustata, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 304.

Galveston, Galveston County; Corpus Christi, Nueces County (Binney). Hidalgo County (Singley).

THYSANOPHORA HORNII (Gabb)

Hondo River in Medina County; Rio San Felipe near Devils River, Val Verde County (Pilsbry and Ferriss). Live Oak County (Vanatta). Devils River and Nueces River drift, scarce in drift (Ferriss). Head of Fern Canyon; drift along Kokernot Creek in Musquiz Canyon, Jeff Davis County (Cheatum).

PUPISOMA DIOSCORICOLA (C. B. Adams) var. INSIGNIS Pilsbry

Live Oak County (Vanatta).

PUPISOMA DIOSCORICOLA (C. B. Adams) var. CAECA (Guppy)

Patula caeca, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 304.

Hidalgo County (Singley).

PUPISOMA MACNEILLI (Clapp)

Ellis County (Cheatum and Burt).

Family BULIMULIDAE

BULIMULUS PATRIARCHA (W. G. Binney)

Ellis County (Cheatum and Burt). This identification is based on a young specimen and is questionable.

BULIMULUS DEALBATUS (Say)

Northeast Texas (Acad. Nat. Sci. Philadelphia, Ms.).

BULIMULUS DEALBATUS (Say) var. LIQUABILIS (Reeve)

Pl. III, figs. 21, 22

Bulimulus dealbatus, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 309.

Bulimulus dealbatus var. *liquabilis,* Pilsbry and Ferriss, 1906, Proc. Acad. Nat. Sci. Philadelphia, vol. 58, p. 134, pl. 6, figs. 7–12.

Lake Kemp, Baylor County; McLennan, Falls, Bosque, Hays, San Marcos counties (Strecker). Ellis County (Cheatum and Burt). DeKalb, Bowie County (Ferriss). Eastern and southeastern Texas (Pilsbry and Ferriss). Double Mountain and Aspermont, Stonewall County (Case (Walker)). Somerset, Atascosa County (Kirn, Strecker collection). Jackson and Victoria counties (Mitchell). Bloomington, Victoria County (Quillin, Strecker collection). Live Oak County (Vanatta). Madison and Milam counties (Kennedy (Singley)). Duval, Gillespie, and Grayson counties (Askew (Singley)). Cooke, Hill, and Lampasas counties (Ragsdale (Singley)). Lee, Brazos, Nueces, Burleson, Wharton, Robertson, Washington, Waller, Fort Bend, Travis, Frio, and Hidalgo counties (Singley). Fort Clark, Kinney County (Mearns).

BULIMULUS DEALBATUS (Say) var. RAGSDALEI (Pilsbry)

Bulimulus ragsdalei, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 309.

Bulimulus dealbatus ragsdalei, Pilsbry and Ferriss, 1906, Proc. Acad. Nat. Sci. Philadelphia, vol. 58, p. 137, pl. 6, figs. 16–24.

Alpine, Housetop Mountain, Brewster County; Sanderson, small hills west of St. John ranch, Terrell County; Langtry, Devils River, and about three miles east of Del Rio, Val Verde County (Ferriss). Fort Clark, Kinney County (Mearns). St. Jo, Montague County (Pilsbry, Singley). Bluffs of Red River and southwest Texas (Pilsbry and Ferriss).

BULIMULUS DEALBATUS (Say) var. MOOREANA (W. G. Binney)

Bulimulus schiedeanus var. *mooreanus,* W. G. Binney, 1885, U. S. Nat. Mus. Bull. 28, p. 400, fig. 438.

Bulimulus schiedeanus, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 309.

Bulimulus schiedeanus var. *mooreanus,* Singley, 1893, Idem, p. 309.

Bulimulus dealbatus mooreanus, Pilsbry and Ferriss, 1906, Proc. Acad. Nat. Sci. Philadelphia, vol. 58, p. 133, pl. 6, figs. 1–6.

Originally described from Washington and DeWitt counties. San Antonio, Bexar County (Quillin and Strecker). "Arid region of central and southern Texas" (Pilsbry and Ferriss). San Marcos, Hays County; Oglesby, Coryell County; New Braunfels, Comal County; McLennan

County (Strecker). San Marcos, Hays County; Baylor Park in Waco, McLennan County, all brown form (Williams). Bloomington, Victoria County (Quillin). Temple, Bell County, white form (York). Wilson County (Johnson and Strecker). Victoria County (Mitchell, as *B. schiedeanus).* Somervell County (Sterki). Coleman, Cameron, Guadalupe, Goliad, Kerr, Kendall, Duval, and McLennan counties (Askew (Singley)). Denton County (Ragsdale (Singley)). Burnet County (Cummins (Singley)). Milam County (Kennedy (Singley)). Williamson County (Walker (Singley)). Hidalgo, Caldwell, Austin, Waller, Washington, Travis, Comal, Bexar, Frio, Webb, and Nueces counties (Singley).

BULIMULUS DEALBATUS (Say) var. SCHIEDEANA (Pfeiffer)

Rare in the mountains of western Texas. Terlingua, Brewster County (Koch (Clapp)).

BULIMULUS DEALBATUS (Say) var. PASONIS Pilsbry

Bulimulus dealbatus pasonis Pilsbry, 1902, Nautilus, vol. 16, pp. 32–33.
Bulimulus dealbatus pasonis, Pilsbry and Ferriss, 1906, Proc. Acad. Nat. Sci. Philadelphia, p. 139, pl. 6, fig. 25.

Type locality at El Paso, El Paso County.

BULIMULUS DEALBATUS (Say) var. PECOSENSIS Pilsbry and Ferriss

Bulimulus dealbatus pecosensis Pilsbry and Ferriss, 1906, Proc. Acad. Nat. Sci. Philadelphia, p. 138, pl. 6, figs. 26, 27.

Type locality on mesa one and one-half miles southeast of the eastern end of High Bridge over the Pecos (S. P. R. R.), Val Verde County (Pilsbry and Ferriss). Mouth of Pecos in several places, and about halfway between there and Del Rio; near, and west of, Nueces River below junction of two dry branches and in river drift (Ferriss).

BULIMULUS ALTERNATUS (Say) var. MARIAE (Albers)

Tuleta and Beeville, Bee County; Kenedy, Karnes County; Bloomington, Victoria County; Ayrea Dugout, 2 C Islands, between Rockport and Seadrift, very large patriarchal form (Quillin). Sharyland, Hidalgo County (Mrs. M. B. Seitz). Brownsville, Cameron County (Strecker Coll.). Jackson and Victoria counties (Mitchell). Edinburg, Hidalgo County (Fitzpatrick). Falfurrias, Brooks County; Eagle Pass, Maverick County (Plummer). Live Oak County (Vanatta). Duval, Cameron, Maverick, Frio, Webb, Hidalgo, and Nueces counties (Singley).

BULIMULUS ALTERNATUS (Say) var. ALBIDA Taylor

Derly, Frio County.

BULIMULUS ALTERNATUS (Say) var. INTERMEDIA Singley

Corpus Christi, Nueces County.

BULIMULUS ALTERNATUS (Say) var. HESPERIA Pilsbry and Ferriss

Bulimulus alternatus mariae (western form), Pilsbry and Ferriss, 1906, Proc. Acad. Nat. Sci. Philadelphia, vol. 58, p. 139, pl. 7, figs. 1–12.

Bulimulus alteratus hesperius Pilsbry and Ferriss, 1924, Nautilus, vol. 38, pp. 40–41.

The type locality is on the east of the Pecos High Bridge, Val Verde County. Valley north of the canyon of the Rio Grande south-southwest of Terlingua, Brewster County; Langtry, west of and at the highway bridge over the Pecos near its mouth, Val Verde County (Ferriss). Fort Clark, Kinney County (Mearns).

BULIMULUS PILSBRYI Ferriss

Bulimulus pilsbryi Ferriss, 1925, Nautilus, vol. 39, p. 25.

The type locality is Sanderson, Terrell County.

DRYMAEUS SERPERASTRUM (Say)

A Mexican species said to occur just north of the Rio Grande in Texas.

Family UROCOPTIDAE

MICROCERAMUS TEXANUS (Pilsbry)

Macroceramus texanus Pilsbry, 1898, Nautilus, p. 23, 1898.

Macroceramus gossei, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 310.

Microceramus texanus, Pilsbry, 1904, Manual of Conchology, ser. 2, vol. 16, pl. 25, figs. 1–4, 1904.

The type locality is New Braunfels, Comal County (Pilsbry, Singley, Strecker, Bartsch). Helotes, Bexar County (Bartsch, Strecker). Sinking Creek near San Marcos, Hays County (Pilsbry and Ferriss). Travis County (Singley).

HOLOSPIRA GOLDFUSSI (Menke)

Holospira goldfussi, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 309.

New Braunfels, Comal County (Gurley, Singley, Strecker). Helotes, Bexar County; rare (Strecker). San Marcos, Hays County (Stearns (Bartsch)). Blanco River (Shumard (Bartsch)).

HOLOSPIRA GOLDFUSSI (Menke) var. ANACACHENSIS Bartsch

Holospira (Holospira) goldfussi anacachensis Bartsch, 1907, Proc. U. S. Nat. Mus., vol. 31, p. 123, pl. 4, fig. 4.

The type locality is in Anacacho Mountains, Kinney County. Nueces River (Bartsch). Twenty miles north of Brackettville on Hillcoals ranch, 6 to 8 miles east of Spofford, 6 miles southeast of Cline near Frying Valley, Kinney County (Stanton (Bartsch)). Elm Creek about 6 miles above Eagle Pass, Maverick County (Vaughan and Stanton (Bartsch)).

HOLOSPIRA HAMILTONI Dall

Holospira (Haplostemma) hamiltoni Dall, 1897, Nautilus, vol. 11, p. 39.

The type locality is in Rio Grande Mountains, Brewster County, at an altitude of 3500 feet (collected by J. M. Hamilton (Dall)).

HOLOSPIRA ROEMERI (Pfeiffer)

Holospira roemeri, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 309.

Painted Cave, mouth of Pecos River, and Devils River region (Stearns). Comal County (Singley, Strecker). Helotes, Bexar County (Strecker). Alpine and Housetop Mountain, Brewster County; Nueces River (Ferriss). New Braunfels, Comal County (Gurley (Bartsch)). Helotes, Bexar County (Wetherby (Bartsch)). Japonica, Kerr County; 13 miles south of Juno, Val Verde County (M. Surber (Bartsch)). Headwarters of Nueces River, Edwards County; Round Mount on Uvalde River, Uvalde County (Stanton and Vaughan). Edwards County (Vaughan). Devils River; Painted Cave on Pecos River, Val Verde County (Lloyd (Bartsch)). Near High Bridge over Canyon of Pecos River, Val Verde County (F. M. Bailey (Bartsch)). Near Spofford, Kinney County (T. W. Stanton (Bartsch)).

HOLOSPIRA PASONIS Dall

Holospira pasonis Dall, 1895, Nautilus, vol. 8, p. 112.

The type locality is in Mule Canyon, El Paso County, at an altitude 4,000 feet (J. A. Singley).

HOLOSPIRA MESOLIA Pilsbry

Holospira mesolia Pilsbry, 1912, Nautilus, vol. 26, pp. 88–90.

The type locality is a low limestone ledge along the railroad at Sanderson, Terrell County (Hebard and Rehn (Pilsbry)).

Family PUPIDAE

STROBILOPS TEXASIANA Pilsbry and Ferriss

Helix labyrinthica, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 307.

Strobilops labyrinthica texasiana Pilsbry and Ferriss, 1906, Proc. Acad. Nat. Sci. Philadelphia, vol. 58, p. 147.

The type locality is Guadalupe River four miles above New Braunfels (Pilsbry and Ferriss). Austin, Travis County; New Braunfels, Comal County; Lee, Robertson, Nueces, Bexar, and Hidalgo counties (Singley, as *S. labyrinthica* but most of these are doubtless true *S. texasiana).* Calhoun County (Hubbard). Gainesville, Cooke County (Quintard). Ellis County (Cheatum and Burt, as *S. labyrinthica* Say and *Strobilops texasiana floridana* Pilsbry). San Marcos, Hays County; Hondo River in Medina County (Pilsbry and Ferriss). Lavaca River in Jackson

County; Guadalupe River in Victoria County (Mitchell). Brazos River drift in McLennan County (Strecker). Red River, Burkburnett, Wichita County (Walker, as *S. texasiana).*

STROBILOPS AFFINIS Pilsbry

Somervell County (Sterki).

STROBILOPS HUBBARDI (A. D. Brown)

Helix hubbardi Brown, 1861, Proc. Acad. Nat. Sci. Philadelphia, p. 333, text fig.

Helix hubbardi, Singley, 1893, Geol. Survey Texas, 4th Ann. Rept., pt. 10, p. 307.

The type locality is Indianola, Calhoun County. Ellis County (Cheatum and Burt).

PUPOIDES MARGINATUS (Say)

Pupa fallax, Singley, 1893, Geol. Survey Texas, 4th Ann. Rept, pt. 5, p. 187, pt. 10, p. 307.

Drift on Salt Fork of Red River, Armstrong County; McLennan County (Stecker). Ellis County (Cheatum and Burt). North Fork Wichita River south of Dundee, Archer County (Case (Walker)). Prairie Dog Fork Red River, Silverton-Clarendon road, Briscoe County; Red River and Burkburnett, Wichita County; eight miles southeast of Aspermont, Stonewall County (Walker). Somervell County (Sterki). Live Oak County (Vanatta). Amarillo, Potter County (Henderson). Drift along Pecos, Nueces, and Devils rivers (Ferriss). Fort Clark, Kinney County (Mearns, as *Pupa fallax* Say). "Found throughout the state: Hidalgo and Galveston and all of the central Texas counties and sent from Cooke County by Ragsdale" (Singley).

GASTROCOPTA ARMIFERA (Say)

Pupa armifera, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 5, p. 187, pt. 10, p. 308.

Bifidaria armifera, Pilsbry and Johnson Catalogue, 1898.

New Braunfels, Comal County (Singley). Amarillo, Potter County (Henderson). DeKalb, Bowie County (Ferriss). Somervell County (Sterki). Ellis County (Cheatum and Burt). McLennan County (Strecker).

GASTROCOPTA CONTRACTA (Say)

Pupa contracta, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 308.

Bifidaria contracta, Pilsbry and Johnson Catalogue, 1898.

Wood, Jefferson, Cooke, Clay, Hidalgo, Nueces, and Galveston counties (Singley, "all over the state"). Devils and Nueces rivers (Ferriss). Live Oak County (Vanatta). Somervell County (Sterki)

Red River, Burkburnett, Wichita County (Walker). Ellis County (Cheatum and Burt). McLennan County (Strecker). Fort Clark, Kinney County (Mearns).

GASTROCOPTA CONTRACTA (Say) var. CLIMEANA (Vanatta)

Southern United States Gulf Coastal Plain from Alabama to Texas (Pilsbry).

GASTROCOPTA HOLZINGERI (Sterki)

Pupa holzingeri, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 308.
Bifidaria holzingeri, Pilsbry and Johnson Catalogue, 1898.

New Braunfels, Comal County, drift (Singley). Somervell County (Sterki).

GASTROCOPTA HORDEACEA (Gabb)

Pupa hordeacea, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 308.
Bifidaria hordeacea, Pilsbry and Johnson Catalogue, 1898.

Colorado County (Sterki (Singley)). Lee, Comal, and Fort Bend counties (Singley). Hardeman County (Cummins). Subfossil.

GASTROCOPTA PROCERA (Gould)

Pupa procera, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 308.
Bifidaria procera, Pilsbry and Johnson Catalogue, 1898.

Lee and Comal counties (Singley). North Fork Little Wichita River south of Dundee, Archer County; eight miles southeast of Aspermont, Stonewall County (Case (Walker)). Live Oak County (Vanatta). Somervell County (Sterki).

GASTROCOPTA CRISTATA (Pilsbry and Vanatta)

Pecos, Devils, and Nueces river drift (Ferriss). Amarillo, Potter County (Henderson). Eight miles southeast of Aspermont, Stonewall County; Prairie Dog Fork Red River on Silverton-Clarendon road, Briscoe County (Walker). Red River, Burkburnett, Wichita County; North Fork Little Wichita River south of Dundee, Archer County (Case (Walker)). McLennan County (Strecker).

GASTROCOPTA PELLUCIDA (Pfeiffer) var. HORDEACELLA (Pilsbry)

Pupa hordeacella, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 308.
Bifidaria hordeacella, Pilsbry and Johnson Catalogue, 1898.

Pecos, Devils, and Nueces river drift (Ferriss). Colorado County (Sterki (Singley)). Lee, Comal, and Fort Bend counties (Singley). McLennan County (Stretcker). Amarillo, Potter County (Henderson). Live Oak County (Vanatta). Somervell County (Sterki). Eight miles southeast of Aspermont, Stonewall County; Red River, Burkburnett, Wichita County; North Fork Little Wichita River south of Dundee, Archer County (Case (Walker)). Prairie Dog Fork Red River on Silverton-Clarendon road, Briscoe County (Walker). One specimen in humus from *Quercus texana* eight miles north of Fort Davis in Limpia Canyon, Jeff Davis County (Cheatum).

GASTROCOPTA RUPICOLA (Say)

Bifidaria rupicola, Pilsbry and Johnson Catalogue, 1898.

"Texas" in the first draft but not mentioned in the completed work. Probably not a Texan species.

GASTROCOPTA RIOGRANDENSIS (Sterki)

Pupa riograndensis Sterki, 1892, Nautilus, vol. 6, p. 4.

The type locality is Hidalgo County (Sterki). Humus from *Quercus texana* eight miles north of Fort Davis in Limpia Canyon, Jeff Davis County (Cheatum).

GASTROCOPTA CORTICARIA (Say)

Pupa corticaria, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 307.

Bifidaria corticaria, Pilsbry and Johnson Catalogue, 1898.

Columbus, Colorado County (Sterki (Singley)). Somervell County (Sterki). Ellis County (Cheatum and Burt).

GASTROCOPTA CURVIDENS (Gould)

Pupa curvidens, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 308.

Bifidaria curvidens, Pilsbry and Johnson Catalogue, 1898.

Colorado County (Sterki (Singley)). Comal County (Singley).

GASTROCOPTA DUPLICATA (Sterki)

Somervell County (Sterki).

GASTROCOPTA PENTODON (Say)

Pupa pentodon, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 308.

Bifidaria pentodon, Pilsbry and Johnson Catalogue, 1898.

Live Oak County (Vanatta). Nueces River (Ferriss). Somervell County (Sterki). Ellis County (Cheatum and Burt). McLennan County (Strecker). Colorado County (Sterki (Singley)). Comal and Fort Bend counties (Singley). Hardeman and Swisher counties (Cummins (Singley)). Subfossil. Humus from *Quercus texana* about eight miles north of Fort Davis in Limpia Canyon, Jeff Davis County (Cheatum).

GASTROCOPTA PENTODON (Say) var. FLORIDANA (Dall)

Somervell County (Sterki).

GASTROCOPTA TAPPANIANA (C. B. Adams)

Pupa pentodon, of authors, not Say.

Amarillo, Potter County (Henderson). North Fork Little Wichita River south of Dundee, Archer County (Case (Walker)). Somervell County (Sterki). Salt Fork Red River, Armstrong County; McLennan County (Strecker).

GASTROCOPTA TAPPANIANA (C. B. Adams) var. CURTA (Sterki)

Somervell County (Sterki).

PUPA MUSCORUM Linné var. BLANDI (Morse)

Pupa muscorum var. *blandi,* Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 307.

New Braunfels, Comal County, river drift (Singley).

PUPA SYNGENES Pilsbry

Pupa syngenes, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 308.

New Braunfels, Comal County, river drift (Singley).

VERTIGO MILIUM (Gould)

Pupa milium, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 308.

Colorado and Somervell counties (Sterki). Comal County (Singley).

VERTIGO RUGOSULA Sterki

Vertigo rugosula, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 308.

Colorado County (Sterki (Singley)). Lee and Comal counties (Singley). Somervell County (Sterki).

VERTIGO OVATA Say

Vertigo ovata, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 308.

Colorado County (Sterki (Singley)). Comal and Fort Bend counties (Singley). Swisher County (Cummins (Singley)). Subfossil. Amarillo, Potter County (Henderson). Nueces River drift (Ferriss).

VERTIGO TRIDENTATA Wolf

Vertigo tridentata, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 309.

Colorado County (Sterki (Singley)). Comal County (Singley).

VERTIGO OSCARIANA Sterki

Vertigo oscariana, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 309.

Colorado County (Sterki). Comal County (Singley).

Family ACHATINIDAE

RUMINA DECOLLATA (Linné)

Pl. II, figs. 9, 10

Introduced. Brownsville, Cameron County (Camp (Ferriss)). Austin, Travis County (Plummer and Strecker). San Antonio, Bexar County (Quillin and Strecker). Waco, McLennan County (Potter, Strecker, Williams).

Family GLANDULINIDAE

EUGLANDINA TEXASIANA (Pfeiffer)

Glandina texasiana, W. G. Binney, 1878, Bull. Mus. Comp. Zool., vol. 4, p. 87, text fig.

Glandina texasiana, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 301.

Brownsville, Cameron County (Binney, Camp, Ferriss). Fort Clark, Kinney County (Mearns). Found on both sides of Pecos River near the highway (Ferriss).

EUGLANDINA SINGLEYANA (W. G. Binney)

Pl. III, figs. 23, 24

Glandina decussata var. *singleyana,* Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 302.

Atascosa County (Kirn). Bexar County (Quillin). Austin, Travis County; Helotes, Bexar County (Strecker). Wilson County (Johnson and Strecker). San Marcos, Hays County (Williams). Guadalupe River bottoms, Victoria County (Mitchell in Strecker collection). Goliad, Gonzales, and Guadalupe counties (Askew (Singley)). Bexar, Comal, Caldwell, Frio, and Travis counties (Singley).

EUGLANDINA EXESA Cockerell

Euglandina exesa Cockerell, 1930, Proc. Colorado Mus. Nat. Hist., vol. 9, No. 5, pp. 52–53, text fig.

Type from cinnabar mine, 90 miles south of Alpine, Brewster County.

EUGLANDINA VANUXEMENSIS (Lea)

A Mexican species recorded by Binney from southern Texas. A very doubtful record.

EUGLANDINA TRUNCATA (Gmelin)

Recorded from Texas by Binney but not likely to occur in the State

Family CIRCINARIIDAE

HAPLOTREMA CONCAVUM (Say)

Ellis County (Cheatum and Burt).

Family ZONITIDAE

OMPHALINA FRIABILIS (W. G. Binney)

Zonites friabilis, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 302.

Waco, McLennan County; San Marcos, Hays County (Strecker). Bowie County: Sulphur River bottoms (Williams and Strecker); DeKalb County (Ferriss). Bell and Gonzales counties (Askew (Singley)). Brazos County (Kennedy (Singley)). Lampasas County (Ragsdale (Singley)). Milam and Williamson counties (Walker (Singley)). Lee, Caldwell, Waller, Hays, and Travis counties (Singley).

RETINELLA SCULPTILIS (Bland)

Recorded from Waco by Binney and from northern Texas by Pilsbry Not Texan. These records are based on the large form of *Retinella indentata* (Say).

RETINELLA INDENTATA (Say)

Pl. III, figs. 13, 14

Zonites identatus, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 303.

Live Oak County (Vanatta). Somervell County (Sterki). Red River, Burkburnett, Wichita County (Case (Walker)). Ellis County (Cheatum and Burt). Wilson County (Johnson and Strecker). "Entire State" (Singley). McLennan, Travis, Bell, Hays, and Bexar counties (Strecker).

RETINELLA INDENTATA (Say) var. UMBILICATA (Singley)

Vitrea indentata var. *umbilicata*, Cockerell, Nautilus, vol. 12, p. 120.

Pecos, Nueces, and Devils river drift (Ferriss). Lee County (Cockerell). McLennan County (Strecker). In the majority of localities investigated by me, both the typical form of the species and its variety are associated.

RETINELLA INDENTATA (Say) var. PAUCILIRATA (Morelet)

Fern Canyon in a bed of humus beneath *Crataegus* trees; drift along Kokernot Creek in Musquiz Canyon, Jeff Davis County (Cheatum).

RETINELLA HAMMONIS (Ström) var. ELECTRINA (Gould)

Fort Clark, Kinney County (Mearns, as *Zonites radiatula* (Alder)).

RETINELLA DALLIANA (Simpson) var. ROEMERI (Pilsbry and Ferriss)

Vitrea dalliana roemeri Pilsbry and Ferriss, 1906, Proc. Acad. Nat. Sci. Philadelphia, vol. 58, p. 151, fig. 8.

The type localtiy is Sinking Spring Creek near San Marcos, Hays County. The species occurs also along Hondo River in Medina County; Rio San Filipe and Devils River in Val Verde County (Pilsbry and Ferriss). McLennan County (Strecker). Somervell County (Sterki). Nueces river drift (Ferriss).

RETINELLA CRYPTOMPHALA (Clapp)

Vitrea cryptomphala Clapp, 1915, Nautilus, vol. 29, pp. 25–28, fig. 1.

San Antonio, Bexar County (Clapp).

EUCONULUS FULVUS (Draparnaud)

Zonites fulvus, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 303.

McLennan County (Strecker). "Widely distributed" entire state (Singley).

EUCONULUS CHERSINUS (Say)

Ellis County (Cheatum and Burt).

EUCONULUS CHERSINUS (Say) var. TROCHULUS (Reinhard)

Conulus cherisinus trochulus, Pilsbry, 1899, Nautilus, vol. 12, p. 116.

McLennan County (Strecker). Live Oak County (Vanatta). Hondo River in Medina County; Sinking Springs in Hays County (Pilsbry and Ferriss). New Braunfels, Comal County (Pilsbry). Rio San Filipe, Devils, and Nueces river drift (Ferriss).

EUCONULUS CHERSINUS (Say) var. POLYGYRATA (Pilsbry)

Ellis County (Cheatum and Burt).

GUPPYA GUNDLACHI (Pfeiffer)

Zonites gundlachi, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 303.

Hidalgo County (Singley, Pilsbry).

ZONITOIDES ARBOREUS (Say)

Zonites arboreus, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 302.

"Entire state", Sabine River to Rio Grande; Cooke and Hidalgo counties (Singley). Ellis County (Cheatum and Burt). Somervell County (Sterki). New Braunfels, Comal County; Sinking Spring, Hays County (Pilsbry and Ferriss). Live Oak County (Vanatta). Mt. Pleasant, Titus County (Ferriss). McLennan, Falls, Bell, Coryell, Travis, Hays, and Bexar counties (Strecker). In bed of humus under *Quercus texana* in Limpia Canyon, Jeff Davis County (Cheatum).

HAWAIIA MINUSCULA (W. G. Binney)

Zonites minusculus, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 303.

Devils and Nueces river drift (Ferriss). Salt Fork Red River in Armstrong County; McLennan County (Strecker). "Entire state"; Colorado and Fort Bend counties; New Braunfels, Comal County

(Singley). Fifteen miles southeast of Amarillo, Potter County (Henderson). Prairie Dog Fork Red River near Silverton-Clarendon road, Briscoe County; North Fork Little Wichita River south of Dundee, Archer County (Walker). Red River, Burkburnett, Wichita County; eight miles southeast Aspermont, Stonewall County (Case (Walker)). Somervell County (Sterki). Live Oak County (Vanatta). Hondo River, Medina County; Del Rio, Devils River, and Pecos River, Val Verde County (Pilsbry and Ferriss). Hidalgo County (Pilsbry).

The variety, *Hawaiia minuscula* var. *alachuana* Dall occurs with the typical form at most Texas localities. Specimens from Galveston in the collections of the Academy of Natural Sciences of Philadelphia are labeled "near to *H. minuscula neomexicana* (Pilsbry and Cockerell)."

STRIATURA MILIUM (Morse) var. MERIDIONALIS (Pilsbry and Ferriss)

Zonites milium, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 303.

Vitrea milium meridionalis Pilsbry and Ferriss, 1906, Proc. Acad. Nat. Sci. Philadelphia, vol. 58, p. 152.

The type locality is along Guadalupe River above New Braunfels, Comal County (Pilsbry and Ferriss). Sinking Spring Creek, near San Marcos, Hays County; Hondo River, Medina County; Drift from Pecos River, Val Verde County (Pilsbry and Ferriss). Comal and Fort Bend counties (Singley). Somervell County (Sterki).

VENTRIDENS INTERTEXTUS (W. G. Binney)

Zonites intertextus, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 302.

Beaumont, Jefferson County (Wetherby (Singley)).

VENTRIDENS DEMISSUS (W. G. Binney)

Zonites demissus, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 302.

Beaumont, Jefferson County (Wetherby (Singley)). Carinated variety.

Family LIMACIDAE

LIMAX MAXIMA Linné

New Braunfels, Comal County (Pilsbry (Singley)). Introduced.

LIMAX FLAVA Linné

Waco, McLennan County (Strecker). Introduced.

AGRIOLIMAX AGRESTIS (Linné)

Agriolimax agrestis, Strecker, 1910, Nautilus, vol. 24, pp. 3–4.

Waco, McLennan County (Strecker). Introduced.

AGRIOLIMAX CAMPESTRIS (A. Binney)

Fort Clark, Kinney County (Mearns). Supposed to inhabit the entire United States. Probably occurs in McLennan County.

Family PHILOMYCIDAE

PHILOMYCUS CAROLINENSIS (Bosc)

Tebennophorus carolinensis, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt .10, p. 303.

Anderson County (Singley). Falls and McLennan counties (Strecker).

Family ENDODONTIDAE

ANGUISPIRA ALTERNATA (Say)

Pl. II, figs. 3, 4

Patula alternata, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 303.

Pyramidula alternata, Pilsbry and Johnson Catalogue, 1898.

I have specimens of *A. alternata* which, though not perfectly typical, are nearer the typical form than to the next variety. These specimens are from McLennan County and other central and eastern Texas counties.

ANGUISPIRA ALTERNATA (Say) var. RARINOTATA (Pilsbry)

Pyramidula alternata rarinotata Pilsbry, 1900, Nautilus, vol. 13, p. 114.

This is the common Texas form of *Anguispira.* Probably most of the following records refer to it. Caldwell and Fayette counties (Singley (Pilsbry)). Navidad River bottom, Jackson County (Mitchell (Pilsbry)). Bruceville, McLennan County; New Braunfels, Comal County; San Marcos, Hays County; Texarkana, Bowie County (Strecker). Denison, Grayson County (Ferriss). Bell, Gonzales, and Guadalupe counties (Askew (Singley)). Williamson County (Walker (Singley)). Burleson, Fort Bend, and Travis counties (Singley). New Braunfels, Comal County (Pilsbry). Colorado and Victoria counties (Mitchell).

ANGUISPIRA ALTERNATA (Say) var. CARINATA (Pilsbry and Rhoads)

Waxahachie, Ellis County (Cheatum and Burt).

GONYODISCUS PERSPECTIVUS (Say)

Patula perspectiva, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 303.

Is found in Texas, according to Binney and Pilsbry.

GONYODISCUS STRIATELLA (Anthony)

Patula striatella, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 303.

Swisher County (Cummins (Singley)). Post-Pliocene.

GONYODISCUS CRONKHITEI (Newcomb) var. ANTHONYI (Pilsbry)

Midlothian, Ellis County (Cheatum and Burt). Drift.

HELICODISCUS SINGLEYANUS (Pilsbry)

Zonites singleyanus Pilsbry, 1889, Proc. Acad. Nat. Sci. Philadelphia, p. 84.

Hyalinia laeviuscula Sterki, 1892, Nautilus, vol. 6, p. 53. (Type locality, New Braunfels, Comal County.)

Zonites laeviuscula, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 303.

Zonites singleyanus, Singley, Idem, p. 303.

The type locality is at New Braunfels, Comal County (Singley). Devils and Nueces river drift (Ferriss). Salt Fork Red River in Armstrong County; McLennan County (Strecker). New Braunfels, Comal County; Columbus, Colorado County (Singley). Ellis County (Cheatum and Burt). Fifteen miles southeast of Amarillo, Potter County (Henderson). Prairie Dog Fork Red River on the Clarendon-Silverton road, Briscoe County; North Fork Little Wichita River south of Dundee, Archer County; Red River, Burkburnett, Wichita County; eight miles southeast of Aspermont, Stonewall County (Walker). Somervell County (Sterki). Live Oak County (Vanatta). Drift along Kokernot Creek in Musquiz Canyon between Fort Davis and Alpine, Jeff Davis County (Cheatum). Comal, Fort Bend, and Colorado counties (Singley, as *Zonites laeviuscula).*

HELICODISCUS NUMMUS (Vanatta)

Zonitoides nummus Vanatta, 1899, Proc. Acad. Nat. Sci. Philadelphia, p. 524, text fig.

The type locality is at New Braunfels, Comal County (Ferriss). Devils River, Pecos River canyon above High Bridge, Del Rio, Val Verde County; San Marcos, Hays County; Hondo River in Medina County (Pilsbry and Ferriss). Devils and Nueces River drift (Ferriss). North Fork Little Wichita River south of Dundee, Archer County (Case (Walker)). Red River, Burkburnett, Wichita County; eight miles southeast of Aspermont, Stonewall County (Walker). Somervell County (Sterki).

HELICODISCUS PARALLELUS (Say)

Helix lineata Say, 1817, (not Olivi, 1792), Jour. Acad. Nat. Sci. Philadelphia, vol. 1, p. 18, vol. 2, p. 373.

Helicodiscus parallelus, Pilsbry and Ferriss, 1906, Proc. Acad. Nat. Sci. Philadelphia, vol. 58, p. 156, pl. 8, figs. 7–10.

Eight miles southeast of Aspermont, Stonewall County (Case (Walker)). Amarillo, Potter County (Henderson). Ellis County (Cheatum and Burt).

"I have not seen Texas specimens of typical *lineatus,* but it doubtless occurs in northern and eastern parts of the state. In New Mexico, at Pecos, Las Vegas, Mesilla, Sandia Mountains, and other places, and in the Pecos River canyon near its mouth, Val Verde County, Texas, there is a form of *H. parallellus* with rather weak, sparse spirals, the intervals more distinctly striate radially than in typical *parallelus.* This seems to be a form of the southeastern Rocky Mountains and southward to the Rio Grande, occupying territory between the ranges of *H. eigenmanni and H. arizonensis,* with some overlapping on the territory of the latter" (Pilsbry and Ferriss). Near a large reservoir one mile west of Fort Davis on a rocky ledge covered by a bed of cactus humus, Jeff Davis County (Cheatum).

HELICODISCUS EIGENMANNI Pilsbry

Helicodiscus eigenmanni Pilsbry, 1900, Nautilus, vol. 14, p. 41.

Helicodiscus eigenmanni, Pilsbry and Ferriss, 1906, Proc. Acad. Nat. Sci. Philadelphia, vol. 58, p. 157, pl. 8, figs. 1–3.

The type locality is Beaver Cave near San Marcos, Hays County (Pilsbry). Pecos, Devils, and Nueces river drift (Ferriss). Sinking Spring Creek, Hays County; Hondo River, Medina County; Alpine, Brewster County (Pilsbry and Ferriss). Calhoun County (Hubbard). Lee County (Singley). Navidad River in Jackson County (Mitchell). McLennan County (Strecker).

For *H. lineatus (H. parallelus)* Singley records Lee, Burleson, Comal, Bexar, Hidalgo, and Cooke counties, and Sterki records Somervell County, but most of these are *H. eigenmanni.*

PUNCTUM PYGMAEUM (Drapernaud)

Punctum pygmaeum, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 304.

Nueces River (Ferriss). River drift in Comal County (Singley). River drift at Columbus, Colorado County (Sterki (Singley)). Hondo River, Medina County (Pilsbry and Ferriss). McLennan County (Strecker). North Fork Little Wichita River south of Dundee, Archer County (Case (Walker)). Somervell County (Sterki).

COLUMELLA EDENTULA (Drapernaud)

Sphyradium edentulus, Pilsbry and Johnson Catalogue, 1898.

Ellis County (Cheatum and Burt).

Family SUCCINEIDAE

SUCCINEA SALLEANA Pfeiffer

Lake in Jackson County and Traylor's Lake, Victoria County (Mitchell).

SUCCINEA CAMPESTRIS Say

Succinea campestris, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 311.

Galveston Island, Galveston County (Singley). Ellis County (Cheatum and Burt). It is possible that the form recorded from these localities is *S. unicolor* Tryon.

SUCCINEA LUTEOLA Gould

Succinea luteola, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 310.

Edinburg, Hidalgo County (Fitzpatrick). Fort Clark, Kinney County (Mearns). Fort Worth, Tarrant County (Mearns (Dall)). Alpine, Brewster County; Langtry, mouth of Pecos, and Devils River, Val Verde County (Ferriss). Frio County (Singley). Comal, Val Verde, and Medina counties (Pilsbry and Ferriss). Bexar County (Askew (Singley)).

SUCCINEA CONCORDIALIS Gould

Succinea concordialis, Pilsbry and Ferriss, 1906, Proc. Acad. Nat. Sci. Philadelphia, vol. 58, p. 159, text figs. 11, 12.

Succinea concordialis, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 310.

Lake Concordia, Louisiana (not Texas), (Pilsbry); Gould thought locality in Texas. Mud Island off coast, Aransas County (Quillin (Strecker collection)). Matagorda Peninsula, Matagorda County (Strecker). West Yegua Creek, Lee County (Singley). Waller County (Ragsdale (Singley)). Hays, Comal, Bexar, Val Verde, and Victoria counties (Pilsbry and Ferriss).

SUCCINEA GROSVENORII Lea

Succinea grosvenori, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 311.

Ellis County (Cheatum and Burt). North Fork Little Wichita River south of Dundee, Archer County; Piedroso Creek north of Amarillo, Potter County (Case (Walker)). San Antonio, Bexar County (Pilsbry). Lee, Washington, and Fort Bend counties (Singley). Cockerell named a form *S. rufescens* from Lee County specimens. Fort Clark, Kinney County (Mearns, as *S. lineata* W. G. Binney). Howard County (Cummins (Singley)). Subfossil (W. G. Binney, as *S. lineata).*

SUCCINEA AVARA Say

Pl. III, figs. 1, 2

Succinea avara, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 310.

Jefferson County (Kennedy (Singley)). Rockwall County (Ragsdale (Singley)). Ward, Reeves, and Bexar counties (Askew (Singley)). Comal, Bexar, and Val Verde counties (Pilsbry and Ferriss). Webb and

Travis counties (Singley). McLennan, Falls, Hays, and Travis counties (Williams and Strecker). Turk Head, Medina County (Quillin (Strecker collection)). Wilson County (Johnson and Strecker). Fort Clark, Kinney County (Mearns). Ellis County (Cheatum and Burt). Mt. Pleasant, Titus County; Devils and Nueces rivers (Ferriss). Fern Canyon on moist ledge; Musquiz and Limpia canyons, Jeff Davis County (Cheatum).

Family AURICULIDAE

CARYCHIUM EXIGUUM (Say)

Carychium exiguum, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 311.

Colorado and Somervell counties (Sterki). Hondo River, Medina County; Devils River in Val Verde County (Pilsbry and Ferriss). Comal, Fort Bend, and Travis counties, Guadalupe River (Singley).

CARYCHIUM EXILE H. C. Lea

Carychium exile, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 311.

Somervell County (Sterki). McLennan County (Strecker). Comal County (Singley). Drift in Hays, Medina, and Val Verde counties (Pilsbry and Ferriss).

Family LYMNAEIDAE

LYMNAEA DALLI Baker

Drift along Kokernot Creek in Musquiz Canyon between Fort Davis and Alpine, Jeff Davis County (Cheatum).

PSEUDOSUCCINEA COLUMELLA (Say)

Limnaea columella, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 313.

West Yegua Creek, Lee County (Singley). Fort Clark, Kinney County (Mearns). "South to central Texas" (Baker).

PSEUDOSUCCINEA COLUMELLA (Say) var. CHALYBEA (Gould)

"In Texas, lies on the border of the Rio Grandian region" (Baker). Baker mentions no specific localities but a dot on the map outlining the distribution of this subspecies indicates the neighborhood of Jackson and Victoria counties where most of J. D. Mitchell's conchological collecting was done.

GALBA CUBENSIS (Pfeiffer)

Garcitas Creek, Victoria County (collected by Mitchell (Baker)).

GALBA BULIMOIDES (Lea) var. TECHELLA (Haldeman)

Pl. III, figs. 5, 6

Limnea techella Haldeman, 1867, Am. Jour. Conch., vol. 3, pl. 6, fig. 4.

Limnea bulimoides, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 313.

Lymnaea bulimoides techella, Pilsbry and Ferriss, 1906, Proc. Acad. Nat. Sci. Philadelphia, vol. 58, p. 163, text figs. 20–23.

Galba bulimoides techella, Baker, 1911, Chicago Acad. Sci., Spec. Publ. 3, pp. 214–217, pl. 27, fig. 32.

Dallas, Dallas County (E. Hall (Baker)). Greenville, Hunt County (Hanna (Baker)). Houston, Harris County (Hemphill, Pilsbry). Dallas, Dallas County (Hemphill). Rockwall County (Ferriss). San Marcos, Hays County (Pilsbry and Ferriss, Strecker). San Antonio, Bexar County (Pilsbry). Royse City, Rockwall County (Ragsdale). Fort Worth, Tarrant County (Sampson, Walker, Mearns (Dall)). Rio Grande near El Paso, El Paso County (Smith collections, Mearns (Dall)). Bouldin Creek, Travis County; New Braunfels, Comal County; Cala Creek, Throckmorton County; Jackson County (Smith collection). North Fork Little Wichita River near Dundee, Archer County (Case (Walker)). Ellis County (Cheatum and Burt). McLennan County (Strecker). Sabine River, Hunt County (Askew (Singley)). Lampasas County (Mrs. Sinks (Singley)). Brazos River in Fort Bend County; Colorado River and tributaries in Travis County (Singley).

GALBA BULIMOIDES (Lea) var. COCKERELLI (Pilsbry and Ferriss)

Lymnaea bulimoides cockerelli Pilsbry and Ferriss, 1906, Proc. Acad. Nat. Sci. Philadelphia, vol. 58, p. 162, text figs. 13–17.

Sabine River, Greenville, Hunt County (Smith collection (Baker)). Rutersville, Fayette County (Lea).

GALBA CAPERATA (Say)

Limnaea caperata, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 313.

Reeves County (Askew), "an elongate variety" (Singley). Swisher, Hardeman, and Cottle counties; subfossil (Cummins (Singley)). Piedroso Creek north of Amarillo, Potter County (Case (Walker)).

GALBA PARVA (Lea)

Drift in Somervell County (Sterki). Devils and Nueces river drift (Ferriss). Drift along Kokernot Creek, Musquiz Canyon, between Fort Davis and Alpine, Jeff Davis County (Cheatum).

GALBA HUMILIS (Say) var. MODICELLA (Say)

Limnaea humilis, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 313.

Limnaea modicella, Singley, 1893, Idem, p. 313.

Fort Clark, Kinney County (Mearns). Wild Horse Creek, Big Spring, Howard County; Hardeman County (Cummins) ; Pleistocene. Southern Texas (Pilsbry).

GALBA OBRUSSA (Say)

Limnaea desidiosa, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 313.

McLennan County (Strecker). Leon Creek in Bexar County (Askew (Singley)). Comal Creek, New Braunfels, Comal County; Colorado River and tributaries in Travis County (Singley).

GALBA PALUSTRIS (Müller)

Limnaea palustris, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 313.

Limnaea tryoniana, Singley, 1893, Idem, p. 314.

No Recent specimens from Texas (Baker). Tule Canyon, Swisher County; Kiowa Peak, Stonewall County (Cummins (Singley)). Pleistocene.

GALBA REFLEXA (Say)

Limnaea reflexa, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 313.

This species is recorded by Singley from a Pleistocene deposit in Robertson County (collected by Kennedy). Baker makes the following comment on these specimens: "Kennedy's record from the Brazos River valley, Robertson County, Texas, needs confirmation, as *reflexa* has not been authentically reported south of Illinois."

Family PLANORBIDAE

PLANORBIS ANTROSUS Conrad

Planorbis bicarinata, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 5, pp. 186, 187, pt. 10, p. 314.

Nueces River (Ferriss). Somervell County (Sterki). Fort Clark, Kinney County (Mearns). McLennan County (Strecker). Pedernales River in Gillespie County (Askew (Singley)). Brushy Creek in Williamson County (Walker (Singley)). Guadalupe River and tributaries in Comal County; San Marcos River in Hays County; Colorado River and tributaries in Travis County; San Antonio River in Bexar County; Burton, Washington County (Singley). Stonewall, Howard, and Hardeman counties (Cummins (Singley)). Pleistocene.

