

THE POLEMONIALES OF KANSAS

by

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INTRODUCTION AND PURPOSE

The present thesis is the result of a study of the order Polemoniales as represented in the herbaria of Kansas State College, Kansas University, and Fort Hays Kansas State College done at Kansas State College during 1931 and 1932.

The purpose of this paper is three-fold, i.e., (1) to show the distribution by counties of the species of Polemoniales found in Kansas, (2) to note the types of distribution of the various species and genera and their probable relation to various ecological factors, and (3) to construct keys to the families, genera, and species, in so far as possible, based on vegetative characters only.

The construction of the distribution maps was based on the actual herbarium specimens examined supplemented by records of species found and identified by various investigators.

The points used in making the keys were obtained in part by examining critically the actual herbarium specimens and in part by consulting written descriptions of the families, genera, and species found in "Gray's Manual of Botany", Rydberg's "Flora of the Prairie and Plains", and Britton and Brown's "Illustrated Flora".

A vegetative key has at least four distinct values. First, it can be used in the field practically throughout the growing season beginning before the plant flowers and

continuing even after the blossoms, and the fruit, have disappeared in the fall. Second, with a vegetative key no dissection of the flower is necessary and no microscope is needed. Third, it is valuable in working with dried herbarium specimens where the floral parts have dried up or are otherwise distorted and rendered less valuable as points of differentiation. Fourth, this type of key can doubtless be used advantageously as a check upon specimens which key down with difficulty with a manual of the ordinary type.

CLIMATIC AND PHYSICAL FEATURES OF KANSAS

"Kansas has a typical continental climate, characterized by wide extremes of temperature, great variations in rain and snowfall from season to season, much sunshine and dry, bracing air, with a good wind movement." (36)

The precipitation varies from about 42 inches a year in the extreme southeast portion to about 15 inches along the western border. (See map No. 1). Approximately three-fourths of the annual amount falls over the state during the growing season, i.e., from April to September. However, the occurrence of the rainfall during this season is quite irregular, especially in the western third of the state. This together with the high rate of evaporation that prevails there and the frequent hot, dry winds bring on rather

severe drouths; so that this portion of the state is properly termed a semi-arid or xeric region.

The velocity of the wind varies almost as much for different parts of the state as does the amount of the precipitation. The wind in the eastern third of the state is not noticeably stronger than it is in those states lying east of Kansas; while Western Kansas is one of the windiest inland localities in the entire country.

Kansas has a wide range of temperatures, such extremes as -35 degrees and 116 degrees having been recorded at places in the state; however, such extremes are usually of very short duration. The western third has cool nights even during July and August when the day temperatures are very high. The average annual temperature ranges from 58 degrees in the southeastern counties to 52 degrees in the northwestern portion with a mean of 54 degrees for the state as a whole. (See maps Nos. 2 & 3).

In proportion to the amount of moisture received, Kansas receives a remarkable amount of sunshine. "At Dodge City, which is representative of the western part of the state, there is an average of but 63 cloudy days per year." (36). This number increases as one goes eastward.

The elevation varies from 700 feet along the Verdigris River in Montgomery County to a little more than 4000 feet at a point on the west boundary.

The length of the growing season, on the average, varies between 194 days in the extreme southeast corner of the state to approximately 150 days in the extreme northwest. (See maps Nos. 4 & 5).

Phytogeographically Kansas is almost wholly in the prairie province, the forest creeping in on the eastern border and up the rivers for considerable distances. The eastern third of the state is made up of rolling prairies broken frequently by wooded streams, but regarded in general as a tall grass region. Most of the western half is made up of short grass plains; while the intervening area is known as a mixed prairie region.

THE ORDER POLEMONIALES.

The order Polemoniales consists of a group of families, the phloxes, the morning-glories, the forget-me-nots, etc., that are closely related and have been so regarded for a great many years. Their relationship to the orders that are placed lower in this series, i.e., the Primulales and the Caryophyllales is apparently quite clear. (4)(5).

Most taxonomists hold that the flowering plants (Phylum Anthophyta) have sprung from cycadean strobiliferous ancestors. Of the two classes of Anthophyta, Monocotyledoneae and Dicotyledoneae, the latter, to which the Polemoniales

belong, was quite certainly the first to arise from the cycadean phylum appearing as the ranalean complex which gave rise to five apopetalous orders of sympetalous, polycarpellate plants, the Ebenales, Ericales, and Primulales; and the latter have developed the dicarpellate orders, Gentianales, Polemoniales, Scrophulariales, and Lamiales. This phyletic sequence from Ranales to Lamiales constitutes the sub-class, Dicotyledoneae - Axiflorae. (4).

The taxonomic position of the order perhaps is more clearly indicated by the diagram given below.

Phylum-Anthophyta.

Class-Dicotyledoneae.

Subclass-Dicotyledoneae-Axiflorae..

Super Order-Axiflorae -Apopetalae-Polycarpellatae.

Order-Polemoniales.

The order is characterized as follows: Flowers typically actinomorphic, but with a decided tendency toward the development of zygomorphy in the later families, gamopetalous, pentamerous; stamens epipetalous, of the same number as corolla lobes and alternate with them; ovary tricarpellary or bicarpellary, superior; leaves usually alternate; largely herbs or climbers.