PLANORBIS CARUS Pilsbry and Ferriss

Planorbis carus Pilsbry and Ferris, 1906, Proc. Acad. Nat. Sci. Philadelphia, vol. 58, p. 164, pl. 9, figs. 4, 5.

The type locality is the canyon of Pecos River above High Bridge, Val Verde County; Rio San Felipe, Devils River; Sinking Springs near San Marcos, Hays County; Guadalupe River, Comal County (Pilsbry and Ferriss). Devils, Pecos, Nueces river drift (Ferriss). Somervell County (Sterki).

PLANORBIS CULTRATUS d'Orbigny

Planorbis cultratus, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 314.

Hidalgo County (Singley). Devils River, Val Verde County (Pilsbry and Ferriss). Brownsville, Cameron County (Ferriss, Camp's specimens).

PLANORBIS DILATATUS Gould

Planorbis dilatatus, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 314.

Guadalupe River in Victoria County (Mitchell). Nueces River drift (Ferriss). Pond in Greenwood Cemetery in Houston, Harris County (Westgate (Singley)). Colorado River drift at Columbus, Colorado County (Sterki (Singley)). Guadalupe River in Comal County (Singley).

PLANORBIS EXACUOUS Say[2]

Planorbis exacutus, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 314.

Swisher County (Cummins (Singley)).

PLANORBIS LENTUS Say

Planorbis lentus, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 314.

Staked Plains at Crosbyton, Crosby County (Walker). North Fork of Wichita River south of Dundee, Archer County; Piedroso Creek north of Amarillo, Potter County (Case (Walker)). Ellis County (Cheatum and Burt). "Common in all of the (Texas) streams that have been explored" (Singley). Pleistocene deposits in the Staked Plains region (Cummins (Singley)). Scenic drive one mile northwest of Fort Davis; Limpia and Musquiz canyons, Jeff Davis County (Cheatum).

PLANORBIS LIEBMANNI Dunker

Planorbis liebmanni, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 314.

Devils and Nueces river drift (Ferriss). Ellis County (Cheatum and Burt). Fort Clark, Kinney County (Mearns). McLennan County; Guadalupe River in Comal County (Strecker). Rancho Los Fresnos

[2] Because of fundamental anatomical differences, this species is now placed by Frank Collins Baker in the genus *Menetus* (American Midland Naturalist, vol. 16, p. 271, 1935) Editor.

in Cameron County; Pedernales River in Gillespie County; Leon Creek in Bexar County (Askew (Singley)). Comal Creek, New Braunfels, Comal County; pond in Hidalgo County (Singley). Tributaries of Colorado River in Travis County (Singley, Strecker).

PLANORBIS PARVUS Say

Planorbis parvus, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 314.

Salt Fork of Red River in drift, Armstrong County; McLennan County (Strecker). Amarillo, Potter County (Henderson). Somervell County; Colorado River at Columbus, Colorado County (Sterki). Eight miles southeast of Aspermont, Stonewall County (Case (Walker)). Ellis County (Cheatum and Burt). Swisher and Stonewall counties (Cummins (Singley)). Pleistocene.

PLANORBIS TRIVOLVIS Say

Pl. II, figs. 1, 2

Planorbis trivolvis, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 314.

Nueces River (Ferriss). A lake in Jackson County; Spring Creek and Traylor Lake in Victoria County (Mitchell). Fort Clark, Kinney County (Mearns). McLennan County (Strecker). Stonewall County (Cummins (Singley)). Pleistocene.

PLANORBIS TUMIDUS Pfeiffer

Planorbis tumidus, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 314.

Walker (1918) claims that *Planorbis caribaeus* d'Orbigny has priority over *P. tumidus.*

Tank on Lutrell ranch in Armstrong County; Blanco River in Hays County; McLennan and Falls counties (Strecker). Las Moros Creek in Kinney County; Rio Grande near El Paso in El Paso County (Mearns (Dall)). Creek near San Antonio in Bexar County (Quillin). Fort Clark, Kinney County (Mearns). Devils River (Stearns). Rancho Los Fresnos, Cameron County (Askew (Singley)). Lampasas County (Mrs. Sinks (Singley)). Tributaries of the Colorado River in Travis County (Singley).

SEGMENTINA HAVANENSIS (Pfeiffer)

"This species is said to have been collected by Dr. F. Roemer in Texas, the locality not given. I have not seen it" (Singley, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 315, 1893).

SEGMENTINA OBSTRUCTA (Morelet)

Segmentina armigera, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 315.

"Occurs abundantly in Texas as far north as Austin" (Pilsbry). Brownsville, Cameron County (Ferriss, Camp's specimens). Live Oak

County (Vanatta). Devils and Nueces river drift (Ferriss). Eight miles southeast of Aspermont, Stonewall County (Case (Walker)).

Family PHYSIDAE

PHYSA ANATINA Lea

Ellis County (Cheatum and Burt). Pot-holes in Limpia, Musquiz, and Fern canyons; reservoir just northwest of Fort Davis, Jeff Davis County (Cheatum).

PHYSA AMYGDALUS G. B. Sowerby

Physa amygdalus Geo. B. Sowerby, Jr., 1873, Conchologia Iconica, vol. 19, pl. 8, sp. 63. Physa.

Type locality, "Texas, North America".

PHYSA CRANDALLI Baker

Middle Bosque River in McLennan County (Strecker; identified by Bryant Walker).

PHYSA FORSHEYI Lea

Physa forsheyi Lea, 1864, Proc. Acad. Nat. Sci. Philadelphia, p. 114.

Physa forsheyi, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 312.

The type locality is at Rutersville, Fayette County (Forshey). Stroud's Branch, Cooke County (Ragsdale (Singley)). Ponds and streams in Lee County (Singley). Armstrong and McLennan counties (Strecker). Piedroso Creek north of Amarillo, Potter County (Case (Singley)). North Fork Little Wichita River south of Dundee, Archer County (Case (Walker)). Eight miles southeast of Aspermont, Stonewall County (Walker).

PHYSA GYRINA Say

Spring near forks of Navidad and Lavaca rivers, Jackson County (Mitchell, who listed it as *P. heterostropha,* dwarf variety; identified as *P. gyrinus* by Crandall). Piedroso Creek north of Amarillo, Potter County (Case (Walker)). Tank in Hubbard City, Hill County (Askew (Singley)). Brazos River in Fort Bend County (Singley). Brownsville, Cameron County (Camp).

PHYSA HALEI Lea

Physa halei, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 312.

Ellis County (Cheatum and Burt). Balcone's Creek in Kendall County; Pedernales River in Gillespie County (Askew (Singley)). Ponds and streams in Bexar, Hays, and Comal counties.

PHYSA HETEROSTROPHA (Say)

Physa heterostropha, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 5' p. 188, pt. 10, p. 312.

Rio Grande at Eagle Pass, Maverick County; Sabine River in Hunt County (Askew (Singley)). Reeves, Ward, and Smith counties

(Askew). Tule Ranch, Swisher County; Stonewall and Hardeman counties; Pleistocene (Cummins (Singley)). Colorado River and tributaries in Travis County; Clear Lake in Fort Bend County; brackish pond in Galveston County (Singley).

PHYSA MEXICANA Philippi

Pl. III, figs. 3, 4

Physa mexicana, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 312.

McLennan County; Rush Creek in Armstrong County (Strecker). Corpus Christi, Nueces County (Singley). Fort Worth, Tarrant County; Fort Clark, Kinney County (Mearns (Dall)).

PHYSA MEXICANA Philippi var. CONOIDEA Fischer and Crosse

McLennan County (Strecker); identified by Bryant Walker.

PHYSA OSCULANS Haldeman

Physa osculans, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 313.

Includes *P. mexicana,* according to Fischer and Crosse, Pilsbry, and von Martens (see Walker, 1918). Fort Clark, Kinney County (Mearns). McLennan County (Strecker). Del Rio, Val Verde County (Stearns).

PHYSA SAYII Tappan

Physa sayii, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 312.

West Yegua Creek, Lee County (Singley).

BULIMUS BERLANDIERIANUS W. G. Binney

Bulinus berlandierianus, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 313.

"Texas, in the vicinity of Matamoros" (Binney).

Family ANCYLIDAE

FERRISSIA PARALLELA (Haldeman)

Ancyclus parallelus, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 5. p. 187, pt. 10, p. 315.

Pecos River in Ward County (Askew (Singley)).

FERRISSIA TARDA (Say)

Ancyclus tardus, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 315.

Tule Canyon, Swisher County (Cummins (Singley)). Subfossil.

FERRISSIA EXCENTRICA (Morelet)

Ancyclus excentricus, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 315.
Ancyclus excentricus, Baker, 1906, Nautilus, vol. 17, p. 27.

Comal Creek, New Braunfels, Comal County; Barton Creek, Travis County (Walker, Pilsbry, Singley).

FERRISSIA KIRKLANDI (Walker)

Comal Creek, New Braunfels, Comal County (Pilsbry and Ferriss). Garcitas Creek and Guadalupe River in Victoria County (Mitchell (Pilsbry and Ferriss)).

GUNDLACHIA HJALMARSONI Pfeiffer

Rio Grande drift at Brownsville, Cameron County (Clapp).

Family VIVIPARIDAE

VIVIPARUS SUBPURPUREUS (Say)

Vivipara subpurpurea, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 311.

Caddo Lake in Harrison County (Vaughan (Singley)). Houston, Harris County (Kennedy (Singley)). Subfossil. Artesian well in Galveston, Galveston County (Gwyn). Sulphur River in Bowie County (Strecker and Williams).

CAMPELOMA LEWISII Walker

Campeloma lewisii Walker, 1915, Nautilus, vol. 28, pp. 126–127, pl. 5, fig. 3.
Campeloma decisa Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 311.

Sabine River in Shelby County; Village Creek in Hardin County (Askew (Singley)). Caddo Lake in Harrison County (Vaughan (Singley)). Sulphur River in Bowie County (Strecker and Williams).

Family VALVATIDAE

VALVATA TRICARINATA Say

Valvata tricarinata, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 5, p. 187, pt. 10, p. 312.

Tule Canyon, Swisher County (Cummins (Singley)). Subfossil.

VALVATA GUATAMALENSIS Morlet

Fort Clark, Kinney County (Mearns).

Family AMNICOLIDAE

AMNICOLA COMALENSIS Pilsbry and Ferriss

Amnicola comalensis Pilsbry and Ferriss, 1906, Proc. Acad. Nat. Sci. Philadelphia, vol. 58, p. 171, text fig. 37.

The type locality is Comal Creek near New Braunfels, Guadalupe River four miles above New Braunfels, Comal County (Pilsbry and Ferriss).

AMNICOLA PERACUTA Pilsbry and Walker

Amnicola peracuta Pilsbry and Walker, 1889, Proc. Acad. Nat. Sci. Philadelphia, p. 88, pl. 3, fig. 20.

Amnicola peracuta, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 312.

The type locality is at Spivey's Lake, Navarro County. McLennan County (Strecker). Fort Clark, Kinney County (Mearns). Comal County; Colorado River and tributaries in Travis County; Long Lake in Anderson County; Galveston, Galveston County (Singley). White Oak Bayou in Houston, Harris County (Askew (Singley)).

PALUDESTRINA DIABOLI Pilsbry and Ferriss

Paludestrina diaboli Pilsbry and Ferriss, 1906, Proc. Acad. Nat. Sci. Philadelphia, vol. 58, p. 170, text fig. 36.

The type locality is drift debris on Devils River about four miles from its mouth; also Rio San Filipe near Del Rio, Val Verde County (Pilsbry and Ferriss). Somervell County (Sterki).

PALUDESTRINA PROTEA (Gould)

Nueces River drift (Ferriss).

PALUDESTRINA SEEMANNI (Frauenfeld)

Nueces river drift (Ferriss).

POTAMOPYRGUS SPINOSUS (Call and Pilsbry)

Pyrgulopsis spinosus Call and Pilsbry, 1893, Proc. Davenport Acad. Nat. Sci., vol. 5, p. 14, pl. 2, figs. 17–19.

Hydrobia texana Pilsbry, 1893, Idem, p. 33, pl. 3, figs. 1–6. Type locality, Guadalupe River and Comal Creek, Comal County. This is the non-carinate form of the species.

Hydrobia texana, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 312.

The type locality is Comal Creek, Comal County.

POTAMOPYRGUS CHEATUMI Pilsbry

Phantom Lake, about four and one-half miles southwest of Toyahvale, Reeves County (Cheatum).

COCHLIOPA TEXANA Pilsbry

Phantom Lake, about four and one-half miles southwest of Toyahvale, Reeves County (Cheatum).

COCHLIOPA RIOGRANDENSIS Pilsbry and Ferriss

Cochliopa riograndensis Pilsbry and Ferriss, 1906, Proc. Acad. Nat. Sci. Philadelphia, vol. 58, p. 171, pl. 9, figs. 10–13.

The type locality is Rio San Felipe near the Rio Grande in Val Verde County (Pilsbry and Ferriss). Devils, Pecos, and Nueces rivers.

HORATIA MICRA (Pilsbry and Ferriss)

Valvata micra Pilsbry and Ferriss, 1906, Proc. Acad. Nat. Sci. Philadelphia, vol. 58, p. 172, pl. 9, figs. 7–9.

The type locality is drift on Guadalupe River about four miles above New Braunfels, Comal County (Pilsbry and Ferriss).

HORATIA MICRA (Pilsbry and Ferriss) var. NUGAX (Pilsbry and Ferriss)

Valvata micra nugax Pilsbry and Ferriss, 1906, Proc. Acad. Nat. Sci. Philadelphia, vol. 58, p. 173, pl. 9, fig. 6.

The type locality is on Guadalupe River near New Braunfels, Comal County.

GONIOBASIS COMALENSIS Pilsbry

Pl. III, figs. 19, 20

Goniobasis comalensis Pilsbry, 1890, Nautilus, vol. 4, p. 49.

Goniobasis pleuristriata, Singley, 1893, Geol. Survey Texas, 4th Ann. Rpt., pt. 10, p. 311.

Goniobasis comalensis, Singley, 1893, Idem, p. 312.

Goniobasis comalensis, Pilsbry, 1906, Proc. Acad. Nat. Sci. Philadelphia, vol. 58, p. 167, text figs. 24–28.

The type locality is Comal Creek at New Braunfels, Comal County; also on Guadalupe River, Comal County; San Marcos River at San Marcos, Hays County (Pilsbry and Ferriss). San Marcos, Hays County (Singley, Strecker). Helotes Creek in Bexar County (Walker, Wetherby).

GONIOBASIS COMALENSIS Pilsbry var. FONTINALIS Pilsbry and Ferriss

Goniobasis comalensis form *fontinalis* Pilsbry and Ferriss, 1906, Proc. Acad. Nat. Sci. Philadelphia, vol. 58, p. 169, text figs. 32–35.

The type locality is at a small spring that feeds Comal Creek in New Braunfels, Comal County.

BIBLIOGRAPHY[3]

Baker, Frank Collins, The *Lymnaeidae* of North and Middle America, recent and fossil: Chicago Acad. Sci., Special Publication No. 3, pp. i–xvi, 1–539, pls. 1–57, 1911.

Bartsch, Paul, The urocoptid mollusks from the mainland of America in the collection of the U. S. National Museum: Proc. U. S. Nat. Mus., vol. 31, pp. 109–160, 3 pls., 1907.

Binney, W. G., Land and fresh-water shells of North America; Pt. II, Pulmonata, Limnophila, and Thallasophila: Smithsonian Misc. Coll., No. 143, pp. 1–161, Sept., 1865.

———— Land and fresh-water shells of North America; Pt. III, *Ampullaridae, Valvatidae, Viviparidae,* etc.: Smithsonian Misc. Coll., No. 144, pp. 1–120, Sept., 1865.

———— The terrestrial air-breathing mollusks of the United States and adjacent territories of North America (vol. 5): Bull. Mus. Comp. Zool., Harvard College, vol. 4, pp. 1–439, pls. 1–16, 1878.

———— A manual of American land shells: U. S. Nat. Mus., Bull. 28, pp. 1–528, 1885.

Brown, A. D., Description of two new species of *Helix:* Proc. Acad. Nat. Sci. Philadelphia, p. 333, 1861.

Call, R. E., and Pilsbry, Henry A., On *Pyrgulopsis,* a new genus of rissoid mollusk, with descriptions of two new forms: Proc. Davenport Acad. Nat. Sci. for 1885–1889, vol. 5, pp. 9–14, pl. 2, 1893.

Cheatum, Elmer P., and Burt, Charles E., An annotated list of the snails of Ellis County, Texas: Amer. Midland Naturalist, vol. 12, pp. 329–340, 1931.

———— An annotated list of the snails of Dallas County, Texas: Field and Laboratory, vol. 2, pp. 1–8, 1933; pp. 43–52, 1934.

Cheatum, Elmer P., Gastropods of the Davis Mountains vicinity in west Texas: Nautilus, vol. 48, pp. 1–4, pl. 5, 1935.

Clapp, G. H., *Gundlachia hjalmarsoni* Pfr. in the Rio Grande, Texas: Nautilus, vol. 27, pp. 77–78, 1913.

———— *Bulimulus schiedeanus* (Pfr.) in Texas: Nautilus, vol. 28, p. 132, 1915.

———— *Vitrea cryptomphala* n. sp., with notes on the *indentata* group: Nautilus, vol. 29, pp. 25–28, 1915.

Clench, William J., and Rehder, H. A., A new *Humboldtiana* from Texas: Nautilus, vol. 44, pp. 10–13, pl. 2, 1930.

Cockerell, T. D. A., Notes on the *indenta* group of *Vitrea:* Nautilus, vol. 12, p. 120, 1899.

———— An arboreal *Polygyra:* Nautilus, vol. 31, p. 36, 1917.

———— An apparently extinct *Euglandina* from Texas: Proc. Colorado Mus. Nat. Hist., vol. 9, No. 5, pp. 52–53, text fig., Dec. 16, 1930.

Dall, W. H., On a new species of *Holospira* from Texas: Nautilus, vol. 8, p. 112, 1895.

———— Report of the mollusks collected by the International Boundary Commission of the United States and Mexico, 1892–1894: Proc. U. S. Nat. Mus., vol. 19, art. 1111, pp. 333–379, pls. 31–33, 1897.

———— On a new *Holospira* from Texas: Nautilus, vol. 11, p. 39, 1897.

[3] Only the publications that contain definite Texas locality records are listed.

——— Illustrations and descriptions of new, unfigured, or imperfectly known shells, chiefly American, in the U. S. National Museum: Proc. U. S. Nat. Mus., vol. 24, art. 1264, pp. 499–566, pls. 27–40, 1902.

Ferriss, James H., In search of *Polygyra pilsbryi:* Nautilus, vol. 14, pp. 25–31, 1900.

——— Notes: Nautilus, vol. 27, pp. 134–136, 1914.

——— *Rumina decollata* in Texas: Nautilus, vol. 28, p. 11, 1914.

——— On the Rio Grande: Nautilus, vol. 38, pp. 37–43, 1924.

——— A new Texas *Bulimulus:* Nautilus, vol. 39, pp. 24–25, 1925.

Henderson, Jr., J. B., Lists of mollusks from Amarillo, Texas: Nautilus, vol. 22, p. 9, May, 1908.

Lea, Issac, Descriptions of 24 new species of *Physa* of the United States and Canada: Proc. Acad. Nat. Sci. Philadelphia, pp. 114–116, 1864.

Mearns, Edgar Alexander, Mammals of the Mexican boundary of the United States: U. S. Nat. Mus. Bull. 56, p. 77, 1907. (Contains list of Mollusca collected in the vicinity of Fort Clark, Kinney County, Texas.)

Mitchell, J. D., List of Texas Mollusca, land and fresh water: Natural Science News, vol. 1, p. 40, 1895.

——— General Notes: Nautilus, vol. 12, p. 144, 1899.

Pilsbry, H. A., New and little known molluscs: Proc. Acad. Nat. Sci. Philadelphia, pp. 81–89, pl. 3, 1889.

——— Description of a new *Hydrobia,* with notes on other Rissoidae: Proc. Davenport Acad. Nat. Sci., vol. 5, pp. 33–34, 1885–1889 (1893).

——— Notices of new species and varieties of American land shells: Nautilus, vol. 12, pp. 23, 24, 1898.

——— Remarks on the American species of *Conulus:* Nautilus, vol. 12, pp. 111–117, 1899.

——— New species and subspecies of American land snails: Nautilus, vol. 13, pp. 114–115, 1900.

——— Notices of new American snails: Nautilus, vol. 14, pp. 40–41, 1900.

——— New American land shells: Nautilus, vol. 16, pp. 30–33, 1902.

——— Two new American land shells collected by Messrs. Hebard and Rehn: Nautilus, vol. 26, pp. 88–90, 1912.

——— The structure and affinites of *Humboldtiana* and related helicid genera of Mexico and Texas: Proc. Acad. Nat. Sci. Philadelphia, vol. 79, pp. 165–192, pls. 11–14, text figs. 1–14, 1927.

——— Helices from California and Texas and a Zonitid from Virginia: Nautilus, vol. 41, pp. 81–83, 1928.

Pilsbry, H. A., and Ferriss, J. H., Mollusca of the southwestern states; pt. II: Proc. Acad. Nat. Sci. Philadelphia, vol. 58, pp. 123–175, pls. 5–9, text figs. 1–37, 1906.

——— Mollusca of the Ozarkian fauna: Proc. Acad. Nat. Sci. Philadelphia, vol. 58, pp. 529–567, pls. 20–22, text figs. 1–5, 1906.

Pilsbry, H. A., and Johnson, C. W., A classified catalogue with localities of the land shells of America north of Mexico: pp. 1–35, Philadelphia, 1898.

Sampson, F. A., Notes on the distribution of shells; pt. II, Shells of Fort Worth, Texas: Kansas City Review of Science and Industry, vol. 5, pp. 681–682, 1882.

Singley, J. A., List of Pleistocene and Recent shells: in "Notes on the Geology of Northwest Texas", by W. F. Cummins, Geol. Survey Texas, Fourth Ann. Rpt., pt. 5, pp. 186–190, 1893.

——— Contributions to the natural history of Texas; pt. I, Texas Mollusca: Geol. Survey Texas, Fourth Ann. Rpt., pt. 10, pp. 297–343, 1893.

Stearns, R. E. C., List of North American land and fresh-water shells received from the U. S. Department of Agriculture with notes and comments thereon: Proc. U. S. Nat. Mus., vol. 14, pp. 95–106, 1891.

Sterki, V., Preliminary list of North American *Pupidae* (north of Mexico): Nautilus, vol. 6, pp. 2–8, 1892.

——— Drift shells from Texas: Nautilus, vol. 25, pp. 115–117, 1912.

Strecker, Jr., John K., The Mollusca of McLennan County, Texas: Nautilus, vol. 22, pp. 63–67, 1908.

——— *Agriolimax agrestris* Linn. at Waco, Texas: Nautilus, vol. 24, pp. 3–4, 1910.

——— Notes on land shells from Matagorda Peninsula, Texas: Nautilus, vol. 24, pp. 4–6, 1910.

——— Notes on the fauna of a portion of the canyon region of northwestern Texas: Baylor Univ. Bull., vol. 13, Nos. 4–5, p. 31, 1910.

——— Edible-snail colony at Waco: Contrib. Baylor Univ. Mus., No. 18, pp. 10–11, 1929.

——— Notes on the eggs of *Euglandina singleyana* (W. G. Binney): Contrib. Baylor Univ. Mus., No. 18, p. 12, 1929.

Vanatta, E. G., A new species of Zonitoides: Proc. Acad. Nat. Sci. Philadelphia, p. 524, text fig., 1899.

——— Shells from Live Oak County, Texas: Nautilus, vol. 42, p. 66, 1928.

Walker, Bryant, Notes on eastern American *Ancyli:* Nautilus, vol. 17, pp. 25–31, 1903.

——— Notes on Planorbis; pt. II, *P. bicarinatus:* Nautilus, vol. 23, p. 27, 1909.

——— A list of shells collected in Arizona, New Mexico, Texas, and Oklahoma by Dr. E. C. Case: Univ. Michigan Mus. Zool., Occasional Papers, No. 15, pp. 1–11, 1915.

——— On *Paludina coarctata* and *incrassata* Lea: Nautilus, vol. 28, pp. 121–127, pl. 5, fig. 3, 1915.

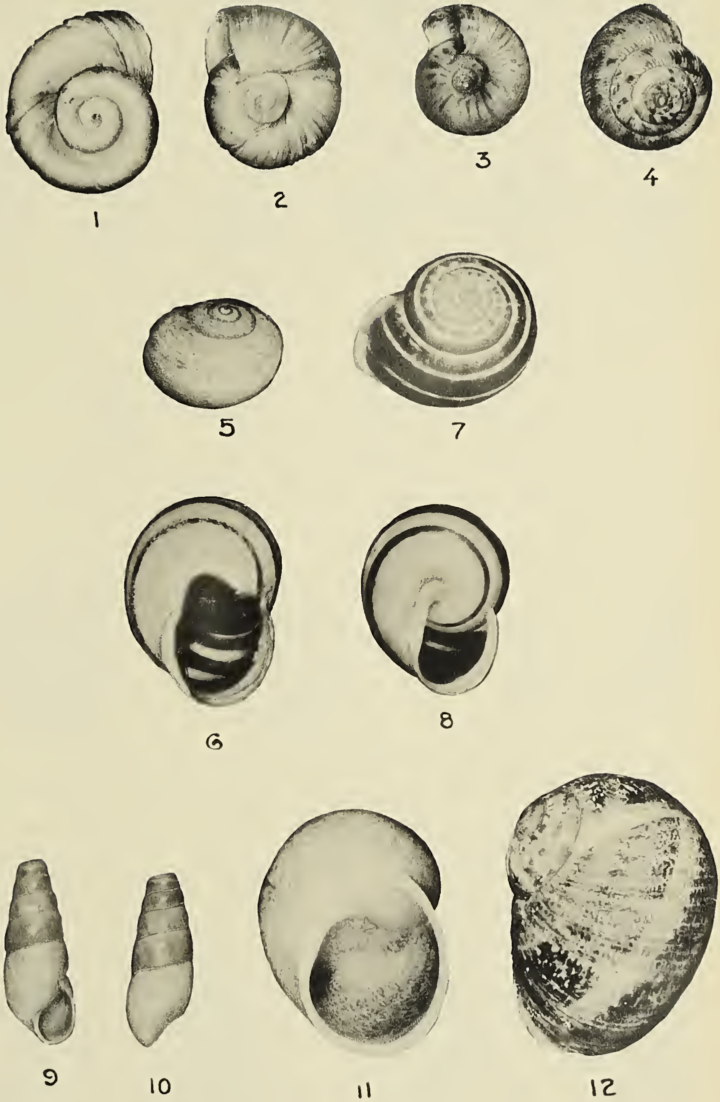
——— A synopsis of the classification of the fresh-water Mollusca of North America, north of Mexico, and a catalogue of the more recently described species, with notes: Univ. Michigan Mus. Zool., Misc. Pub., No. 6, pp. 1–213, 1918.

DESCRIPTIONS OF PLATES

PLATE II

PLATE III

(All figures are approximately natural size)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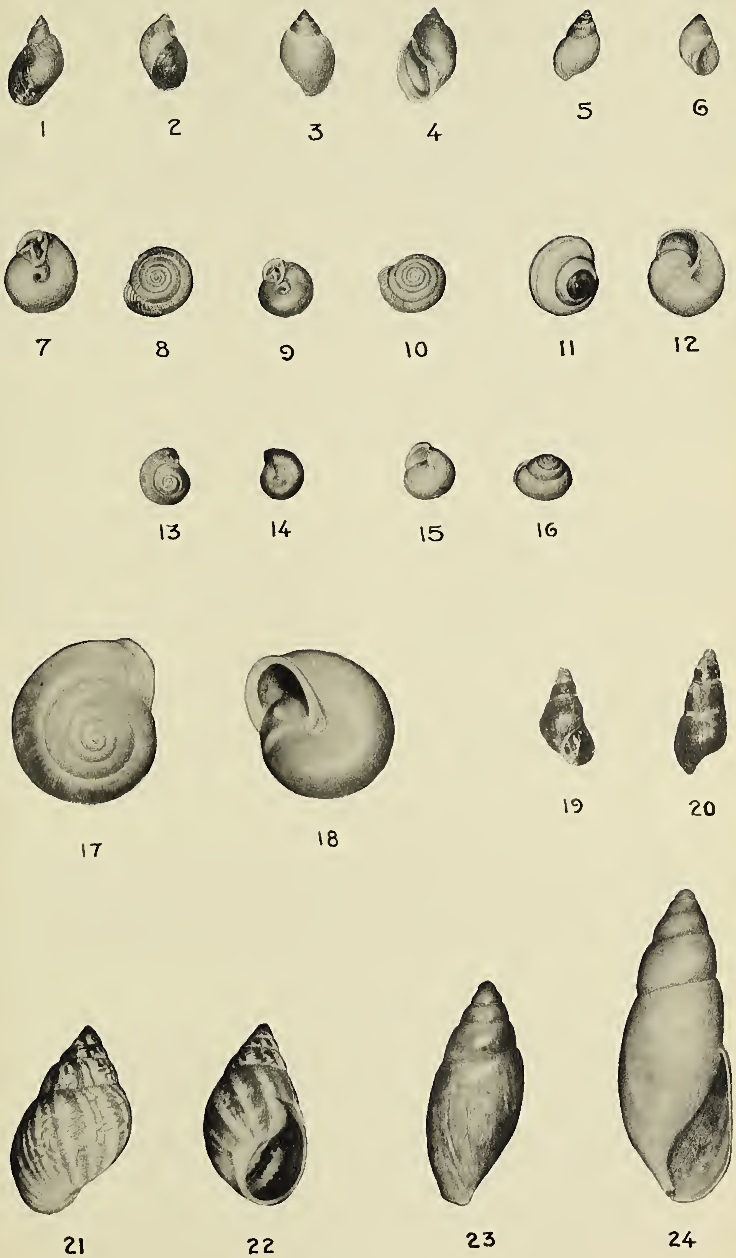
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PROCEEDINGS
of the
TEXAS ACADEMY OF SCIENCE

Annual Meeting, October 20, 21, 1933

The annual fall meeting of the Texas Academy of Science was held at Baker Hotel, Dallas, Texas, Friday and Saturday, October 20 and 21, 1933, E. N. Jones, President, presiding. Four members were raised to the rank of Fellow, and officers for the coming year were elected. A program of excellent papers filled the two days. Friday evening Dr. R. T. Hill, pioneer geologist, geographer, and early member of the Academy, was the guest of honor and received a certificate of Life Membership. Dr. A. C., Noé, Professor of Paleobotany, University of Chicago, delivered the main address, "Plant Life of the Past", and showed a very fine series of lantern slides. Saturday morning three educational moving pictures of sound films, prepared by the University of Chicago, were shown: "Electrostatics", "Molecular Theory", and "Oxidation and Reduction".

Officers elected for 1933–1934.—B. C. Tharp, President; J. C. Burr, Executive Vice-President; J. C. Godbey, Vice-President section 1; Mayne Longnecker, Vice-President section 2; W. J. McConnell, Vice-President section 3; Gayle Scott, Vice-President section 4; F. A. Burt, Secretary-Treasurer; S. W. Bilsing, representative A.A.A.S. Council.

Fellows elected.—Mayne Longnecker, J. G. Burr, Mrs. Augusta H. Kemp, and Miss Jet C. Winters.

Report of the Treasurer.—The following report for the period from October 31, 1932, to October 20, 1933, was presented:

EXPENSES

Expenses of Houston meeting (Dec. 10, 1932)	$ 10.00
Printing and mailing Vol. 15	209.35
Expenses, Strecker death and memorial	22.92
Expenses College Station meeting	5.60
Printing and mailing Vol. 16	359.73
Interest on indebtedness to A. J. Kirn	24.00
	$631.60

RECEIPTS

Cash on hand (Oct. 31)	$226.47
Received from A.A.A.S	64.50
From J. K. Strecker's friends	22.92
Donations to aid College Station Meeting	5.00
Sale of 50 copies Vol. 16	30.00
Dues	245.00
Entrance fees	6.00
Old publications	58.21
	$658.10

STATEMENT

Receipts	$658.10
Expenses	631.60
Balance	$ 26.50

Papers presented.—The following papers were presented during Friday and Saturday of this meeting. A few of these will be selected for publication in the Transactions of the Texas Academy of Science, and others will be published elsewhere:

BIOLOGICAL SCIENCES

The zonation of intertidal organisms in selected areas of the Pacific coast; by W. G. Hewatt, Texas Christian University.

Development of the posterior cardinal veins in relation to the swim bladder in *Lepidosteus;* by G. E. Potter and J. Teague Self, Baylor University.

"Stinging asps" in Dallas in 1933; by O. C. Charlton, Dallas.

The colonial bryozoan, *Pectinatella magnifica* Leidy, as an epidemic river pest; by S. W. Geiser, Southern Methodist University.

1933 trapping studies of Texas Orthoptera; by F. B. Isely, Trinity University.

The beach as a habitat; bv J. K. G. Silvey, McMurry College.

Parasitology in Texas; by Asa C. Chandler, Rice Institute.

New and little-known insects; by H. B. Parks, San Antonio.

The ability of fresh-water fish to extract oxygen at different hydrogen-ion concentrations; by A. W. Wiebe.

The explorations in Texas of Jean Berlandier; by S. W. Geiser, Southern Methodist University.

Root systems of some native plants of west Texas; by E. L. Reed, Texas Technological College.

Census of Texas ferns and flowering plants; by Geo. L. Fisher, Houston.

Growth phenomena and unusual anatomical features of American mistletoe; by S. R. Warner, Sam Houston State Teacher's College.

The coastal sand dunes in Texas; by B. C. Tharp, University of Texas.

AGRICULTURAL SCIENCES

The genetic viewpoint in the breeding of dairy cattle; by W. R. Horlacher, A. & M. College.

Alkali in some Texas soils and its significance; by L. G. Jones, A. & M. College.

Diseases of cultivated bluebells; by J. J. Taubenhaus and W. N. Ezekiel, A. & M. College.

An improved technique for the emasculation and bagging of cotton flowers; by Clifton C. Doak, A. & M. College.

Hybridization and species relationships in the genus *Nicotina;* by F. A. McCray, Sam Houston State Teacher's College.

The evolution of the cone scale in Pinus; by Clifton C. Doak, A. & M. College.

Some insect problems in Texas; by F. L. Thomas, A. & M. College.

Some problems of plant diseases in Texas; by J. J. Taubenhaus, A. & M. College.

MEDICAL SCIENCES

A comparison of the types of dysentery bacilli observed in an epidemic of dysentery in Dallas, Texas, particularly in the South; by Sol Haberman, Baylor Medical College.

Relapsing fever in Texas, a summary of the work done up to the present time at Baylor University of Medicine; by Hardy A. Kemp, Baylor Medical College.

PHYSICAL SCIENCES

The gamma rays of radium C; by H. A. Wilson, Rice Institute.

Neutrons; by T. W. Bonner, Rice Institute.

A combination of fine-structure photometer, densitometer, and comparator; by Sidon Harris, University of Texas.

Camphor from cedar leaves; by J. C. Godbey, Southwestern University.

The electromagnet spectrum; by S. LeRoy Brown, University of Texas.

A colloidial mechanism for the formation of gall stones; by H. B. Weiser, Rice Institute.

The relations of mathematics to the natural sciences; by G. C. Evans, Rice Institute.

The production of electrical energy by the living cell and its significance; by E. J. Lund, University of Texas.

GEOLOGICAL AND GEOGRAPHICAL SCIENCES

Notes on the formation of oolite from spray in a water-cooling plant; by Augusta H. Kemp, Seymour High School.

Pennsylvanian glaciation in Brewster County, Texas; by Willard Gill, Baylor University.

Some notes on the fauna of the Pennsylvanian of Parker County, Texas; by George D. Harris, Baylor University.

Progress made on the geology of the Carboniferous in Franklin Mountains; by L. H. Nelson, School of Mines, El Paso.

Geologic reconnaissance of lower Conchos Valley, Chihuahua, Mexico; by W. S. Adkins, University of Texas.

Age of the Midway group with special reference to Texas; by Gayle Scott, Texas Christian University.

Occurrence and origin of the mineral waters of north-central Texas; by F. B. Plummer, University of Texas.

Investigations under way at the Bureau of Economic Geology; by E. H. Sellards, University of Texas.

Geographical centers of origin of cultivated plants of the world; by Elmer H. Johnson, University of Texas.

SOCIAL SCIENCES

The basket-maker Indian; by Mrs. Ellen Schultz Quillin, Witte Museum.

Archeology among the Humanities; by J. E. Pearce, University of Texas.

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CONTENTS

CONTRASTING TRAITS OF CERTAIN WILD ANIMALS OF THE WEST

By J. G. BURR[1]

Looking upward at one of the mountain ranges of the Big Bend area some one made this remark: "Thank God, nobody can turn this into a farm." It was the citadel of a wilderness that could not be taken by agriculture, the home of the exclusive wild animals fond of the privacy of mountain peaks. In choosing a habitat a wild animal is governed by two considerations: food, and safety from its enemies. Crags and declivities afford a protection against pursuit that is more valuable than speed in the open plains. That is probably the reason why the little Sonora deer, *Odocoileus couesi,* has chosen the rugged uplifts of Chisos Mountains and the ranges south and westward. These little creatures, weighing from 50 to 75 pounds range from 5000 feet at the upper edge of the Lower Sonoran zone through Upper Sonoran and Transition to the top of the mountains at 9,000 feet. They are most numerous on the plateau top at 8,500 feet where a steep, 3000-foot slope protects them from most hunters and where the sweet acorns of the little gray oak are abundant (Vernon Bailey, 1905).

Of similar exclusive habits is the mountain sheep or Texas Bighorn, *Ovis canadensis texiana,* which inhabit the Upper Sonoran and Transition zones of the desert ranges of extreme west Texas with other races to the north and west. They are found in the Guadalupe and other mountain ranges. They come into the Grand Canyon of the Rio Grande mainly from the Mexican side, says Vernon Bailey, and continuing he says "most of the ranges are steep, extremely rugged, and barren with deep canyons and high cliffs. Here the sheep find ideal homes on the open slopes of terraced lime rock or jagged crests of old lava dikes, and, thanks to the arid and inaccessible nature of the country, they have held their own against a few hunters of the region." They have enjoyed a continuously closed season since 1903.

Less given to the higher elevations, the mule deer, *Odocoileus hemionus canus,* is found in the United States west of the 100th meridian. It is a creature of the half open, dry hilly country typical of the lower Sonoran desert regions. They choose the high slopes of the mountains in summer, and in winter they return to the lowlands. The mule deer is regarded as one of the most imposing of the Cervidae in appearance. It holds its head and neck erect, and its antlers are much wider than those of the white-tail. "It is a proud spirited, high-headed animal," says Dr. Hornaday, "a bold traveler and like the mountain sheep is often found where the scenery is wild and picturesque." In winter the coat is blue; in summer, reddish. When seen alive the deer appears to be large with immense ears and a white face with a large black patch on the forehead. From behind it shows

[1] Director Public Relations, Game, Fish and Oyster Commission.

an angular whitish patch taking in the tail, which is small and mainly white with a black tip (Seton 1929). The white patch is suggestive of the antelope.

The mule deer is not so swift as the white-tail deer which prefers the level country. When they hurry away from danger it is with leaps and bounds. Their bounding is what lessens their speed. They leap from 15 to 25 feet. Seton speaks graphically of their style. "I watched them bounding along the level bottom-lands, bounding, bounding, oh, it was beautiful, it was glorious, but it was sad: For they were losing time. The greyhounds far behind at first were low, skimming like prairie hawks, were making three yards to the deer's two, were gaining, would surely win. In vain we tried to call the dogs off. On and on the chase. The little ones suffering now—it was a mother doe and her twins. It was a question of barely a quarter mile. Then we riders saw a thing that touched our hearts. The poor, devoted mother, in despair, dropped back behind—deliberately it seemed—at least her young should have a chance, and my blood rushed hot. My hand sought the gun in reckless determination to stop those dogs. Only 25 yards ahead the mother now, when all at once an inspiration came. The unseen prompter whispered wisdom; and the mother turned aside, made for the rugged piling hills so near; she—all three—soon reached their base and tapped with their toes, then rose in the air to land some 15 feet above, and tapped again—and tapped and tapped all three; and so they rose and sailed and soared. The greyhounds reached the rise and there were lost; their kingdom was the level plain; on the rugged hills they were hopeless, balked and left behind. But the mother and her two went bounding, soaring like hill-hawks, and so they sailed away till hidden in the heights and safely at peace. That day I learned the meaning of the bounding. These are the deer of the broken lands; theirs is the way of the uplands; this pace is their gift, their power, and their hold on life."

Mearns (1907) says "the fawns made gentle pets, fawning like dogs on those they knew and climbing upon one to be petted. They like to rub their heads against those whom they knew well but would butt and kick vigorously if strangers tried to pick them up or carry them." Owing to the gentleness or stupidity of the mule deer and the openness of the country that it occupies, this fine deer is perhaps doomed to an early extinction, says Mearns. In recent years their dwindling numbers in the trans-Pecos brought a shortening of the open season down to two weeks and one buck to the season. Again quoting Mearns, "no wild animal of the region is so valuable to man as this deer, especially to the Indians whom it supplied with meat, clothing, shelter, and numerous utensils made from its skin, tendons, or skeleton. Its charred bones and various tools fashioned from the bones and teeth were usually found in the deserted buildings and cave dwellings formerly occupied by the extinct people known as the Cliff Dwellers, in the

Verde Valley of Arizona." That the mule deer is a creature of the high elevations became evident when an effort to stock them in Kerr County was made a few years ago. Several importations were made from the Kaibab forest of Arizona, but all died in a few months from hemorrhagic septisemia.

The tactics of the mule deer contrast widely with those of the antelope, *Antilocapra americana americana,* whose original range was over most of the states west of the Mississippi, but now limited to scattered areas. They are an animal of the open plains, though they are driven by winter weather into the shelter of the woodlands. There are perhaps 2000 in Texas mostly in the extreme west and a few in Jim Hogg County. It is estimated that at one time the antelope was more numerous than the buffalo, between 30 and 40 million, not that their herds were so large, but because the area occupied was so much greater than that of the buffalo.

State law had to come to the rescue of the antelope in 1903 to avert extinction, and there has been no open season since. The fleetest of all wild animals, the safest from all his natural enemies, he could not protect himself from man. With his keen eyes to discover danger and the certainty that he could out-run any pursurer, the antelope had a great sense of curiosity which was his undoing. A hunter could lie down on the ground and wave a handkerchief to and fro and cause the animal to approach within firing range. They would sometimes trot towards the object and run away, then overcome by curiosity, return for a closer inspection. But it is said they overcome this curiosity to a great extent when the ruse was practiced too often. Their habit is to see everything with those keen eyes, thus they prefer the open spaces and will invariably see a man before they are seen. The antelope is equipped with a heliograph by which he can transmit the danger signal to his fellows, and this habit of seeing everything that is going on makes the heliograph effective. On the buttocks are two white circular patches of hair. According to Seton, under the skin is a circular muscle by means of which the hair can, in a moment, be raised and spread radially into two great blooming chrysanthemums, more or less flattened at the center. When this is done in the bright sunlight, they shine like tin pans, giving flashes of light that can be seen father than the animal itself, affording conspicuous identification mark. At the sight of danger all the long white hairs of the rump-patch are raised with a jerk that makes the patch flash in the sun. Each grazing antelope sees the flash, repeats it instantly and looks in the direction toward which the first was looking. In addition to this there is a musk gland in the center of the disk from which a quantity of musk odor is set free as an additional sign of danger. Both these signals may be also a serving of notice to its attacker that the antelope as such can not be caught, so why bother him. At any rate his shining disks are the reverse of protective colors used by most animals to evade discovery and constitute the highest kind of self-advertisement and an implied boast to come and get me if you can.

In some respects the antelope is a perfect symbol of what a man ought to be. He comes out and faces the world without fear, though he has great caution. His life is such that he has nothing to hide; he defies the world to get him if it can, and he has the fine judgment to fall back in an orderly way in the presence of danger. I once knew a man of great physical strength who boasted that he had never been whipped. He said "You have got to catch a man before you can whip him." The antelope is the perfect example of non-resistance. But his fatal defect was that he had a single-track mind. He was not versatile in self-protection, and he could not survive in great numbers.

The white-tail deer was versatile and highly adaptable to all conditions. He could run, but he preferred to hide. He did not accept that notion of getting out and facing the world. He made his color conform to the seasonal landscape; in summer reddish and in winter slaty. His powers of smelling an enemy is another means of self-preservation. They can doubtless smell a man a mile away when the wind is right, and possibly they could smell some men that far when the wind is not right. I assume that an occasional bath might improve the hunter's success.

Thus, the white-tail has survived and is destined to remain the most useful of the large game. Its range is throughout the United States, except California, Nevada, Utah, and portions of Arizona and New Mexico, extending well up into Canada and over into Mexico and Central America. Seton estimated a few years ago the total white-tails of the United States to number around three quarters of a million. The Texas form, *Odocoileus texanus,* numbers perhaps 50,000 to 75,000. The annual kill in Texas is about 10,000. Seton estimates for the nation a 20-percent annual drain. This is not too low, when we consider that only bucks are shot. White-tail deer in Texas have been increasing during the past 15 years and on certain ranches for longer than that. The white-tail has followed the frontierman into the forest, possibly because his farm furnishes certain forage and also because where live stock is multiplied, the cougar and the wolf, great enemies of deer, subsist more on the young of domesticated animals, thus diminishing the pressure on wild game. A further increase in deer became possible when ranchmen provided watering places in desert areas for their stock, thus extending the deer range and at the same time preventing their concentrations at few waterholes where predators laid in wait.

But the great herds of deer that were once known are no longer possible even if all hunting were stopped. Competition with livestock for food is the insurmountable barrier. Over-pasturage with sheep and goats is the unpardonable crime to all game. Cattle do not so much compete with wild animals. The maximum production of wild game rests with the land owner. Many ranchers of the West and Southwest have converted the nuisance of hunters into revenue by selling hunting rights, and sometimes they make as much money on game as they do on livestock. This is possible because they reap a natural harvest which costs them nothing. Domesticated animals must be cared for and often at considerable expense, and there was of course, the original investment. The wild animal will take care of itself.

We have had much to say about the relative speed of deer and antelope and some exact figures might be more to the point. Capt. R. B. Marcy (1852) in his exploration of the upper Red River says: "The greyhounds have, upon several different occasions, run down and captured the deer and the prairie-rabbits, which are also regarded as very fleet, but although they have had many races with the antelope under favorable circumstances, yet they have never, in one instance, been able to overtake them; on the contrary, the longer the chase has continued the greater has been the distance between them. Our deer have usually been considered the fleetest animal upon the continent after the horse but the pronghorned antelope of the plains is much swifter."

Following is the racing table of some wild animals compared with the race horse, according to Seton.

Race horse, speed for a mile, 34 miles per hour.
Pronghorned antelope, speed for a mile, 32 miles per hour, though there are claims of 43 miles per hour.
Greyhound, 30 miles per hour.
Jack rabbit, 28 miles per hour.
Common fox, 26 miles per hour.
Coyote, 24 miles per hour.
Foxhound, 22 miles per hour.
American gray wolf, 20 miles per hour.

Ancestors of the antelope had four hoofs to the foot, but the back pair have been dropped. Deer, living in swamps, could utilize the little hind or mud hoofs, but antelope, living on the hard, dry upland, had no use for them and they were eliminated by evolution.

As stated in the outset, food and safety from its enemies determines the habitat of the wild animal. With the coming of men both the food and the safety have passed to a large extent from natural to artificial conditions, and man has become the custodian of the future of wildlife.

In Genesis we read that the Creator caused creeping things and beasts to appear on the earth and birds to fly in the firmament above the earth and gave man dominion over them. It is only in recent years that man has begun to make intelligent use of that dominion, and now the journals of the nation are shouting from the housetops the conservation of wild life and the preservation of all useful species.

OLD AND NEW FOSSIL PLANT LOCALITIES IN BEXAR COUNTY AND ADJACENT AREAS

H. B. PARKS[1] and A. J. KIRN[2]

INTRODUCTION

In geological literature on Bexar County a number of plant localities have been recorded. Because of changes that have been made in roads and because of utilization of fossiliferous limestones for road construction, a number of these localities have ceased to exist or can not be located through the aid of modern maps. It is therefore thought best to offer new records of the localities mentioned in literature and to make comment on their present status.

WILCOX GROUP OF STRATA

Earle locality.—This was a group of large, very hard, tightly cemented, gray sandstone concretions lying in the zone of outcrop of middle Rockdale formation, and they formerly lay between Medina River bridge and the town of Earle (now called Florestown) on Highway No. 9, twelve miles south of San Antonio, Bexar County. The plant impressions in these concretions were numerous and quite perfect. This deposit was first described by E. W. Berry from notes made by L. W. Stephenson and Alexander Deussen. Berry lists ten species from here. (Berry, E. W., U. S. Geol. Survey Prof. Paper 91, 1916, and Prof. Paper 132-E, 1924.) Additional collecting by the authors has added thirty species.

The rock near Earle was long thought to be a continuous massive sandstone layer. It was a source of stone for building and for road work for almost three generations. Large amounts of rock were hauled from here for buildings, for road improvement, and for other construction work. The last rock was removed by the San Antonio, Uvalde & Gulf Railroad when it built southward about thirty years ago. At this time the last of the rock was removed, and it was evident that the rock was a local ledge of concretions in softer Tertiary beds. The only rock available from this locality for study at the present time is to be found along the face of the dam of Mitchell Lake and in some few scattered rock fills along Highway No. 9.

Calaveras locality.—This exposure of fossiliferous beds in Wilson County was discovered by Alexander Deussen. It is said to be located five hundred yards east of the San Antonio & Aransas Pass Railroad just north of the city of Calaveras, and from here twelve species are recorded. (Berry, E. W., U. S. Geol. Survey Prof. Paper 91, p. 59, 1916).

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[2] Somerset, Texas.

On account of changes in the course of Calaveras Creek, it has been impossible in recent years to find this fossiliferous deposit.

Elmendorf locality.—C. L. Baker reported to E. W. Berry the occurrence of three species of fossil plants in the clay pit worked by the Star Pottery Company four and one-half miles south of Elmendorf, Bexar County. (Berry, E. W., U. S. Geol. Survey Prof. Paper 131-A, p. 3, 1923.)

The two clay pits referred to are located at the foot of the hill on the south side of San Antonio River four and one-half miles south of Elmendorf. The first and largest is located slightly west of south from the junction of the Borregas road and the old Corpus Christi highway. The other is one-fourth mile south of the Borregas school and store. These clay pits have not been worked for at least twenty years, and as a result all plant material there is very badly weathered. The authors have added two species to the list given by Berry.

Saspamco locality.—This deposit was reported by C. L. Baker from the pit of the San Antonio Sewer Pipe Company which is located near the plant of that company and is to be found about three-fourths of a mile north and east of the town of Saspamco, Wilson County. Mr. Baker remarks that it contains many plant impressions but gives no lists. (Sellards, E. H., Univ. Texas Bull. 1932, June 5, p. 113, 1919.)

This pit is no longer used, and the walls have caved in. The plant-bearing strata have not been relocated.

Pirie locality.—These fossiliferous strata are known only from shallow-well material near the intersection of the new Sutherland Springs road and the Elmendorf-Adkins road, eighteen miles east of San Antonio in the extreme eastern edge of Bexar County. The leaves were said to occur in a clay formation and to be well preserved. No record is given as to the depth of the formation. (Sellards, E. H., Univ. Texas Bull. 1932, p. 58, 1919.)

This well was located, but the materials coming from it had long lost their original form. The owner of the land said that the leaves were found at a depth of about twelve feet. This location is very important, as it gives evidence of the exact location of the Simsboro sands in a section of Bexar County where no recognizable outcrops are available.

Adkins locality.—Mr. L. C. Gass collected a specimen of *Cinnamomum affine* Lesquereux from the fragments of a boulder which had been removed from a field near Adkins, Bexar County. (Ball, O. M., A Contribution to the Paleobotany of the Eocene of Texas; Bull. A. & M. College of Texas, ser. 4, vol. 2, No. 5, p. 63, May 1, 1931.)

This deposit was located, after much inquiry, on the farm of Theodore Dzerzonowski two and one-half miles east of Adkins. This is a typical outcrop of the weathered middle Rockdale boulders, and they were found to contain numerous plant impressions. The deposit consisted of a line of boulders extending along the slope of a hill for over one-half mile. Most of them have been blasted and removed from the fields, the fragments having been used to fill up gullies and for cement work. The only available rock is to be found in the gullies on the farm mentioned and along the road between the farm and Adkins. Twenty-five additional species are now known to occur at this location.

Lytle locality.—This boulder, found in a field about one and one-half miles northwest of Lytle, is amply described in a paper by A. J. Kirn and H. B. Parks (Trans. Texas Acad. Sci., vol. 19, p. 11, 1936). Dr. Berry has recorded thirty-five species, and the authors have added ten additional ones. (Berry, E. W., Jour. Washington Acad. Sci., vol. 19, pp. 39-40, 1929.)

The remainder of this boulder consists of a few blocks of stone lying beside the old Frio City road which runs due west from the north boundary of the city of Lytle. Numerous other boulders are in the same neighborhood, but whether any of these are fossiliferous is a question.

Cassiano locality.—These fossiliferous beds are found on the Cassiano road twelve miles east of San Antonio where the road no longer can be followed because of the very deeply eroded condition of the country. This outcrop consists of an exposure of the middle Rockdale.

	Thickness *Feet*
3. Red clay	----
2. Simsboro sand	8
1. Alternating layers of compact, yellow and sandy clays, containing a lense of steel-blue sandstone similar to those at Adkins, Earle, and Lytle	12

The entire lower 12 feet of the above section is rich in plant remains. The sandstone concretions have been worked only sufficiently to prove that they carry the same impressions as do the others mentioned. The clays have been worked enough to prove that the deposit is very rich in large well-preserved leaves and that these layers extend over considerable area. The leaves in this clay are such that the surface must be coated with some cohesive as soon as the block is exposed to the air. Over forty species are known from this location. This deposit will probably repay the investigator more than any other one in this district. It was discovered by the writer in August, 1933.

Thelma locality.—This locality is found on the Williams farm at the right hand of Highway No. 9 about a mile and one-half east of

Thelma and one hundred yards up the hill from the road, Bexar County. It consists of layers of white, compact sand carrying very delicate impressions of many kinds of plants. Owing to the softness of the layers it is very hard to work. This location was discovered in 1934.

CARRIZO FORMATION

F. B. Plummer (Univ. Texas Bull. 3232, pp. 612-619, 1933) in several places makes statements which summed up would indicate that Carrizo plants or plant-bearing strata have not been recorded. These statements have led the authors to make a search for plant remains in this formation.

Senior locality.—One and one-half miles from the old town of Senior, Bexar County, the hard, red, quartzitic member of the Carrizo is exposed. Here in 1933 the authors procured material from which sixteen species of plants have been recognized. In a reconnaissance survey of the Carrizo formation plant remains in varying amounts are found in almost any exposure, but not generally in a condition to give any information as to their identity.

Rossville locality.—This exposure is the same zone of the Carrizo and at about the same horizon as is the Senior locality. It is located on the Benton-Rossville private road on the west side of Atascosa Creek about four miles south of Benton, Atascosa County. Very little work has been done at this place, but four species have so far been recognized. This was found in 1934.

Cibolo locality.—These fossiliferous sands lie in the bank of Cibolo Creek about one hundred feet downstream from the bridge on Highway 81, northern Wilson County. At this point the creek cuts through the lowest layer of the Carrizo sands. The plant impressions occur in unconsolidated sand, and, though they are quite perfect, it is almost impossible to remove them. Six species have been recognized.

FAYETTE FORMATION

Scattered along the belt of Fayette deposits (Univ. Texas Bull. 3232, p. 683, fig. 46, 1933) F. B. Plummer has shown a large number of deposits of filter clays commonly known as Fuller's Earth. No record is at hand showing that fossil plants, other than petrified wood and palm stumps, occur in these layers. It is therefore thought of value to give the following records.

Muldoon locality.—In the west pit of the Texas Company located at Muldoon, Fayette County, are numerous plant impressions of the species belonging to the Fayette formation. Impressions have been observed in the other pits at the same place, but nowhere were they so well defined and so numerous as in the west pit. Twelve species have been easily identifiable.

Gonzales locality.—This plant-bearing layer is to be found in the pits of the Earth's Products Company of Houston. These pits are located six and one-half miles southeast of Gonzales and opposite the Dubois home, Gonzales County. The plant layer is just above the filler clay. In some places the plant impressions are very numerous and quite perfect. There are at least fifty species represented at this locality ranging from palm to *Dryophyllum*. The only drawback to these Fayette localities is the fragility of the specimens, which must be taken out very carefully and slowly dried; after the shrinkage has taken place, the specimens must be hardened.

Conquiesta locality.—This deposit is located on the south bluff of San Antonio River four miles west of Fall City in Karnes County. The plant layers are about ten feet above the high-water mark on the face of the bluff, and they extend for about one-half of a mile along the river. Surface findings indicate that with sufficient work this outcrop should yield fine specimens.

Witherspoon locality.—This is a pit leased from the Witherspoon ranch by Three Rivers Glass Company. It is to be found in McMullen County just south of San Miguel Creek about three miles from Cross Store on the Christine-Tilden highway. Surface indications show many fragments of the common Fayette plants.

Los Angeles locality.—This exposure in LaSalle County is found three miles east of the town of Los Angeles and about eighteen miles west of Fowlerton near the Fowlerton-Cotulla road. The Fuller's Earth here is massive, very hard, and porcelain-white. Weathered specimens show numerous fragments of the common Fayette flora. Because of the hardness of the rock this location, if properly worked, will undoubtedly repay the time spent upon it.

FORMATIONAL CONTACTS

In order to be certain of the stratigraphic positions of plant localities found, it became necessary to have an accurate knowledge of formational contacts in the Eocene section in eastern Bexar County. During the past four years these contacts have been hunted out and are herewithin recorded.

Navarro-Midway.—No contact between the Midway and the older formations is known to be exposed in central Bexar County.

Midway-Seguin.—On account of erosion and of the presence of Pleistocene deposits, no actual contact of the Midway and Seguin can be found, yet it is easily discernible in the differences in soils and by changes in types of concretions exposed by erosion.

Seguin-Rockdale.—The Seguin is well marked throughout much of central Bexar County, and the line of contact of the Seguin and the

Rockdale with its layers of sand concretions and oyster beds is easily recognizable. Good exposures are found west of Highway No. 2 sixteen miles south of San Antonio at the Tinsley schoolhouse and ranging west to the line of the Texas and Pacific Railroad. Another exposure is found on the Somerset road just south of the crossing of Elm Creek within two and one-half miles of Somerset. It is exposed also on the Palo Alto road eleven miles south of San Antonio.

Rockdale-Sabinetown.—The Simsboro sands as a common outcrop can be recognized on the surface from a point twelve miles east of San Antonio on the Cassiano road to a point three miles north and east of Lavernia. This deposit is generally about one half of a mile wide but is evident and continuous save for ravines which cross it. The contact with the Sabinetown is marked by a layer of very hard, blue, ripple-marked sandstone on which is a layer of a marine beach deposit containing shells (*Venericardia* and gastropods), shark's teeth, and water-worn pebbles (Univ. Texas Bull. 3232, pp. 603-604). This contact line is exposed on Losoya Creek at the crossing of the old Corpus Christi highway; in the clay pits one-fourth of a mile east of the Utzville schoolhouse; in the crossing of the Stuart road and Parita Creek; and at the crossing of Parita Creek and the Adkins-Elmendorf road. These contacts are very similar, and their combined exposures give a very complete record of the Sabinetown formation.

Sabinetown-Carrizo.—This contact is to be found in three widely separated locations in Bexar County. One lies in a steep hillside along the road leading from Somerset through Senior to Poteet, one-half mile north of Senior. The contact is a severe unconformity. Another is in the east pit near the town of Borregas. The third is on the Williams farm one and one-half miles east of Thelma. These locations are well exposed and are easily accessible.

NORTH TEXAS METEORITES

By RALPH H. KING[1]

There are definite historical records of three meteorites in north-central Texas. In 1808 Capt. Anthony Glass (5)[2] saw one of these masses and was informed that there were two others in the vicinity, one about 30 miles, the other about 50 miles distant. In 1810 two parties headed by men who had been with Capt. Glass set out to procure the largest mass, and one party accomplished its purpose (5). In 1812 and 1813 John Maley (5) saw one or both of the remaining masses and bargained with the Indians for them. He was not of the type of man who would purchase anything "sight unseen", so probably he knew where both were located. Although he failed to acquire either of these two bodies, the fact that there were originally three such meteorites seems definitely established.

On the return of Capt. Glass and his men to settled country two of the men organized parties to go after the mass they had seen in place. George Schamp led a party of nine, who started from Natchitoches, Louisiana. John Davis set out with eight or ten men from Nacogdoches, Texas. Davis's party found the stone but had no means of taking it away, as it weighed 1635 pounds, so they hid it under a flat rock while they went back for a wagon. The other party found the hiding place after a few days' search and made a truck wagon into which they loaded the meteorite. They crossed the Brazos without much trouble, but Indians stole their horses one night, and they were delayed until more horses could be obtained from Natchitoches. They finally reached Red River, where the meteor was loaded on a boat and taken downstream to the Mississippi and down that river to New Orleans (5). It was shipped from there to New York, where it was bought by Col. Gibbs, who placed it in trust in the Museum of the Lyceum of New York. Upon the death of Col. Gibbs in 1835 his widow presented the meteor to Peabody Museum of Natural History at Yale University, where the main Gibbs collection of meteorites (2) was deposited.

In 1812 John Maley (5) traveled through north-central Texas and saw one or both of the other two stones in place. He finally agreed on the price which he was to pay the Indians for the masses of iron and returned to New Orleans to obtain the merchandise. In 1813 he started after the meteorites with the goods which he was to give in payment, but he was attacked by some members of a hostile tribe and lost his goods and horses so gave up the enterprise.

Not until 1856[3] is there any other record of these meteorites. In that year Major Neighbors, United States Indian Agent, sent a wagon out to obtain one of the stones (6, 7). How he knew its whereabouts

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[2] Numbers in parenthesis refer to articles in the appended bibliography.
[3] Erroneously 1836 in Shumard (7). Major Neighbors was not appointed Indian agent until after 1845.

is not stated, but it was found about 60 miles from the Indian Reservation on the east side of Brazos River and hauled to Ft. Belknap, which was about three miles south of the present town of Newcastle in Young County. Major Neighbors took the 320-pound mass to San Antonio with him and later, at Dr. Shumard's request, sent it to Austin, where it was placed in the old Capitol Building. It was uninjured by the fire that destroyed the building in 1881 and was removed from the ashes intact. It remained for a while in the temporary capitol and was then given to The University of Texas. The portion remaining is now in the museum of the Bureau of Economic Geology at Austin.

The third mass is probably where it fell, as there is no record of the removal of a third mass from north-central Texas. The Denton County mass (7) has a different composition and belongs to a different fall. It has been established that when a falling meteor breaks up, the fragments tend to fall along a straight line, the largest pieces traveling farthest because of their greater momentum. Since the distances between the stones under discussion are known approximately, the established locations of the first two should make the location of the third relatively easy.

The largest mass, that which was first removed, was found southwest of the Brazos, about three days' journey southwestward from Red River (5). Maley (5) traveled southwest for about three days in going to the smaller masses, which lay between the Brazos and Red rivers. Both explorers mention a Pawnee Indian village on Red River as their starting point, and later writers have assumed that it was the one below the present city of Texarkana. However, since the village was located about 400 miles above Natchitoches, it probably was the one at the mouth of the Little Wichita, near the present town of Ringgold in Montague County. Incidentally, the Indians were probably Caddo or Wichita rather than Pawnee.

Bringier (3) describes the country in which the meteorites lay as being just west of the "cross-timbers" belt which gives rise to the headwaters of Trinity River, where the timber belt runs south-southeast and is about a mile wide. This is, of course, the western "cross-timbers" on the Trinity-Paluxy sand outcrop, and the place most similar to that described is in the southeastern part of Parker County. Here there are several stream valleys trending southeast, none of which is over a mile in width of outcrop of the Paluxy sand. The outcrop widens about 15 miles north to about 15 or 20 miles, as described by Bringier, and this part of the country is about three days' journey by wagon from Red River and nearly due south of the mouth of Little Wichita River. It could hardly be regarded, however as a part of the ridge between Brazos and Red rivers. This is probably the place visited by Bringier, but it is doubtful whether or not the objects he saw were the meteorites, as he describes them as being scattered over a distance of seven to ten miles and as weighing 1000 to 7000 pounds, whereas the meteoric bodies were 20 to 30 miles apart, and the largest weighed but 1635 pounds. The latitude and longitude cited in his paper indicate a point in northern Cherokee County in the heart of the iron-ore district.

Perhaps the most definite statement of locality is that of Shumard (7), who says that the specimen obtained by Major Neighbors was found on the east side of Brazos River about 60 miles from the Indian Reservation. As Major Neighbors was stationed at Ft. Belknap, the reservation referred to was probably the one in southeastern Young County. The Brazos flows southeastward for more than 150 miles, passing through the Indian Reservation in this portion of its course. The statement that the meteorite was on the east side of the Brazos implies that it was close to that stream. A point 60 miles downstream from the Indian Reservation would be in south-central Parker County, not far from the point which Bringier described. However, this locality is also open to the objection that it can not well be regarded as part of the ridge between Brazos and Red rivers.

On the other hand, a point 60 miles upstream from the Indian Reservation would be a few miles southeast of Seymour, in Baylor County, on the divide between the Brazos and Red River or, more precisely, between Brazos and Wichita rivers. Inasmuch as it was not until 1852 that Marcy determined the source of Red River, it is quite possible that earlier explorers mistook the Wichita for the main stream. The objections to this site as the probable location of the meteorite are, first, it is more west than southwest of the postulated site of the Indian village, and second, there would be very few large limestone ledges such as Maley (5) encountered on his trip to view the stone. The first objection may be discounted in view of the fact that other Indian villages lay farther up the river, any of which might have been the actual starting point of the various expeditions. In answer to the second objection it must be pointed out that the Leuders limestone forms a prominent escarpment passing through Baylor and Throckmorton counties, and it provided a solid footing where the old military road crossed Wichita River at Military Crossing.

The most likely conclusion, therefore, is that the stone collected by Major Neighbors was found in southeastern Baylor County and the Gibbs stone was found on the south side of Salt Fork of Brazos River in what is now Throckmorton County, about 30 miles to the south. The third mass is probably lying near Wichita River in northern Baylor County, possibly covered by the waters of Lake Kemp.

Since the heavier fragments of a broken meteorite travel farther than the lighter ones, the body in falling probably had a southward course, because the largest fragment was found on the southwest side and a lighter one on the northeast side of Brazos River. Chemical analysis shows the stones were part of the same fall.

In *Coronado's Children,* by J. Frank Dobie, the tales of past mineral riches in Texas include a record of a "lump of platina" that was used by the Indians for fashioning their arrows. This lump was quite likely one of the meteorites and seems to settle the matter of their location.

BIBLIOGRAPHY

1. ANONYMOUS, Meteroic iron (1. In Texas): Am. Jour. Sci., ser. 1, vol. 33, p. 257, 1838.
2. ANONYMOUS, Great mass of meteoric iron from Louisiana: Am. Jour. Sci., ser. 1, vol. 27, p. 382, 1835. (Notice of presentation to Yale University.)
3. BRINGIER, L., Notices of the geology, mineralogy, topography, productions, aboriginal inhabitants of the regions around the Mississippi and its confluent waters: Am. Jour. Sci., ser. 1, vol. 3, pp. 45-46, 1821.
4. CUMMINS, W. F., The Texas meteorites: Trans. Texas Acad. Sci., vol. 1, No. 1, pp. 14-18, read April 2, 1892.
5. H. C., Notice of the malleable iron of Louisiana: Am. Jour. Sci., ser. 1, vol. 8, pp. 218-225, 1824. (Quotes Glass and Maley MSS.)
6. MALLETT, J. W., On a mass of meteoric iron from Wichita County, Texas: Am. Jour. Sci., ser. 3, vol. 28, pp. 285-288, 1884.
7. SHUMARD, B. F., Notice of meteoric iron from Texas: Trans. St. Louis Acad. Sci., vol. 1, pp. 622-624, paper received May 7, 1860.
8. SILLIMAN, B., JR., and HUNT, T. S., On the meteoric iron of Texas and Lockport: Am. Jour. Sci., series 2, vol. 2, pp. 370-376, 1846.

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MOSQUITOES OF BRAZOS COUNTY, TEXAS

EMORY C. CUSHING[1]

INTRODUCTION

The mosquitoes in the section of Texas in which Brazos County is located constitute an almost constant source of annoyance to the inhabitants. For this reason a study of the mosquito fauna of the county was undertaken with the object of determining, in so far as possible, the number of species present and the relative abundance of each.

The work was done during the spring, summer, and fall of 1927 and consisted of making collections of larvae and pupae wherever they could be found. These were then reared to the adult stage in the laboratory of the Entomology Department of Texas Agricultural and Mechanical College, College Station, Texas. Occasionally adults were taken in the open. These were classified and placed in the collection with those reared from larvae and pupae. Identifications were made by the writer, but when any doubt existed as to the identity of a species, specimens were sent to H. G. Dyar of the U. S. National Museum for verification.

LOCATION AND CLIMATIC CONDITIONS

Brazos County is located in the center of what is known as the "flatwoods country" of east-central Texas. This section comprises the following counties: Navarro, Freestone, Leon, Madison, Walker, San Jacinto, Montgomery, Waller, Austin, Fayette, Bastrop, Washington, Burleson, Lee, Grimes, Brazos, Milam, Robertson, Falls, and Limestone. The elevation is approximately 300 feet above sea level. Bryan, the county seat of Brazos County, is about 95 miles northwest of Houston and 140 miles from the Gulf Coast.

The average annual rainfall amounts to about 39 inches, 20 per cent of which occurs during the months of June, July, and August, and about 50 per cent from January to May. Except in extremely dry years, rainfall is sufficient throughout the year to provide excellent mosquito-breeding places in artificial receptacles, woodland pools, and along stream beds.

The annual frost-free period for the past 21 years has averaged 251 days. The average date of the first killing frost for the same period is November 19, whereas the last killing frost in the spring usually occurs near the middle of March. The temperature rarely drops low enough to inhibit the appearance of mosquitoes until about December 15; some species, however, continue to be pests throughout the milder winters.

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[1] Division of Insects Affecting Man and Animals, Bureau of Entomology and Plant Quarantine, U. S. Dept. Agriculture.

SPECIES IN BRAZOS COUNTY

Dyar, in *The Mosquitoes of the Americas* (2), reports 43 species from Texas. These are given in Table 1, together with the localities from which they have been reported .

TABLE 1.—*Species of mosquitoes reported from Texas and localities where they occur.*

Psorophora ciliata (Fab.)[2]	Brownsville
Psorophora champerico (D. & K.)	Brownsville, Dallas
Psorophora ferox (Humbolt)	Dallas
Psorophora varipes (Coq.)	Dallas, Brownsville
Psorophora cyanescens (Coq.)	Paris, Brownsville
Psorophora signipennis (Coq.)	Camp McAllen, Austin, San Antonio, Laredo
Psorophora discolor (Coq.)	Plano, Brownsville
Psorophora columbiae (D. & K.)[2]	Llano Grande, San Antonio, Brownsville
Aëdes fulvus (Wied.)	Brownsville
Aëdes trivittatus (Coq.)	Denison, Leon Springs
Aëdes infirmatus D. & K.	Brownsville
Aëdes thelcter Dyar	Brownsville, Camp McAllen
Aëdes gonimus D. & K.	Kerrville
Aëdes hirsuteron (Theob.)	Paris
Aëdes nigromaculis (Ludl.)[2]	Brownsville, Plano
Aëdes sollicitans (Walk.)	Sandpoint, Galveston, Corpus Christi, Victoria, Smith Point
Aëdes mitchellae (Dyar)[2]	Victoria
Aëdes taeniorhynchus (Wied.)[2]	Victoria, Houston, Cypress Bayou
Aëdes zoosophus D. & K.	Kerrville
Aëdes triseriatus (Say)[2]	Victoria
Aëdes alleni Turner	Rio Grande Valley
Aëdes vexans (Meig.)[2]	Dallas
Aëdes aegypti (Linné)[2]	Dallas, San Antonio
Culicella inornata (Williston)	Dallas
Culex erraticus (D. & K.)	Plano, Victoria, Brownsville
Culex inhibitator D. & K.	Dallas, San Antonio
Culex stigmatosoma Dyar	Kerrville
Culex salinarius Coq	(Particular locality not given)
Culex declarator D. & K.	Brownsville
Culex restuans Theob.[2]	Denison
Culex quinquefasciatus Say[2]	Corpus Christi
Culex tarsalis Coq.[2]	Dallas, Devils River
Culex coronator D. & K.	San Benito
Culex apicalis Adams	(Particular locality not given)
Orthopodomyia signifera (Coq.)[2]	Kerrville
Megarhinus rutilus Coq	(Not listed by Dyar for Brazos County)
Megarhinus septentrionalis D. & K.	Dallas
Uranotaenia syntheta Dyar & Shannon	Rio Grande Valley
Uranotaenia sapphirina (O. S.)	(Particular locality not given)
Anopheles albimanus Wied	Rio Grande Valley
Anopheles pseudopunctipennis Theob	Devils River, Brownsville
Anopheles punctipennis (Say)[2]	Paris
Anopheles crucians Wied	Galveston
Anopheles quadrimaculatus Say[2]	Dallas

[2] Occurs also in Brazos County.

The following fifteen species have been found in Brazos County, all but one of which, *Megarhinus rutilus* Coquillett, are reported by Dyar.

PSOROPHORA (PSOROPHORA) CILIATA (Fabricius)

The adults are severe biters and are known colloquially as "gallinippers." They are most commonly found in the river bottoms. The larvae live in temporary rain puddles in stream beds and are predacious on one another, as well as on other mosquito larvae with which they are associated. The adults are not abundant but sometimes are annoying to campers and fishermen.

PSOROPHORA (GRABHAMIA) COLUMBIA (Dyar and Knab)

This species is not abundant, and larvae were obtained only from woodland pools near Wellborn. Adult females are persistent biters. They have been taken in cotton fields during the summer.

This species has been called "the spotted-legged mosquito."

AËDES (TAENIORHYNCHUS) NIGROMACULIS (Ludlow)

Only one specimen of this species was obtained. This was reared from a larva obtained from a woodland pool near the central part of the county.

AËDES (TAENIORHYNCHUS) MITCHELLAE (Dyar)

Larvae were obtained from a ground pool near the Brazos River in the southern part of the county, but they are not abundant. Specimens were sent to Dr. Dyar for his determination of the species.

AËDES (TAENIORHYNCHUS) TAENIORHYNCHUS (Wiedemann)

This species is not numerous. One adult female taken near Wellborn was probably transported from the lower coastal region.

AËDES (FINLAYA) TRISERIATUS (Say)

This species was not found near human habitations, as the larvae inhabit tree holes or artificial receptacles in wooded sections in the southern and central parts of the county. The adults are fairly numerous in localities where they occur and are often troublesome in dry woods.

AËDES (AËDIOMORPHUS) VEXANS (Meigen)

The larvae frequent ground pools and can be found in almost every part of the county. The adults cause considerable annoyance in the woods but are seldom troublesome about houses.

AËDES (STEGOMYIA) AEGYPTI (Linné)

In some localities this species is more numerous and is a greater pest than *Culex quinquefasciatus* Say. It is a domesticated species and breeds in any kind of artificial receptacle. The females are severe and extremely irritating biters. Negro communities suffer considerably from these pests, as the houses are usually unscreened. The species occurs generally over the county. With the first hard frost the adults disappear.

CULEX (CULEX) RESTUANS Theobald

Larvae of this species were found most commonly in rain barrels close to habitations but occur also in temporary streams. The species does not occur in large numbers, and specimens are difficult to find late in the season.

This species is rather closely allied to *Culex quinquefasciatus* Say and *Culex pipiens* Linné.

Specimens of this species were sent to Dr. Dyar for identification.

CULEX (CULEX) QUINQUEFASCIATUS Say

This species is probably the one most common in Brazos County. The larvae may be found in any place near habitations where water stands long enough for the eggs to hatch. During mild winters the adults are almost as abundant as in the other seasons. Early in the spring the abdomen of the female is greatly distended with eggs and is of a pale greenish color. Overwintering females are quite abundant in outhouses and underneath buildings. The first spring brood usually appears about the first of March.

CULEX (CULEX) TARSALIS Coquillett

Larvae of this species were found in pools left in stream beds and in woodland pools but never in artificial receptacles. They are extremely shy and disappear rapidly upon the slightest disturbance. The adults bite viciously, but have never been observed in large numbers.

ORTHOPODOMYIA SIGNIFERA (Coquillett)

This species is common in the vicinity of College Station. The larvae are found in places similar to those in which *Aëdes triseriatus* (Say) occur. It is not known whether or not the adults bite.

MEGARHINUS (MEGARHINUS) RUTILUS Coquillett

Heretofore this species has been reported only from Florida. In Texas larvae were found in only one place, a rain barrel in the bee yard of the Entomology Department of Texas Agricultural and Mechanical College, five miles west of Wellborn. They are extremely large and pinkish red, and in general appearance they resemble somewhat the larvae of *Psorophora ciliata* (Fabricius), except that the air tube is shorter and more blunt, and the anal gills are different.

Because of their cannibalistic habits, it is very difficult to rear larvae of *M. rutilus* to the adult stage when they are kept together in the same container. Several hundred were first obtained, but this number was reduced over night to a few dozen. The remaining ones were removed to separate vessels but began to die when they did not have other mosquito larvae upon which to feed. Shredded cooked beef was substituted for mosquito larvae as food, and they ate this with as much avidity as they devoured their brothers.

The reared adults were kept alive for more than a week by feeding them with honey that they obtained from a honey-soaked sponge placed in the cage. Since the adults will feed on honey, it is thought that perhaps their occurrence in the bee yard may have been due to their ability to obtain honey in some way from the beehives.

The adults are hard to distinguish from those of the more common related species *Megarhinus septentrionalis* D. & K. None of the latter, however, have been found in Brazos County.

ANOPHELES (ANOPHELES) PUNCTIPENNIS (Say)

This species is of common occurrence in the county and is commonly found about negro houses and outhouses.

ANOPHELES (ANOPHELES) QUADRIMACULATUS Say

This species is found occasionally but is not so common as *A. punctipennis* (Say).

SUMMARY

Culex quinquefaciatus Say is apparently the most troublesome species around dwellings, but its importance in this respect may be overshadowed by *Aëdes aegypti* (Linné) in certain localities. *Aëdes vexans* (Meigen) and *Aëdes triseriatus* (Say) are the most troublesome species in the woods.

REFERENCES

1. Dyar, H. G., The mosquitoes of the United States: U. S. Nat. Mus. Proc., vol. 62, art. 1, pp. 1–119, 1922.
2. Dyar, H. G., The mosquitoes of the Americas: Carnegie Inst., Washington, Publ. No. 387, pp. 1–616, pls. 1–123, 1928.
3. Freeborn, S. B., The mosquitoes of California: California Univ. Publ., Ent., vol. 3, No. 5, pp. 333–460, 1926.
4. Headlee, T. J., The mosquitoes of New Jersey and their control: New Jersey Agric. Exper. Station Bull. 348, pp. 1–229, 1921.

AN EOCENE FLORULE NEAR LYTLE, TEXAS

By A. J. KIRN[1] and H. B. PARKS[2]

In 1916 E. W. Berry published an account (2) of the discovery of a rock deposit containing the impressions of leaves collected by Alexander Deussen and L. W. Stephenson near the town of Earle in Bexar County. In 1921 Berry, accompanied by A. C. Trowbridge and L. W. Stephenson, visited the locality. The records of the observations made at the two visits constitute the literature of paleobotany of Bexar County with the exception of a few short notices which give résumés of this work.

Dr. Berry describes the plant-bearing formation at Earle as the indurated portions of a sandy deposit which was regarded by him as belonging to the Midway formation. In his publication of 1924(5) he states definitely that, although structural geologists place the Earle locality in the Wilcox, he still maintains that the resemblance of the plant fossils to those common in the Raton and Denver formations of New Mexico and Colorado points to Midway age.

The Earle locality is unique, and its history must be given in order to understand why a number of the proposed studies by Dr. Berry have not been made. The town of Earle was located on the east bank of Medina River at one of the several crossings of the Camino Real (King's Highway) between San Antonio and the City of Mexico. Near the town and the ford there existed a hill of very hard, gray sandstone. This rock deposit furnished foundations, chimneys, and well curbing during several generations for the farmers in that section of country. Large quantities of rock from here went into the walls of Mission El Carmen. Rock for road construction and for the building of the cement wagon bridge at Earle also came from the quarry. When the San Antonio, Uvalde and Gulf Railroad was built from San Antonio southward, it was found necessary to build the right-of-way across the quarry. The large amount of rock then removed was used in building the railway bridge abutments, and many tons were hauled elsewhere and used in culverts. As a result only a few blocks of this sandstone deposit are left, and at a little distance northwest is one remaining boulder of this once-famous quarry. With the coming of the railroad a depot was built on the west side of the river, and around this sprang up the town of Cassin. With the loss of patronage by railroads the station was discontinued. The gin, warehouses, and other properties were moved away, and the town of Cassin like the town of Earle has become simply a name on record. The present town of Florestown is just east of the old town of Earle. It is thus seen that the only chance to study the flora contained in this deposit is to hunt up places where the rock has been used and, where possible, to remove the fragments with the hope of finding additional fossil plants.

[1] Somerset, Texas.
[2] Chief, Division of Apiculture, Texas Agricultural Experiment Station, San Antonio, Texas.

It is very interesting to note that a regular folk-lore has grown up among the Mexicans whose relatives formerly worked the quarry, and one can obtain some most exaggerated stories relative to size and kinds of leaves found there. One of the best tales concerns a grapevine, which had a number of perfect leaves measuring some feet in diameter and clusters of grapes on which from two to three hundred berries had been counted.

There is no doubt from what is now known that the Earle sandstone consisted of a number of large concretions in the upper part of the Rockdale formation. Wherever the Rockdale is exposed, hard, calcareous sandstone concretions occur in that part of its section known as the Simsboro sands. The Wilcox group extends in a twelve-mile belt across the southern part of Bexar County. Near the center of this belt the entire Wilcox group of strata is exposed, but to the northeast and southwest it has been eroded until in many places only a small portion of the deposit remains. Because of the friability of the strata, erosion has carried away the sands and clays, and the gray concretions being too heavy for transportation have remained in their original geographical position. In many places erosion has removed the deposits from under the concretions, which now lie lower than their original stratigraphical position. This is evidenced by the lack of conformity between the stratification in the loose boulders and that in the underlying formation. At the Earle locality a large number of such boulders had been assembled by erosion and possibly by water transportation.

About twenty miles north and west of the Earle location the Rockdale formation occupies almost the entire plain between Medina River and the headwaters of Atascosa River. In a broad belt conforming to the strike of the Rockdale there are numerous concretionary sandstone boulders that belong to the described formation. That these are many feet below their original position is attested by the fact that they lie at angles to the horizontal and below known concretionary deposits *in situ*.

In 1928 the senior author discovered abundant plant impressions in a typical Rockdale boulder that was being removed from a field about one and one-half mile west-northwest of Lytle[3] and in the extreme eastern edge of Medina County. The concretionary boulder was ovate in outline and about three times as long as thick and measured approximately eight feet by sixteen feet by twenty-four feet. It lay at an angle of about thirty-five degrees to the surface of the soil and rested upon an undisturbed portion of Rockdale. The entire boulder was removed, portions of it were used for foundations and the remainder for road work. Collections of this plant material were successfully made.

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[3] The locality is reached from the town of Lytle by driving northwestward along the street that passes south of the Lytle High School to a point 0.7 of a mile from the school; thence northward on the Medina-Atascosa county line road for 0.1 of a mile; thence westward 0.8 of a mile. From this point on the road the location of the large cavity left after the removal of the boulder lies 400 feet to the north in the field, and some remnants of the rock still remain in the bottom of the cavity at this date. The land is a part of the Medina Irrigation Project and lies on the Gillam farm.

Dr. Berry described ten plants from the Earle locality. Stephenson, Vaughan, and Baker later collected a few plants near Elmendorf and Calaveras bringing the total number of species collected in Bexar County up to eighteen. Since these later collections were made in soft clay, and since some question of age may exist, only those species found in the analgous hard sandstone concretions are listed.

Quite a complete collection of species from the Lytle locality was shipped to E. W. Berry, who has been able to identify thirty-five species from this material. It is to be seen that, by comparing the Earle list and the Lytle list, the floras are the same, the Lytle list containing all of the Earle species with the exception of two. The additional species substantiate the Rockdale age of the Earle deposits, as paleobotanical work since the study of that flora has shown very definitely that it is in this part of Texas that the plants recorded from the Eocene of New Mexico and Colorado met and mingled with those in the deposits now called Rockdale and that the Denver and Raton deposits are not Midway in age but are Rockdale. Dr. Berry from the Kirn material described two new species (7, 8) naming one for the senior author (Kirn) and the other from the place of location (Lytle).

Since Berry's study of the Lytle material, further work has been done among the fragments of this boulder, and the present authors are here amplifying the original description of *Ampelocissites lytlensis* Berry, genotype of *Ampelocissites.* This species was described (8) from a single seed belonging to the family Vitaceae and is probably from some kind of a fruit very much resembling the common grape. In the description Berry states that the form of the seed places the plant between the genus *Ampelocissus* and the genus *Vitis.* Among the fragments of the boulder from which this seed came the authors have found three leaves of a plant that likewise falls between these same two genera. As it is not probable that two so closely related species should occur in a fossil flora in a deposit of so small dimensions, the authors are placing these leaves in the species described by Dr. Berry.

Species collected from concretions in the Rockdale formation, Bexar and Medina counties, Texas. (Identifications by E. W. Berry.)

Earle locality—

- Asimina eocenica Lesquereux
- Cinnamomum affine Lesquereux
- Dolichites deusseni Berry
- Ficus denveriana Cockerell
- Ficus sp.[4]
- Ficus occidentalis (Lesquereux)
- Laurus wardiana Knowlton
- Platanus aceroides latifolium Knowlton
- Pourouma texana Berry
- Terminalia hilgardiana (Lesquereux)

[4] Later identified as *F. mississippiensis* Berry.

Lytle locality—
- Anacardium kirni Berry
- Anona ampla Berry
- Anona eolignitica Berry
- Ampelocissites lytlensis Berry
- Apocynophyllum wilcoxense Berry
- Apocynophyllum sapindifolium Hollick
- Artocarpus pungens (Lesquereux)
- Asimina eocenica Lesquereux
- Banisteria repandifolium Berry
- Celastrus taurinensis Ward
- Cinnamomum affine Lesquereux
- Cinnamomum postnewberryi Berry
- Cucurbites acrobiculatus Berry
- Dryophyllum tennesseense Berry
- Euonymus splendens Berry
- Engelhardtia ettingshauseni Berry
- Ficus denveriana Cockerell
- Ficus mississippiensis Berry
- Ficus pseudopopulus Lesquereux
- Ficus occidentalis (Lesquereux)
- Ficus schimperi Lesquereux
- Ficus vaughani Berry
- Gleditsiophyllum eocenicum Berry
- Glyptostrobus europaeus (Brogniart)
- Lygodium kaulfussi Heer
- Laurus? caudata Knowlton
- Laurus wardiana Knowlton
- Magnolia angustifolium Newberry
- Magnolia leei Knowlton
- Nyssa eolignitica Berry
- Oreodaphne obtusifolium Berry
- Platanus aceroides latifolium Knowlton
- Sabalites grayanus (Lesquereux)
- Terminalia hilgardiana (Lesquereux)
- Ternstroemites eolignitica Berry.

AMPELOCISSITES LYTLENSIS Berry

Ampelocissites lytlensis Berry, 1929, Jour. Washington Acad. Sci., vol. 19, p. 39, text fig. 1.

The genus *Ampelocissites* was erected by E. W. Berry (8) to accommodate a fossil plant that was found in a hard, calcareous, sandstone concretion belonging to upper Rockdale formation one and one-half miles west-northwest of the town of Lytle and in the extreme eastern edge of Medina County. This plant, as first described, is represented by a single seed which is well preserved and shows the characteristics of both *Ampelocissus* and *Vitis*. Further collecting has been rewarded by the discovery in the fragments of the rock from which the seed came, portions of three leaves, which like the seed described by Berry exhibits the characteristics of *Ampelocissus* and *Vitis*. An extensive sutdy of the two genera has led to the conclusion that there is no doubt that these leaves represent the species described by Berry. It is hard to believe that another species so nearly related would be found within a few feet of the first discovery. The fossil material is well defined, and fortunately both surfaces of the leaves are represented.

The leaves have the typical venation of the Vitaceae. The specimens agree in that the leaves bear the same relative proportion of length, width, and outline. The leaves are serrate and tridentate. The base of the leaves lies 84 degrees from the direction of the main vein, and the upper edge of the lateral dentation is parallel to the base of the leaf. The upper surface of the leaf is smooth and punctate, whereas the under surface is decidedly woolly. The small leaf is six by eight centimeters; the largest ones measure ten by twelve centimeters.

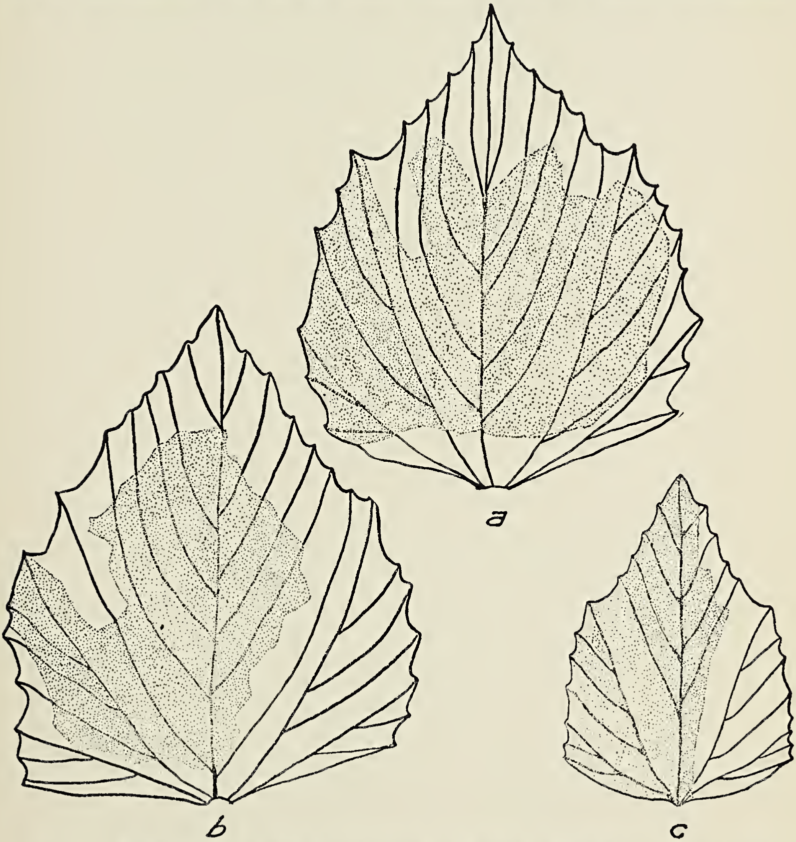

FIG. 1. Reproductions and restorations of leaves of *Ampelocissites lytlensis* Berry, ×0.5, found at the type locality for the species. The shaded areas represent the preserved portions of the leaves. *a,* Leaf with the largest preserved area (L-1-33; K-0.1A). *b,* Leaf restored from specimen showing opposite surfaces (L-1-33; K-P-1 and K-P-1A). *c,* Small leaf showing considerable surface preserved (L-1-33; K-0.1). The notations in parentheses refer to collection numbers in the collections of the authors. The drawings have been made by Miss Mabel Parks.

Drawings of these leaves, as accurately as can be produced, have been compared with the leaves of the Mustang grape, *Vitis candicans* Engelmann. The resemblance is very striking, especially as comparison shows that the smaller leaf grew near the end of the vine, whereas the larger leaves, which are slightly different in outline, belong farther back on the stem. Reproductions of these leaves are given in the accompanying illustrations (fig. 1).

These specimens are the property of the authors, who take pleasure in making this addition to a more complete knowledge of this species described by E. W. Berry.

BIBLIOGRAPHY

1. Ball, O. M., A contribution to the paleobotany of the Eocene of Texas: Agric. Mech. Coll. Texas Bull., ser. 4, vol. 2, No. 5, pp. 1–173, pls. 1–48, 1931.
2. Berry, E. W., The lower Eocene floras of southeastern North America: U. S. Geol. Survey Prof. Paper 91, pp. 1–490, pls. 1–117, 1916.
3. .... An Eocene flora from the trans-Pecos Texas: U. S. Geol. Survey Prof. Paper 125, pp. 1–9, pls. 1–3, text figs. 1, 2, 1920.
4. .... Additions to the flora of the Wilcox group: U. S. Geol. Survey Prof. Paper 131-A, pp. 1–21, pls. 1–18, 1922.
5. .... Middle and upper Eocene floras of southeastern North America: U. S. Geol. Survey Prof. Paper 92, pp. 1–206, pls. 1–65, 1924.
6. .... An early Eocene florule from central Texas: U. S. Geol. Survey Prof. Paper 132-E, pp. 87–92, pl. 23, text fig. 8, 1924.
7. .... An *Anacardium* in the lower Eocene of Texas: Jour. Washington Acad. Sci., vol. 19, pp. 37–39, figs. 1, 2, 1929.
8. .... Seeds of a new species of Vitaceae from the Wilcox Eocene of Texas: Jour. Washington Acad. Sci., vol. 19, pp. 39–41, text fig. 1, 1929.
9. .... Revision of the lower Eocene Wilcox flora of the southeastern states: U. S. Geol. Survey Prof. Paper 156, pp. 1–196, pls. 1–50, 1930.

PROCEEDINGS
of the
TEXAS ACADEMY OF SCIENCE

REGIONAL MEETINGS

South Texas Meeting.—This meeting was held at Kingsville, April 26 to 27, W. Armstrong Price presiding. At the technical sessions sixteen papers were presented. The program at the banquet consisted of an illustrated talk by a Junior Academy member and an address by Pres. H. Y. Benedict of The University of Texas on "Early Attempts at Measuring Distances of Stars." At the business session eighteen new members were elected and other business discussed. A field trip over King Ranch filled the afternoon.

East Texas Meeting.—This meeting was held at Huntsville, May 3 and 4, Don O. Baird presiding. At the technical sessions ten papers were presented. The unique feature of the general session was an illustrated lecture by Robert M. Zimmerman, a deep-sea diver, entitled "Down, Down, Down to the Bottom of the Sea." In the business session sixteen new members were elected. A tour of inspection of the State Penitentiary was conducted.

West Texas Meeting.—This meeting was held at Abilene, W. M. Winton presiding. Eleven papers were presented at the technical sessions. After the banquet J. M. Kuehne gave an illustrated lecture, "The McDonald Observatory." At the brief business session four new members were elected.

ANNUAL MEETING

The annual fall meeting of the Texas Academy of Science was held on the campus of Agricultural and Mechanical College of Texas, College Station, November 7–9, 1935, J. C. Godbey, President, presiding. Technical sessions filled most of the second day and business sessions were held on the first and last days. Capt. G. B. Troland was guest speaker after the annual banquet, his title being "The Melting Pot of the Pacific." Another guest speaker at the general session was geologist for the Second Byrd Expedition, Charles G. Morgan, who spoke on his experiences in the Antarctic. Thirteen members were raised to the rank of Fellow, and fifteen new members were elected, making fifty-three new members added during the year. Following the final business session at which new officers were elected field trips in the vicinity were led by members located at College Station.

Officers elected for 1935–1936.—W. Armstrong Price, President; Don O. Baird, Executive Vice-President; W. T. Gooch, W. R. Horlacher, S. B. McAlister, Olin G. Bell, and John G. Sinclair, Vice-Presidents and Chairmen of Sections 1–5 respectively; Frederick A. Burt, Secretary; Mayne Longnecker, Treasurer. (The other officers carry over from the previous year.)

Fellows elected.—C. L. Svensen, Sister Michael Edward O'Byrne, M. F. Landwer, F. A. Cray, W. Goodrich Jones, D. B. Casteel, J. A. Place, Donald Duncan, J. Frank Dobie, S. B. McAlister, T. D. Brooks, L. W. Blau, Olin G. Bell.

New Junior Academy chapters.—Science Club of Georgetown High School, Science Club of the high school division of Incarnate Word College, Nature Science Club No. 1 of Austin High School.

New section.—Section 5, Basic Medical Sciences.

Report of the Treasurer.—The following report for the period of November 17th, 1934, to November 9th, 1935, was presented as follows:

RECEIPTS

From F. A. Burt (Sec.-Treas., 1933–1934)	$240.36
Dues from members	244.35
Received from A.A.A.S.	73.50
	$558.21

EXPENSES

Printing of certificates	$ 12.01
Expenses of Secretary	50.00
Clerical assistance	18.00
Interest on indebtedness to A. J. Kirn	23.13
Expenses of Kingsville meeting	6.57
Expenses of Huntsville meeting	40.00
Secretarial supplies	1.85
Check returned	2.00
Printing and mailing of Vol. 17	251.65
	$405.21

STATEMENT

Receipts	$558.21
Expenses	405.21
	$153.00

Papers presented.—The following papers were presented on Friday of this meeting:

BIOLOGICAL SCIENCES

The cotton flower in relation to developmental times; by Clifton C. Doak, A. & M. College.

A new method of the determination of the velocity of absorption of water on different regions of the root; by H. F. Rosene and E. J. Lund, The University of Texas.

Hybrid vigor in cotton; by D. T. Killough and W. R. Horlacher, College Station.

Vegetational survey of the lower Rio Grande Valley; by Elzada U. Clover, University of Michigan.

Effects of sulphur on the control of potato scab; by J. J. Taubenhaus, College Station.

Some additions to the flora of Texas; by George L. Fisher, Houston Museum.

Chimeras in cotton; by W. R. Horlacher and D. T. Killough, College Station.

The pollution of North Fork of Trinity River with special reference to the effect of waste dye on fish life; by A. H. Wiebe, Fish, Game, and Oyster Commission.

Distribution of bioelectrical potentials in *Chara vulgaris;* by Sidney O. Brown, The University of Texas.

Flight stridulation in American acridians; by F. B. Isely, Trinity University.

Notes on the feeding habits of the short-eared owl; by Claude Kelley and E. P. Cheatum, Southern Methodist University.

Deforestation, the nemesis of historic civilizations; by O. C. Charlton, Forester, Dallas.

The genus *Ephedra* in Texas; by V. L. Cory, Agricultural Experiment Station, Sonora.

Fossil plants; by H. B. Parks, Agricultural Experiment Station, San Antonio.

Wild flowers of Erath County; by Lewis Waters, Baylor College, Dallas.

Notes on the plankton of the Gulf shore waters; by Clyde T. Reed, Texas College of Arts and Industries, Kingsville.

A unique distribution of littoral habitats for oceanographic studies on the Gulf; by E. J. Lund, The University of Texas, and A. H. Wiebe, Fish, Game, and Oyster Commission, Austin.

Procedure in protection of wild life; by J. G. Burr, Fish, Game, and Oyster Commission, Austin.

GEOLOGICAL SCIENCES

Biology of fossil crabs; by H. B. Stenzel, Bureau of Economic Geology.

Recent advances in oil-field technology and their application to oil-field production problems; by F. B. Plummer, Bureau of Economic Geology.

Hydrothermal activity in Yellowstone and other points in Wyoming; by Augusta H. Kemp, Seymour High School.

The use of electrical surveys in drill holes; by J. L. Mathieu, Schlumberger Well Survey Corporation, Houston.

Exhibit of gastroliths from Wyoming; by Augusta H. Kemp, Seymour High School.

Recent studies in the classification of the Paleozoic ammonites in Texas; by F. B. Plummer, Bureau of Economic Geology.

Some tectonics of the Gulf Coastal Plain; by Charles L. Baker, A. & M. College.

Tentative glacial time scale for south Texas Quaternary formations; by W. Armstrong Price, Corpus Christi, and John Doering, J. R. Black, and J. L. Collins, Dallas.

New structural map in Texas; by E. H. Sellards, Bureau of Economic Geology.

Some contributions of paleontology; by N. L. Thomas, Pure Oil Co., Dallas.

Subsurface evidence of the Navarro-Taylor contact in central Texas; by Helen Jeanne Plummer, Bureau of Economic Geology.

Geology of the Antarctic; by C. G. Morgan, Geologist of Byrd Expedition.

PHYSICAL SCIENCES

The requirements of animals for vitamin A; by George S. Fraps, State Chemist.

Spectroscopic method for the determination of vitamin A; by A. R. Kemmerer, College Station.

Bromine-sensitized photodecomposition of gaseous dibromotetrachloroethane; by J. L. Carrico, Lamar College.

Chemistry of color in Texas bluebonnets *(Lupinus texensis)*; by Sister Michael Edward O'Byrne, Incarnate Word College.

The nine-point circle; by W. H. Bruce, North Texas State Teachers College.

Recent potash investigations in west Texas; by W. A. Cunningham, The University of Texas.

Study of the gasoline sold in some Texas cities and a review of the modern gasoline specifications; by D. A. McKnight and Reuben Pfenning, The University of Texas.

Demonstration of fluorescence and phosphorescence of minerals with an iron-arc spark-gap lamp; by Clarence L. Brock, Houston Museum of Natural History.

McDonald Observatory; by J. M. Kuehne, The University of Texas.

Scientific gleanings from the Anglo-Saxon Chronical; by Augusta H. Kemp, Seymour High School.

SOCIAL SCIENCES

The Texas securities act; by Karl E. Ashburn, Southern Methodist University.

Silviculture and civilization; by L. L. Bishop, U. S. Forestry Service, Houston.

Social Science in the revised curriculum; by S. B. McAlister, North Texas State Teachers College.

Crime and civilization; by W. Armstrong Price, Corpus Christi.

The cotton program in Egypt; by J. S. Mogford, A. & M. College.

Reactionary aspects of the so-called "New Deal" in the light of possible social order; by F. B. Clark, A. & M. College.

Some practical applications of anthropology; by J. E. Pearce, The University of Texas.

Melting pot of the Pacific; by G. B. Troland, Capt. U. S. Army.

MEDICAL SCIENCES

Stereo-photography in embryology; by J. G. Sinclair, M.D., The University of Texas Medical College.

Some notes on three problems in teaching embryology; by J. G. Sinclair, M.D., The University of Texas Medical College.

Relation of maternal vitamin A to embryonic eye development; by Fred Hale, Agricultural Experiment Station, College Station.

Some studies on the fiber composition of the spinal nerve root; by Donald Duncan, M.D., The University of Texas Medical College.

The biological position of the filterable viruses, a review; by Hardy A. Kemp, M.D., Baylor Medical College.

Use of the headless (spinal) cat for research on the nervous system; by E. L. Porter, M.D., The University of Texas Medical College.

Preparation and performance in medical students; by J. G. Sinclair, M.D., The University of Texas Medical College.

Impending trends in medical education; by Hardy A. Kemp, M.D., Baylor Medical College.

ABSTRACTS OF PAPERS

The following abstracts represent some of the papers presented at regional meetings and at the annual fall meeting of the Academy.

BIOLOGICAL SCIENCES

Distribution of bioelectric potentials in Chara vulgaris, by Sidney O. Brown.—Measurement of the distribution of electric potentials along the axis of the stonewort, *Chara vulgaris,* shows that this water plant exhibits the usual electric polarity found in many other plants and animals. The observed continuously maintained E. M. F.'s between the apex and base of the second internode average about 20 millivolts with the apex positive. The potential pattern is quite variable among individual plants, and the electric polarity in the same individual may be diminished or completely inverted by slight mechanical stimulation of the apex.

Control of gar and carp, by J. G. Burr.—So long as the predacious fishes, such as gar and carp, go uncontrolled, increasing the supply of food fish in the rapidly increasing number of lakes and reservoirs is extremely difficult. The best time to meet such destroyers is at the time of spawning in April and May, when the communal species concentrate in great numbers after the waters have reached the proper temperature of 60 degrees and above and when spring rains make running a common habit. Hoop nets at such times are used effectively in catching gar and this and other netting devices can be employed successfully on carp, when they approach the shoreline to spawn. They can be kept coming all summer if baited with corn and other suitable foods. An electrical machine has also been used effectively in taking gar during the summer weather, when they swim near the surface, and the same form of electrical current has been used at the spawning beds to sterilize the eggs to prevent hatching.

We have three species of gars in Texas: the Long-nosed Garpike, *Lepisosteus osseus,* the Short-nosed Garpiks, *Cylindrosteus playstomus,* and the Alligator Gar, *Atractosteus spatula.* The first-named species is the most numerous and widely distributed, and it is most easily caught. The Short-nosed is not so well understood; their shorter bill indicates a closer kinship with the Alligator Gar, though they never grow large. Like the Alligator Gar, they spawn later than the Long-nosed. It is said that they do not school at spawning time, nor does the Alligator Gar school, and further study of their habits is essential to effective control.

Procedure in protection of wildlife, by J. G. Burr.—This paper traces the procedure of the Game, Fish, and Oyster Commission in protecting wildlife and shows methods of restoration by direct purchase of the game, by trapping from areas where a surplus exists, and by distributing species in areas where they are scarce or absent. Trapping of wild deer has not been found feasible, because the animal often kills itself in an effort to escape; the methods of catching the fawn and rearing it to a certain age before distribution has been found the only feasible plan. Quail, bobwhite, and the Gambel species are trapped successfully and are planted in depleted areas. Pheasant propagation, though widely practiced in the last year or two, has not been tried out with success in the open, and it is yet to be learned where and under what conditions they will survive. Fish production from nine hatcheries supplies the nucleus of species that are planted in all parts of the state, and lake studies indicate adaptability of the various waters to fish life. This department has prevented the extermination of game species of the type that can easily be exterminated and has increased the population beyond what it was a few years ago. It has furnished recreational values in fishing and hunting beyond estimation in dollars and cents.

Vegetational survey of Rio Grande Valley, Texas, by Elzada Clover.—This survey covers 5,000 square miles, extending over Zapata, Starr, Hidalgo, Cameron, and Willacy counties. Edaphic factors and geologic formations seem to have a definite relation to plant distribution. *Prosopis juliflora* var. *glandulosa* Torrey is conspicuous or dominant in a large part of this area. *Inodes texana* Cook forms the most distinctive association, appearing tropical. It covers approximately one hundred acres in the vicinity of Brownsville. An intensive study was made of the vegetation on Clark island, which lies about one mile west of Boca Chica, Cameron County. Two new species, *Dyssodia tephroleuca* Blake and *Echinocereus angusticeps* Clover were found, and several possible new species are still under investigation.

The genus Ephedra in Texas, by V. L. Cory.—This paper presents general information concerning species of the genus *Ephedra,* and in particular the latest information relative to the botanical knowledge of its several Texas species. To the latest published list of the species of this genus (1928) the addition of two species and one variety is made. The circumstance that heretofore two distinct species have been included under one name is detailed, and the proper separation of these two species is announced. A botanical key is presented to give aid in the separation and the recognition of the Texas species, and this is supplemented by a discussion of the distribution of each of these species. Mention is made of the economic importance of certain species and of their worth as medicinal plants, including their usage in Mexico and southwestern United States in the forms of infusions either as medicinal drinks or as hot beverages.

Cotton flower in relation to developmental time, by Clifton C. Doak.—The fruiting branches of cotton are nearly typical sympodia. The regularity with which they produce nodal organs makes possible the establishment of an average time interval between successive flowers. This interval may be used in turn as a measure of physiologic vigor or as a measure of the rate of floral ontogeny. Successive nodes were tagged on the date of anthesis of their respective flowers. Averages were taken. These were then used as a measure by which to estimate the probable time which would have been required to bring the series of floral buds on dissected branches into flower. The story of floral ontogeny with reference to time was thus outlined. The minimum time required for a flower bud primordium to develop into an open flower was found to be approximately thirty-one days.

Bud and sheath scales of Pinus, by Clifton C. Doak.—The bud and sheath scales of *Pinus* are unique in that their primordia become hooded over the growing plant and the young needles respectively. Subsequent growth of underlying parts perforates the crown of the hood and they thus provide encircling sheathes. On the short shoot this serves to reinforce the weak bases of the leaves. By pressure it shapes them into circular forms. Its support makes possible their zonal growth. The first three scales on the short shoot are morphologically different from the others. They are regularly placed, the first adaxial and the others lateral. This is held to be significant because these scales are thought to be homologous to the three sporophyll constituents in the seed scale. The number of scales per sheath varies from seven in *P. albicaulis* to twenty-three in *P. torreyana* but is not a sufficiently fixed character to be of taxonomic value.

Additions to the flora of Texas, by George L. Fisher.—Species, varieties, and forms of uncultivated plants in Texas not mentioned in the usual floras or manuals as growing in this state are here presented. While making a list of Texas plants in cooperation with C. V. Cory, State Range Botanist, and H. B. Parks, Chief of Division of Apiculture, many plants heretofore not recorded from Texas, except in pamphlets, miscellaneous papers, and botanical periodicals, have been observed. Some new species, varieties, and forms have been found and named from material sent by the U. S. National Museum, Field Museum, and by specialists in certain groups of plants. A short review of this unrecorded group of plants, together with location of each, the collector, and other information is given.

Ecological succession in the Mytilus californianus habitat as observed in Monterey Bay, California, by Willis G. Hewatt.—Ecological succession was observed for a period of two years on a denuded square yard of rock surface in the mussel habitat along the southern margin of the Monterey Bay, California. The results of the investigation indicate that the succession in this densely populated habitat progresses in the following manner: (1) a cleaned area first becomes covered with a film of algae and bacteria; (2) those forms that feed on this algal growth, such as limpets, are the first animals to appear in the area; (3) during their respective spawning seasons the mussels, goose barnacles, and rock barnacles attach themselves to the cleaned surface; (4) these sessile forms gradually come to occupy the greater part of the surface and to make the habitat unfavorable for the larger specimens of the limpets; (5) the limpets thus move to a higher zone, in which the mussels and barnacles cannot exist.

Chimeras in cotton, by W. R. Horlacher and D. T. Killough.—Chimeras, resulting from the absence of chlorophyll from certain areas of the plant, have occurred and continue to occur in several varieties of American Upland cotton, *Gossypium hirsutum.* This characteristic is transmitted through the cytoplasm. Green areas of a chimera plant give rise to green progeny, chimera areas to chimera progeny, and white areas to white seedlings, which do not live because of the absence of chlorophyll. Chimera female × green male gave chimeras in the F_1. White female (white area on a chimera plant) × green male gave all white seedlings in the F_1. Green female × chimera male gave all green plants in both the F_1 and F_2 generations. A similar chimera has been observed in Chinese cotton, *G. nanking.*

Flight stridulation in American acridians, by F. B. Isely.—In 1908 Karny experimentally demonstrated that in a number of European acridians only the hind wings are used in making flight noises. Current American authors, however, still hold to the theory that during flight the grasshopper rubs the wings and the tegmina (wing covers) together, producing the characteristic clacking sound.

During last summer actively stridulating grasshoppers were secured, and from these the tegmina were carefully clipped off at their bases. The operated specimens when liberated were still able to make their characteristic flight songs. Eleven species were checked, and for each species the results were the same, that is, the tegmina were not concerned in flight noises. Snodgrass has shown that the fan-like opening and closing of the hind wings is operated by an independent flexor mechanism. It seems evident that the flight stridulation emanates entirely from the hind wings and results from the fan-like opening and closing of these wings.

Hybrid vigor in cotton, by D. T. Killough and W. R. Horlacher.—Interspecific crosses in cotton manifest considerable hybrid vigor in the vegetative characters in the F_1 generation. Succeeding generations from one cross have segregated into large and small lines. The crosses analyzed in this study are: *Gossypium hirsutum* × *G. barbadense* (Sea Island); *G. hirsutum* × *G. barbadense* (Pima); and *G. hirsutum* × *G. purpurescens.* Hybrid vigor was studied in the following vegetative characters: height of plant, length of vegetative branches, length of fruiting branches, diameter of stem, length of leaf, width of leaf, thickness of leaf, number of vegetative branches, number of fruiting branches, number of cases in which two branches grew from one node, length of boll, and diameter of boll.

Unique distribution of littoral habitats for oceanographic studies on the Gulf, by E. J. Lund and A. H. Wiebe.—Attention is called to the fact that two drainage systems, which for practical purposes may be regarded as two symmetrical systems of habitats, consist of (1) Nueces River, Nueces Bay, Corpus Christi Bay, Ship Channel, and (2) Aransas and Mission rivers, Mission Bay, Copano Bay, Aransas Bay, and Lighthouse Channel. Both these systems empty into the Gulf of Mexico through a common deep government-maintained outlet, the Pass, at Port Aransas. Control of gradients of the salinity, the depth, the direction, magnitude, and times of flow of water in this symmetrical system is controlled by rainfall, wind, and tides. Since the system is very shallow (average of ten feet), it is subject to a wide amplitude of change in water temperature, salinity, and rapid displacement. Such a variable and symmetrical system of graded habitats is obviously admirably suited for observations on marine organisms that migrate into it from the open Gulf, and vice versa.

A few preliminary hydrographic observations in the Pass, the two channels, and the two sets of connecting bays are presented in tables. One of the facts brought out by the tables is the stratification of water of different salinities in the Pass and adjacent regions of the open Gulf near the jetties *during outflow* from the system. These phenomena appear to be the primary basis for the recent mortality of fish on the Gulf Coast. A brief report on the conditions that induced this fish mortality has already been made to the Texas State Game, Fish, and Oyster Commission. It will be pointed out that the pass at Port Aransas is an unusually strategic center from which may be observed on a large scale the action of environmental factors on marine organisms. No other location on the Texas coast appears to offer so unique a set of opportunities for oceanographic studies.

Digest of "Preliminary Work on Problems of Shrimp Investigation," by Kenneth H. Mosher.—The development of the shrimp industry has been so rapid, that now about one-hundred million pounds are obtained each year. Of that amount about 97 per cent are caught from the south Atlantic and Gulf coasts. Louisiana, Florida, Mississippi, and Texas are the leading shrimp-producing states. In 1931, the Bureau of Fisheries obtained the cooperation of Louisiana, Georgia, and Texas and began a study of the commercial shrimp. The shrimp catches were found to consist of *Penaeus setiferus, P. brasiliensis,* and a closely related *Xiphopenaeus kroyeri.* The first-named species comprises more than 95 per cent of the catches.

Evidence points to a rapid growth for this species. Shrimp hatched out one season spawn and probably die the next. This life history makes it imperative that our shrimp-producing states, especially Texas, adopt some suitable method for the collection of fishery statistics concerning shrimp, as well as our fish. If depletion should set in, it might run a rapid course to extinction of shrimp. If some method were in force to obtain from the fishermen the catch per boat, per day or trip, depletion could be detected as soon as it sets in, and measures could be taken to stop any further inroads on the supply and to build up the supply again to its former level.

Spiders of Texas, by Stanley Mulaik.—The economic importance of many spiders as insect controls has been considerably underestimated by agriculture. These have remained one of the little-studied, though conspicuous, groups of invertebrates inhabiting Texas. Over three years of collecting in south Texas and a number of summers and week-ends into west and central Texas have netted over five hundred species, eighty-six of which are new. Thirty-three families, two of which are new to the fauna of the United States, and a number of new genera are included. The rate with which new state records and new species are being added indicates that there is still much to be done in this large group, specially in the work on microscopic spiders. Likewise, life histories need to be worked out, in order to understand better the biology of the group.

New method for the determination of the velocity of absorption of water by different regions of the root, by H. F. Rosene and E. J. Lund.—For the first time it has been possible to make a quantitative determination of the distribution of the rate of the absorption of water in a single intact root under controlled conditions (humidity, transpiration, light, etc.). This was accomplished by means of a technique that permitted a comparison of the velocity of absorption of different regions of the same root simultaneously under the same conditions. Measurements were made on the roots of small white onions *(Allium cepa)* which were grown either in a saturated atmosphere or in tap water in the dark at 28° C.

The experimental chamber consisted of a removable glass cover which fitted over the apparatus and rested in a groove in a bakelite base. An onion bulb from which all roots but one had been carefully removed was placed in a cork ring held by a swivel attachment, which was supported by a rod that passed through the base and was mechanically manipulated from the outside. Water was absorbed from small glass potetometers which consisted of graduated capillary tubes of uniform bore and twenty-five millimeters or more in length made from pyrex tubing. One end of each tube had been ground down on opposite sides and a hole had been bored through for the passage of the root. A selected number of tubes were carefully aligned and cemented in horizontal positions at given distances to a vertical support which passed through the base and was manipulated from the outside. By means of delicate adjustments of three-way manipulators on the outside of the chamber, it was possible to thread the intact root without injury or stimulation through the holes in the horizontal tubes by either moving the root down through the holes or by moving the tubes up over the root to the desired position. All adjustments were made with the aid of a horizontal microscope which was fitted with a micrometer ocular for the measurements. The apparatus made possible very accurate placing of the tubes and control of the water levels. When desired the contacts were maintained at given distances from the apex by moving them at frequent intervals. Air or other gases saturated with water vapor were circulated through the chamber by means of entrance and exit tubes that passed through the bakelite base. The chamber could be completely isolated from the exterior.

The rate of water absorption was determined by recording the movement of the terminal meniscus in each tube. By making a series of careful measurements of the diameter of the root at each region under observation it was possible to make a reasonably accurate estimate of the volume of tissue in any given region. A typical series of determinations made on certain regions of the first 16 mm. of a given root during a 15-hour period when it grew from 30.2 mm. to 40 mm. in length gave the following averages in milligrams of water per hour per cubic millimeter of tissue at the regions designated: 0.19 mg. by the two millimeter segment between points 0.5 to 2.5 mm. from the apex, 0.30 mg. by the segment represented by the fourth and fifth millimeters, 0.42 mg. by the ninth and tenth millimeters, and 0.613 mg. by the fourteenth and fifteenth millimeters of the root.

Life of Frederick Wilheim Thurow, by Martinus H. Stougaard.—Thurow was born at Wartenstein, Germany, April 3, 1852. In 1864 his parents migrated to Burlington, Wisconsin, where his mother died shortly afterwards. His father left for parts unknown and he remained at the mercy of relatives, for whom he worked to earn his board and clothing. Though he had practically no schooling, after his first wages began at the age of 15 he spent everything he had for books to get an education and accumulated a fine library that consisted mainly of scientific and natural history books. He became especially proficient in botany.

In 1876 he left for Texas and settled near Hockley, Waller County. Here he set out exploring the surrounding country and discovered many new species, one of which was later named *Thurowia triflora.* He made contacts with a number of prominent botanists, one of which was J. M. Coulter, whom he assisted in collecting material for Coulter's *Botany of West Texas.* He furnished also the U. S. National Museum and the Field Museum with hundreds of specimens. His collection of 1600 Texas species of plants constitutes the herbarium located at present at Sam Houston State Teacher's College at Huntsville.

Thurow died in the Harris County Old Folk's Home in May, 1930.

Pollution of East Fork of Trinity River at McKinney, Texas, by A. H. Wiebe.—That this stream is grossly polluted is shown by a set of dissolved-oxygen determinations on September 24th, 1935. At a point 0.5 of a mile below the city discharge the $O_2 = 0.0$ p.p.m.; at 3.5 miles, 1.25 p.p.m.; at 7 miles, 2.5 p.p.m.; and at 14 miles, 3.44 p.p.m. The flow of the creek had practically ceased. On October 10th, three days after a heavy rain, conditions were greatly improved. Seven days later conditions were again bad. The disposal plant handles the domestic sewage of the city as well as the sewage from a cotton mill where cotton is dyed. The sewage from this mill is a combination of domestic and industrial (dye) waste, and its character is subject to wide variations. The effluent of the sewage plant had a pH varying from 7.6 to 8.0, and that of the cotton mill from 7.0 to 10.0(?). Total alkalinity of the former is from 900 to 1,000 p.p.m.; that of the latter approximately 1,100. The immediate oxygen demand ranges from 12.56 to 14.6 p.p.m. in the former and from 22.45 to 28.78 in the latter. The sewage plant effluent contains 21 p.p.m. H_2S (5 p.p.m. are lethal to fish) and 29 p.p.m. sulfide as Na_2S. The pollution of the stream is not due to a direct action of the waste dye (except as H_2S) but to the overloading of the stream with unstable organic matter. A mixture of 50 per cent sewage plant effluent and 50 per cent mill effluent failed to kill catfish in 72 hours so long as O_2 was supplied (aeration removes H_2S). Either $Al_2(SO_4)_3$ or $FeCl_3$ will remove the waste dye completely and leave clear supernatant liquid.

Effect of water-soluble fraction of crude oil on fresh-water fish, by A. H. Wiebe.—An extensive series of experiments with fresh-water fish shows that crude oil contains a water-soluble gas extremely toxic to fish. The gas enters the water when the latter is shaken in contact with the oil or by diffusion from a layer of crude oil over the surface. The subnatant liquid from a water-and-oil mixture containing as little as 0.5 per cent crude oil caused an 11-centimeter bass and a 6-centimeter bream to lose their equilibria in 32 and 25 minutes respectively. Higher concentrations of crude oil are more rapidly fatal. Concentrations of 0.1 per cent and 0.05 per cent produced no ill effects. A 10-per cent mixture of refined oil yielded no toxic substances. The toxic substance is a gas and can be completely removed by mechanical aeration. Fish that have lost their equilibria in the presence of this gas recover completely if transferred immediately to fresh water.

Vertical distribution of dissolved oxygen in some Texas lakes, by A. H. Wiebe.—The variations with depth of dissolved oxygen have been determined for lakes Medina, Cisco, Kemp, and others. A series of readings for Medina Lake on August 13th, 1934, is as follows: surface, 8.0 p.p.m.; at 10 feet, 7.6 p.p.m.; at 20 feet, 7.2 p.p.m.; at 30 feet, 5.2 p.p.m.; at 40 feet, 2.4 p.p.m.; at 50 feet, 1.0 p.p.m.; at 60 feet, 0.0 p.p.m. The winter overturn again affects the almost uniform distribution of O_2. On March 11th, 1935, the O_2 in Medina Lake decreased from 9.45 p.p.m. at the surafce to 5.25 p.p.m. at 95 feet. Lake Cisco has a definite thermocline between a depth of 24 and 34 feet during the summer. At the bottom of the thermocline and in the hypolimnion dissolved oxygen is absent; the epilimnion has 6.4 p.p.m. That the stratification depends on the size and shape of the lake as well as on the depth of the lake is shown by the data for lakes Cisco and Kemp. These lakes have approximately the same maximum depth, yet Lake Cisco shows a much more complete stratification. Lake Kemp has no thermocline. Lake Waco shows no stratification, whereas a much smaller lake, Lake Crockett, shows definite variations in dissolved oxygen with respect to depth. The maximum depths of these two lakes were the same at the time of the observation.

Investigations on the cause of puffing in tomatoes, by S. H. Yarnell.—As early as 1894 R. H. Price found the Terra Cotta variety of tomatoes to be badly puffed. Affected fruits are partially hollow because of abnormal development of the seed-bearing tissue. Wide differences have since been found in the amount of puffing in present-day varieties. Marglobe, one of the most popular varieties, is one of the worst to puff. Bonny Best, another popular variety, has much less puff. Significant differences have been found between strains of certain varieties. Selections of plants showing least and greatest amount of puff have also given significant differences between their progeny. Intervarietal crosses have less puff than the parent varieties because of covering up of hereditary factors affecting this character by dominant factors for normal development from the other parent. Environmental factors, such as the amount of available water, also affect the amount of puff obtained.

PHYSICS, CHEMISTRY, AND ENGINEERING

Trends in water purification, by H. R. Arrant.—Through the splendid cooperation of state and national health agencies water purification plants are improving by procuring better equipment and by employing better-trained operators. The aim of these plants and organizations is toward uniformity in water treatment procedure and technique, the objective being to provide water that is free of bacteriological impurities and reasonably soft and palatable (free from objectionable taste and odor). Uniformity and efficiency are accomplished, in part at least, by facilities for coagulation, sedimentation, filtration, and chlorination as primary treatment processes. In addition to these aeration, ammonification, and adsorption through the use of activated carbon are looked upon as valuable secondary processes. The accomplishment of these objectives is in no way completed. Much study and research remain to be done. Details and procedures will undoubtedlv be changed frequently, but the general trend is fairly well established along the lines indicated.

Bromine-sensitized photo-decomposition of gaseous dibromotetrachloroethane, by James L. Carrico.—Quantum yields of the bromine-sensitized photodecomposition of dibromotetrachloroethane have been measured with 4358Å radiation between 100–150° C. and they established the chain nature of the reaction. Conditions have been chosen to render the reverse reaction more or less negligible. The rate of decomposition has been found proportional to the dibromotetrachloroethane pressure and proportional to the first power of the light intensity at relatively low intensities but to a power less than the first when the light intensities become higher. A satisfactory mechanism involving bromine atoms and a C_2Cl_4Br intermediate has been developed. This mechanism attributes an inhibition to the bromine. The mechanism follows:

$$
\begin{array}{ll}
 & (1)\ Br_2 + h\nu \rightarrow 2Br \\
(2) & (2')\ Br + C_2Cl_4Br_2 \rightleftarrows C_2Cl_4Br + Br_2 \\
(3) & (3')\ C_2Cl_4Br \rightleftarrows C_2Cl_4 + Br \\
 & (4)\ Br \rightarrow Br(\text{Wall}) \rightarrow \tfrac{1}{2}Br_2 \\
 & (5)\ 2Br + M \rightarrow Br_2 + M
\end{array}
$$

This work was done in collaboration with Dr. R. G. Dickinson, Institute of Technology, California.

Recent potash investigations in west Texas, by Wm. A. Cunningham.—The recently completed survey of the potash resources in west Texas (made under the direction of the Board of Regents, The University of Texas) indicates the possible presence of polyhalite-bearing strata of commercial importance in Crane, Ector, Upton, Crockett, Midland, and Irion counties. The survey was conducted by chemical and microscopical examination of cuttings from oil wells drilled in the area, hence results are only qualitative. Data concerning the thickness and purity of the strata are available only by core drilling. No definite indication of the presence of soluble potash minerals was found.

The areas where polyhalite ($2CaSO_4 \cdot MgSO_4 \cdot K_2SO_4 \cdot 2H_2O$) was found in largest quantities are on or near the edge of the original Perman Salt Basin and not in the middle or deepest portions of the basin. Since this is contrary to the accepted principles of deposition of evaporites, it indicates that polyhalite formation took place near the point of influx of gypsum, the least soluble of the three minerals.

Spectroscopic method for the determination of vitamin A, by A. B. Kemmerer.—The importance of vitamin A as a nutritive factor in the diet necessitates speedy and accurate methods for its assay. Biological procedures frequently used are: the growth method, the opthalmic method, and the vaginal smear method. These methods within their limitations do very well, but progress will be expediated when suitable chemical techniques are standardized. The chemical methods for vitamin A are the antimony trichloride test and the spectrographic procedure. The spectrographic method has been tested and used successfully at this laboratory for vitamin A in butters and livers. The technique consists in photographing the intensity of the absorption bands at 328 mμ of the unsaponifiable residue dissolved in methanol. The amount of vitamin A is then calculated by use of the Beer-Lambert equation $E = 1/cd \log I/I_o$ where E is 1600 (the extinction coefficient of pure vitamin A), d the depth in centimeters of the solution $\log I/I_o$ the reading of the sectorphotometer, and c the concentration of vitamin A.

To obtain the most accurate results the methyl alcohol solution of the unsaponifiable residue must be purified by cooling several hours with an ice-salt mixture. This removes substances other than vitamin A that absorb at 328μ. After purifying, the methyl alcohol solution must be diluted to such a volume as to give a value for $\log I/I_o$ of 0.6 to 1.1. Also apparatus with ground glass seals should be used as material from either cork or rubber stoppers absorb 328mμ.

MacDonald Observatory, by J. M. Kuehne.—Through the munificent bequest of W. J. McDonald and the unique arrangement of cooperation with Yerkes Observatory, Texas has suddenly come into the possession of an astronomical observatory that will rank among the foremost in the world. The type of equipment is such as to adapt it to the problems of modern astronomy or astrophysics. An 80-inch reflecting telescope having many unique features and a spectroscopic equipment in advance of anything so far realized are to constitute the basic instrumental equipment. The location in Davis Mountains seems, from all indications, to be one of the most favorable so far found. With a strong personnel of astronomers in charge of the work, great results can be confidently expected.

Study of gasoline sold in Texas and review of gasoline specifications, by David McKnight, Jr., and Ruben F. Pfenning.—A review of the technical literature reveals that, in the light of present knowledge on the subject, a satisfactory motor gasoline can be assured by specifying minimum 10-per cent, 50-per cent, and 90-per cent points on the distillation curve, maximum vapor pressure, maximum sulphur and gum contents, negative doctor and corrosion tests, and range of anti-knock rating. The allowable vapor pressure, varies with climatic conditions and with the time of the year. Range of anti-knock values varies according to the type of motor in which the gasoline is to be used. Most distributors offer three grades of gasolines, from which the motorist must choose the grade that gives most satisfactory performance in his car. Of seventy-seven gasolines obtained in Austin, Houston, and San Antonio, only a few were found unsatisfactory, as judged by the specifications mentioned. The only general conclusion to be gained from the results is that the motorist will do well to beware of gasolines offered at inordinately low prices. (Published as Univ. Texas Bull. 3543.)

The use of the Schlumberger electrical logging, by J. L. Mathieu.—The Schlumberger process is electrical and uses two electrical diagrams for the identification of formations. One shows the electrical resistivity of the formations; the other their permeability. The first diagram, or log, varies with the electrical resistance of the successive formations, which is directly related to the amount of conductive salt water contained. The second diagram varies according to the electrical current generated spontaneously opposite a porous medium by electro-filtration and electro-osmosis phenomena. These two diagrams offer: (1) numerous points of correlation in neighbouring wells, permitting the exact location of faults and the otherwise improved subsurface mapping of a field; (2) cross-country correlations; (3) information about physical characteristics of formations and often about the exact character of the fluids contained; (4) location of porous media overlooked in the drilling. The

Schlumberger method can therefore aid the geologist greatly in his subsurface studies, and the production engineer in his problems about casing points, perforating depths, water determination, and other salient problems.

Chemistry of color in Texas bluebonnets (Lupinus texensis), by Sister Michael Edward O'Byrne.—Chrysanthemin chloride, an anthocyanin coloring matter has been isolated. It was purified by the use of picric acid. This pigment on hydrolysis yields cyanidin chloride and glucose. In appearance and reactions with chemical reagents the crystals resemble those of Willistater and Bolton. The fats and waxes were extracted with ether; the pigment was extracted by means of five-per cent methyl alcoholic hydrogen chloride and evaporated under reduced pressure. After filtration, the deep red solution was treated again with ether. This precipitate was dissolved in 0.01-per cent aqueous hydrochloric acid. The anthocyanin, as a bluish violet salt, resulted from the addition of neutral lead acetate. This pigment was dissolved in a minimum quantity of 10-per cent methyl alcoholic hydrogen chloride, and the lead chloride was removed by filtration. The pigment was then converted into chrysanthemin picrate. The picrate has a metallic lustre and forms slender needle-like prisms. The chloride showed diamond-shaped platelets.

Recent advances in oil-field technology and their application to oil-field production problems, by B. F. Plummer.—This paper presents a brief résumé of the history of the petroleum industry and the present importance of petroleum as the state's largest natural resource except underground water; importance of one or two of the leading recent technical developmnts in measuring the reservoir energy and in controlling rate of flow of oil through sands; and a brief description of two recent investigations carried on at The University of Texas and their application to these problems.

GEOLOGY AND GEOGRAPHY

Fluorescence and phosphorescence of certain minerals when exposed to the ultra-violet rays of the iron arc spark-gap lamp, by Clarence L. Brock.—Few people have seen the beautiful colors exhibited by certain minerals exposed to the ultra-violet rays, because the cost of equipment has been almost prohibitive. Now this equipment is so priced, that lamps of several types are owned by museums, schools, and colleges, and one type of lamp (argon gas-filled bulb) sells for half a dollar, so that almost any mineral collector can afford some type of lamp.

Willemite from New Jersey comes in many shades of green, brown, and red, as well as in white. This mineral fluoresces a beautiful apple-green, and the white variety phosphoresces long after the light is turned off. A pinkish calcite from Brewster County, Texas, is fluorescent pink and phosphorescent a rare shade of purple. Sphalerite from Tsumeb, Africa, fluoresces and phosphoresces golden. Hyalite from Mitchell County, North Carolina, fluoresces bluish green. Calcium arsenate from Franklin, New Jersey, fluoresces yellow. Scheelite from Nevada fluoresces blue. Fluorite from England fluoresces a beautiful purple. Calcite from Franklin, New Jersey, fluoresces a beautiful pink or red. In addition to these and many other minerals, certain shells, butterflies, and many kinds of wood show fluorescence.

Scientific gleanings from the Anglo-Saxon Chronicle, by Augusta H. Kemp.—These consist largely of records of eclipses. In the meticulous care with which their dates and times are recorded, and the way in which other facts are stated, we see some signs of the scientific spirit during the "Dark Ages."

An exhibit of gastroliths from Wyoming, by Augusta H. Kemp.—These gastroliths came from the eastern foothills of the Wind River Mountains about 20 miles southwest of Lander, Wyoming. Most of them were found on the slopes of the Morrison formation not far from a large mass of *Brontosaur* bones. The pebbles are all quartzitic rocks and are highly polished.

Hydrothermal activity in Yellowstone and other points in Wyoming, by Augusta H. Kemp.—The extent of hydrothermal action in Yellowstone is not realized until the region is seen. Hot springs are active, or have been active, in widely separated areas, such as Cody, Thermopolis, and Alcova. At these points their activity is associated with thrust faults or folds. Sulphur of low commercial value is associated with some of these hydrothermal deposits.

Additions to the knowledge of the paleobotany of Bexar County, by H. B. Parks and A. J. Kirn.—Dr. E. W. Berry (U. S. Geol. Survey, Prof. Paper 91) records ten species of fossil plants collected by Alexander Deussen and L. W. Stephenson, at Earle, Texas, and concludes that the formation is lower Midway, an opinion that he has maintained for years. An intensive study of this location shows definitely that the plant impressions occur in a layer about the middle of the Simsboro sand member of the Rockdale and that this layer in this part of the state is generally fossiliferous. Careful collecting has added thirty-seven species to the original list. Later Dr. Berry identified thirty-five species from the Lytle location. Thirty-five species were collected from fragments of the rock removed from the Adkins location and used for road metal. Ten species are known from a newly discovered boulder near Sayres. A systematic tabulation of species from the sandstone boulders shows seventy species. In clay and sand locations in the same layer about the same number of species is found. If Dr. Berry had had sufficient material, he would have correlated this flora with that part of the section now known as Rockdale Wilcox instead of with the Midway. The central sandy member of the Simsboro contains fossil plants throughout Bexar and adjoining counties.

It is very evident that the concretions represent the filling of pot holes by slowly deposited sand containing organic matter and that the decay of organic matter caused the concretions. These must have been located in streams flowing from Eocene land to the ocean. The plant material obtained from the clay and packed sand indicate that the vegetable material was either blown or washed out on a sandy beach where it was later covered by very thin layers of sand seemingly deposited in shallow waters.

A number of undescribed plants occur in this material. The collection, with the exception of a few specimens, is in the hands of the authors.

Microscopical evidence of the Navarro-Taylor contact in subsurface sections in central Texas, by Helen Jeanne Plummer.—Each of the two grey, calcareous clay units, the Navarro and Taylor formations, have been found in outcrop to carry numerous diagnostic species of foraminifera, and *Inoceramus* prisms have been observed in no strata higher than the topmost Taylor. Geologic sections penetrated by wells are represented mainly by series of cuttings contaminated by any or all the strata above each sample taken. In such material, formations where first penetrated are likely to be present in small proportions in the samples taken just below the upper formational limit. Consequently only the most abundant species present in the top of a formation are likely to be observed in the concentrates. In central Texas the best evidence of topmost Taylor has been found to be *Inoceramus* prisms, *Anomalina henbesti* Plummer, and *Cibicides nelsoni* (W. Berry). (See Univ. Texas Bull. 3501, pp. 281–292, 1936.)

Hurricanes, deltas, and resacas, by W. Armstrong Price.—A resume of salient characteristics of tropical cyclones, and their severe phases known as "hurricanes," with the geologic work attributable to them in Texas coastal lowlands.

Although two or three cyclones occur monthly somewhere on the earth, severe damage is rare at any one point, because of their curving paths and the narrow zone of heavy damage compared to the great width of the storms. Texas expects one hurricane in three years, any coastal town one in 14.3 years (but irregularly grouped in a century), and severe damage not oftener than twice a century. Hurricanes produce storm floods 10 to 16 feet high with strong winds and waves for periods of 24 to 48 hours and with heavy soaking rains. Their total erosive effect on bluffs of clay and low-lying sand and silt deposits has been very great, probably including much of the marine planation which widened Texas bays during the Recent period from narrow, drowned valleys to oval basins eight to ten miles wide. Hurricane tides form new tidal inlets in the offshore bar.

The Coast Prairie and adjoining Lissie Prairie are deltaic plains built during the Pleistocene. Floods following the striking of tropical cyclones on mountains and hills interior to the Coastal plain did much of the delta building by forming new distributaries or "resacas," and by spreading silt over the plain. Delta building in Texas ceased with a sea-level change at the end of the Ice Age, except for the active Rio Grande Delta, known as the Lower Rio Grande "Valley."

Prediction of numerous Gulf cyclones between 1933 and 1935, inclusive, and of their concentration in the Brownsville and Tampico sectors, was made in 1932 from statistical studies. An interesting phase of local hurricane lore is the belief (apparently true for this coast) that hurricanes strike only in the light of the moon and toward full moon.

Geologic criteria of climatic zone boundaries in the south Texas depositional plains, by W. Armstrong Price.—Thornthwaite's new quantitative classification of climate is recommended as a substitute for the rainfall zones as climatic zone boundaries. Distribution patterns of physiographic types and geologic deposits dependant upon climatic factors, of soil types, of soil minerals, and, so far as the writer knows, of plant assemblages and agricultural methods fit Thornthwaite zones closely. Rainfall zones fit only roughly with appreciable disconformity.

Variation of stream pattern, abundance and permanence of stream branches, effective wind scour, sand movement, dune occurrence (both sand and clay dunes), evaporites in lagoons and playa lakes, boundaries of lime-accumulating and non-lime-accumulating soil types, and the distribution of caliche in Pliocene strata—all these evidences have been employed in checking the Thornthwaite zones and zone boundaries. Distribution of young stages of caliche in Pleistocene coastal plain deposits also checks the climatic zones. These checks are remarkably close.

Tentative glacial time scale for south Texas Quaternary formations, by W. Armstrong Price and John Doering.—Two positive tie points have been found. (1) The gravel bed below the Goliad sandstone of Howeth and Martyn (LaBahia beds of Plummer) contains unworn bones of *Hipparion,* a Pliocene horse, identified by Chester Stock. The Goliad and overlying Willis strata (of Doering) seem to form one period of sedimentation followed by pre-Lissie warping. Pleistocene is assumed to begin with the basal gravel of the Lissie. (2) The Ingleside terrace (of Price) is a shoreline of latest Beaumont time, the Beaumont outcrop showing fluviatile deposits. Sea level then fell more than 50 feet, dropping by stages that are represented by river terraces (Corpus Christi and Angelita terraces on the Nueces). The return of the sea to the present level began in the Recent epoch with dry-humid and semi-arid climate in south Texas. The preceding low sea-level stage was not more arid than today. The latest Beaumont sedimentation occurred in a pluvial period. Hence the Ingleside terrace represents the last interglacial stage (Peorian). Post-Ingleside Pleistocene represents the last glacial stage (Wisconsin).

Other possible tie points are suggested. The loess on the Beaumont terrace up Mississippi River (Doering) is probably Iowan (glacial) on pre-Ingleside surface. Bayside coquina (Price) may represent the Sangamon interglacial stage, and basal Beaumont the Illinoisan, leaving Lissie to cover Yarmouth, Kansan, Aftonian, and Nebraskan.

Biology of fossil crabs, by H. B. Stenzel.—The shape and structure of an animal is indicative of its mode of life. Even in fossils it is possible to make deductions concerning life habits. The position of the eyes is characteristic in species that live partly or largely buried in bottom sediment. Their eyes are turned upward and forward, as in *Calappa, Calappilia,* and *Notopocorystes.*

Fossil moults of crabs are common. They are recognized by the displacement of arms with reference to the top of the carapace, although left and right arms are in place with reference to each other. This indicates a cleft between top and bottom of the moulted skin. Moults of fossil shrimp are recognized by a gap between the cephalothorax and the abdomen.

Some contributions of paleontology, by N. L. Thomas.—Ideas concerning fluctuations of sea-level, evolution of organisms, and the use of fossils for correlations have been amongst the leading contributions. Zones of index fossils and the appearance and disappearance of fossils are used for correlation. Formations, fossil zones, and time horizons are three different units, the first two being useful for determining the third.

SOCIAL SCIENCES

The Texas Securities Act, by Carl E. Ashburn.—The Texas Securities Act, which went into effect May 23, 1935, should be thoroughly understood by every person in the state. The act was sponsored and guided by Gerald C. Mann, brilliant former Secretary of State. The whole purpose of the act is to protect Texas investors from sellers of worthless securities and to prevent outright fraud. The Legislature passed the new Securities Act to supplant the old Blue Sky Law, which was notoriously ineffective. The act is modelled on the Pennsylvania statute, which has served that state effectively for twelve years. The penal provisions of the act are stringent, and the law is doubtless one of the most constructive pieces of legislation ever passed by a Texas legislature. Stocks, bonds, certificates of interest in oil and gas properties, and many other forms of commercial interests are defined as *securities* under the law. The act requires the registration of the issuers of securities, security dealers, and salesmen, and explicitly defines their activities. Permits are issued for one year and are revocable at any time for violation of the law's provisions. Sworn statements are required of those registered with regard to the securities in which they propose to deal, and copies of all advertising literature in the furtherance of security sales are required to be filed with the Department of State. Administration of the Texas Securities Act is vested in the person of the Secretary of State. Finally, it must be stated that the Texas Securities Act was passed to run the stock swindler and racketeer out of Texas. This state has been infested by security parasites far too long. They must be driven out of the state and the investment business placed in the hands of honest men. When the crooked dealers and salesmen are exterminated, legitimate business will be greatly helped.

Deforestation, the nemesis of historic cizilizations, by O. C. Charlton.—Long before the Christian Era the most highly civilized nations of eastern Asia and of the Mediterranean region sacrificed their forests both in peace and war. Coincident therewith their resources for pastoral life, in agriculture and in inland waters, decreased, and the stagnation of poverty gradually succeeded. In all this vast region the ruins of exhausted civilizations abound. Shall we not hope that enlightened statesmanship, aided by science, will restore forests ultimately to these ancient lands and with them renew the prosperity of remote ages?

Reactionary aspects of the so-called "New Deal" in the light of possible social orders, by F. B. Clark.—If we view the social orders from the puristic point of view, we are forced to conclude that the human intellect is capable of conceiving of only five social orders. Any one of these five may become an established order. By way of historical sequence these possible five social orders are: (1) anarchy, (2) communism, (3) feudalism, (4) mercantilism, and (5) economic freedom. The order which the so-called "New Deal" challenges is the last. It is possible to examine the essential characteristics of each of these social orders. If that is done, we are led to conclude that the characteristics of the "New Deal" are almost identical with those of mercantilism. Since, therefore, the so-called "New Deal" amounts to an effort to re-establish mercantilism, an order which has long been discredited, we are forced to conclude that the so-called "New Deal" is reactionary in nature.

Social sciences in the revised curriculum, by S. B. McAlister.—Our public-school-trained students are greatly deficient in the fundamentals of sociology, economics, and government. This is due primarily to (1) unbalanced public-school curriculum, and (2) lack of training of the school teachers of Texas in the social sciences. A pupil may graduate from a fully accredited high school without having studied in an organized way sociology, economics, or government. Knowledge of these subjects is not required either for admission to, or graduation from, our colleges or universities. About six per cent of our college faculties are engaged in teaching courses in sociology, economics, and government. Few teachers major or minor in these subjects because they are not taught in the public schools. Our college and public-school leaders should give more thought to the place of the social sciences in the modernized curriculum.

The cotton program in Egypt, by J. S. Mogford.—The growing of crops in Egypt, the granary of the East, antedate her recorded dates in history. Ancient tombs have carved on their walls picturesque designs of ancient agriculturists engaged in their daily toil. In many of the tombs grains of wheat and barley were stored. The Egyptian proper is truly an agronomist; he depends on the soil for his food and clothing. Cotton first came into Egypt as a crop in 1820. The growing of this crop has been directed more or less by the Egyptian government from its first introduction. An effort has been put forth to get the natives to adopt modern methods in their cultural operations, but to date this encouragement has had little or no effect on the farmer. The high percentage of illiteracy has made it very hard for the foreigner to have any effect on the Egyptian's way of doing things. Egypt's seed-control program and marketing system, however, are being followed by all new cotton-growing countries. A study of the Egyptian farmer in his home, his methods of producing his living, implements used, and the way this crop (90 per cent of his cash income) is handled give one a better appreciation of how cotton is produced in different parts of the world.

Race survival under civilization, by J. E. Pearce.—The factors of race survival are considered according to the following outline:

1. The meaning of species and race in organic evolution.
    a. Race survival emphasized in all reproductive activities.
    b. Sense of kind in animal life.

2. Race in history.
    a. Effects of cross-breeding under slavery and conquest.
    b. Effects of pure race inbreeding; examples.

3. Disintegrative and degenerative factors under civilization.
    a. War.
    b. Slavery.
    c. Differential birth rate.
        (1) Luxury and standard of living.
        (2) Doctrine of equalitarianism.

4. Effects of care of the weak.
   a. Kindliness and its meaning in civilization.
   b. Medicine and eleemosynary institutions.
   c. Doctrine of all men equal.
5. The history of great peoples in the past.
   a. All have ultimately gone down.
   b. No one of them has ever come back.
6. Evidences of race decay in the Western world.
   a. Physical disease and physical decrepitude.
   b. Mental defects.
7. Eugenic program.

Evidence of early man in Texas, by J. E. Pearce.—Evidences of early man in Texas consist of (1) deep kitchen middens in central Texas, (2) oldest kitchen deposits on the coast, and (3) the oldest evidences of man in central Texas revealed in deposits uncovered in the bed of Tehuacana Creek at Waco and in an old diluvial terrace along Brush Creek at Round Rock. On the basis of such evidences it seems logical now to conclude that man must have come into North America during the retreat of the last ice sheet, probably some 20,000 years ago and that the earliest migration wave was either possessed of a low culture of late Paleolithic times or that in the vast raw American continent the culture of the first comers degenerated to a Paleolithic level and that later Neolithic culture was revived by later waves of migration from Asia.

Crime and civilization, by W. Armstrong Price.—We commonly say that the prevalence of crime reflects on civilization. Some psychologists startlingly announce that crime is one of its characteristic features. Civilization is *a* human culture. It arose from a single stem and spread throughout the world by a complex course. Its progress is attained by *change.* Non-civilized cultures are *static,* regulated by taboos strictly adhered to, preventing progress. Change, under civilization is accomplished mainly by law-breaking, in the widest sense, *crime.* All great reformers were criminals, consciously breaking laws for the advancement of the race. Change by legal processes have proved ineffective, because slow. Unfortunately the spirit of unrest, which has fostered civilization, engenders also *violent* crimes, prevalent where progress is most rapid, as in pioneer lands.

Influences that contribute to the development of a wholesome personality, by Jesse D. Reynolds.—Properly trained individuals frequently can detect symptoms of personality defects in their incipiency and can trace their genesis to such causes in the home as early formation of bad habits, wrong methods of discipline, and faulty attitudes of the parents toward their children. Often schools are at fault in failing to supervise adequately the selection of courses, in training the intellect and neglecting the emotions, and in emphasizing what the child is, rather than what he may become. Such other causes as physical defects, mental inferiority, and deep underlying mental conflicts often can be detected. A wholesome personality is important to the individual, as it affects his vocational success and his feeling of social adequacy; it is important to society, in that defective personality is a basic factor in delinquency, dependency, and poverty. Because of present waste in money and in human personality, child-guidance departments should be established in connection with our public schools and be given real financial support.

Some men of science, by B. E. Schulze.—A study of the men who have made worth-while contributions to the theoretical phases of the physical sciences shows that they were comparatively very young men, some of humble origin and others highborn. The rule as to age does not appear to hold, when the great experimentalists are studied, and several important cases may be cited. Further, the men who have advanced the frontiers in science most were and are men of great versatility. It appears, therefore that encouragement should early be given to those that show ability to the end that their powers will not be lost to civilization.

The proposed Big Bend National Park, by W. M. Winton.—This area of the Big Bend of Texas is the American half of a proposed International Park, which will preserve a typical sonoran region. Several of the parks already established by the United States exhibit either the high montane type of flora and fauna or the intervening desert phenomena, but no one of these shows the characteristic sonoran features of deserts and mountains or "life islands." At present the region, at least on the American side, is nearly untouched, but road construction and other encroachments of civilization are threatening to change the original character and to upset the delicate balance of the living things.

The principal features of interest are in the geology, zoology, and botany; but it is thought that archeological possibilities exist. Basket-maker's caves are within the proposed boundaries.

MEDICAL SCIENCES

Some studies on the fiber composition of the spinal nerve roots, by Donald Duncan.—This is a brief review of the present knowledge of the types and sources of fibers in the dorsal and ventral roots, and some unpublished ratios of fibers to cells in the thoracic dorsal roots and ganglia of the cat. Most of the fibers in the ventral roots are myelinated and arise from spinal grey matter of the same side and segment. Varying small numbers of unmyelinated fibers are found, and fibers arising from cells in the opposite side of the cord, the dorsal root ganglia, and the ventral roots are described. The dorsal roots contain fibers arising principally from the corresponding dorsal root ganglia, but possibly a small percentage have cells of origin in the spinal cord and in adjacent ganglia. The number of fibers in the dorsal roots is within ten per cent of the number of cells in the ganglion. From 50 to 70 per cent of these fibers are unmyelinated in the cat.

Inheritance in diabetes, by Sidney E. Goldman.—One of every 250 persons in the United States suffers from *Diabetes mellitus.* The part that inheritance plays in its incidence has long puzzled the medical profession. For many reasons, the study is a difficult one on which to procure accurate and reliable data. A consensus of opinions of the best-informed men interested in this problem seems to be that diabetes is inherited as a pure Mendelian recessive. There seems to be some relation between inheritance of diabetes and race, explained partly by mode of living, type of work, and amount of exercise of the individual. Obesity and high living, together with mental anxiety, seem to be predisposing factors. The disease is contracted usually between the ages of forty and forty-five, and this has led medical authorities, insurance companies, and others interested in public health to warn against obesity, high living, rich foods, and lack of exercise during middle life.

Relation of maternal vitamin-A deficiency to embryonic eye development, by Fred Hale.—Forty-two pigs (four litters) were born blind at Texas Agricultural Experiment Station in the course of experiments relating to maternal vitamin-A deficiency. Other defects noted were cleft palate, cleft lip, accessory ears, and arrested ascension of the kidneys. Definite and complete genetic tests were made to determine whether or not an hereditary factor was responsible for the eye anomaly. Close matings, such as blind brother × blind sister, and normal mother × blind son, produced only normal pigs. These studies leave no reasonable doubt that maternal deficiency of vitamin A will result in a variety of defects in the offspring, including blindness and even a failure of complete development of eye tissue, cleft palate, cleft lip, and the arrested ascension of the embryo kidney.

Vitamin-A deficiency is by no means uncommon in human diet, and it may easily be that many of the eye weaknesses which we suffer today are due to maternal vitamin-A deficiency, just as Dr. H. M. Taylor has recently discovered that some of the deafness among southern children is due to quinine taken by the mother during pregnancy. In any case, it is obvious that until we have evidence to the contrary, we should insist on an abundance of vitamin A in the diet of the expectant mother in the early stages of pregnancy, when so many of the vital organs of the embryo are being formed.

Biological position of viruses, a review, by Dr. Hardy A. Kemp.—After forty years of study of viruses, their exact nature is still unknown. Four theories have been advanced: (1) inheritable cell mutations produced by external stimuli; (2) the formation through external stimuli of separable cell complexes not antigenic; (3) similar complexes antigenic; and (4) the possibility of a minute living organism. It is regarded as possible that the many virus diseases may be explained in particular through all these several explanations. (The full paper will be published in the *Texas State Journal of Medicine.)*

Use of the headless (spinal) cat for research on the nervous system, by Eugene L. Porter.—A cat is etherized, arteries to head tied, artificial respiration supplied, and head cut off. Such a preparation will survive for hours and show numerous reflexes from the spinal cord. The simplest is flexion of the leg on stimulating a "pain" nerve. If special precautions are taken to keep the nerve in normal condition, this flexion reflex can be used as a delicate indicator of the condition of the spinal cord. The effect of drugs on the cord, or the effect of changes in the character of the blood may be followed quantitatively for many hours. The resultant data are more accurate than those obtained on the whole animal.

Stereo-photography in teaching embryology, by J. G. Sinclair.—Students have great difficulty in visualizing the third dimension from sections. Some dissections are not satisfactory, because relations are distorted in the process. X-ray stereo-photography of many types and degrees of injection are easily procured. The negatives can then be reduced to the standard card size, or contact prints of small areas from the larger negatives can be made. Thus the cranial, thoracic, or pelvic circulation of the late foetus may be shown *in situ* before dissection. The use of the wide-field binocular, using a camera in each tube successively, covers the field from 1 mm. up to 45 mm. For higher powers it is possible to place two new screw holes at the sides of the old hole at one end of the track in a standard mirroscope, so the track can be shifted at the standard angle and the tube tilted. This permits even oil immersion stereo-photographs with the standard microscope. If smaller fields are satisfactory, it is possible to take stereo-photographs on two parts of one plate by shifting the image, thus using the two sides of the ocular separately. This is the principle in common use in producing stereo-images in the mon-objective binocular. In copying, fields larger than 45 mm. as in the Leitz copying stand using a Leica camera, a brass plate is placed between the sliding attachment and the stand. This plate has one screw hole and one slot whose limits are calculated to give just the proper tilt to the camera in two directions. Stereo-photographs of dissections have been used successfully in demonstrating the development of the palate, face, and diaphragm as well as brain neuromeres and ventricles.

Preparation and performance in medical students, by J. G. Sinclair.—The problem of selecting 100 from about 200 applicants for entrance to Medical School of The University of Texas calls for evaluation of previous records and determination of minimum requirements for entrance. It is commonly supposed that a longer period of pre-medical training would produce work of higher grade and fewer failures. Since the minimum requirement for entrance is two years of general college work, men coming with a degree should on the whole be better prepared. Out of 300 students studied over a two-year period, 90 with degrees averaged 2.3 per cent below the general average. The cause may lie possibly in the average age of entrance beyond the point of average greatest learning capacity, which is shown by Wechsler to be 21 years. Pre-medical scholastic records are not comparable for different schools, because of different methods of grading and of standards. Pre-medical aptitude tests are supposed to give a clue to capacity and are commonly used to weigh the applicants. It is true that a statistical correlation exists between tests and performance, but results are erratic as applied to any individual. Amongst 300 students, 232 aptitude scores available were recalculated in terms of grade expectancy. These were compared with the average two-year performance. The expectancy shows an average deviation of 4.1 per cent with individual deviations of 12 to 32 per cent. This is in contrast to the average grade of two first-year courses, a grade that shows an average deviation from the two-year (14-course) average of 1.7 per cent with a single deviation of 8 per cent for 300 students. Those whose expectancy on aptitude scores was below 70 (43 students) actually averaged 73 and included one at 89 and six above 80. The 27 who actually failed had an average aptitude expectancy of 68, but this group included students who should have made 80, 82, or 83.

Notes on problems in teaching embryology, by J. G. Sinclair.—In teaching embryology, an important objective is to present the unity of the animal world and the great similarity of developmental processes. Some facts available for this purpose are commonly omitted from text-books. Mesoderm formation in *Amphioxus* is presented as pouched evaginations from the archenteron in the form of somites, neglecting the fact that more caudal somites are formed exactly like the amphibian and still more caudal somites like the chick and man. Human amnion formation is pictured like that of the hedgehog and unlike that of other primates. The youngest human embryo known is the Miller embryo, and it shows an invaginated pit suggesting the method the amnion formation like other primates. Endoderm in the chick and human is pictured as forming by delamination, while a close study of thin sections shows proliferation from two grooves lateral to the primitive knot and a very small blastopore present in the primitive knot up to the 11-somite stage. Origin of the tongue is said to be hypothetically traced to occipital somites. It need not be hypothetical if frontal and transverse section of the stages between 20 and 30 somites be correlated.

AFFILIATED SOCIETIES

A brief account of each local society affiliated with the Texas Academy of Science is here presented, together with the officers of each during the year 1935–1936.

Beta Beta Beta, Beta Tau Chapter, was organized at Baylor University May 15, 1931. Its aim is to encourage high scholarship in the biological sciences by promoting interest in research being done in this field through acquaintanceship with current literature and by bringing about friendly social relationships between biological students and alumni. At each meeting a member presents a paper of interest, and occasionally a guest speaker gives a lecture. The present officers are: Walter B. King, President; Billie Lynn Packingham, Secretary (Dept. of Biology, Baylor University, Waco); Brewer Wheelis, Historian; and G. E. Potter, Treasurer.

The *Central Texas Section of the American Chemical Society* was organized in 1916 and comprises the members of the American Chemical Society residing in central Texas, which includes the area bounded by Dallas and Fort Worth on the north and by College Station, Georgetown, and Austin on the south. Approximately eighty members meet twice annually to enjoy a program of original papers or to hear lectures by chemists of national reputation. The officers are: H. L. Lochte, President; N. C. Hamner, Vice-President; W. T. Gooch, Secretary-Treasurer (Baylor University, Waco); and J. R. Bailey, Councillor.

The *Dallas Astronomical Society* was organized in November, 1921, to promote astronomical knowledge by personal intercourse of its members, to present papers and lectures, to acquire telescopes and other astronomical instruments, to establish and maintain a suitable library, and to erect and operate an astronomical observatory in the vicinity of Dallas. The subsidiary organization known as Howard Observatory was formed in October, 1926, and is controlled by officers of the Dallas Astronomical Society. The equipment consists of a 12¼-inch reflecting telescope equatorially mounted. Dr. A. D. Laugenour, Chester A. Howard, and Prof. J. D. Boon make studies of planetary markings; E. F. McIntyre, Dr. A. D. Laugnenour, and Chester A. Howard study the supposed lunar changes of surface detail. The present officers are: Chester A. Howard, President; W. F. Bane and D. E. Waggoner, Vice Presidents; P. W. Eble, Secretary-Treasurer (1033 Cedar Hill, Dallas); and Mrs. Chester A. Howard, Librarian.

The *El Paso Archeological Society* was organized June 15, 1922, by a small group of El Pasoans interested in the study of archeological problems of the Southwest. The purpose of the organization has been to promote the study of this science and to preserve the records of ancient life in the Southwest. Through the generosity of friends and members sites near El Paso have been surveyed and artifacts collected by the society have been stored in the Public Library. At present the organization is inactive, but it is likely that renewed activity will be resumed in the near future. Meanwhile Miss Maude Sullivan, Librarian of the El Paso Public Library and former secretary-treasurer of the society, is preserving the records and the collections.

The *Faculty Science Club of The University of Texas* was founded December 8, 1911. Its purpose is to encourage scientific research and study amongst its members. Meetings are the first Monday evening in each month and speakers are procured through a regular exchange with A. & M. Seminar and Houston Philosophical Society. The present officers are: D. W. Goldsmith, President; and F. M. Bullard, Secretary-Treasurer.

Houston Museum and Scientific Society, Inc., was organized in 1909 and incorporated with a fifty-year charter. Its purpose was to establish a free public museum in Houston and to sponsor scientific lectures and research. In 1914 the society procured a part of the H. P. Atwater Collection, which was installed with a few other exhibits in a building in Hermann Park and opened in 1928. In 1930 the society came into possession of the Major John Milsaps Collection of minerals and other specimens and also of the Sigmund Westheimer Collection (balance of Atwater Collection), and the museum was opened in a new building in Hermann Park in 1930. Property and collections belong to the City of Houston, but the society owns books, pamphlets, and cash. The present officers are: Alston Clapp, Sr., President; Geo. L. Fisher, Vice President; J. W. Stiles, Treasurer; and Clarence L. Brock, Secretary and Director (Hermann Park, Houston).

The *North Texas Biological Society* was organized in 1924 at Fort Worth for the purpose of binding together a group interested in biological work. The organization holds meetings regularly in March or April, and other meetings are irregularly scheduled on occasion throughout the year. The only publication issued consists of mimeographed abstracts of papers distributed to members at time of registration at the annual meetings. The present officers are: Mayne Longnecker, President; George Potter, Vice President; W. L. Hughes, Secretary-Treasurer (North Texas Agricultural College, Arlington).

The *Science Club of Texas Technological College* was organized December 3, 1925, at Lubbock for the purpose of stimulating interest in scientific progress, of diffusing scientific knowledge, and of promoting fellowship amongst its members. The group meets once each month during the school year. The present officers are: C. C. Schmidt, President; W. F. Helwig, Secretary; and Harry Hill, Treasurer.

Southwestern Science Society was organized in 1918 on the campus of Southwestern University at Georgetown as the Southwestern Chemical Society. Within a very short period it was made to include all the scientific departments and the name was changed to its present title. The organization aims to promote intense interest in scientific advancement and in scientific research amongst its members. The present officers are: Owen Erekson, President; Eugene Smith, Lilla Bessonette, and Sybil Atkins, Vice Presidents; Lawrence Wilkenson, Secretary-Treasurer (Southwestern University, Georgetown); and J. C. Godbey, Counselor.

The *Texas Archeological and Paleontological Society* was organized with headquarters in Abilene in 1928 for the purpose of collecting, studying, and preserving the evidences of past and disappearing cultures. The activities of the society have consisted of annual meetings and programs on the last Saturday in October and of the publication of the *Bulletin.* To date seven publications have been issued, each consisting of 100 to 150 pages of text and of 15 to 20 pages of illustrations. The present officers are: Cyrus N. Ray, President; J. Olsen, Vice President; Otto O. Watts, Secretary-Treasurer (Abilene); Cyrus N. Ray, Editor.

The *Texas Association of Science Teachers* was organized as the science section of the State Teachers' Association. Its purpose is "to establish and to maintain a professional consciousness in this great group of teachers to the end that membership in the profession may be more pleasant and desirable and that the profession of teaching be dignified and science education effectively promoted and achieved through mutual helpfulness, cooperative study and planning and concerted action." Annual meetings are held with the State Teachers' Association in November. Officers are: J. C. Godbey, President; Miss Grace Kelley, Vice President; and Miss Greta Oppe, Secretary-Treasurer (Ball High School, Galveston).

The *Texas Entomological Society* was organized November 23, 1928, at Austin, to promote and advance the development of the science of entomology in Texas. No regular publication is issued, and dates of annual meetings are decided by the Executive Committee. Present officers are: M. A. Stewart, President; F. A. Fenton, Vice President; H. J. Reinhard, Secretary-Treasurer (Texas Experiment Station, College Station).

The *Texas Folk-Lore Society* was organized in 1911 for the purpose of collecting and recording the folk-lore of Texas. An annual publication is issued, and contributors are scattered over Texas, New Mexico, California, and Mexico. Twelve volumes have been printed, and recently three of the four volumes that had gone out of print were reprinted, and *Legends of Texas* (1924) is now being revised and amplified for reprinting. The present officers are: Martha Emmons, President; Marcelle L. Hamer, Treasurer; and J. Frank Dobie, Secretary and Editor (University of Texas, Austin).

The *West Texas Historical and Scientific Society, Inc.,* was organized at Alpine December 7, 1925, with twenty-five charter members. It was incorporated under the laws of the State of Texas April 28, 1926. The museum sponsored by the society has grown from a few artifacts to approximately 10,000 specimens, which are housed in two rooms of the Administration Building of Sul Ross State Teachers College. A grant of $25,000 from the Texas Centennial Committee will be used as a nucleus for a modern-building fund. The organization has issued five publications that present papers of varied interests. Members are actively engaged in research in history, anthropology, folk-lore, biology, geology, and meteorology. An annual meeting and several sectional meetings are held each year. Present officers are: H. T. Fletcher, President; Capt. J. B. Gillett, Vice President; Anna D. Linn, Secretary-Treasurer (West Texas State Teachers College, Alpine), John Perkins, Legal Advisor; E. E. Townsend, Curator.

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CONTENTS

VEGETATION IN CHISOS MOUNTAINS, TEXAS

By

C. H. MULLER[1]

INTRODUCTION

Work was undertaken in Chisos Mountains in the summers of 1931 and 1932 over a total period of about five months. The collections enumerated in the following list were made for the purpose of determining as nearly as possible the constituent vegetation as a necessary preliminary to an attack upon the phytoecology of these mountains. Ample equipment and supplies were transported by pack train up the steep trail from the end of the automobile road to a centrally located camp site. From this base excursions of one to several days duration were made afoot, on horseback, and partly by automobile to the neighboring canyons, mountain sides, and desert.

The author wishes to acknowledge his indebtedness to Dr. B. C. Tharp, who suggested the problem, aided materially in its initiation, and contributed to its execution both in the field and laboratory. The hospitality and cooperation of Mr. Homer Wilson, ranchman and owner of a large part of the mountains, contributed greatly to the thoroughness of the investigation and to the pleasantness of the work.

The identification of the collections was undertaken by Dr. B. C. Tharp, Miss Eula Whitehouse, and the author to the extent that library facilities have permitted. Further identification and verifications were kindly made by Mr. Paul Standley (all groups except the Poaceae, Rhinanthaceae, and Pteridophyta) of the Field Museum, Prof. A. S. Hitchcock (Poaceae) of Smithsonian Institution, Dr. W. R. Maxon (Pteridophyta) of Smithsonian Institution, and Dr. F. W. Pennell (Rhinanthaceae) of the Academy of Natural Sciences of Philadelphia. To all these the author makes grateful acknowledgement.

GENERAL CHARACTERS OF THE AREA

Chisos Mountains, situated near the apex of the "Big Bend" region of Texas, are the southernmost spur of the Rocky Mountain system in the United States. They consist of an uplift of igneous and metamorphic material in the form of a rough circle of peaks about five or six miles across situated in the midst of an extensive sloping plain and surrounded by the usual foothills. The major peaks average about 7500 feet in altitude, the highest being 7835 feet or about 4000 feet above the surrounding desert. The topography is exceedingly

[1] This work was done at The University of Texas in partial fulfillment of the requirements for a Master's degree.

rough, though several broad canyons occur. Frequent deposits of late Cretaceous clays and limestone occur in the mountains and on the plain.

The upper mountains are watered by springs and in summer normally by almost daily afternoon rains. The plain receives little rain and has for the most part a high percentage of run-off, due in part to scant vegetation, in part to the nature of the soil, and in part to the torrential character of precipitation. Only three of the upper waterways run normally. These are reduced to dry creek beds before they reach the foothills, and water runs in their lower reaches only after torrential rains. Grazing by sheep and goats is quite intensive in the foothills but is rare in the mountains because of predatory animals.

The occurrence of so luxuriant a forest as that of the Chisos Mountains in the midst of a vast desert plain is paradoxical but nevertheless easily explainable. The most powerful influence in the distribution of plants is climate, as it affects the quantity of water available to plant roots and the severity of water loss from plant leaves by evaporation. Differences in the climates of the upper mountains and the surrounding desert are readily discernible by the most casual observer. These differences are brought about by the altitudinal and physiographic features of the area.

If for any reason a mass of air is forced to rise, it expands with the lessening pressure and in so doing becomes cooler. Cooling of a mass of air reduces its ability to retain water vapor with the result that the moisture condenses and ultimately is precipitated usually in the form of rain. A current of air moving horizontally across a plain and encountering any obstruction is forced to rise. Thus a wind striking the slopes of a mountain rises above the peak, and if the rise is sufficiently great, cloudiness and rain occur about the peak. In Chisos Mountains rains of this nature occur every time an atmospheric disturbance passes over them.

The daily afternoon rains that characterize the summer season of that area are caused by a different condition. The mountains, because of their great altitude, cloudiness, and dense vegetational cover, are not heated so rapidly as the surrounding desert. By mid-day there is a very considerable difference in the temperatures of the two areas. The heating of the atmosphere lying above the desert causes its rapid expansion. Because the mountain atmosphere does not expand so rapidly, the expanding desert air overflows into the mountain area and causes currents of air into the mountains from all sides. As these are deflected upward by the mountains and cooled, the resultant condensation of water vapor forms a hood of clouds over the peaks and a very considerable amount of rain is precipitated. The greatly reduced evaporation caused by the cloudiness and the increased water supply resulting from the rain greatly favor more luxuriant plant growth, all of which serve to increase the temperature differences between desert and mountain. Thus these conditions form a cycle that perpetuates itself by means of energy supplied by the sun.

The close proximity of Chisos Mountains to the extensive Sierra del Carmen of Mexico would lead one to expect them to be biologically related. This is readily evidenced by the grosser characters of the almost identical forests that occur in the two mountain ranges. More specifically it is indicated by the occurrence in both areas of the same dominant species of plants. Most striking to the lay observer is perhaps the occurrence in most of the Big Bend region of such typically Mexican desert genera as *Dasylirion, Agave, Yucca, Fouquiera, Larrea*, and others. Several Mexican species of *Stipa, Aristida*, and other genera are noteworthy constituents of the various vegetational communities. Of great interest to the biologist and of particular significance in establishing the relationships of the Chisos flora is the occurrence of several species of oaks whose centers of distribution lie south of the Rio Grande. *Quercus graciliformis,* known only from Chisos Mountains, is related to no other species in that area but bears a close relationship to *Quercus canbyi* near Monterrey, Mexico. *Quercus endemica* occurs only sparsely in the Chisos area but forms an extensive forest in the Sierra del Carmen. *Quercus chisosensis* is abundant in both the Chisos and Davis mountain regions of Texas, but its greatest abundance and widest extent of range occurs in the Sierra del Carmen and ranges to the south over half the length of the state of Coahuila. *Quercus intricata* occurs sparsely in the Chisos and Davis mountains; its greatest luxuriance is found in southern Coahuila.

The relation of the vegetation to that of the Rockies is indicated by the occurrence of a number of relatively northern plants. Of these, *Pinus brachyptera, Cupressus arizonica* var. *bonita, Pseudotsuga mucronata, Acer grandidentatum, Populus tremuloides,* and *Rhamus betulaefolia* are the more striking examples.

The occurrence of a surprisingly great number of plants found frequently east of the 98th meridian is also interesting. Among the grasses are two gramas, *Bouteloua hirsuta* and *B. curtipendula;* three bluestems, *Andropogon saccharoides, A. scoparius,* and *A. furcatus;* and *Tripsacum dactyloides.* Among the shrubs are *Clematis drummondii, Ptelia trifoliata, Celtis pallida, Ungnadia speciosa, Rhus virens, R. trilobata.* Common herbs are *Argemone platyceras, Solanum rostratum, S. eleagnifolium, Alternanthera repens,* and *Silene antirrhina.*

The surrounding plain averages about 3500 feet in altitude and slopes gradually away from the mountains. Most of the plains soil is derived from Cretaceous rocks and supports desert scrub such as *Larrea, Flourensia, Condalia, Acacia, Mimosa,* and *Prosopis.* In this are frequently found societies of *Leucophyllum texanum, L. minus, Parthenium incanum,* and *Porlieria angustifolia.* Grasses are sparse, due in part to extreme overgrazing and in part to desert conditions.

On the low foothills and the uneven outwash of the mountains are found relatively heavy growths of *Dasylirion, Agave lechuguilla, Yucca macrocarpa, Fouquiera, Condalia,* and numerous cacti. The waterways support *Ungnadia, Chilopsis linearis, Juglans rupestris, Fallugia paradoxa,* and *Fraxinus greggii.*

In the higher foothills the shrubbery becomes denser and is less confined to waterways. On the lower mountain slopes are vast areas thickly covered by *Rhus virens, R. trilobata, Fraxinus greggii,* and occasional junipers, *Pinus edulis,* and oaks. Of the oaks, *Quercus grisea, Q. emoryi,* and *Q. chisosensis* are more common. *Quercus grisea* is found in practically all types of situations in the upper mountains, but *Q. chisosensis* requires more moisture and is consequently confined to arroyos, hollows, and better watered areas. The junipers are *Juniperus flaccida, J. pachyphlaea,* and *J. monosperma.*

The vegetational composition of the tops of the mountain is relatively quite simple. Practically all mesas and gentle slopes bear a more or less dense growth of *Quercus grisea, Pinus edulis, Juniperus flaccida,* and *J. pachyphlaea.* Of the grass dominants *Mühlenbergia emersleyi* and *M. rigida* are the most important. Less important are *Valota saccharata, Lycurus phleoides,* and *Oryzopsis fimbriata.* The community becomes more wooded and less grassy on north exposures in proportion to the declination of the slope. Some south slopes are almost devoid of trees and are thickly covered by grass. The shrubs are mostly *Rhus, Salvia, Agave lechuguilla, A. scabra, Nolina, Garrya ovata,* and scrub *Quercus grisea, Q. undulata* var. *pungens,* and *Pinus edulis.*

In the canyons and on steeper slopes can be found heavy growths of *Quercus chisosensis,* with which there occur locally *Cupressus arizonica* var. *bonita, Pseudotsuga mucronata, Arbutus xalapensis, Prunus virens,* and others. The forests thus formed are quite dense, and the grasses are of the less xeric types. *Stipa tenuissima, Bromus marginatus, Poa involuta, Panicum bulbosum, Oryzopsis fimbriata,* and *Mühlenbergia pauciflora* are the principal ones.

On one northeast slope an almost pure stand of *Cupressus arizonica* var. *bonita* covers the upper 1500 feet (from 6000 to 7500 feet elevation) so conspicuously as to have caused the canyon to be named Juniper Canyon. Intermingled with *Cupressus* are *Quercus grisea* and *Q. chisosensis. Acer grandidentatum* and *Pseudotsuga mucronata* are added where the slope face swings to the northwest.

The west slope of another high canyon bears a heavy growth of *Pinus brachyptera* with which are found *Cercis reniformis* and the previously mentioned oaks and junipers.

The foregoing description presents only the grosser characters of the vegetation. The following list of all the species found offers notes on habitats.

LIST OF CHISOS MOUNTAIN PLANTS[2]

POLYPODIACEAE (Fern Family)

Polypodium thysanolepis A. Br. (Polypody)—Matted along crevices in boulders in one moist, densely wooded canyon at about 6500 feet.

Notholaena bonariensis (Willd.) C. Chr. (Notholaena)—Common on dry, rock-strewn slopes of 6500 to 7500 feet in altitude.

Notholaena sinuata (Ser.) Kaulf.—More or less moist crevices in rocks at high altitudes; common about talus slopes and on east exposures at about 7300 feet.

Notholaena standleyi Maxon—Common on rocky, grass-covered, south and east slopes at 5500 to 6500 feet.

Adiantum capillus-veneris L. (Maiden-hair fern)—Abundant at the water's edge in two moist, wooded canyons from 4200 to 4300 feet.

Pellaea atropurpurea (L.) Link (Cliff brake)—Common in oak and pine woodland at 6000 to 7000 feet.

Pellaea intermedia Mett.—Sparse in the moist woodland from 6500 to 7500 feet.

Pellaea microphylla Mett.—More or less abundant on one very dry north exposure at 6800 feet.

Pellaea wrightiana Hook.—Sparse in rock crevices on the east-facing talus slope at about 7300 feet.

Cheilanthes castenea Maxon (Lip-fern)—Scattered in oak and pine woodland from 7300 to 7800 feet.

Cheilanthes eatoni Baker—Scattered in east-facing rock crevices at 7300 to 7800 feet on one mountain side.

Cheilanthes lindheimeri Hook.—A few specimens in the shelter of a boulder in one very dry locality in the foothills at about 4000 feet.

Cheilanthes wrightii Hook.—One specimen from the water's edge in an unwooded canyon at about 6300 feet.

Asplenium resiliens Kuntze (Spleen-wort)—Infrequent in rock crevices in one moist, wooded canyon at about 6500 to 6700 feet.

Woodsia mexicana Fee (Woodsia)—Common in moist, wooded canyons and slopes at 6500 to 7500 feet.

EQUISETACEAE (Horsetail Family)

Equisetum sp. (Horsetail)—One fragmentary and sterile specimen in shallow water in a moist, wooded canyon at about 4100 feet.

SELAGINELLACEAE (Selaginella Family)

Selaginella lepidophylla (H. & G.) Spreng. (Club moss; resurrection plant)—Abundant on north-facing, vertical faces of rock in one canyon at about 6200 feet.

Selaginella pringlei Baker—Abundant on north-facing vertical faces of rock in two canyons at about 4200 feet.

Selaginella sherwoodii Maxon—Abundant on rocks and in crevices in moist, wooded canyons at 6500 to 7500 feet.

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[2] The species are arranged in families in the order of Engler and Prantl partly as emended by Small. Species indicated by an asterisk (*) are quoted on the authority of Mr. Paul C. Stanley who has made, or intends to make, formal publication of such changes as are implied but whose specific references are not at present available.

PINACEAE (Pine Family)

Pinus brachyptera Engelm. (Western yellow pine)—Abundant in one moist canyon, covering the west-facing slope and floor; occurs very sparsely in another similar canyon (5700 to 6600 feet).

Pinus edulis Engelm. (Pinyon pine)—Probably the most abundant tree in the vicinity, a major constituent of the woodland and the last of that group to give way to grassland in the lower and drier localities. It is shaded out only by the dense stands of *P. brachyptera* and *Cupressus arizonica.* Its altitude range is from about 5000 to 7800 feet.

Pseudotsuga mucronata (Raf.) Sudw. (Douglas fir)—Frequent but inconspicuously scattered on the floor and slopes of one moist and densely wooded canyon at about 6500 feet.

JUNIPERACEAE (Juniper Family)

Cupressus arizonica var. *bonita* Greene (Arizona cypress)—Abundant but restricted to two contiguous north and northwest slopes; a very dense stand of trees at 6000 to 7500 feet.

Juniperus flaccida Schlecht. (Weeping juniper)—A common constituent of woodland; very abundant from 5500 to 7800 feet.

Juniperus monosperma (Engelm.) Sarg. (One-seeded juniper)—More or less common but restricted to savannahs on the more gentle slopes at 5300 to 6800 feet.

Juniperus pachyphlaea Torr. (Alligator juniper)—A common constituent of the woodland; very abundant from 5500 to 7800 feet.

GNETACEAE (Joint-fir Family)

Ephedra antisyphilitica Mey. (Joint fir)—Scattered generally about the foothills and desert from 2500 to 4200 feet.

TYPHACEAE (Cat-tail Family)

Typha latifolia L. (Cat-tail)—Several specimens in small pools in one densely wooded canyon at 4300 feet.

ZANNICHELLIACEAE (Pondweed Family)

Potamogeton diversifolia Raf. (Pondweed)—Common in pools of two unwooded canyons from 6400 to 6700 feet.

POACEAE (Grass Family)

Festuceae

Bromus marginatus Nees (Brome grass)—Common in moist situations in several wooded canyons from 6400 to 6800 feet.

Bromus porteri (Coult.) Nash.—Common in two moist, wooded canyons at 5000 and 6500 feet.

Festuca ligulata Swallen. (Fescue grass)—Sparse in one moist, wooded canyon at 6500 feet.

Poa involuta Hitchc. (Involute blue grass)—Abundant throughout the more dense woodland in moist situations from 6500 to 7800 feet.

Eragrostis cilianensis (All.) Link. (Love-grass)—Common about a ranch house in one more or less moist and wooded canyon at 4200 feet.

Eragrostis diffusa Buckl.—Common along the unwooded waterways of two more or less moist canyons from 6300 to 6800 feet.

Eragrostis lugens Nees—Commonly scattered in moist situations all over the mountains from 5000 to 7700 feet.

Phragmites communis Trin. (Giant reed)—Numerous, but limited to one moist, unwooded situation at about 4800 feet.

Pappophorum mucronulatum Nees—Common about a ranch house in one more or less moist and wooded canyon at about 4200 feet.

Triodia avenacea HBK.—Common along the dry creek bed of one unwooded canyon at about 4800 feet.

Triodia mutica (Torr.) Scribn.—Scattered along one dry arroyo at about 4500 feet and a few specimens about a ranch house in the foothills at 3600 feet.

Triodia pulchella HBK.—Scattered in the dry foothills and lower canyons from 4000 to 4300 feet.

Hordeae

Agropyron arizonicum Scribn. & Smith—Sparse in two moist situations at 6500 and 7500 feet.

Agropyron inerme (Scribn. & Smith) Rydb. (Wheat grass)—Sparse in dry, unwooded situations from 5600 to 6300 feet.

Agropyron smithii Rydb.—A few specimens in one more or less moist and unwooded meadow at 6800 feet.

Sitanion hystrix (Nutt.) J. G. Smith (Fox-tail grass)—Scattered in dry situations from 5600 to 6900 feet.

Aveneae

Koeleria cristata (L.) Pers. (June grass)—Common in several more or less moist wooded situations from 5000 to 6500 feet.

Sphenopholis obtusata (Michx.) Scribn.—Common along the moist floor of one wooded canyon from 6500 to 6800 feet.

Agrostideae

Agrostis hiemalis (Walt.) B. S. P. (Bent grass)—Sparse in two moist, more or less wooded canyons at about 6300 feet.

Agrostis verticellata Vill.—Common at the water's edge in several more or less openly wooded canyons from 4100 to 4800 feet.

Lycurus phleoides HBK.—Abundantly scattered throughout the woodland from 5200 to 7800 feet.

Mühlenbergia cuspidata (Torr.) Rydb. (Dropseed grass)—Sparse in two moist, wooded situations of 6500 and 7500 feet.

Mühlenbergia emersleyi Vasey (Dropseed grass)—Very abundant throughout the mountains from 5000 to 7800 feet; dominant on open or unwooded slopes.

Mühlenbergia monticola Buckl. (Dropseed grass)—Common in rock crevices in dry situations from 5500 to 7300 feet.

Mühlenbergia pauciflora Buckl. (Dropseed grass)—Commonly scattered in south and east exposed rock crevices from 7000 to 7800 feet.

Mühlenbergia polycaulis Scribn. (Dropseed grass)—Scattered in rock crevices in wooded situations from 6500 to 7000 feet.

Mühlenbergia porteri Scribn. (Dropseed grass)—Common on the dry, open foothills east of the mountains at about 3500 feet.

Mühlenbergia repens (Presl.) Hitchc. (Dropseed grass)—Abundant in one more or less moist and openly wooded meadow at 6800 feet.

Mühlenbergia rigida (HBK.) Knuth (Dropseed grass)—Sparsely scattered in the moist woodland from 6500 to 7200 feet, and co-dominant with *Mühlenbergia emersleyi* in two grassy canyons at about 6000 feet.

Sporobolus cryptandrus (Torr.) Gray (Covered dropseed grass)—Commonly scattered along the dry creek bed of one canyon from 4500 to 5500 feet.

Blepharoneuron tricholepis (Torr.) Nash—Sparsely scattered in a few moist situations from 6500 to 7500 feet.

Oryzopsis fimbriata (HBK.) Hemsl.—Abundantly scattered throughout the moist woodland from 5400 to 7800 feet.

Stipa eminens Cav. (Needle grass)—Abundantly scattered over the grassy slopes from 5000 to 7800 feet.

Stipa neomexicana (Thurb.) Scribn.—Sparsely scattered on one somewhat dry north slope from 6600 to 6900 feet.

Stipa scribneri Vasey—Scattered on the slope of one shrub-covered foothill at about 5700 feet.

Stipa tenuissima Trin.—Abundant on moist soil in wooded and unwooded situations from 6500 to 7800 feet.

Aristida adscensionis L. (Triple-awn grass)—Very sparse on two openly wooded slopes from 6400 to 6800 feet.

Aristida arizonica Vasey—Common on several grassy slopes from 6800 to 7500 feet.

Aristida divaricata Humb. & Bonpl.—Commonly scattered on rocky south slopes from 4500 to 7700 feet.

Aristida glauca (Nees) Walp.—Common on dry slopes from 5000 to 6500 feet.

Aristida schiedeana Trin. & Rupr.—Commonly scattered in more or less dry situations from 5400 to 7000 feet.

Aristida ternipes Cav.—Sparse in two dry, shrub-covered canyons of about 5500 feet.

Aristida wrightii Nash—Sparse on very dry, rocky slopes from 4000 to 5500 feet.

Nazieae

Nazia aliena (Spreng.) Scribn.—One specimen near a ranch house in a moist, wooded canyon at about 4200 feet.

Chlorideae

Leptochloa dubia (HBK.) Nees—Scattered on dry slopes in several unwooded canyons from 5300 to 6400 feet.

Chloris virgata Swartz (Crowfoot grass)—Numerous about a ranch house in one moist, wooded canyon at about 4200 feet.

Bouteloua aristidoides (HBK) Thurb. (Grama grass)—Sparse in one unwooded canyon at about 4800 feet.

Bouteloua breviseta Vasey—Numerous in one very dry canyon at about 4300 feet.

Bouteloua curtipendula (Michx.) Torr.—Common in both dry and moist, wooded and unwooded situations from 5400 to 6800 feet.

Bouteloua eriopoda Torr.—Numerous in two dry, shrub-covered canyons of 4400 and 5400 feet.

Bouteloua gracilis (HBK.) Lag.—Common on unwooded or openly wooded slopes throughout the mountains from 5000 to 7000 feet.

Bouteloua hirsuta Lag.—Common on open ground from 5000 to 6800 feet.

Bouteloua trifida Thurb.—Numerous in one more or less moist and wooded canyon at about 4200 feet.

Paniceae

Valota saccharata (Buckl.) Chase—Commonly scattered throughout the woodland and shrubby slopes from 5500 to 7500 feet.

Leptoloma cognatum (Schult.) Chase—Sparse in one dry, unwooded canyon at about 5000 feet.

Panicum bulbosum HBK. (Panic grass)—Common in moist, wooded situations from 5000 to 7000 feet.

Panicum hallii Vasey—Scattered in several openly wooded situations from 5300 to 6800 feet.

Panicum obtusum HBK.—Sparse in one moist, wooded canyon at about 5000 feet.

Panicum tennesseensis Ashe—Numerous in one moist, wooded canyon at about 4300 feet.

Echinochloa colonum (L.) Link—Common at the water's edge in two canyons near ranch houses at 4200 and 5000 feet.

Setaria grisebachii Fourn. (Wild millet)—Numerous at the water's edge in one wooded canyon at about 6800 feet.

Setaria macrostachya HBK.—Widely scattered in more or less moist situations in the foothills and canyons from 4000 to 6300 feet.

Setaria viridis L.—Sparse in one openly wooded canyon at about 5400 feet.

Andropogoneae

Andropogon furcatus Mühl. (Beard grass)—Scattered in three more or less moist and wooded canyons from 4300 to 6800 feet.

Andropogon saccharoides Swartz—Commonly scattered on unwooded slopes from 5200 to 7700 feet.

Andropogon saccharoides var. *laguroides* (DC.) Hack.—Occurs sparsely in one dry, unwooded canyon at about 5400 feet.

Andropogon scoparius Michx.—Abundant in numerous more or less moist and wooded situations from 4500 to 7700 feet but never very extensive.

Heteropogon contortus (L.) Roem. & Schult.—Commonly scattered in two dry, unwooded canyons from 5000 to 5400 feet.

Tripsaceae

Tripsacum dactyloides L. (Gama grass)—Numerous but limited to a small area in a moist, unwooded canyon at about 4800 feet.

CYPERACEAE (Sedge Family)

Cyperus fendlerianus Boeck.—Scattered sparsely in moist, grassy situations from 5000 to 7300 feet.

Cyperus inflexus Mühl.—Common at the water's edge in one unwooded canyon at 6300 feet.

Cyperus rusbyi Britton—Sparse in one moist, unwooded canyon at 6300 feet.

Cyperus seslerioides HBK.—Scattered on one moist slope at about 7500 feet and in one mioist, unwooded canyon at 6300 feet.

Cyperus sp.—Abundant in the saturated soil of one canyon at about 4200 feet.

Stenophyllus capillaris (L.) Britton—Abundant on one moist slope at about 7500 feet and in one moist, unwooded canyon at 6300 feet.

Fuirena simplex Vahl—Abundant in the saturated soil of one canyon at about 4200 feet.

Carex sp.—Abundantly scattered on one more or less wooded east slope at about 6500 feet.

BROMELIACEAE (Pineapple Family)

Tillandsia recurvata L. (Ball moss)—Abundant on vertical faces of south-facing bluffs in one moist canyon from 6500 to 7000 feet. Although in its eastern range this plant grows usually on the branches of trees, in this vicinity it was observed only once growing sparingly on one scrubby *Juniper flaccida* on the face of a cliff literally covered with *Tillandsia.*

COMMELINACEAE (Spiderwort Family)

Tradescantia leiandra Torr. var. *ovata* Coult. (Spiderwort)—Frequent in moist situations in the woodland from 6500 to 7800 feet.

Commelina crispa Woot. (Day-flower)—Abundant in one moist, unwooded situation at about 4800 feet.

Commelina dianthifolia Delile.—Frequent in moist soil in unwooded canyons from 6500 to 7500 feet.

JUNCACEAE (Rush Family)

Juncus interior? Wiegand (Bullrush)—Common; usually in saturated soil in upper canyons on mountain sides. (4300 to 7000 feet.)

Juncus nodosus L.—Abundant in the saturated soil of one wooded canyon at about 4200 feet.

ALLIACEAE (Onion Family)

Allium recurvatum Rydb. (Wild onion)—Abundant in the woodland and along the waterway of one moist, wooded canyon at 6500 to 7000 feet.

Allium scaposum Benth.—Abundant in moist soil of the upper canyons and mountains from 6300 to 7700 feet.

DRACAENACEAE (Yucca Family)

Yucca elata Engelm. (Bear grass)—A few in one locality on the dry sand flats near the mountains at about 3400 feet.

Yucca macrocarpa (Torr.) Engelm. (Spanish bayonet)—Abundant in some of the dry, lower canyons and common throughout the foothills from 4000 to 5000 feet.

Nolina erumpens (Torr.) Wats. (Slender beargrass)—Common throughout the woodland of the upper mountains as well as in the shrub zones of the lower slopes. (5000 to 7500 feet.)

Dasylirion leiophyllum Engelm. (Sotol)—Very abundant in the foothills as low as 4000 feet and common on dry slopes to altitudes of 5500 feet.

LEUCOJACEAE (Amaryllis Family)

Agave lechuguilla Torr. (Lechuguilla)—Very abundant throughout the flats and foothills and, on very dry slopes, to altitudes of 6000 feet.

Agave wislizeni Engelm. (Century plant)—Reaches its best growth on the grassy lower slopes (especially on south exposures) as low as 4000 feet but is common throughout the mountains to 7500 feet.

Cooperia drummondii Herb. (Rain lily)—Abundant in two moist situations in openly wooded canyons from 6800 to 7000 feet.

ORCHIDACEAE (Orchid Family)

Hexalectris aphyllus (Nutt.) Raf. (Leafless orchid)—Occurs very rarely in all moist, wooded canyons from 5000 to 7000 feet.

Gyrostachys cinnabarina (Llave) Kuntze (Scarlet ladies' tresses)—Sparse in one unwooded canyon on a grassy slope at about 6300 feet.

Epipactis gigantea Dougl. (Giant orchid)—Fairly abundant at the water's edge in one moist, wooded canyon at about 4300 feet.

SALICACEAE (Willow Family)

Populus palmeri Sarg. (Palmer's poplar)—Several specimens about each of a number of springs on the desert at about 3500 feet. Usually they are the only trees in sight for miles.

Populus tremuloides Michx. (Quaking aspen)—Numerous specimens on a south-facing talus slope at about 7250 feet.

Salix goodingii Ball (Willow)—Common at the mouths of the lower, moist canyons from 4200 to 4300 feet.

Salix taxifolia HBK.—A few specimens near a waterhole in the foothills; apparently not planted by the ranchman about whose house they occur. (At about 3650 feet.)

JUGLANDACEAE (Walnut Family)

Juglans rupestris Engelm. (Western walnut)—Common along the more moist arroyos of the foothills from 4100 to 4300 feet.

FAGACEAE (Beech Family)

Quercus diversicolor Trel. (Reticulate oak)—One or two specimens in one moist, heavily wooded canyon at about 6500 feet.

Quercus endemica C. H. Mull.—Common in the dense wood along the waterway of one moist canyon at about 6500 feet.

Quercus grisea Liebm. (Grey oak)—An important constituent of the woodland, penetrating the coniferous savannahs of the lower, grassy slopes as well as the dense stands of *Cupressus* and *Pinus brachyptera* at higher altitudes. (About 5000 to 7800 feet.)

Quercus intricata Trel. (Intricate oak)—Abundant in two localities on a heavy, weathered limestone soil at about 6800 feet. A few specimens were found scattered in the woodland.

Quercus undulata var. *vaseyana* Rydb. (Undulate oak)—Very abundant in one moist canyon at about 4300 feet and sparsely scattered on dry slopes up to 7800 feet.

Quercus undulata var. *pungens* Engelm.—A rare shrub on one dry slope at about 6000 feet.

Quercus chisosensis (Sarg.) C. H. Mull. (Chisos Mt. oak)—This species is, next to *Pinus edulis,* the most abundant and most apparent growth in the vicinity. It is found in all the more moist situations, especially on north slopes, from 4300 to 7800 feet.

Quercus emoryi Torr. (Emory's oak)—Very abundant in the dry, lower canyons, extending down to 4000 feet, and scattered more or less throughout the mountains up to 6800 feet; intolerant of shade.

Quercus graciliformis C. H. Mull.—An abundant small tree on the slopes and along the waterway of one canyon at 4000 to 5000 feet.

Quercus graciliformis f. *parvilobata* C. H. Mull.—Common with the typical form.

Quercus robusta C. H. Mull.—A few large trees along the streamside at the mouth of one canyon at about 4200 feet.

Quercus tardifolia C. H. Mull.—Rare in the moist wood of one canyon at about 6800 feet.

ULMACEAE (Elm Family)

Celtis laevigata var. *texana* (Scheele) Sarg. (Mississippi hackberry)—Frequent along waterways in the lower, dry canyons; some specimens growing luxuriantly in the more moist, upper canyons (4500 to 6800 feet).

Celtis pallida Torr. (Pallid hackberry)—A few specimens scattered throughout the scrub of the foothills and flats from 3600 to 4300 feet.

ARTOCARPACEAE (Mulberry Family)

Morus microphylla Buckl. (Small-leafed mulberry)—Very few specimens in the lower shrub zones of one somewhat moist, unwooded canyon and a few in one low, wooded canyon. (4100 to 5500 feet.)

URTICACEAE (Nettle Family)

Parietaria pennsylvanica Mühl. (False nettle)—Sparse in one locality in a dry, unwooded waterway at about 5300 feet.

LORANTHACEAE (Mistletoe Family)

Phoradendron juniperinum Engelm. (Juniper mistletoe)—Commonly growing on *Juniperus flaccida* and *J. pachyphlaea* in the more moist canyons at 6000 to 7000 feet.

Phoradendron tomentosum (DC.) Oliver (Woolly mistletoe)—Common on *Quercus grisea, Q. undulata,* and *Q. chisosensis* in the upper canyons from 6000 to 7500 feet.

POLYGONACEAE (Buckwheat Family)

Eriogonum hieracifolium Benth.—A few specimens in one more or less dry situation at about 6800 feet.

**Eriogonum hieracifolium* f. *atropurpureum* Standl.—A new form differing from *E. hieracifolium* in having a deep wine-colored perianth. Common in two more or less wooded canyons from 5000 to 6800 feet.

Eriogonum pineatorum Greene—Scattered along an intermittently flowing waterway in one moist canyon at about 4200 feet.

Eriogonum tenellum Torr.—Common in rock crevices and on rocky soil in dry situations all over the upper mountains and occasionally lower. (5500 to 7800 feet.)

Eriogonum undulatum Benth.—Distribution the same as *E. tenellum* but more abundant.

Eriogonum wrightii Torr.—Sparse on rocky soil in one dry, unwooded canyon at about 5600 feet.

Rumex crispus L.—A few specimens in one moist, wooded canyon at about 6500 feet.

CHENOPODIACEAE (Goosefoot Family)

Chenopodium album L. (Lamb's quarters)—A few specimens on a high, grassy mountain side, in a low, moist canyon, and about a waterhole in the dry, lower foothills. (From 4000 to 7500 feet.)

Chenopodium incisum Poir.—A few specimens about an old camp site in a moist, wooded canyon at about 6500 feet.

Atriplex canescens (Pursh) Nutt. (Shodscale)—A few specimens about a waterhole in the dry, lower foothills at about 3600 feet.

AMARANTHACEAE (Amaranth Family)

Amaranthus powellii Wats. (Pigweed)—Numerous specimens about old camp sites and along trails in the upper mountains from 5500 to 6500 feet.

Alternanthera repens (L.) Kuntze (Creeping pigweed)—Abundant over small areas in two wooded canyons at about 4900 feet.

Froelichia campestris Small—Abundant in rocky soil in the dry, unwooded canyons from 4800 to 5000 feet.

Froelichia gracilis Moq.—Locally scattered along the waterways of the unwooded upper canyons from 6300 to 6700 feet.

Iresine celosia L.—Occurs sparsely in one heavily wooded, moist canyon at about 6000 feet.

Tidestroemia lanuginosa (Nutt.) Small—Abundant in one locality of the dry, lower foothills at about 3600 to 4000 feet.

ALLIONIACEAE (Four-o'clock Family)

Mirabilis aggregata (Ort.) Cav. (Four-o'clock)—Common throughout the woodland of the upper mountains from 5500 to 7700 feet.

Mirabilis linearis (Pursh) Heimerl. (Four-o'clock)—Sparse in the open wood land of two canyons at about 5500 feet.

Mirabilis oxybaphoides Gray (Four-o'clock)—Luxuriant in the dense woodland of one mountain slope at about 7500 feet.

Allionia incarnata L. (Umbrellawort)—Very sparse near a ranch house in the dry, lower foothills at about 4200 feet.

Boerhaavia caribea Jacq. (Stickseed)—Common in the woodland of the upper mountains from 6500 to 7000 feet.

Boerhaavia gracillima Heimerl.—Common along the stream beds of the dry canyons around 5000 feet.

Boerhaavia intermedia Jones—One specimen near a ranch house in the lower, dry foothills at 4200 feet and one on a dry slope at about 4800 feet.

Cyphomeris gypsophiloides (Mart. & Gal.) Standl.—Sparse in one dry, unwooded situation at 6800 feet and one moist, wooded canyon at 4200 feet.

PETIVERACEAE (Pokeweed Family)

Rivina humilis L. (Dwarf red pokeweed)—Inconspicuously scattered in various wooded canyons and along waterways in the upper foothills, ranging from 4300 to 6000 feet.

PORTULACACEAE (Purslane Family)

Talinum aurantiacum Engelm.—Sparsely scattered in two situations on dry, rocky soil from 5500 to 6300 feet.

Talinum parviflorum Nutt.—Scattered in one dry, unwooded canyon at about 6300 feet.

Talinum youngae C. H. Mull. (Torreya, vol. 33: p. 148)—Sparse on the rocky, grassy bank of one arroyo at about 6300 feet.

Portulaca pilosa L. (Pursley)—Sparse in one moist, wooded canyon at about 4200 feet.

Portulaca retusa Engelm.—Commonly scattered in two dry, unwooded canyons ranging from 5500 to 6300 feet.

ALSINACEAE (Chickweed Family)

Silene antirrhina L. (Sleepy catchfly)—Common in more moist, upper woodland from 6500 to 7000 feet.

Silene laciniata Cav.—Conspicuous throughout the moist upper woodland from 6300 to 7500 feet.

Cerastium brachypodum (Engelm.) Robinson (Powder-horn)—Scattered in the dense wood of one canyon from 6500 to 7300 feet.

Stellaria prostrata Baldw.—Luxuriant in one limited area in a dense coniferous wood at about 6800 feet.

Arenaria benthamii Fendl.—Sparse in one openly wooded canyon at about 6600 feet.

CORRIGIOLACEAE (Whitlow-wort Family)

Paronychia jamesii Torr. & Gray—Sparsely scattered on the dry soil of two canyons from 5000 to 5500 feet.

RANUNCULACEAE (Crowfoot Family)

Aquilegia longissima Gray (Columbine)—Dense along the water's edge in three moist, wooded canyons ranging from 4200 to 6000 feet.

Clematis simsii Sweet—Scattered in the drier, openly wooded canyons from 4200 to 5500 feet.

Clematis drummondii Torr. & Gray—Sparse in the dry, lower canyons from 4200 to 5500 feet.

PODOPHYLLACEAE (Barberry Family)

Berberis haematocarpa Woot. (Barberry)—Abundant in one dry situation at 6800 feet and sparsely scattered in the lower canyons at about 5500 feet.

Berberis trifoliata Moric.—Sparsely scattered on the flats surrounding the mountains at about 3500 feet.

PAPAVERACEAE (Poppy Family)

Argemone platyceras Link & Otto (Prickly poppy)—Common in the waterways of the dry canyons from 4200 to 6300 feet.

BRASSICACEAE (Mustard Family)

Lepidium lasiocarpum Nutt. (Pepper-grass)—A few specimens about an old camp site in a moist, wooded canyon at 6500 feet.

Greggia camporum Gray—One collection from a sand flat in the lower, brush-covered foothills at about 4000 feet.

Lesquerella purpurea Wats. (Bladderpod)—Common on the grassy slopes of the upper mountains from 6000 to 7800 feet.

Thelypodium wrightii Gray—A single occurrence in an openly wooded canyon at about 5500 feet.

Thelypodium micranthum Wats.—Abundant throughout the more moist woodland from 6400 to 7500 feet.

Sisymbrium diffusum Gray—A single occurrence in each of two openly wooded canyons at 5000 and 5500 feet.

Erysimum asperrimum (Greene) Rydb.—Conspicuous in several of the moist, densely wooded canyons from 6500 to 7000 feet.

Arabis virginica (L.) Trelease—Scattered in the moist, upper woodland from 6300 to 7000 feet.

Sophia halictorum Cockerell—Abundant in one small area in a dense coniferous wood at about 6800 feet.

CAPPARIDACEAE (Caper Family)

Polanisia uniglandulosa (Cav.) DC. (Clammy-weed)—Sparse in one locality in the foothills and one dry canyon, ranging from 4000 to 5500 feet.

SEDACEAE (Orpine Family)

Sedum moranense? HBK. (Flowering moss)—Common in rock crevices along the waterways of the openly wooded upper canyons from 6600 to 7500 feet.

Echeveria strictiflora Gray—Scattered on dry ridges and south-facing slopes throughout the mountains from 5000 to 7500 feet.

HYDRANGEACEAE (Hydrangea Family)

Philadelphus microphyllus Gray (Mock-orange)—Abundant along the waterways in the heavily wooded, moist, upper canyons from 5500 to 6800 feet.

Heuchera rubescens Torr.—Common in moist soil pockets in the upper woodland from 6500 to 7800 feet.

ROSACEAE (Rose Family)

Fallugia paradoxa (Don.) Endl. (False rose)—Very abundant along the dry waterways of the lower canyons and arroyos, ranging from 4000 to 6500 feet.

Holodiscus dumosus (Nutt.) Heller—A few specimens in the woodland on one peak ranging from 7500 to 7800 feet.

Cercocarpus eximius (Schneid.) Rydb. (Mountain mahogany)—Very abundant throughout the woodland and adjacent shrub zones of the upper mountains from 4500 to 7800 feet.

Vauquelinia corymbosa Correa—Common in one low, dry canyon and occurring sparsely in a high, dry, unwooded canyon. (5300 to 6300 feet.)

Prunus minutiflora Engelm. (Wild plum)—Inconspicuously scattered throughout the drier situations of the mountains, attaining abundance in one dry, unwooded canyon. (5000 to 6500 feet.)

Prunus virens (Woot. & Standl.) Standl.—Common throughout the more moist woodland of the upper mountains, ranging from 5500 to 7800 feet.

MIMOSACEAE (Mimosa Family)

Calliandra humilis (Schlecht.) Benth.—Scattered in one dry, openly wooded canyon at about 5600 feet.

Acacia constricta Benth. (Cat-claw)—Abundant throughout the shrub zones of the drier slopes from 4000 to 6000 feet.

Acacia filicioides (Cav.) Trelease—Common throughout the woodland from 5500 to 7500 feet.

Acacia greggii Gray—Scattered in the foothills and abundant on the adjacent flats, ranging from 3500 to 5000 feet.

Acacia roemeriana Scheele—Scattered throughout the foothills from 4000 to 5000 feet.

Prosopis chilense (Mol.) Stuntz, var. *glandulosa* (Torr.) Standl. (Mesquite)—Scattered on the flats adjacent to the foothills and in one dry canyon of middle altitude. (3500 to 5500 feet.)

Mimosa biuncifera Benth. (Cat-claw)—Commonly scattered throughout the drier slopes of the mountains and foothills from 4000 to 6500 feet.

Mimosa lindheimeri Gray—Abundant in the lower, dry canyons and adjacent foothills; scattered sparsely on the drier, upper slopes. (4000 to 6000 feet.)

Leucaena retusa Benth.—One specimen in an openly wooded, dry canyon near an abandoned ranch house at about 5000 feet.

Desmanthus acuminatus Benth.—One specimen in a dry, rocky waterway at about 5200 feet.

CASSIACEAE (Senna Family)

Cercis reniformis Engelm. (Redbud)—Common along the waterway of one moist, heavily wooded canyon from 5500 to 6000 feet.

Cassia durangensis Rose (Senna)—Sparse in two dry, unwooded situations at 5500 and 6500 feet.

Cassia lindheimeri Scheele (Senna)—Common along the waterways of the dry, unwooded canyons from 4300 to 6500 feet.

KRAMERIACEAE (Krameria Family)

Krameria grayi Rose & Painter—Common on dry, gravelly slopes and flats from 3500 to 6500 feet.

FABACEAE (Pea Family)

Sophora secundiflora Lag. (Texas Mountain laurel)—A few specimens in one wooded canyon at about 5000 feet.

Lotus puberulus (Benth.) Greene—Common in several of the more moist, wooded situations from 5300 to 7500 feet.

Oxytropis lambertii Pursh (Lambert's loco-weed)—Common in several localities varying from densely wooded, moist situations to openly wooded, dry ones, ranging from 5500 to 6800 feet.

Eysenhardtia texana Scheele—A few specimens in one moist, wooded canyon at 4100 feet.

Parosela aurea (Nutt.) Britton—Scattered in several dry, unwooded canyons from 5000 to 5500 feet.

Parosela dalea (L.) Britton—Sparse in one dry, unwooded canyon at about 5200 feet.

Parosela frutescens (Gray) Vail—Common throughout the woodland from 6000 to 7500 feet.

Parosela lachnostachys (Gray) Heller—Sparse in one dry, unwooded canyon at about 5000 feet.

Parosela wrightii (Gray) Vail—Sparse in one dry, unwooded canyon at about 5000 feet.

Rhynchosia texana Torr. & Gray—Common throughout the woodland from 6000 to 7500 feet.

Phaseolus grayanus Woot. & Standl. (Wild bean)—Common in one moist, densely wooded canyon from 6500 to 7000 feet.

Cologania longifolia Gray—Scattered commonly in one moist, densely wooded canyon from 6500 to 7000 feet.

Desmodium grahami Gray—Abundant over a small area in one moist, wooded canyon at about 6500 feet.

Desmodium wrightii Gray—Abundant over a small area in one moist, wooded canyon at about 6500 feet.

Vicia exigua Nutt. (Wild Pea)—Common throughout the woodland from 6000 to 7000 feet.

GERANIACEAE (Geranium Family)

Geranium caespitosum James—Sparse in two moist, wooded canyons of 5000 and 6000 feet.

OXALIDACEAE (Wood-sorrel Family)

Oxalis divergens Benth.—Sparse in very moist soil pockets in one densely wooded canyon at about 6500 feet.

Oxalis stricta L.—Common throughout the woodland from 5500 to 7000 feet.

Oxalis violacea L.—Common in moist situations throughout the woodland from 6000 to 7800 feet.

LINACEAE (Flax Family)

Linum aristatum Engelm. (Wild flax)—Sparse in one dry, unwooded canyon at about 5300 feet.

Linum greggii Engelm.—Frequent along the waterway of one dry, unwooded canyon from 5000 to 5500 feet.

Linum lewisii Pursh—Common on grassy spots throughout the woodland from 6000 to 7800 feet.

Linum multicaule Hook.—Sparse in one dry, unwooded canyon at about 5400 feet.

Linum rigidum Pursh—Scattered on the dry slopes of one wooded canyon at about 5400 feet.

Linum schiedeanum Schlecht. & Cham.—Common in one densely wooded canyon from 6400 to 7000 feet.

ZYGOPHYLLACEAE (Caltrop Family)

Larrea mexicana Moric. (Creosote bush)—Very abundant throughout the lower foothills and desert from 3000 to 4500 feet.

Tribulus terrestris L. (Weed bur)—Common in several low, dry canyons in the vicinity of old camp sites at about 5500 feet.

Porlieria angustifolia (Engelm.) Gray (Lignum-vitae)—Abundant on sandy soil on the lower foothills and adjacent flats from about 3500 to 4000 feet.

Kallstroemia hirsutissima Vail—Common in one dry, openly wooded canyon near an old camp site at about 5500 feet.

RUTACEAE (Rue Family)

Thamnosma texana (Gray) Torr.—Scattered in the foothills at about 4000 feet.

Ptelea trifoliata L. (Wafer ash)—Common in the moist, wooded canyons from 6000 to 7000 feet.

POLYGALACEAE (Milkwort Family)

Polygala alba Nutt. (Milkwort)—Common on dry slopes from 4300 to 5400 feet.

Polygala macrodenia Gray—Sparse in one dry, unwooded canyon at about 5000 feet.

Polygala scoparium HBK.—Scattered in one dry, unwooded canyon at about 5000 feet.

Polygala puberula Gray—Commonly scattered throughout the drier slopes of the mountains from 4100 to 7500 feet.

EUPHORBIACEAE (Spurge Family)

Phyllanthus polygonoides Nutt. (Leaf flower)—Common in open spots throughout the woodland from 5500 to 7800 feet.

Croton corymbulosus Engelm.—Common along low, dry waterways on the drier, upper slopes from 4000 to 5500 feet.

Croton fruticulosus Torr.—Scattered in two dry, shrub-covered canyons at about 5500 feet.

Croton neomexicanus Muell.—Abundant in one vicinity in the dry foothills at about 3500 feet.

Ditaxis humilis (Engelm. & Gray) Pax.—One specimen in the dry foothills at about 4200 feet.

Acalypha lindheimeri Muell.—Common in two openly wooded, dry canyons at 5400 feet.

Acalypha neomexicana Muell.-Arg.—A few specimens in the dry waterway of one moist, wooded canyon at about 4300 feet.

Tragia ramosa Torr. (Spurge nettle)—Scattered in several more or less dry canyons from 5200 to 6000 feet.

Jatropha spathulata Muell. (Leather plant)—Abundant in two dry localities in the foothills between 4000 and 4300 feet.

Euphorbia antisiphylitica Zucc. (Spurge)—Scattered sparsely on the foothills and dry flats at about 3500 feet.

Euphorbia chaetocalyx (Boiss.) Standl.—Scattered sparsely in one dry, openly wooded canyon at about 5500 feet.

Euphorbia cuphosperma (Engelm.) Boiss.—Sparse along the waterway of one canyon at about 6300 feet.

Euphorbia dentata Michx.—Sparse at the water's edge in two unwooded canyons of 6300 and 6800 feet.

Euphorbia melanadenia Torr.—Common in two dry, unwooded canyons between 5500 and 6000 feet.

Euphorbia montana Engelm.—Common throughout the denser woodland from 6000 to 7500 feet.

Euphorbia nutans Lag.—A few specimens in one moist, wooded canyon at about 4200 feet.

Euphorbia serpyllifolia Pers.—Scattered in one more or less dry, openly wooded canyon at about 5500 feet and one moist, wooded canyon of 4200 feet.

Euphorbia serrula Engelm.—Scattered throughout the drier woodland from 4200 to 6500 feet.

Euphorbia villifera Scheele—A few specimens in one moist, wooded canyon at 4200 feet.

SPONDIACEAE (Sumac Family)

Rhus microphylla Engelm. (Small leafed sumac)—Abundant in one vicinity on the flats and a few specimens in one dry, more or less wooded upper canyon. (3600 to 5000 feet.)

Rhus toxicodendron L. (Poison oak; poison ivy)—A few specimens in two moist, wooded canyons from 4100 to 4300 feet.

Rhus trilobata Nutt. (Three-leafed sumac)—Rather generally abundant throughout the mountains, ranging from about 4100 (in moist canyons) to 7500 feet.

Rhus virens Lindh. (Evergreen sumac)—A common constituent of the shrub zones and scattered throughout the woodland from 4000 to 7700 feet.

ACERACEAE (Maple Family)

Acer grandidentatum Nutt. (Maple)—Abundant in two moist, densely wooded canyons from 5800 to 6800 feet.

SAPINDACEAE (Soapberry Family)

Sapindus drummondii Hook. & Arn. (Soap-berry)—Abundant in one small, moist, wooded canyon at about 4300 feet and a few specimens about a ranch house on the flats at 3600 feet.

Ungnadia speciosa Endl. (Mexican buckeye)—Abundant in the dry waterways of the lower, unwooded canyons and a few specimens in some of the high, moist, wooded canyons. (5000 to 6600 feet.)

FRANGULACEAE (Buckthorn Family)

Condalia lycioides (Gray) Weberb.—Common in the lower foothills and on the flats from 3500 to 5000 feet.

Condalia spathulata Gray—Common on the flats and in one dry situation in an openly wooded canyon. (3500 to 5500 feet.)

Rhamnus betulaefolia Greene (Buckthorn)—Abundant in one moist, densely wooded canyon at about 6500 feet.

Ceanothus greggii Gray (Red-root)—A few specimens in one dry, unwooded canyon at about 6300 feet and scattered on the openly wooded slopes as low as 5600 feet.

VITACEAE (Grape Family)

Vitis vulpina L. (Grape)—Common in the moist, wooded canyons from 5800 to 7700 feet.

MALVACEAE (Mallow Family)

Abutilon incanum (Link) Sweet (Indian mallow)—One specimen in a more or less wooded canyon at about 6000 feet.

Abutilon parvulum Gray—Scattered in two dry, openly wooded canyons from 5300 to 5500 feet.

Sphaeralcea cuspidata (Gray) Britton—Common throughout the drier woodland from 5500 to 6800 feet.

Sida neomexicana Gray—Scattered in one dry, unwooded canyon at about 5600 feet.

Sida physocalyx Gray—A few specimens in one moist, wooded canyon of 4100 feet.

Sida procumbens Swartz—Variously scattered in several dry localities in the foothills and canyons from 4100 to 5000 feet.

Hibiscus coulteri Harv.—Sparsely scattered over the flats and foothills from 3500 to 4500 feet.

FOUQUIERACEAE (Coach-whip Family)

Fouquiera splendens Engelm. (Ocotillo)—Abundant throughout the dry ridges of the entire mountains and desert from 3500 to 7000 feet.

CISTACEAE (Rock-rose Family)

Helianthemum majus (L.) B.S.P. (Rock-rose)—A few specimens along the waterway of one dry, unwooded canyon at about 6300 feet.

Lechea tenuifolia Michx. (Pinweed)—Scattered in one dry, unwooded canyon at 5300 feet.

KOEBERLINIACEAE (Junco Fomily)

Koeberlinia spinosa Zucc. (Allthorn)—Common throughout the lower, dry foothills and flats from 3500 to 4000 feet.

LOASACEAE (Loasa Family)

Mentzelia multiflora (Nutt.) Gray (Leech-leaf)—Scattered in one vicinity on the flats at 3500 feet.

Mentzelia oligosperma Nutt.—One specimen in a dry waterway at about 5500 feet.

Cevallia sinuata Lag. (Stinging leech-leaf)—A few specimens in one dry, openly wooded canyon at about 4100 feet.

CACTACEAE (Cactus Family[3])

Mamillaria tuberculosa Engelm. (Nipple cactus)—Common in rock crevices on unwooded mountain sides and canyons from 6000 to 7500 feet.

Opuntia engelmannii? Salm-Dyck (Prickly pear)—Commonly scattered throughout both the moist and dry woodlands of the entire mountains; the most conspicuous species of the family in the upper mountains. (5500 to 7800 feet.)

Opuntia imbricata? (Haworth) DC. (Tasajo)—Conspicuously scattered on dry slopes and ridges of the foothills from 3700 to 5000 feet.

Opuntia leptocaulis DC. (Pencil cactus; tasajillo)—Very abundant in wide areas of the flats at about 3700 feet.

ONAGRACEAE (Evening-promise Family)

Oenothera brachycarpa Gray (Evening primrose)—Scattered in one limited area in a dry, unwooded canyon at 5500 feet.

Kneiffia spachiana (Torr. & Gray) Small—A few specimens scattered in one moist, wooded canyon at 4200 feet.

Gaura drummondii Torr. & Gray (Standing honeysuckle)—Numerous over limited areas on the dry slopes of two unwooded canyons from 5300 to 5600 feet.

AMMIACEAE (Carrot Family)

Aletes acaulis (Torr.) Coult. & Rose (Stemless carrot)—One specimen in a moist, wooded canyon at about 5800 feet.

NYSSACEAE (Dogwood Family)

Garrya ovata Benth.—Abundant throughout the upper woodland from 6000 to 7800 feet.

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[3] No attempt was made to procure a representative collection of the many species of cacti present in the mountains. The three Opuntias are perhaps the most common species of the family in the vicinity.

ERICACEAE (Heath Family)

Arbutus xalapensis HBK. (Madroña)—Common throughout the more moist upper woodland from 5500 to 7800 feet.

PRIMULACEAE (Primrose Family)

Samolus ebracteatus HBK.—Common at the water's edge in two moist, wooded canyons at about 4200 feet.

EBENACEAE (Ebony Family)

Diospyros texana Scheele (Mexican persimmon)—Abundant in the dry, lower canyons and the upper foothills from 4500 to 5500 feet.

OLEACEAE (Olive Family)

Forestiera angustifolia (Engelm.) Gray (Devil's elbow; crooked bush)—Common in one vicinity in the lower foothills and adjacent flats from 3600 to 4000 feet.

Forestiera neomexicana Gray—Abundant over small areas on moist soil in three wooded canyons from 5500 to 6800 feet.

Fraxinus cuspidata Torr. (Ash)—Scattered frequently in several wooded and shrub-covered canyons at about 5500 feet.

Fraxinus greggii Gray—The most abundant and conspicuous shrub in the vicinity; common along dry, lower canyons, upper foothills, and grassy slopes at all altitudes. (4000 to 7800 feet.)

Menodora longiflora Gray (Twin-pod)—A common inhabitant of dry, unwooded slopes from 5000 to 6000 feet.

Menodora scabra Gray—Scattered in one vicinity on the flats at about 3600 feet.

APOCYNACEAE (Dogbane Family)

Apocynum androsaemifolium L. (Dogbane)—Abundant along the waterway of one moist, densely wooded canyon at about 6500 feet.

Macrosiphonia macrosiphon (Torr.) Heller—Common on dry, unwooded slopes from 5000 to 7000 feet throughout the mountains.

ASCLEPIADACEAE (Milkweed Family)

Funastrum heterophyllum (Engelm.) Standl.—A few about a waterhole on the flats at about 3600 feet.

Funastrum torreyi (Gray) Schlecht.—Commonly scattered in one canyon ranging from lower woodland at about 6000 feet to the shrub zone at 5000 feet.

**Funastrum undulatum* (Gray) Standl.—One specimen in a dry, openly wooded canyon at about 6000 feet.

Asclepias glaucescens HBK. (Milkweed)—Scattered generally in moist situations all over the mountains from 5000 to 7300 feet.

Asclepias lindheimeri Gray (Milkweed)—One specimen in a dry, openly wooded canyon at about 6000 feet.

Asclepias perrenis Walt. (Milkweed)—Common throughout the woodland from 4200 to 7000 feet.

Metastelma barbigerum Scheele (Small climbing milkweed)—A few specimens on one dry, unwooded slope at about 6800 feet.

Roulinia unifaria (Scheele) Engelm.—A few specimens in one more or less wooded, dry canyon at about 5500 feet.

DICHONDRACEAE (Dichondra Family)

Dichondra argentea Willd. (Dwarf morning-glory)—Abundant over small areas in two wooded canyons ranging from 5000 to 6500 feet.

Dichondra brachypodum Woot. & Standl.—Common in several moist, wooded canyons from 6500 to 7000 feet.

CONVOLVULACEAE (Morning-glory Family)

Evolvulus alsinoides L. (Prostrate morning-glory)—Common in one high, moist, unwooded canyon and a few specimens in one low, moist, wooded canyon. (4200 to 6500 feet.)

Evolvulus argenteus Pursh (Prostrate morning-glory)—One specimen in a dry, unwooded canyon at about 5300 feet.

Ipomoea leptosiphon Wats. (Wild morning-glory)—Abundant in the moist soil of one unwooded east exposure at about 7600 feet and common in one moist, unwooded canyon at 6300 feet.

Ipomoea lindheimeri Gray (Wild morning-glory)—Scattered in the more moist situations of one high, unwooded canyon and one grassy mountain side (6600 to 7500 feet).

Ipomoea muricata Cav. (Wild morning-glory)—Scattered in one dry, sparsely wooded canyon at about 6800 feet.

Convolvulus hermannioides Gray (Small bindweed)—Scattered in the drier situations in one wooded canyon at about 4200 feet.

Convolvulus incanus Vahl—Common in one dry, unwooded canyon from 4500 to 5300 feet.

CUSCUTACEAE (Dodder Family)

Cuscuta indecora Engelm. (Dodder; love-vine)—Abundant on one dry, unwooded south slope at 5500 feet.

POLEMONIACEAE (Phlox Family)

Phlox mesoleuca Greene (Phlox)—Scattered over small areas on dry slopes from 5400 to 6800 feet.

Gilia aggregata Spreng.—Common in one more or less moist, wooded canyon from 6500 to 6800 feet.

Gilia incisa Benth.—Sparsely scattered in one wooded canyon from 4100 to 5500 feet.

HYDROLEACEAE (Water-leaf Family)

Phacelia congesta Hook. (Blue curls)—Common in a few moist, wooded situations ranging from 5000 to 7800 feet.

Phacelia corrugata A. Nels.—Sparse in one moist, wooded canyon at about 6800 feet.

BORRAGINACEAE (Borage Family)

Lithospermum linearifolium Goldie (Stone-seed)—A few specimens in one dry, unwooded situation at about 6800 feet.

Lithospermum multiflorum Torr.—Abundant in the more moist woodland from 6000 to 7000 feet.

Onosmodium thurberi? Gray (Borage)—A few specimens in one moist, wooded situation at about 5500 feet.

Coldenia greggii (Torr.) Gray (Shrub borage)—Frequent on the dry, open foothills east of the mountains at about 3000 to 4000 feet.

VERBENACEAE (Vervain Family)

Verbena neomexicana (Gray) Small (Verbena)—Abundant in one locality in the foothills at about 3600 feet.

Verbena wrightii Gray—Numerous specimens on dry, unwooded slopes ranging from 5500 to 6900 feet.

Verbena xutha Lehm.—Common in one moist, wooded canyon at 6800 feet.

Lippia ligustrina (Lag.) Britton—Scattered in several dry situations in the sparsely wooded canyons of about 5500 feet and abundant in one locality in the lower foothills and adjacent flats from 3700 to 4000 feet.

Lantana macropoda Torr. (Lantana)—Sparsely scattered in several dry canyons from 4000 to 5000 feet.

LAMIACEAE (Mint Family)

Teucrium laciniatum Torr.—Abundant along the waterway of one moist, wooded canyon from 4100 to 4800 feet.

Scutellaria wrightii Gray (Skullcap)—Common in several dry, unwooded canyons at about 5500 feet.

Marrubium vulgare L. (Hoarhound)—A few specimens in one dry canyon about an old camp site at 5500 feet.

Agastache micrantha (Gray) Woot. & Standl.—Scattered along the waterway of one moist, densely wooded canyon from 6500 to 6800 feet.

Stachys coccinea Jacq.—Abundant on one south talus slope at about 7700 feet.

Salvia roemeriana Scheele (Sage)—One specimen in a moist, densely wooded canyon at about 6000 feet.

Salvia arizonica Gray (Sage)—Common in one moist, densely wooded canyon from 6400 to 6900 feet.

Salvia ramosissima Fernald (Sage)—Common in several moist, wooded canyons at about 6500 feet.

Salvia regla Cav. (Sage)—A common and conspicuous shrub throughout the moist woodland from 6000 to 7800 feet.

Hedeoma nana (Torr.) Greene (Lemon-mint)—A few specimens in one dry, sparsely wooded canyon at about 5500 feet.

Hedeoma plicata Torr.—Common in several moist, more or less wooded canyons from 6300 to 6900 feet.

Poliomintha mollis (Torr.) Gray—Scattered sparsely throughout the moist woodland from 4200 to 7800 feet.

SOLANACEAE (Potato Family)

Physalis hederifolia Gray (Ground-cherry)—Common in several more or less moist, openly wooded situations from 4200 to 7800 feet.

Solanum eleagnifolium Cav. (Nightshade)—Common in two dry, sparsely wooded canyons from 5000 to 5500 feet (about old camp sites).

Solanum nigrum L.—Sparse in several dry, unwooded situations of 5500 to 6800 feet.

Solanum rostratum Dunal—Common in the dry foothills and in several dry, unwooded canyons. (3600 to 5000 feet.)

Nectouxia formosa HBK.—A few specimens in one wooded situation at 7800 feet.

Nicotiana trigonophylla Dunal (Wild tobacco)—Common in two moist, wooded canyons from 4200 to 5500 feet.

Petunia parviflora Juss. (Midget petunia)—Abundant at the water's edge of one moist, wooded canyon at 4200 feet.

RHINANTHACEAE (Figwort Family)

Leucophyllum minus Gray—Abundant over limited areas throughout the desert at about 3600 feet.

Leucophyllum texanum Benth. (Cenizo; purple sage)—Abundant over limited areas in two dry, unwooded canyons and throughout the desert (3500 to 5200 feet).

Maurandya antirrhiniflora H. & B. (Climbing snapdragon)—Sparsely scattered in several moist, wooded situations ranging from 4200 to 7500 feet.

Pentstemon havardii Gray (Beard-tongue)—Common along the dry stream beds of the unwooded canyons from 4300 to 6300 feet.

Pentstemon torreyi Benth.—Common in moist, wooded canyons all over the mountains from 5500 to 7800 feet.

Seymeria scabra Gray—Very common on one grassy east exposure at about 7600 feet.

Pagesia humilis S. & M.—Common at the water's edge in one unwooded canyon at about 6300 feet.

Castilleja integra Gray (Indian paint brush)—Common on dry, unwooded slopes throughout the mountains and on the desert. (3600 to 7000 feet.)

BIGNONIACEAE (Trumpet-creeper Family)

Tecoma stans Juss. (Trumpet bush)—Common along the dry waterways of the lower, unwooded canyons and foothills from 4000 to 5400 feet.

Chilopsis linearis (Cav.) Sweet (Desert willow)—An abundant shrub along the dry, lower waterways from 4000 to 5500 feet.

MARTYNIACEAE (Unicorn-plant Family)

Proboscidea parviflora (Woot.) Woot. & Standl.—Sparsely scattered in the less dry situations on the desert at about 3500 feet.

OROBANCHACEAE (Broom-rape Family)

Conopholis mexicana Gray (Broom-rape)—Common; parasitic on the roots of oaks in the moist, dense woodland from about 6300 to 6800 feet.

Orobanche ludoviciana Nutt. (Broom-rape)—Sparse in one dry, openly wooded canyon at about 4600 feet.

ACANTHACEAE (Acanthus Family)

Anisacanthus insignis Gray—A common shrub along the dry waterways of unwooded canyons from 4000 to 5500 feet.

Calophanes linearis (Torr. & Gray) Gray—Scattered sparsely in one dry, openly wooded canyon at about 5500 feet.

RUBIACEAE (Madder Family)

Galium circaezans Michx. (Bedstraw)—Scattered in soil pockets amongst the rocks of one moist, wooded canyon at about 6500 feet.

Galium rothrockii Gray—Scattered in two moist, wooded canyons from 6500 to 7300 feet.

Galium wrightii Gray—Abundant along one moist, wooded canyon at about 6500 feet.

Bouvardia ternifolia (Cav.) Schlecht.—Abundant on well-drained soil in several moist, more or less wooded canyons and mountain slopes from 6200 to 7500 feet.

Houstonia angustifolia Michx. (Narrow-leafed bluet)—Common in several moist, wooded situations from 4200 to 7800 feet.

Houstonia fasciculata Gray—Common in one dry, unwooded canyon at about 5400 feet and sparse in one moist, wooded canyon of 6200 feet.

Houstonia polypremoides Gray—Commonly scattered on grassy, south exposed slopes from 4500 to 6900 feet.

CAPRIFOLIACEAE (Honeysuckle Family)

Sambucus caerulea Raf. (Elder)—A few specimens on one south exposed rock slide at about 7700 feet.

Symphoricarpos rotundifolia Gray (Partridge-berry)—Abundant over limited areas in two moist, wooded canyons at about 7000 feet.

Lonicera albiflora Torr. & Gray, var. *dumosa* (Gray) Rehder (White bush morning-glory)—Scattered in two wooded, more or less moist canyons from 6500 to 6900 feet.

CUCURBITACEAE (Gourd Family)

Sicyos angulatus? L.—A few specimens in two sheltered, moist, wooded situations, one at 5500 and one at 7800 feet.

Ibervillia tenuisecta (Gray) Small (Wild balsam)—Sparsely scattered, growing in the shelter of *Koeberlinia spinosa* in one locality in the lower, dry foothills and adjacent desert at about 4000 feet.

LOBELIACEAE (Lobelia Family)

Lobelia splendens Willd. (Cardinal flower)—A few specimens at the water's edge in two moist, wooded canyons, ranging from 4000 to 4500 feet.

AMBROSIACEAE (Ragweed Family)

Iva ambrosiaefolia Gray (False ragweed)—A few specimens on one grassy east slope at about 7500 feet.

CARDUACEAE (Thistle Family)

Eupatorieae

Carminatia tenuiflora DC.—A few specimens in one moist, wooded canyon at about 4400 feet.

Eupatorium dissectum Gray—Abundant over small areas in two dry, openly wooded canyons at about 5000 feet.

Eupatorium fendleri Gray—Common in one moist, wooded canyon at about 6500 feet.

Eupatorium wrightii Gray—Scattered in several more or less moist and wooded canyons from 6300 to 7500 feet.

Stevia serrata Cav.—Common along the waterways of three more or less moist and wooded canyons from 6300 to 6800 feet.

Carpochaeta bigelovii Gray—Scattered in one moist, densely wooded canyon at about 6500 feet.

Liatris punctata Hook. (Blazing star)—Scattered in colonies in three dry, openly wooded canyons from 5000 to 5500 feet.

Brickellia grandiflora (Hook.) Nutt.—Common in one moist, wooded canyon at about 6500 feet.

Brickellia oliganthes Gray—A few specimens in one moist, wooded canyon at 6500 feet.

Astereae

Baccharis glutinosa Pers.—Sparsely scattered about one waterhole on the desert at about 3600 feet.

Baccharis havardii Gray—Abundant on one grassy, east exposed slope from 7300 to 7700 feet.

Erigeron bellidiastrum Nutt. (Fleabane)—Common throughout the woodland from about 5000 to 7800 feet.

Erigeron canadensis L.—A few specimens along the waterway of one moist, wooded canyon at about 4500 feet.

Aster leucelene Blake (Aster)—A few specimens in one dry, unwooded canyon of about 5000 feet.

Aster leucelene var. *arenosus* (Heller) Standl. (Aster)—Sparse in one dry, unwooded canyon at 5400 feet.

Chrysopsis fulcrata Greene (Yellow aster)—Common in crevices of rocks in several dry situations from 6500 to 7800 feet.

Sideranthus australis (Greene) Rydb.—Common in two dry, unwooded canyons at about 5200 feet.

Solidago wrightii Gray (Goldenrod)—Abundant in one moist, wooded canyon at 6500 feet and in one openly wooded, more or less dry canyon at 5400 feet.

Chrysothamnus baileyi Woot. & Standl.—A few specimens on one dry, unwooded slope at about 6500 feet.

Selloa glutinosa Spreng. (Gum-weed)—Common throughout the woodland from 4200 to 7000 feet.

Inuleae

Gnaphalium chilense Spreng. (Rabbit tobacco)—A few specimens in one moist, wooded canyon from 6500 to 6800 feet.

Gnaphalium decurrens Ives—In small groups in several moist, wooded canyons from 5500 to 6800 feet.

Gnaphalium wrightii Gray—Common in one moist, wooded canyon from 6500 to 6700 feet.

Heliantheae

Melampodium leucanthum Torr. & Gray (Mountain daisy)—Common in dry situations throughout the woodland from 5000 to 7800 feet.

Parthenium incanum HBK. (False guayule)—Abundant over considerable areas throughout the foothills and desert from 3500 to 4500 feet.

Parthenium lyratum Gray—Scattered on one grassy east slope at about 7500 feet.

Berlandiera lyrata Benth.—A few specimens in two dry unwooded canyons from 4300 to 5300 feet.

Heliopsis scabra Dunal—Abundant in two more or less moist and wooded canyons, ranging from 5400 to 7000 feet.

Cosmos parviflorus (Jacq.) HBK.—Sparse along the water's edge of one moist, wooded canyon at about 6700 feet.

Thelysperma gracile Gray—Scattered in two dry, unwooded canyons ranging from 5000 to 5400 feet.

Thelysperma longipes Gray—Common in one dry, unwooded canyon at about 5000 feet.

Bidens bigelovii Gray (Tick-seed)—Scattered at the water's edge of several moist, wooded and unwooded canyons ranging from 4200 to 6400 feet.

Heterospermum pinnatum Cav.—A few specimens in one moist, openly wooded situation at about 6800 feet.

Lepachys columnifera (Nutt.) McBride (Cone-flower)—Abundant in one limited area in a moist meadow at 6800 feet.

Viguiera cordifolia Gray (False sunflower)—Abundant in one moist, wooded canyon at 6500 feet.

Viguiera multiflora (Nutt.) Blake—Scattered in one moist, wooded canyon at about 6500 feet.

Viguiera stenoloba Blake—Common throughout the drier woodland and lower waterways from 4500 to 7500 feet.

Flourensia cernua DC. (Tar-bush)—A very abundant shrub on the desert, usually associated with *Larrea mexicana,* but frequently dominant alone (3000 to 4200 feet).

Zexmenia brevifolia Gray—Common throughout the drier woodland from 5400 to 7500 feet.

Helenieae

Porophyllum scoparium Gray—Abundant in one dry, unwooded canyon from about 4300 to 5200 feet.

Chrysactinia mexicana Gray—Common throughout the upper woodland from about 6000 to 7800 feet.

Pectis tenellum DC.—Scattered abundantly over an extensive flat in the lower foothills at about 4000 feet.

Tagetes micrantha Cav.—Scattered at the water's edge in one moist, wooded canyon at about 6700 feet.

Dyssodia polychaeta (Gray) Robinson—Scattered in one dry, unwooded canyon at about 4800 feet.

Ridellia tagetinae Nutt.—Abundant throughout the lower foothills and canyons from 4000 to 5000 feet.

Baileya multiradiata Harv. & Gray—Abundant along the dry, lower waterways from 4000 to 5000 feet.

Pericome caudata Gray—Abundant on several high rock slides from 6000 to 7800 feet.

Perityle parryi Gray—A few specimens in one moist, wooded canyon at about 4500 feet.

Schkuhria wrightii Gray—Scattered along the water's edge of two moist, openly wooded canyons from 6400 to 6700 feet.

Bahia biternata Gray—Common along several dry, unwooded canyons from 5000 to 5500 feet.

Bahia dealbata Gray—A few specimens on dry ridges in the foothills and in one unwooded canyon (4000 to 6400 feet).

Bahia dissecta (Gray) Britton—A few specimens in one moist, wooded canyon at about 6500 feet.

Helenium amphibolum Gray (Sneezeweed)—Sparse in one moist, wooded canyon at about 4200 feet.

Tetraneuris linearis (Nutt.) Greene—Common on dry, grassy, openly wooded slopes from 4500 to 7000 feet throughout the mountains.

Flaveria repanda Lag.—A few specimens in one moist, wooded canyon at about 4200 feet.

Anthelmideae

Artemisia dracunculoides Pursh (Sage-brush)—Scattered in one moist, wooded canyon at about 6500 feet.

Artemisia redolens Gray—Sparse in one moist, wooded canyon at about 6500 feet.

Senecioneae

Senecio filifolius Nutt. (Squaw weed)—Scattered in one dry, unwooded canyon of about 5500 feet.

Senecio lobatus Pers.—Abundant in two moist, wooded canyons from 6000 to 7000 feet.

Cynareae

Cirsium undulatum (Nutt.) Spreng.—Common in several more or less moist, unwooded canyons from 5000 to 6500 feet.

Mutisieae

Perezia wrightii Gray—Abundant on openly wooded and shrub-covered slopes in dry areas of 5000 to 6500 feet.

Trixis californica Kell.—A few specimens in one dry, unwooded canyon of about 5000 feet and about a waterhole on the desert at 3600 feet.

CICHORIACEAE (Chicory Family)

Hieracium fendleri Schultz—Common throughout the moist, upper woodland from about 6000 to 7700 feet.

BIBLIOGRAPHY

1. Bray, W. L., Vegetation of the sotol country in Texas: Univ. Texas Bull. 60, 1905.
2. Coulter, J. M., Botany of western Texas: Contrib. U. S. Nat. Herb., vol. 2, 1891-1894.
3. Hitchcock, A. S., The genera of grasses of the United States: U. S. Dept. Agric. Bull. 772, 1920.
4. Sargent, C. S., Manual of the trees of North America: Second edition, Boston, 1922.
5. Small, J. K., Flora of the southeastern United States: Second edition, New York, 1913.
6. Standley, P. C., Trees and shrubs of Mexico: Contrib. U. S. Nat. Herb., vol. 23, 1920-1926.
7. Stiles, A., Chisos Mountains quadrangle: U. S. Geol. Survey, Washington, 1903.
8. Torrey, J., Botany of the boundary: U. S. Mexican Boundary Survey, Washington, 1859.
9. Udden, J. A., A sketch of the geology of the Chisos country, Brewster County, Texas: Univ. Texas Bull. 93, 1907.
10. Wooten, E. O., and Standley, P. C., Flora of New Mexico: Contrib. U. S. Nat. Herb., vol. 19, 1915.

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DEDICATION

Twenty-one years have passed since John K. Strecker's catalogue of the "Reptiles and Amphibians of Texas" (1915) appeared. His introduction and bibliography make unnecessary any such attempt in this paper, which is here dedicated to John K. Strecker, his predecessors and successors in Texas. Some of these earnest field workers have made this account possible.

Albert H. Wright and Anna A. Wright.

AMPHIBIANS OF TEXAS

By

ALBERT HAZEN WRIGHT AND ANNA ALLEN WRIGHT

INTRODUCTION

In a "Check List of North American Amphibians and Reptiles" Drs. Leonhard Stejneger and Thomas Barbour (1933) give 86 salamanders and 81 frogs and toads. Today doubtless no more than 5 species of salamanders and 5 frogs might be added to this list. In Texas 16 salamanders, or one-sixth the total number for the United States and Canada, are recorded; three of these are restricted to Texas. Of frogs and toads Texas claims 38 species or five-twelfths of the total number, and nine are restricted to Texas.

In adjoining states are recorded 13 species of salamanders not yet reported from Texas, but at least half of these might well be found in eastern or northern Texas. About 6 frogs and toads recorded in adjoining states may yet be found in Texas.

Many plants and animals have been named for Texas as for other states in the Union. Before 1850 from twenty-three to twenty-five animals were specifically named by their authors *texanus* or *texana* or *texanum, texensis* or *texense, texianus* or *texiana* or *texianum,* and certainly some forty or fifty more have received similar names since that date. The salamander, *Ambystoma texanum,* still retains its state name, but within the last year or so the name of a frog, *Gastrophryne texana,* has been found to be invalid according to the International Rules of Zoological Nomenclature, and is known as *Microhyla olivacea.* Amongst the frogs, at least two have the common names "Texas" or " Texan", namely, Texan cliff frog and Texas narrow-mouthed toad. Amongst the salamanders are three such species: Texas blind salamander, Texan salamander, and Texan newt.

Some forty citizens, scientists, and scholars are honored by the name of some amphibian or reptile. Probably few educated Texans could state what connections Attwater, Boll, Bailey, Emory, Graham, Lindheimer, Lacey, Marcy, Poinsett, and Schott have had with Texas zoology or natural history or why the scientific or common names of Texas frogs, toads, or tree frogs have been named for Berlandier, Camp, Clark, Cope, Couch, Hammond, Hurter, Hallowell, Marnock, Mitchell, Strecker, Taylor, Van Vliet, and Woodhouse. These men, like some seventy-five more, are indelibly linked with Texas zoology. They have scientific monuments more enduring (than evanescent publicity) in the names of snails, rattlers, fish, cacti, thorns or flowers of plants, and other living species. Several explorers in Texas have as many as forty plants named after each of them.

Of the forty to fifty principal articles or works that treat of Texas amphibians nearly one-half have been written from 1898 to 1929 by John K. Strecker, Jr., of Baylor University. Many of his students and friends, particularly Professor Walter J. Williams, have helped him. In his last years he began devoting his efforts to eastern Texas from Brazos River to the Louisiana line, where much work yet needs to be done. Contemporaneous with Strecker were M. C. Dickerson, A. E. Brown, Julius Hurter, C. S. Brimley, Witmer Stone, R. W. Camp, P. H. Pope, C. E. Burt, H. T. Gaige, E. H. Taylor, and Dr. Remington Kellogg whose "Mexican Tailless Amphibians in the United States National Museum" treats of Texas amphibian material and scientific exploration in Texas and Mexico.

The period preceding 1898 might well be divided into two parts· the period from 1851 to 1860, when Spencer Fullerton Baird and Charles Girard published vigorously; and the period from 1860 to 1898, when Cope dominated the field. From 1851 to 1860 Baird, by correspondence, through appointments of collectors with army explorations, through purchases, and by other means, assembled in Washington much Texas material from Dr. Thomas H. Webb, John H. Clark, Arthur C. V. Schott, Lieutenant D. N. Couch of the army, and from Lindheimer, L. Berlandier, and other naturalists of Texas. From 1860 to 1891 Baird and Cope corresponded with numerous outstanding naturalists, such as Jacob Boll, Marnock, and others, to help to complete the survey of Texas amphibians and reptiles. In this period Edward Hallowell, H. C. Yarrow, Samuel Garman, F. W. Cragin, G. A. Boulenger (through correspondents like Taylor of San Diego, Texas), L. Stejneger, and many others have contributed.

TABLE 1—*Key to Texas species in the order* Salientia

A. Waist wide; body broad and thick; hind limbs short.

B. With transverse fold of skin across head behind eyes; no tympanum; no paratoid; snout pointed; head narrow; mouth small (4–6.5 times in length); fingers and toes without webs except slight in *Hypopachus;* eyes small and depressed; size small, 0.75–1.6 inches.

NARROW-MOUTHED TOADS, MICROHYLIDAE

C. Two sole (metatarsal) tubercles; basal webs on feet; snout shorter (9–10 times in length); skin smooth, loose and leathery; back greenish brown or olive with a light-yellow or orange thread stripe down mid-back, oblique white band from eye to shoulder, belly mottled gray with a mid-ventral white thread line; size 1.0–1.6 inches.

1. TAYLOR'S TOAD, *Hypopachus cuneus* (Pl. 2, fig. 1)

CC. One sole (metatarsal) tubercle; no webs on feet; snout longer (6.6–8.2 times in length); no mid-dorsal or mid-ventral lines nor oblique postorbital band.

D. Muzzle longer (6.6–8.2 times in length); hind foot longer (2.2–2.6 times in length); back more or less smooth.

E. Body depressed (thickness 3–5.6 times in length); skin usually smooth; upper eyelid wider (10–18 times in length; under parts white, back grayish olive with fine black spots; head appears more pointed than in *Microhyla carolinensis;* limbs more slender (tibial width 3–4 times in tibial length).

2. TEXAS NARROW-MOUTHED TOAD, *Microhyla olivacea* (Pl. 2, figs. 2, 3)

EE. Body less depressed (thickness 2.5–3.4 times in length); skin smooth, tuberculate, or postular; upper eyelid narrower (18.6–28 times in length); under parts gray or brown speckled and mottled; dorsum black, gray, or brown with black and white dots; head appears less pointed than in *M. olivacea* and limbs more stocky (tibial width 2.5–3 times in tibial length); size 0.8–1.4 inches.

3. NARROW-MOUTHED TOAD, *Microhyla carolinensis* (Pl. 2, fig. 4)

DD. Muzzle shorter (8 times in length); hind foot usually short (2.5–2.8 times in length; back areolate, posterior parts even pustular.

4. MITCHELL'S NARROW-MOUTHED TOAD, *Microhyla areolata*

BB. Without transverse fold of skin across head behind eyes; tympanum distinct or indistinct; parotoids present except in two species of spadefoots; snout blunt; head broad; mouth larger (2.4–4.4 times in length); feet with extensively fleshy webs; eyes large; size medium to large, 1.5–8.8 inches, except *Bufo debilis.*

C. Pupil vertical (by day); paratoids absent in two species, present but rounded and indistinct in one species; sole without subarticular tubercles; dorsal skin relatively smooth; venter smooth; no cranial crests; males without discolored throats; forward ventral surface more or less white, rear ventral surfaces distinctly vinaceous (purplish).

SPADEFOOTS, SCAPHIOPODIDAE

D. Parotoid absent or indistinct; tympanum indistinct; no pectoral glands.

E. Skin on crown of head thick and horny; hind limb longer (0.78–0.96 times in length); fore limb longer (1.51–2.19 times in length); fourth finger longer (6.28–8 times in length); foot with tarsus longer (1.57–1.76 times in length); fourth toe longer (2.66–3.29 times in length); back greenish, the sides yellowish glaucous or light mineral gray or greenish, with green spots on back, top of head and legs; skin fine, relatively smooth, dotted with fine roundish tubercles; size small, 1.5–2.4 inches.

5. HAMMOND'S SPADEFOOT, *Scaphiopus hammondii*

EE. Skin on crown of head thin; hind limb shorter (0.89–1.15 times in length); fore limb shorter (2–2.31 times in length); fourth finger shorter (8–11.2 times in length); foot with tarsus shorter (1.7–2.35 times in length); fourth toe shorter (3.02–4 times in length); back greenish, more or less marbled with light, a dark line extending backward from each eye; skin roughly tuberculate with many light tubercles on the sides; size larger, 1.9–3.2 inches.

6. COUCH'S SPADEFOOT, *Scaphiopus couchii* (Pl. 1, fig. 1)

DD. Parotoid distinct; tympanum distinct; pectoral glands present; skin on crown of head thin; size 2.0–2.9 inches.

E. Head to angle of mouth greater (2.93–3.56 times in length); width of head greater (2.24–2.75 times in length); snout larger (5.17–6.6 times in length); tympanum greater (10.1–12 times in length); skin relatively smooth, brown in color with two·more or less evident light dorsal stripes.

7. SOLITARY SPADEFOOT, *Scaphiopus holbrookii holbrookii*

EE. Head to angle of mouth smaller (3.14–3.81 times in length); width of head smaller (2.58–2.66 times in length); snout smaller (5.4–6.3 times in length); tympanum smaller (11.5–16 times in length); upper surfaces with small, closely set tubercles, very uniform in size and distribution; the color varies from gray and yellowish green to dark, and usually shows two light dorsal stripes. Skull deeper (H. M. Smith).

8. HURTER'S SPADEFOOT, *Scaphiopus holbrookii hurterii*

CC. Pupil not vertical; parotoids present and elevated; sole with subarticular tubercles; skin warty; venter usually granulated; cranial crests present in most species; lacking in *Bufo compactilis, B. debilis,* and *B. punctatus;* males usually with discolored throats.

TOADS, BUFONIDAE

D. Cranial crests absent or obscure.

E. Parotoids elongate, sometimes smooth; interorbital narrower (9.7–11.7 times in length); size above 3 inches or slightly below; no sharp-edged ridge from eye to nostril; snout short; toes half webbed; sole tubercles large, each with a cutting edge; tympanum much smaller than the eye; femur largely enclosed in body skin; vocal sac elliptical; color pinkish drab marked with dull citrine spots, fingers and toes light; size 2.1–3.6 inches.

9. SPADEFOOT TOAD, *Bufo compactilis* (Pl. 1, fig. 3)

EE. Parotoids not elongate; interorbital broader (7.2–9.8 times in length); size usually below 3 inches.

F. Parotoids large, low, descending on sides and as long as the side of the head; body rounded; head narrower; snout pointed and protruding; fingers shorter, e. g. first finger 8.8–12 times in length; back green or gray with small black spots and with a few gold or yellow tipped tubercles on sides and legs; size 1.0–1.8 inches.

10. LITTLE GREEN TOAD, *Bufo debilis* (Pl. 1, fig. 7)

FF. Parotoids small, raised, rounded; body flat; head broader; snout not distinctly protruding; ridge from eye to nostril prominent; fingers longer, e. g. first finger 6–7.5 times in length; color, red to gray sometimes spotted with black, and with tubercles more or less tipped with red or cinnamon; size 1.6–3.0 inches.

11. CANYON TOAD, *Bufo punctatus* (Pl. 1, fig. 6)

DD. Cranial crests present.

E. Femur almost entirely enclosed in body skin; vocal sac elliptical with conspicuous lappet when collapsed; 2 sole (metatarsal) tubercles with a cutting edge; crests uniting into a boss on the snout; parotoid glands small and oval; color brown, gray or greenish with or without a mid-dorsal stripe, and with large light-bordered spots or sometimes with small inconspicuous ones; size 1.9–4.0 inches.

12. GREAT PLAINS TOAD. *Bufo cognatus* (Pl. 1, fig. 2)

EE. Half or more of femur free from body skin; vocal sac spherical, without lappet; outer metatarsal tubercle without cutting edge; boss usually absent, rarely present in Fowler's and Woodhouse's toads.

F. Parotoids oval to elongate; interorbital space narrow (10–15 times in length); dorsal pattern of 4–6 pairs of spots along mid-dorsal line; crests low; superciliary crests meeting postorbitals at right angles.

G. Small uniform warts on back; 2 or more warts in each dark dorsal spot; warts on upper surface of hind legs small; occasionally the cranial crests form a boss between the eyes; no preparotoid longitudinal crests; underparts usually unspotted; voice harsh; back greenish with a yellow or buff mid-dorsal stripe, and underparts cream with a dark pectoral spot; size smaller, 2.0–3.25 inches.

13. Fowler's toad, *Bufo fowleri* (Pl. 1, fig. 10)

GG. Large dorsal warts; usually a single wart in each dark dorsal spot; underparts spotted or plain; size larger, 2.25–4.75 inches.

H. Many warts spiny, particularly on the hind legs; parotoids parallel, closest together at mid-points; parotoid gland on dorso-lateral line or on dorsum; preparotoid longitudinal crest present; call a musical trill; general color olive, brown or diverse colors; size 2.2–4.25 inches.

14. American toad, *Bufo americanus americanus* (Pl. 1, fig. 8)

HH. Warts round; parotoids slightly divergent at rear, and on lateral aspect; parotoid usually in contact with postorbital crest; often with boss on nostril with crest extending backward; color grayish drab or brown with brownish warts and a narrow light mid-dorsal stripe; size 2.25–4.75 inches.

15. Rocky Mountain toad, *Bufo woodhousii* (Pl. 1, fig. 9)

FF. Parotoids round or triangular; interorbital space broad (7–9.3 times in length); dorsal pattern without 4–6 paired spots; crests prominent.

G. Parotoid as large or larger than side of head, divergent, not bicolored; toes ½–⅔ webbed; crests not trenchant, with top of head not a deep valley; parietal crests absent or inconspicuous; color brown with some black, yellow, red, olive; with or without black spots on a light vertebral line; size large, 5.6–8.8 inches.

16. Marine toad, *Bufo marinus* (Pl. 1, fig. 5)

GG. Parotoid much smaller, not so large as side of head, not divergent, is bicolored; row of light conical tubercles on side of body; body flat; toes ⅓ webbed; crests high and trenchant, with top of head a deep valley; parietal crests present; color brown or blackish brown with light-olive, buff, or cinnamon area down back and a similar band or stripe on each side; size 2.1–5.0 inches.

17. Mexican toad, *Bufo valliceps* (Pl. 1, fig. 4)

AA. Waist narrow; body narrower and thinner; hind limbs long; no parotoid.

B. Disks on digits (absent in *Leptodactylus labialis)* neither thumb nor other fingers enlarged in male; size small to medium (usually below 1.6–2.0 inches) except *Eleutherodactylus latrans* and *Hyla baudinii.*

C. Disks transverse (absent in *Leptodactylus labialis)* venter usually smooth; subarticular tubercles saw-toothed; eggs large; male throat not discolored; pupil horizontal; tympanum distinct; outer metatarsal united.

ROBBER FROGS, LEPTODACTYLIDAE

D. Fingers and toes free without distinct terminal disks; white or cream stripe on upper jaw; dark vittal stripe from nostril to tympanum; dorso-lateral fold and lateral fold below it present; dorsal color olive yellow, olive, brown or reddish brown with irregular dark spots, light margined or not; size small, 1.4–2.0 inches.

18. WHITE-LIPPED FROG, *Leptodactylus labialis* (Pl. 3, fig. 3)

DD. Tips of phalanges T-shaped; toes and fingers free; terminal finger and toe disks small; no white upper jaw stripe; no dorso-lateral or lateral fold.

E. Size medium, 1.9–3.6 inches; with a ventral disk; voice a resounding bark; head broad (2–2.57 times in length) head wider than head to tympanum; eye small (7.2–9.25 times in length); eye much less than first finger; fingers larger; back light purplish brown with large black spots and a light median area; middle of throat and underparts pale pinkish buff.

19. TEXAS CLIFF FROG, *Eleutherodactylus latrans* (Pl. 3, fig. 2)

EE. Size small, 0.6–1.6 inches; without a ventral disk; voice a cricket-like chirp; head narrower (2.66–3.38 times in length); head usually narrower than head to tympanum; eye larger (5–8 times in length); eye greater than first finger; fingers smaller; usually no transverse band between eyes.

F. Tympanum smaller (11–13 times in length); hind limb shorter (0.72–0.87 times in length); internasal broader (8–9 times in length); fore limb usually greater than foot with tarsus; back greenish spotted with brown, the underparts light-brownish vinaceous, the legs crossbarred.

20. MARNOCK'S FROG, *Syrrhophus marnockii* (Pl. 3, fig. 7)

FF. Tympanum larger (8–10 times in length); hind limb longer (0.72–0.73 times in length); internasal narrower (9–10 times in length); fore limb usually less than (rarely equal to) foot with tarsus; color grayish olive with scattered dark spots on back, with a dark band from nostril through eye to tympanum and dark crossbars on legs.

21. CAMP'S FROG, *Syrrhophus campi* (Pl. 3, fig. 6)

CC. Disks round, large or small; venter usually granular or areolate; subarticular tubercles rounded; eggs small; male throat discolored; pupil elliptically horizontal.

TREE FROGS, HYLIDAE

D. Alternating dark and light bands on rear of thighs; oblique white stripe from eye to shoulder; vertical dark and light bars on upper jaw; white margined triangle between eyes; hind leg very long (0.5–0.6 times in length); tibia very long (1.5–1.7 times in length); color variable brown, olive, green or gray with oblique bars on the sides; size 0.6–1.25 inches.

22. CRICKET FROG, *Acris gryllus crepitans* (Pl. 2, fig. 6)

DD. No alternation of dark and light bands on rear of thighs; no oblique white stripe from eye to shoulder; triangle between eyes if present not white margined; no vertical dark and light bars on upper jaw; hind legs shorter (0.6–0.8 times in length); tibia shorter (1.75–2.3 times in length).

E. No dark brown or black stripes in front of or behind eye; rear of thigh unspotted.

F. Rear of thigh purple; no interorbital bar or triangle; throat with green on either side; body slender; back smooth, green, with a yellow or white line along sides and on upper jaw, also with a white edge on rear of tibia, foot and forearm; size 1.5–2.5 inches.

23. GREEN TREE FROG, *Hyla cinerea cinerea* (Pl. 2, fig. 10)

FF. Rear of thigh orange or ocher; interocular bar present; throat without green on each side; no white edge on rear of tibia, foot or forearm.

G. Light stripe below eye to shoulder; back black, green or brown with or without spots; smooth; medium disks on fingers and toes; first finger shorter (7–9.3 times in length); size 0.9–1.5 inches.

24. SQUIRREL TREE FROG, *Hyla squirella*

GG. No light stripe on upper jaw or light spot below eye; brown or gray usually spotted; large disks on fingers and toes; first finger longer (5.1–6.5 times in length); size 1.2–2.2 inches.

25. CANYON TREE FROG, *Hyla arenicolor* (Pl. 2, fig. 11)

EE. With dark brown or black stripe in front of or behind eye, or both.

F. Rear of thigh spotted; light spot below eye except in *H. femoralis;* size in general larger, 1.0–3.6 inches.

G. Network of black on yellow sides; broad dark vitta back from eye becoming a vertical shoulder bar; throat with greenish or yellow; rear of thigh netted with greenish yellow and purplish russet; light yellow or green spot below eye; interocular bar present; back green or tan usually with spots; size large, 1.75–3.6 inches.

26. MEXICAN TREE FROG, *Hyla baudinii* (Pl. 2, fig. 9)

GG. No network of black on yellow sides; no black or brown shoulder bar; throat not prominently greenish; small to medium, 0.75–2.4 inches.

H. Rear of thigh netted black or dark and with some yellow or orange; groin orange; light spot below eye; cross on forward half of back; color ashy gray, grayish tan, or green.

I. Dorsal surfaces smooth; rear of femur often marked with fine dots; size 1.7–1.9 inches.

27. COPE'S TREE FROG, *Hyla versicolor chrysoscelis*

II. Dorsal surfaces commonly rough; size 1.25–2.4 inches.

28. TREE TOAD, *Hyla versicolor versicolor* (Pl. 2, fig. 12)

HH. Rear of thigh brown, with distinct round or elliptic spots of orange or chrome; no light spot below eye; a cross-shaped spot on back; color brown or green; size 1.0–1.6 inches.

29. PINEY WOODS TREE FROG, *Hyla femoralis*

FF. Rear of thigh unspotted; usually with a transverse bar or triangle or median longitudinal line between eyes; no light spot below eye; usually dorsal and lateral stripes or rows of spots present; size in general smaller, 0.75–2.0 inches.

G. Five stripes or rows of spots usually present (3 dorsal and 2 lateral); disks inconspicuous; color back, olive, or gray; size small, 0.75–1.5 inches.

H. Stripes usually broken into round or longitudinal spots; tibia 2–2.24 times in length; hind limb 0.64–0.75 times in length; head to tympanum 2.85–3.11 times in length; head to angle of mouth 3.29–3.53 times in length; snout 5.7–7 times in length; size 0.75–1.25 inches.

30. CLARK'S STRIPED CRICKET FROG, *Pseudacris nigrita clarkii* (Pl. 2, fig. 5)

HH. Stripes distinct; tibia 2.24–2.54 times in length; hind limb 0.71–0.75 times in length; head to tympanum 3.14–3.29 times in length; head to angle of mouth 3.66–3.73 times in length; snout 6–8 times in length; size 0.8–1.5 inches.

31. STRIPED CRICKET FROG, *Pseudacris nigrita triseriata*

GG. Two lateral stripes present; two dorsal stripes usually broken into spots or occasionally absent; (mid-dorsal stripe absent); lateral stripe darker than other stripes or rows of spots and white bordered above; color of back, green, gray or brown; size 1–2 inches.

H. Disks inconspicuous; usually with an interocular bar; lateral stripe broken at shoulder, sometimes ending there; body broad, toad like; width of head greater (2.4–2.88 times in length); snout longer (5.0–6.54 times in length); intertympanic space greater (3.1–3.6 times in length); fourth finger short (5.6–7.2 times in length); foot with tarsus shorter (1.47–1.71 times in length); size 1.0–1.6 inches.

32. Texas ornate chorus frog, *Pseudacris streckeri* (Pl. 2, fig. 7)

HH. Disks distinct; interocular bar or triangle absent; lateral stripe may extend some distance along the side; no light borders around groin spots if present; a pair of dark longitudinal post-sacral bars or spots the conspicuous dorsal markings; body narrower; width of head less (2.88–3.5 times in length; snout shorter (6.54–7 times in length); intertympanic space less (3.6–4.3 times in length); fourth finger longer (4.8–5.6 times in length); foot with tarsus longer (1.3–1.55 times in length); size 1–2 inches.

33. Sonora tree frog, *Hyla gracilipes* (Pl. 2, fig. 8)

BB. No disks on digits; extensive webbing on toes; thumb of male enlarged at base; venter smooth; sacral hump conspicuous; size medium to large, 1.6–8.0 inches.

True frogs, RANIDAE

C. Tympanum equal to eye in female, larger in male (5.6–11.5 times in length); dorso-lateral fold absent or on cephalic half of body only; dorsal color more or less uniform; no light upper jaw stripe; no external vocal sacs; throat of males differently colored from rest of venter; dusky bars or spots on legs.

D. Upper jaw unicolor; dorso-lateral fold absent except short fold over and behind tympanum; toes completely webbed; eye smaller (9.4–12 times in length); upper eyelid smaller (12.3–16 times in length); color greenish drab to black on back, undersurfaces yellowish white or may be mottled with black on Gulf Coast; size large, 3.4–8.0 inches.

34. Bullfrog, *Rana catesbeiana* (Pl. 3, fig. 9)

DD. Upper jaw mottled below the bright green mask from tympanum forward; dorso-lateral fold present on cephalic half of body; 1 or 2 phalanges of fourth toe free of webbing; eye larger (7–10 times in length); upped eyelid larger (10–13.5 times in length; color of back uniform greenish drab with or without a few black spots; male with a yellow throat; size medium, 2–4 inches.

35. GREEN FROG, *Rana clamitans* (Pl. 3, fig. 1)

CC. Tympanum smaller than the eye in both sexes (11–15.8 times in length); dorso-lateral folds both long and prominent; 2–4 rows of dark spots between dorso-lateral folds and 1–3 rows below the fold; male with large lateral external vocal sacs; throats of males not so differently colored from rest of venter; 2 phalanges of fourth toe free of webbing, legs barred with prominent spots or less light margined.

D. Upper jaw mottled light and dark with no clear-cut line of light above a dark labial margin; color drab, grayish olive or brown; 3–4 rows of prominent large dark dorsal spots encircled by grayish lines and sometimes light centered, between or extending over the dorso-lateral folds; spaces between the spots and leg bar mottled; glandular folds present on tibia and between the dorso-lateral folds; skin warty; vocal sacs prominent, the collapsed plaited sacs resting as folds of gray skin and continuing along the sides past the axils, the middle of the sac being back of the tympanum; fore limb shorter (2.2–2.6 times in length); size 2.50–4.5 inches.

36. NORTHERN GOPHER FROG, *Rana areolata* (Pl. 3, fig. 5)

DD. Upper jaw rim dark with a clear light line above; the round dorsal spots do not cross the prominent light-colored dorso-lateral lines and cover not more than half the back and are generally in two rows; the spaces between the spots and leg bars are clear; vocal sac not extending beyond the axil; skin smooth; color green or brown.

E. Snout shorter (6–6.8 times in length); more lateral spots below dorso-lateral fold; tibia shorter (1.73–1.94 times in length; head to angle of mouth short (3.33–3.88 times in length); head to tympanum 2.8–3.2 times in length; upper eyelid medium (11.2–14.6 times in length); tympanum normally without light center; size 2–4 inches.

37. MEADOW FROG, *Rana pipiens pipiens* (Pl. 3, fig. 8)

EE. Snout longer (5.23–6.3 times in length); fewer lateral spots below dorso-lateral fold; tibia longer (1.55–1.82 times in length); head to angle of mouth long (2.66–3.1 times in length); head to tympanum 2.38–2.8 times in length; upper eyelid wide (9.33–11.7 times in length); tympanum usually with light center; size 2.0–3.25 inches.

38. SOUTHERN MEADOW FROG, *Rana sphenocephala* (Pl. 3, fig. 4)

TEXAS SPECIES IN THE ORDER SALIENTIA

Family MICROHYLIDAE

1. TAYLOR'S TOAD, *Hypopachus cuneus* Cope (Pl. 2, fig. 1)

Range—Records from Cameron and Hidalgo counties northward to 28°, or to Duval and Kleberg counties.

Habitat—In holes near tree stumps and in other subterranean places.

Breeding—They breed in natural water holes, ditches, and overflows from March to September. "The eggs float on the surface of temporary pools in rafts barely held together." The eggs "are black and white"—and "the envelope is truncate" (Mulaik and Sallberger, 1938). The tadpoles, 1.2 inches long, transform from April to October into frogs 0.4 to 0.5 inch.

2. TEXAS NARROW-MOUTHED TOAD, *Microhyla olivacea* (Hallowell) (Pl. 2, figs. 2, 3)

Range—Records mainly west of line from Fort Worth, Waco, Austin, Victoria, and Brownsville.

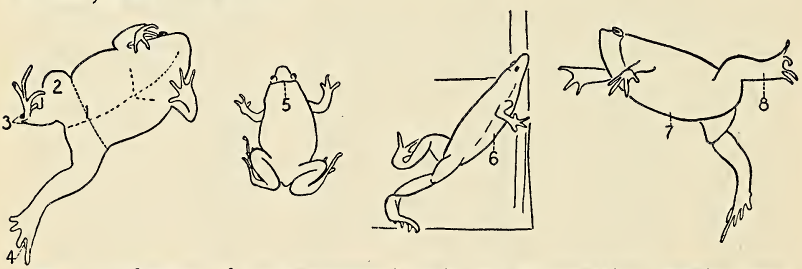


FIG. 1.—Sketches of narrow-mouthed toads, the Microhylidae, showing essential characteristics. 1, Broad waist. 2, Femur partially involved in body skin. 3, Two metatarsal tubercles. 4, Slight basal web. 5, Transverse fold of skin across the head. 6, Depressed form of body. 7, Thick body. 8, Short legs.

Habitat—Under logs, dead stumps, fallen trunks of Spanish bayonets, and other decomposing vegetation, and in different kinds of holes.

Breeding—They breed in ponds, temporary rain pools, "prairie ponds, pools in damp gulches, road side ditches" from March 25 to September during heavy rainy periods. The eggs float on the surface. The grayish-olive tadpoles, 0.94 inch long, transform April 15 to October into frogs 0.4 to 0.5 inch.

3. NARROW-MOUTHED TOAD, *Microhyla carolinensis* (Holbrook) (Pl. 2, fig. 4)

Range—East Texas, mainly east of the east line of *M. olivacea.*

Habitat—Hides in decaying logs, under haycocks, or any shelter.

Breeding—They breed in many diverse shallow aquatic environments from May 1 to September 1. The egg mass is a surface film. The flat, small tadpoles, 1 inch long, transform from mid-June to mid-October into frogs 0.32 to 0.5 inch.

4. MITCHELL'S NARROW-MOUTHED TOAD, *Microhyla areolata* (Strecker)

Range—Known only from Victoria and Calhoun counties.

Habitat—In bottomlands, lowland pine lands, under logs and similar shelter. This species with back areolate, the posterior parts even pustular, is a debatable form, doubtless synonymous with *M. carolinensis*.

Breeding—In spring they breed in shady, shallow overflows of streams, ponds, and other small bodies of water. The eggs are laid at the surface in trash at edge of ponds. The tadpoles have not been described.

Family SCAPHIOPODIDAE

5. HAMMOND'S SPADEFOOT, *Scaphiopus hammondii* Baird

Range—From Wilbarger to Bexar counties and westward.

Habitat—They live in subterranean burrows at bases of weeds.

Breeding—They breed in temporary pools or temporary areas from

FIG. 2.—Sketches of typical spadefoots, the Scaphiopodidae, showing essential characters. 1, Wide interorbital space. 2, Upper eyelid. 3, Small round parotoids. 4, Fleshy webs. 5, Broad waist. 6, Pectoral glands. 7, Vertical pupil. 8, Two metatarsal tubercles, the outer large and with a cutting edge.

mid-April to August. The eggs are in cylindrical masses attached to grass or plant stems; some eggs are stalked. The dark greenish-black tadpoles, 2.4 to 2.8 inches long, transform from May 20 to September 1 into frogs 0.5 to 1 inch.

6. COUCH'S SPADEFOOT, *Scaphiopus couchii* Baird (Pl. 1, fig. 1)

Range—Western Texas to east boundary of records from Wilbarger to Tarrant, McLennan, Bexar, Refugio, and Cameron counties.

Habitat—They live in subterranean burrows under logs and many diverse shelters.

Breeding—They breed in very temporary pools, hollows, roadside ditches, overflowed fields, abandoned water-filled quarries, and other similar places from April to August. The eggbands soon assume a more or less cylindrical mass-like form, or are loosely arranged. The bronzy small tadpoles, 1 inch long, transform in summer and fall into little spadefoots 0.3 to 0.5 inch.

7. SOLITARY SPADEFOOT, *Scaphiopus holbrookii holbrookii* (Harlan)

Range—With *S. holbrookii hurteri* in east Texas.

Habitat—Nocturnal shallow burrows in ground, in wells, in shade.

Breeding—They breed in all kinds of temporary pools as well as permanent ponds from March to September in rainy periods. The eggs are in irregular bands. The small bronzy tadpoles, 1.12 inches long, transform from July to September into frogs 0.3 to 0.5 inch.

8. HURTER'S SPADEFOOT, *Scaphiopus holbrookii hurterii* (Strecker)

Range—Houston to Somerset and Brownsville. A debatable form; H. M. Smith believes it to be a distinct form.

Habitat—Similar to that of the solitary spadefoot.

Breeding—They breed from April 13 (J. K. Strecker) to June 28 (A. J. Kirn). The eggs and tadpoles have not been described.

Family BUFONIDAE

9. SPADEFOOT TOAD, *Bufo compactilis* Wiegmann (Pl. 1, fig. 3)

Range—Eastern boundary from Wichita County on Red River southeastward along Brazos River.

Habitat—Desert form.

Breeding—They breed from May to August in rain pools in open fields, near streams, in pools, in creek valleys, in irrigation tanks or cattle tanks, or in as temporary places as true spadefoots choose. The brown and yellow eggs are in long, fine strings. The bicolored tadpoles, 1.12 inches long, transform from June to September 1 into frogs 0.5 inch.

10. LITTLE GREEN TOAD, *Bufo debilis* Girard (Pl. 1, fig. 7)

Range—From Brownsville to El Paso; records west of a line from Cooke County to Waco, San Antonio, and Refugio County.

Habitat—Grassy mesquite flats.

Breeding—They breed from last of March to June in temporary rain pools, ditches or shallow ponds, in streams of intermittent flow; prairie ponds. The eggs are in small strings and are attached to grass and weed stems. The tadpoles are smaller than those of *B. punctatus* (J. K. Strecker, 1926, p. 10). They transform into frogs 0.3 to 0.4 inch.

11. CANYON TOAD, *Bufo punctatus* Baird and Girard (Pl. 1, fig. 6)

Range—Dallas to Waco, San Antonio, San Diego, Brownsville, and westward.

Habitat—Desert canyons.

Breeding—They breed from April to July in rock-bottomed or gravelly pools of intermittent streams or gulches. The eggs are single or sometimes stuck together in a film on the bottom. The black tadpoles, 1 inch long, transform in June to August into frogs 0.4 inch.

12. GREAT PLAINS TOAD, *Bufo cognatus* (Say) (Pl. 1, fig. 2)

Range—Mainly west of the 100th meridian.

Habitat—Grazing lands or agricultural lands of Great Plains.

Breeding—They breed from April to September along irrigating ditches, flood plains of stream, overflow bottom lands, and cattle tanks in arroyos. "The eggs are in one or two rows in single tubes of jelly. The almost black tadpoles, one inch long, transform in June to October into frogs 0.4 to 0.5 inch." (Bragg, 1936, 1937.)

13. FOWLER'S TOAD, *Bufo fowleri* Hinckley (Pl. 1, fig. 10)

Range—Schmidt, Myers, Strecker (1926), and others call the *B. americanus* of Strecker, Beyer, and others *B. fowleri,* i. e., the form of

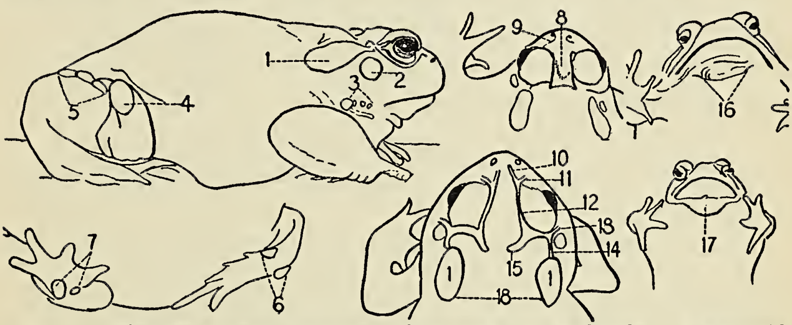


FIG. 3.—Sketches showing characters of the toads, the Bufonidae. 1, Parotoid. 2, Tympanum (ear). 3, Warts at angle of mouth. 4, Gland on femur. 5, Glands on tibia. 6, Two metatarsal (sole) tubercles. 7, Two metacarpal (palmar) tubercles. 8. Crests united forming a prominent raised boss between the eyes. 9, Canthus rostralis. 10, Canthal crest. 11, Preorbital crest. 12, Supraorbital crest. 13, Postorbital crest. 14, Preparotoid crest. 15, Parietal crest. 16, Folds of skin of lower throat of male, covered at periods of rest by the lappet. 17, Lappet or apron at rear of throat of male.

the Gulf Coast, eastern Texas to open plains or central Texas. Others call it *B. woodhousii fowleri.* Others pronounce it *B. woodhousii.* More material is needed.

Habitat—Beaches, coasts, lake shores, river banks; in fields, pastures, gardens, sand dunes, pine barrens.

Breeding—Breeds later than *B. americanus* from April 15 to mid-August in shallow water of permanent ponds, flooded low ground, ditches, rivers, and streams. The eggs are in long files, at first the eggs in a double row. The small tadpoles, 1.1 inches long, transform from mid-June to August into frogs about 0.5 inch.

14. AMERICAN TOAD, *Bufo americanus* Holbrook (Pl. 1, fig. 8)

Range—Records east of line from Fort Worth to Burnet and Refugio counties; along the coast into Louisiana. It is *B. valliceps*-like if not breeding with it.

Habitat—About gardens, cultivated fields, and houses. Under boards, stones, logs, wood piles, and other cover.

Breeding—They breed from April to August 1 in shallow water of diverse environments. The eggs are in long spiral tubes. The small black tadpoles, 1.1 inches long, transform from June 1 to September 1 into frogs 0.25 to 0.5 inch.

15. ROCKY MOUNTAIN TOAD, *Bufo woodhousii* Girard (Pl. 1, fig. 9)

Range—Most records (except for a few) are west of a line from Cooke County to Waco, Austin, to Victoria. Three records east of 96° longitude.

Habitat—In gardens, fields, irrigating ditches, along rivers, and edges of swamps, in canyons, and under shade of many diverse places.

Breeding—They breed from March to August, laying eggs in files, which have only one jelly tube, like that of *B. fowleri.* The young transform from July 1 onward.

16. MARINE TOAD, *Bufo marinus* (Linné) (Pl. 1, fig. 5)

Range—Recorded solely at Zapata, Zapata County, Texas (Taylor and Wright).

Habitat—Roadsides, gardens, edges of swamps and woods. Seek cover under boards, stones, logs, or in burrows of soft earth.

Breeding—Breeding periods vary with different parts of its wide-spread range. The eggs are in strings; tadpole black.

17. MEXICAN TOAD, *Bufo valliceps* Wiegmann (Pl. 1, fig. 4)

Range—Records in eastern and southern Texas, generally south of 33° latitude, i. e., from Henderson and Ellis counties southward to Sabine River, Brownsville, and mouth of Pecos River.

Habitat—Pinelands of eastern Texas.

Breeding—They breed from March to August in open stretches of small streams, often in railroad ditches or roadside pools or in damp gulches. The eggs are often in double rows in each of the two strings. The black tadpole transforms into a frog 0.3 to 0.5 inch.

Family LEPTODACTYLIDAE

18. WHITE-JAWED ROBBER FROG, *Leptodactylus labialis* (Cope) (Pl. 3, fig. 3)

Range—Extreme southern Texas in Starr and Hidalgo counties.

Habitat—Moist meadows, irrigated cane fields, drains, and gutters in towns, beneath stones, logs, in sandy banks and fields; near streams and marshy places.

Breeding—A foamy "egg mass containing 86 yellow eggs was found in a rounded excavation—at the base of a grass hummock afloat from the water's edge. The tadpoles 1.3 to 1.6 inches transform from June onward into frogs 0.5 to 0.6 inch" (Mulaik, 1937).

19. TEXAS CLIFF FROG, *Eleutherodactylus latrans* (Cope) (Pl. 3, fig. 2)

Range—Waco to Burnet, Bexar, and Real counties and possibly into the trans-Pecos country.

Habitat—Limestone ledges of the cliffs that front Edwards Plateau. In rock walls of gorges or on mountainous slopes. Reported also from caves.

Breeding—Breed probably from February to May and doubtless lay their eggs in moist rain-filled cracks, crevices, or caves. The large

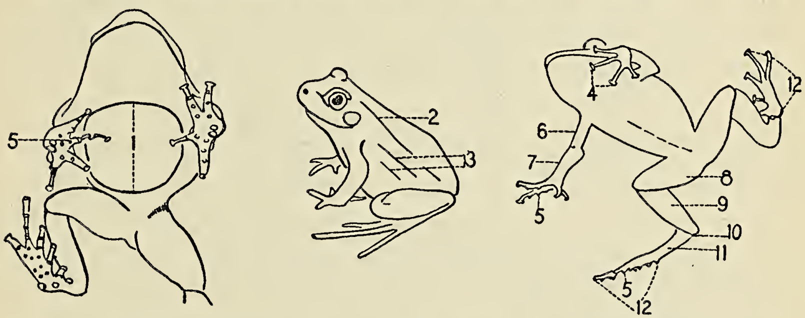


FIG. 4.—Sketches showing characters of robber frogs, the Leptodactylidae. 1, Ventral disk. 2, Dorso-lateral fold. 3, Lateral folds. 4, Transverse (T-shaped) disks. 5, Subarticular tubercles, sharp and sawtoothed. 6, Brachium (upper arm). 7, Antebrachium (forearm). 8, Femur. 9, Tibia. 10, Heel. 11, Tarsus. 12, Foot.

eggs indicate that the whole development takes place in the egg and that a fully formed small cliff frog issues therefrom.

20. MARNOCK'S FROG, *Syrrhophus marnockii* Cope (Pl. 3, fig. 7)

Range—Records from Travis, Hays, and Bexar counties.

Habitat—In cracks, crevices, caves in limestone ledges of the hills and ravines, under flat stones.

Breeding—They breed apparently in spring. The eggs have not been described. There is doubtless no tadpole stage.

21. CAMP'S FROG, *Syrrhophus campi* Stejneger (Pl. 3, fig. 6)

Range—Southern Texas. Recorded from Cameron and Hidalgo counties.

Habitat—In moist earth under board, brick, or stone piles, under walks, or any cover of yard, field, grass, or brush.

Breeding—They breed from April to May or later. The eggs (6–12) are very large, and the whole larval development is doubtless within the egg.

Family HYLIDAE

22. CRICKET FROG, *Acris gryllus crepitans* Baird (Pl. 2, fig. 6)

Range—Sabine River to trans-Pecos; Panhandle to southern Texas.

Habitat—In meadows, creeks, bayous, and ponds; in open areas along wooded edges; abundant in numerous habitats.

Breeding—They breed from February to October. The single eggs are brownish and white. The dark-olive tadpoles, 1.7 inches long, transform from April to October into frogs 0.4 to 0.6 inch.

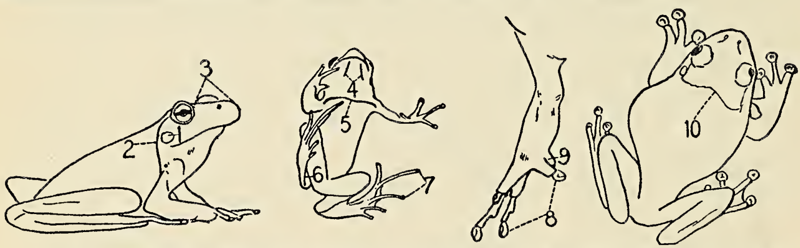


Fig. 5.—Sketches showing essential characters of the tree frogs, the Hylidae. 1, Tympanum (ear). 2, Tympanic fold. 3, Snout (nuzzle). 4, Plaits on throat of male. 5, Pectoral fold across breast. 6, Tarsal fold. 7, Small adhesive disks. 8, Large adhesive disks. 9, Prepollex. 10, Rear of casque (skin fastened to skull) outlines rear of head.

23. GREEN TREE FROG, *Hyla cinerea* (Schneider) (Pl. 2, fig. 10)

Range—Eastern Texas, Beaumont to Brownsville, west to Dallas, Bosque, Burnet, and Real counties.

Habitat.—Swampy edges of water courses; on taller water plants, in ditches or pools; on lily pads, trees, bushes, or vines not far from water.

Breeding—They breed from April to August 15. The black, brown and white, or cream-colored eggs are in small packets or films at or near surface attached to floating vegetation. The medium tadpoles, 1.6 inches long, transform from July 1 to October into frogs 0.5 to 0.7 inch.

24. SQUIRREL TREE FROG, *Hyla squirella* Latreille

Range—Records in eastern Texas roughly run from Bowie to Comal, Bexar, and Goliad counties.

Habitat—In and around buildings; about wells; in bushes, trees, or vines; in fields and gardens.

Breeding—They breed from April to August in open ponds in the pine barrens, or in shallow roadside pools. The brown and cream-colored eggs are singly laid. The citrine, small, drab tadpoles, 1.25 inches long, transform from June to September into frogs 0.4 inch.

25. CANYON TREE FROG, *Hyla arenicolor* Cope (Pl. 2, fig. 11)

Range—Records from Val Verde (Del Rio) to El Paso counties. Possibly in Panhandle.

Habitat—On rocks, canyon walls, trees, or bushes, in rocky canyons.

Breeding—They breed from March 1 to July 1 in pools in ravines, canyons, arroyos. The single eggs floating at or near surface or on the bottom of the pool are attached to leaves. The medium tadpoles, 2 inches long, transform from June 1 to August 15 into a frog 0.6 inch.

26. MEXICAN TREE FROG, *Hyla baudinii* (Dumeril & Bibron) (Pl. 2, fig. 9)

Range—Southern Texas north to Refugio and Bexar counties.

Habitat—On houses, in meadows, overflow lands, on trees of forests, in palm groves.

Breeding—They breed in overflowed pools, wet grassy meadows, overflows or resacas, or streams. The period must be long, though most records are in June and July. The tadpole history is poorly known.

27. COPE'S TREE FROG, *Hyla versicolor chrysoscelis* (Cope)

Range—Eastern Texas from Cooke to McLennan, Comal, Bexar to Refugio counties, and eastward. (This form and pustular form may be identical.)

Habitat—Wooded stretches along creeks, rivers.

Breeding—They breed from March 15 to July in permanent ponds, gravel pit pools, stream courses if quiet, water lily marshes, and other similar locations. The eggs are in films at the surface. The tadpoles transform from July to September into frogs 0.6 inch.

28. COMMON TREE TOAD, *Hyla versicolor versicolor* (Le Conte) (Pl. 2, fig. 12)

Range—Eastern edge of Texas, and coast counties from Liberty to Bexar and Refugio counties.

Habitat—Trees, mossy or lichen-covered stone fences, fruit trees, and other trees and bushes.

Breeding—They breed from April 30 to August 11 in rain pools, permanent ponds, stone-quarry pools, and bayous. The brown and cream-colored eggs are in little packets at the surface. The medium tadpoles, 2 inches long, transform from June 30 to August into frogs 0.5 to 0.8 inch.

29. PINEY WOODS TREE FROG, *Hyla femoralis* Latreille

Range—Strecker could find no authentic record in 1915, but Stejneger and Barbour in 1933 record it. Probably eastern Texas.

Habitat—Trees and shrubs of pine barrens.

Breeding—They breed from April 20 to September 1 in grassy transient pools at roadside, or in the woods, in cypress ponds or bays, or lily-covered marshes. The eggs are in small films at the surface. The small tadpoles, 1.3 inches long, transform from June 15 to October at 0.5 inch.

30. CLARK'S STRIPED TREE TOAD, *Pseudacris nigrita clarkii* (Baird) (Pl. 2, fig. 5)

Range—West of line from Dallas to Waco and Victoria, except for record at Indianola and Galveston.

Habitat—In marshes and many temporary habitats.

Breeding—They breed from March 5 to June 1 in roadside ditches, shallow waterlily ponds, shallow mesquite ponds, grassy ponds, prairie ponds, or transient pools. The eggs are in irregular masses attached to plants. The small grayish-olive tadpoles transform from April 1 to July 1 into frogs 0.3 to 0.5 inch.

31. STRIPED CRICKET FROG, *Pseudacris nigrita triseriata* (Wiedemann)

Range—Possibly from northeastern Texas.

Habitat—On low bushes and plants and on the ground.

Breeding—They breed from March 28 to May 20 in ditches, swamps, or temporary ponds. The eggs are in loosely irregular clusters. The small tadpoles, 0.95 inch long, transform from June to July into frogs 0.3 to 0.45 inch.

32. TEXAS ORNATE CHORUS FROG, *Pseudacris streckeri* Wright & Wright (Pl. 2, fig. 7)

Range—Eastern Texas with a western boundary of records from Tarrant to Coryell, Kendall, and Bandera counties.

Habitat—Moist shady woods, grassy pastures, among grain stalks, or in cotton fields, or flooded corn fields.

Breeding—They breed from December to late May in roadside ditches, semi-swampy, springy, rocky branches, hollows in gulches. The "eggs (are) in small bunches * * * * attached to weeds and water grasses" (Strecker 1926, p. 11).

33. SONORA TREE FROG, *Hyla gracilipes* Cope (Pl. 2, fig. 8)

Range—Stejneger and Barbour credit *Hyla eximia* to Texas (S. & B. 1933, p. 35).

Habitat—Near water.

Breeding—They breed from June to mid-August in marshy and wet places. The eggs, not described, were found by Mr. William Chapel in Arizona. The deep olive and dull citrine tadpoles, 1.95 inches long, transform from July onward into frogs 0.5 to 0.55 inch.

Family RANIDAE

34. BULLFROG, *Rana catesbeiana* Shaw (Pl. 3, fig. 9)

Range—All over the state in suitable habitats.

Habitat—Strictly aquatic, these frogs seem to prefer small ponds, hydraulic lakes, reservoirs, tanks, waterlily streams, stump- and brush-bordered streams or ponds, also marshes.

Breeding—They breed from May to July. The eggs are in a large surface film (1 to 2.5 feet in diameter). The large olive tadpoles, 4 to 6.6 inches long, from June 1 to September 1 transform into frogs at 1.25 to 2.4 inches.

35. GREEN FROG, *Rana clamitans* Latreille (Pl. 3, fig. 1)

Range—Eastern Texas, records from Bowie to McLennan and Harris counties, i. e., mainly east of Brazos Valley.

Habitat—Lives in swamps, large and small ponds and pools, and bayous. Along water courses, edges of all sorts of permanent aquatic habitats.

FIG. 6.—Sketches showing essential characters of true frogs, the Ranidae. 1, Nostril. 2, Internasal space. 3, Costal (dorso-lateral) fold. 4, Enlarged thumb of male. 5, Enlarged tympanum of male. 6, Tympanum of female. 7, Tympanic fold. 8, Fleshy fold on jaw. 9, Glandular folds on tibia. 10, Sacral hump. 11, Full webbing of male bullfrog. 12, Narrow interorbital space. 13, Intertympanic space.

Breeding—They breed from end of May to mid-August. The eggs are a surface film (usually less than 1 foot in diameter). The large olive tadpoles, 2.5 inches, transform between April 1 and September into frogs 0.9 to 1.5 inches.

36. NORTHERN GOPHER FROG, *Rana areolata* Baird and Girard (Pl. 3, fig. 5)

Range—Three records: Galveston, Harris, and Colorado counties. Northward to Oklahoma and Louisiana mainly east of 96° meridian.

Habitat—More or less nocturnal. Old burrows, crayfish burrows, small mammal holes, pasture holes, under stumps, logs, and other similar places.

Breeding—They breed from March to April and possibly May. The eggs are in large masses. The tadpoles we have seen, but they are not yet described. Transformation of the tadpoles begins from June or July onward, the little frogs being about 1.3 inches.

37. MEADOW FROG, *Rana pipiens* Schreber (Pl. 3, fig. 8)

Range—Mainly west of line from Dallas to Waco, Austin, San Antonio, San Diego, and southward.

Habitat—Breeds in swampy marshlands, upland backwaters, overflows, ponds, and creeks. In summer they may be in swamplands, grassy woodlands, moist cultivated fields, and similar locations.

Breeding—They breed from March 25 to June 1. The egg mass is a plinth. The large tadpoles, 3.4 inches long, transform from June to August into frogs 0.75 to 1.25 inches.

38. SOUTHERN MEADOW FROG, *Rana sphenocephala* (Cope) (Pl. 3, fig. 4)

Range—Eastern Texas along coast to Refugio County; up some rivers some distance into central Texas. Some specimens need to be reexamined.

Habitat—Cypress ponds, runs, canals, river swamps, overflowed roads, and ditches. Edges of marshes, small pools, and in creeks.

Breeding—They breed from February to December. The egg mass is a plinth, submerged. The large tadpoles, 3 inches long, transform from April to December into little frogs 0.8 to 1.3 inches.

TABLE 2.—*Key to Texas species in the order* CAUDATA.

A. Adults with external gills (permanent larvae).
- B. Hind limbs absent; digits 4; pigmented; costal grooves 31–39.
  - C. Coastal grooves 31–35 rarely 36; breeding females 7.75–15 inches long.
    39. DWARF SIREN, *Siren intermedia*
  - CC. Coastal grooves 36–39; breeding females 21.5–25.25 inches long.
    40. GREAT SIREN, *Siren lacertina*
- BB. Four limbs present; digits 4–5.
  - C. Unpigmented; blind; costal folds 12; length 4.5–7 inches.
    41. TEXAS BLIND SALAMANDER, *Typhlomolge rathbuni*
  - CC. Pigmented; not blind; costal folds 15–17; length 2–3 inches.
    41a. NEOTENIC SALAMANDER, *Eurycea neotenes*

AA. Adults without external gills.
- B. Digits 3–3 or less; limbs rudimentary; opening on side of neck; costal grooves 60 more or less; body eel-shaped; length 9–33 inches.
  42. THREE-TOED CONGO EEL, *Amphiuma tridactylum*
- BB. Digits 4–5 or 4–4; no opening on side of neck.
  - C. Digits 4–5.
    - D. Costal grooves absent or indistinct; dorsal and ventral tail fins in aquatic adults; keels or grooves on top of head; a dark line on side of head starting at external nostrils and passing through eye; tongue not mushroom-like or free all around; vomerine teeth in two longitudinal rows diverging posteriorly.
      - E. Head broad and flat; tail not flattened or keeled at base; never with red spots; black spots as large as eye; size 3 inches .
        43. TEXAS NEWT, *Triturus meridionalis*
      - EE. Head not particularly broad or flat; tail flattened and with fin for entire length; red spots sometimes present, never completely margined by black; black spots as large as pupil of eye; length 1.4–3 inches.
        44. LOUISIANA NEWT, *Triturus viridescens louisianensis*
    - DD. Costal grooves present; no dorsal or ventral tail fin in adults; no longitudinal grooves or ridges on dorsum of head.

E. Costal grooves 10–14; tongue not free all around nor with central pedicel (mushroom-like); folds of tongue radiating from its posterior part; naso-labial groove absent; parasphenoid teeth absent; vomerine teeth in transverse series.

- F. Costal grooves 10 or 11.
  - G. Costal groves 10; two plantar tubercles; tail short, 1/3–2/5 of total length or less; body short, stout, depressed; head broad; brown or black with definite dorsal markings; length 3–4 inches.
    (45. MOLE SALAMANDER, *Ambystoma talpoideum*)
  - GG. Costal grooves 11; one or no plantar tubercles.
    - H. Black with a row of round or elongate yellow or orange spots down each side of back; belly immaculate; tail about ½ total length; length medium, 4–7.5 inches.
      46. SPOTTED SALAMANDER, *Ambystoma maculatum*
    - HH. Black with 12–14 broad gray, bluish-white or white dorsal crossbands which may unite into a longitudinal band on each end; tail short, 2/5 of body length or less; length 3–5 inches.
      47. MARBLED SALAMANDER, *Ambystoma opacum*
- FF. Costal grooves 12–14; tail longer; about ½ total length.
  - G. Costal grooves 12.
    - H. One or no plantar tubercle; black or blue-black with white, gray, or bluish-white spots all over back, on sides solely or almost absent; belly immaculate; length 4.5–7 inches.
      (48. JEFFERSON'S SALAMANDER, *Ambystoma jeffersonianum*)
    - HH. Two plantar tubercles; black with irregular large yellow spots and blotches; belly more or less spotted with same; size 5–11 inches.
      49. TIGER SALAMANDER, *Ambystoma tigrinum*
  - GG. Costal grooves 14.
    - H. Black or brown with 10–15 broad yellow crossbands on top of head, body and tail; length 5.5–8 inches.
      (50. ANNULATED SALAMANDER, *Ambystoma annulatum*)

HH. Black or bluish black with numerous grayish-white or bluish-white spots on back and sides; length 4–6 inches.

51. Texas salamander, *Ambystoma texanum*

EE. Costal grooves 13–21; naso-labial groove present; parasphenoid teeth present.

F. Digits 4–5.

G. Costal grooves 20–21; 8–9 costal grooves between appressed toes of weak limbs; tongue mushroom-like; length 1.7–3.6 inches.

(52. Many-ribbed salamander, *Eurycea multiplicata*)

GG. Costal grooves 13–17; limbs well developed; 0–5 costal grooves between appressed limbs.

H. Tongue attached in front; color brown, black, or blue-black.

I. Light line from angle of mouth to eye; brown or sooty black; belly pale, mottled; row of light spots on side; costal grooves 14 or 15; 4 or 5 costal grooves between appressed limbs; tail somewhat compressed and keeled above; length 3.5–6 inches.

53. Brimley's triton, *Desmognathus brimleyorum*

II. No light line from angle of mouth to eye; black or blue-black with white light spots on sides and white or red spots on back; 1–4 costal grooves between appressed toes; tail cylindrical.

J. Costal grooves 14–15; black or blue-black with white spots over dorsum or side, or restricted to sides or sometimes entirely absent; 3 or 4 costal grooves between appressed toes; length 4–6 inches.

54. Slimy salamander, *Plethodon glutinosus*

JJ. Costal grooves 15–17; black with dorsum more or less red and sides spotted with white; throat white; 1–4 costal grooves between appressed toes; length 3–4.5 inches. (Rich Mt., Polk Co., Ark.; LeFlore Co., Okla.

(55. Ouachita salamander, *Plethodon ouachitae*)

HH. Tongue mushroom-like, free all around, central pedicel present.

I. Costal grooves 14 or 15; color orange or red; spots scattered over whole dorsum, sides and tail, not in stripes; appressed toes meeting or with 1 costal groove between; length 2.2–6.75 inches.

(56. SPOTTED-TAILED SALAMANDER, *Eurycea lucifuga)*

II. Costal grooves 13 or 14; color yellow or yellowish green, or yellowish brown; two dorso-lateral stripes more or less distinct.

J. A black mid-dorsal line; venter spotted with black; length 2–6.5 inches.

(57. HOLBROOK'S SALAMANDER, *Eurycea gutto-lineata)*

JJ. No mid-dorsal line or row of spots; no vertical bars on tail; appressed toes meeting; length 3–5.5 inches.

(58. STEJNEGER'S CAVE SALAMANDER, *Eurycea melanopleura)*

FF. Digits 4–4.

G. Belly not white with black spots; costal grooves 16; 5 costal grooves between appressed toes; tail not constricted at base; tongue mushroom-like; dark dorso-lateral stripe on yellowish ground color; size small, length 1.5–3.25 inches.

59. DWARF SALAMANDER, *Eurycea quadridigitatus quadridigitatus*

GG. Belly white with ink spots; costal grooves 14; 3 or 4 costal grooves between appressed toes; tail constricted at base; tongue attached in front; reddish brown above; size 1.5–3 inches.

(60. FOUR-TOED SALAMANDER, *Hemidactylium scutatum)*

TEXAS SPECIES IN THE ORDER CAUDATA

39. DWARF SIREN, *Siren intermedia* Le Conte

Range—"Southern United States and northern Mexico, as far north as Arkansas . . . . " (Noble and Marshall). They definitely name Upson, Maverick County, as one locality.

Habitat—See *S. lacertina* Linné.

Breeding—The eggs are laid in March and April and the outer capsule is about one-half the diameter (4.4 mm.) of that of *S. lacertina* (Noble and Marshall).

40. GREAT SIREN, *Siren lacertina* Linné

Range—Eastern Texas. Records from Dallas to Waco, San Antonio, and up Rio Grande to mouth of Pecos River or farther.

Habitat—Nocturnal. In debris, mud and vegetation, and other cover, in or near roadside ditches, marshes, ponds, lakes.

Breeding—The eggs, 0.3–0.4 inch in diameter, are laid singly or in small groups in the habitats above.

41. TEXAS BLIND SALAMANDER, *Typhlomolge rathbuni* Stejneger

Range—Ezell's and Beaver caves, Johnson's Well, all of Purgatory Creek system, San Marcos, Hays County. Uhlenhuth reports it from Burnet Cave in Kendall County, Twin Sister Mt. in Hays County, and from near Ozona in Crockett County. Specimens from these and other localities are needed.

Habitat—Subterranean. In water caves, wells, underground springs.

Breeding—No data.

41a. NEOTENIC SALAMANDER, *Eurycea neotenes* Bishop and Wright

Range—Type locality, "Culebra Creek, 5 miles north of Helotes, Bexar County". We have seen specimens in the leafy mats along the edges of Helotes Creek (H. A. & A. A. Wright) and one is reported from a cave near Boerne (R. D. & Ellen Quillin).

Habitat—Larvae were taken over bedrock at the foot of a wooded ridge, and the water was shallow, except in small pools 12 to 18 inches.

Breeding—Externally larvae with gills, but sexually mature. Do they ever transform? In body form, color, and pattern they resemble the two-lined salamander, *Eurycea bislineata bislineata.*

42. THREE-TOED CONGO EEL, *Amphiuma tridactylum* Cuvier

Range—Probably in extreme eastern and coastal Texas. Taken in Bowie County and in several places across state border in Louisiana.

Habitat—Wet swampy meadows, ditches, alluvial swamp lands in crayfish networks.

Breeding—Eggs laid in rosary strings either on land or in water.

43. TEXAS NEWT, *Triturus meridionalis* (Cope)

Range—We have seen specimens from San Benito, Harlingen, Helotes (type, locality), San Antonio, San Diego, and Brazos River, and it is reported (Cope, type description) from Matamoras, Mexico.

Habitat—Lives on land or in still water, slowly flowing streams, ponds, roadside ditches, or pools in marshlands.

Breeding—Nothing on record concerning its breeding habits. From account by H. G. M. Jopson.

44. LOUISIANA NEWT, *Triturus viridescens louisianensis* (Walterstorff)

Range—Texas specimens from Velasco, Victoria, Collecto Creek, and Fall County have been examined.

Habitat—Much the same as for *T. meridionalis* or *T. viridescens viridescens.*

Breeding—The life history of this form is poorly known; doubtless like that of *T. viridescens viridescens.* From account by H. G. M. Jopson.

45. MOLE SALAMANDER, *Ambystoma talpoideum* (Holbrook)

Range—Hypothetical for Texas. Taken just across Sabine River in Louisiana.

Habitat—Lives in damp places below logs, stones, and stumps, in bases of trees; around ponds. A burrower.

Breeding—Eggs not described. Larvae have been found in ditches and ponds.

46. SPOTTED SALAMANDER, *Ambystoma maculatum* (Shaw)

Range—Only positive record from Bowie County in northeastern Texas. "Between Indianola–El Paso" (Cope). We have seen one in Edinburg school collection. (Is it Texan?)

Habitat—Lives under stones, in stumps, logs, cellars, and similar locations.

Breeding—Breed in ponds. They lay from 100 to 250 eggs in several masses from February to April and transform from the last of July to October.

47. MARBLED SALAMANDER, *Ambystoma opacum* (Gravenhorst)

Range—Records east of line from Wichita County to McLennan, San Jacinto, and Liberty counties, i. e., roughly east of Brazos River.

Habitat—Under logs, slaps of wood.

Breeding—Breed on land near ponds or streams, in swampy or sandy region. Eggs (50 to 150 in all) separate, gelatinous, rubbery; laid in September under bark, logs, on ground, near ponds. Larvae washed into pool or hatched in water and transform from April 1 to May or June at 1.9 to 2.2 inches in length.

48. JEFFERSON'S SALAMANDER, *Ambystoma jeffersonianum* (Green)

Range—Hypothetical for Texas. Taylor records it in extreme southwest Arkansas at Lewisville, Lafayette County.

Habitat—Under logs, in stumps, beneath stones, debris, and other cover.

Breeding—Breeds in ponds, slow streams, and other similar wet places. The eggs are in masses laid earlier than those of *A. maculatum,* i. e., February to April. The larvae transform at 1.5 to 3 inches in length.

49. TIGER SALAMANDER, *Ambystoma tigrinum* (Green)

Range—Most of the records are west of a line from Wise and Tarrant counties to Burnet, Bexar, and Brooks counties. Easternmost record, Henderson County.

Habitat—In burrows, holes of animals, under logs, stones, stone walls, drains, stables, rubbish heaps.

Breeding—They breed in still water, prairie, woodland or roadside ponds and ditches, cattle tanks. Eggs laid in bunches February 15 to April 1 or later. The larvae transform at varying sizes and seasons, and some breed as larvae.

50. ANNULATED SALAMANDER, *Ambystoma annulatum* Cope

Range—Hypothetical for Texas. Missouri to Hot Springs, Arkansas.

Habitat—Under logs, in crayfish holes, under debris and other cover.

Breeding—"They deposit their eggs on the ground, under logs or among masses of decayed wood" in March. "The eggs are never in strings but are always separate, ... (Strecker and Combs). It "lays its eggs in water after rains in September" (Noble and Marshall).

51. TEXAS SALAMANDER, *Ambystoma texanum* (Matthes)

Range—Eastward from the Panhandle to Burnet, Bexar, and Refugio counties, i. e., eastern Texas.

Habitat—In crayfish and animal burrows, under rocks, logs, around ponds.

Breeding—Eggs laid in bunches in water (ponds, ditches, marshy places, gravel pits) from late January to April 25. Transformation of larvae, 1.5 to 2.2 inches, comes from mid-April to late June.

52. MANY-RIBBED SALAMANDER, *Eurycea multiplicata* (Cope)

Range—Pertinent records of Missouri, Little Rock, Arkansas, through Red River, eastern Oklahoma, to Jemez Mts. in New Mexico makes it possible in Texas. U. S. National Museum has an accession card from San Marcos River, Texas, (U. S. Fish Commission) with notation "Lost in transit".

Habitat—Under rocks in water, at edges of springs or their rivulets, in caves or streams from underground sources.

Breeding—Not much information or record.

53. BRIMLEY'S TRITON, *Desmognathus brimleyorum* Stejneger

Range—Pertinent records extend from southeast Oklahoma to Waco, Texas.

Habitat—Under planks, logs, rocks, in damp woods near water (Strecker and Combs).

Breeding—In August and early September female lays 30 to 36 eggs in strings and deposits them under logs or decaying wood near water (Strecker and Combs).

54. SLIMY SALAMANDER, *Plethodon glutinosus* (Green)

Range—Eastern Texas, most of the records from McLennan County to Bexar, Medina, and Real counties.

Habitat—Moist humus, damp moss banks, shady ravines, rocky talus, forest molds, fallen logs, caves.

Breeding—Not well known. Eggs recorded were laid from July to August. In most places the eggs are laid deep in rocky talus, shale, or rock wall possibly earlier than mid-summer.

55. OUACHITA SALAMANDER, *Plethodon ouachitae* Dunn and Heinze

Range—Hypothetical for Texas. At Rich Mt. east of Page in Le Flore County, Oklahoma, and Rich Mt. in Polk County, Arkansas.

Habitat—"Moist, densely shaded, rocky ravine of northern exposure."

Breeding—No data.

56. SPOTTED-TAILED SALAMANDER, *Eurycea lucifuga* Rafinesque

Range—Hypothetical for Texas. Nearest state record in Arkansas.

Habitat—A cave species, under moss, bits of rock near or just within a cave's entrance. Occasionally under logs, under slabs on side of gullies, a mile or more from caves and cave springs.

Breeding—Eggs and mating not recorded. Eggs possibly laid in December or January. Banta and McAtee described the larvae and state they live as larvae from 12 to 15 months. Transformation at 55 to 58 mm.

57. HOLBROOK'S SALAMANDER, *Eurycea gutto-lineata* (Holbrook)

Range—Hypothetical in Texas; known in Louisiana.

Habitat—Under debris and cover, in springy ditches or in logs, under stones in oozy spots or along springy banks of streams or even rivers.

Breeding—Larvae known, but eggs undescribed.

58. STEJNEGER'S CAVE SALAMANDER, *Eurycea melanopleura* (Cope)

Range—Hypothetical in Texas; known in extreme southwest Arkansas. Verbal reports of it from caves of Texas, but no scientific publication of such records.

Habitat—In caves, in twilight regions and mouths of caves, under rocks at margins of springy pools.

Breeding—Breeding habits little known.

59. DWARF SALAMANDER, *Eurycea quadridigitata quadridigitata* (Holbrook)

Range—All records east of Trinity River, but doubtless along many cypress-bordered rivers of coast.

Habitat—Under logs, rubbish, planks, bark, at, near, or in ponds, marshes, leaf-strewn rivulets, springy trickles and oozy spots.

Breeding—Eggs laid singly or in small groups in mid-winter, December 20 to February. Eggs scattered among decaying leaves in water. Larvae transform from May onward at 0.5 to 0.75 inch.

Is F. C. Test's "6. *Spelerpes bilineatus* Green. One very small specimen was secured, shell possessing gills and cirri. It is quite dark . . . . Museum No. 17700, Neches River, 14 miles below Palestine, Texas, Nov. 24, 1891" *E. quadridgitata, E. bislineata,* or some other form of *Eurycea?*

60. FOUR-TOED SALAMANDER, *Hemidactylium scutatum* (Schlegel)

Range—Hypothetical in Texas. "Canada to Texas" (S. Garman, 1884). Dunn gives Texas on basis of "Texas, no locality, 3 (MCZ No. 206)". Possibly in eastern or coastal Texas.

Habitat—On hillsides, in moist woodlands, around pools, swamps, logs.

Breeding—From mid-April to mid-May they lay their eggs in sphagnum moss or in similar moist cover near or over water. They transform when about 0.6 to 0.8 inch.

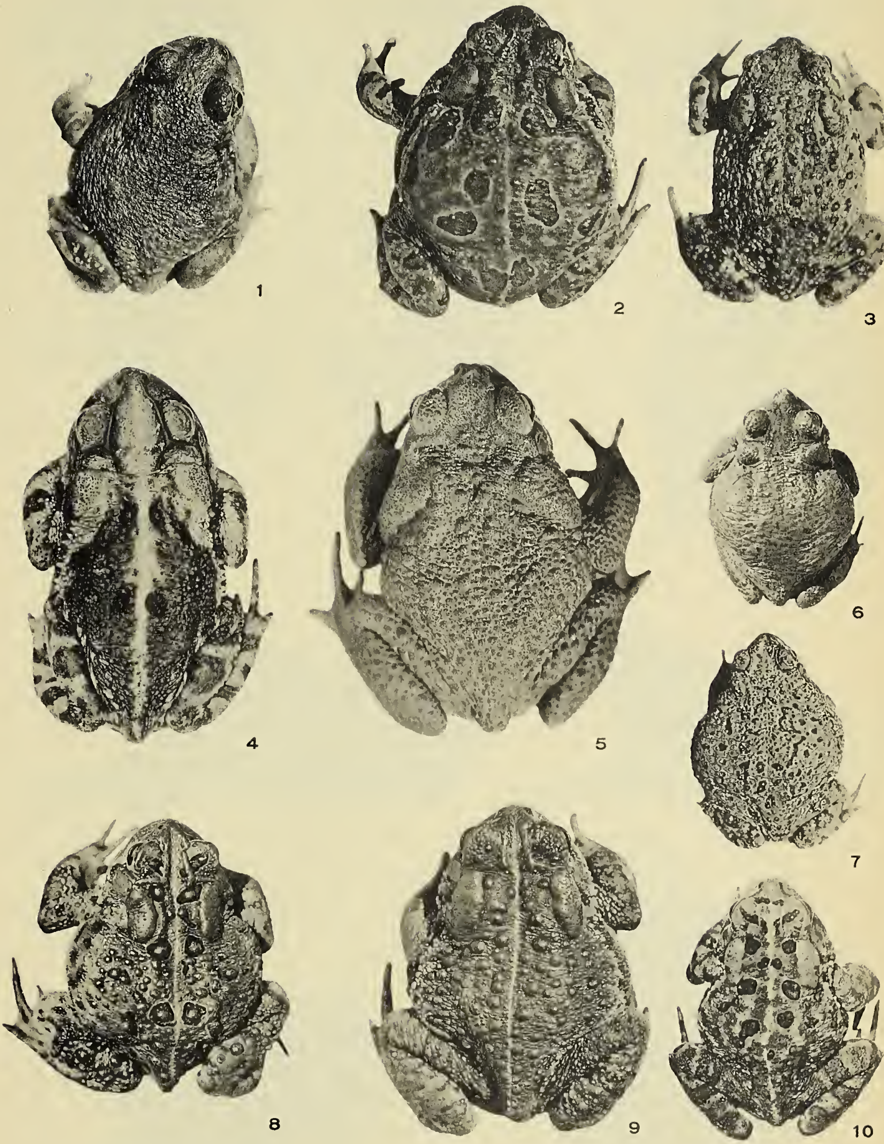
DESCRIPTION OF PLATES

PLATE I

PLATE II

PLATE III

Plate I

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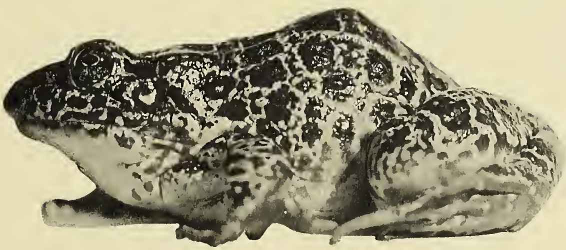

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Murray.