In the order Polemoniales is included a little more than four thousand species distributed among six families, namely; Polemoniaceae, Convolvulaceae, Hydrophyllaceae, Boraginaceae, Nolanaceae, and Solanaceae. The Nolanaceae is a family of herbaceous or suffrutescent prostrate, strand

plants confined to South America, while the other five families are distributed throughout the United States.

Some of the important differences between these five families are best shown by the following key modified slightly from Gray's Manual:

- A. Fruit of 2-4 seed-like nutlets BORAGINACEAE
- A. Fruit a few to many seeded pod.
 - B. Styles 2.
 - C. Pod few (mostly 4) - seeded. CONVOLVULACEAE
 - C. Pod many seeded HYDROPHYLLACEAE
 - B. Style 1, often branched.
 - C. Branches of the style, (or at least, the lobes of the stigma) 3.
 - D. Not twining POLYMONIACEAE
 - D. Twining Ipomoea.
 - C. Branches of style or lobes of stigma 2 or rarely 4.
 - D. Seed few mostly 4. CONVOLVULACEAE
 - D. Seeds many SOLANACEAE

The order is one of more than usual economic importance when taken as a whole. It contributes several very important food plants such as the Irish potato, the sweet potato, the tomatoes, the egg plant and the peppers. In the United States and Europe the potato ranks second to wheat as a food plant. There are many species of this order that are very valuable as ornamental plants.

Others furnish valuable dyes, perfumes, narcotics, and drugs some of which have great medicinal value. Tobacco, which is a species belonging to this order, is a major crop over large areas of the country, there being nearly two million acres of land given over to its cultivation.

There are several species that are of decidedly negative economic importance, such as the dodders some of which live parasitically on cultivated crop plants. The European bind weed and some of the Solanums are very pernicious weeds of field and garden.

THE POLEMONIALES OF KANSAS

Kansas has representatives of all the five families found in North America. There are 28 genera and approximately 104 species, the majority of which are evidently natives of the state. All of the native species are herbs; while the shrub, Lycium halimifolium, and the climber, Solanum dulcamara, have been naturalized. From the standpoint of growth forms, almost all the species found are either hemi-cryptophytes or therophytes.

Besides the native wild species there is quite a list of important cultivated species that have been introduced into the state. In general these cultivated species will not be considered in this paper under distribution nor will any provision for them be made in the keys unless they, after escaping, are found to maintain and propagate themselves year after year. The order of the families used here is that given by Bessey in his phylogenetic arrangement of the families, while the order of the genera under each family

was determined by the order in which they keyed down and hence has no phylogenetic significance.

Economic Importance

Many members of the Polemoniaceae are grown for horticultural purposes, Phlox divaricata and P. pilosa both of which are native to the state, are two species that are especially worthy of note.

The family, Convolvulaceae, has some important ornamental plants two examples of which are Ipomoea purpurea (the common morning-glory) and Quamoclit vulgaris (cypress vine) both of which are cultivated quite extensively. Ipomoea pandurata (variously called Man-of-the-Earth and wild sweet potato) produces an enormous fleshy, edible root but probably was never of any economic importance to any one as food except the Indians. The field bindweed, Convolvulus arvensis, is decidedly the most dangerous weed pest in the state; fields that are heavily infested with it have practically no agricultural value. It spreads easily and can be eradicated only by an enormous output of labor and money. Some species of the genus Cuscuta (dodder) are of decided negative economic importance. They parasitize valuable crop plants thereby reducing their yield and also bind them together making them more difficult to harvest.

The family, Hydrophyllaceae, is represented by only six species and is negligible from the standpoint of economic importance.

The family, Boraginaceae, is rather valuable economically. Some of the cultivated forget-me-nots and heliotropes are highly prized ornamental plants, while from the latter valuable perfumes are obtained. Lithospermum canescens, the most famous of the puccoons as an Indian color source (41), yields a good red dye; in fact the borage family is rather rich in color juices.

The family, Solanaceae, is of extraordinary economic importance to the human race, and the Kansas species are no exception to this rule. The potato, tomato, egg plant, and peppers whose value is well known are all grown in Kansas. Some members of this family are of considerable value as ornamental plants such as petunia, jessamine, flowering tobacco, and Japanese matrimony vine. The fruits of Lycium halimifolium and of Physalis longifolia are edible. The berries of the former are dried like currants or used fresh in soups or stews. The fruit of the latter makes good preserves; the Zuni Indians formerly cultivated it in their gardens. (41).

Several species of this family are poisonous. Hicandra Physalodes is used as a fly poison in parts of the United States. Datura stramonium is very poisonous, the seeds

of which are very dangerous. This plant has been used for medicinal purposes since the close of the sixteenth century. Solanum nigrum, the ordinary garden nightshade is rather poisonous; children have been made sick from eating the green berries. It is reported that live stock have died as a result of eating this plant; however on account of the rather pungent odor characteristic of the nightshade family, animals are liable to eat it only in case the pasture is short.

Solanum carolinense and S. rostratum are two very troublesome weeds in cultivated fields. The latter was formerly the host of the Colorado potato beetle which has become, since the introduction of the potato into the Great Plains Region, one of the most destructive and most widely distributed insect pests attacking the potato in the United States.

Distribution

It is not to be assumed that the maps show the complete distribution of the species concerned in all cases, for only a few complete county collections have been made in recent years.

A much greater number of species of Polemoniales is represented in the herbaria from such counties as Riley, Douglas, and Ellis than from the counties adjoining them. This result is easily explained by the fact that these

counties have been collected more frequently and more thoroughly.

The majority of the herbarium specimens examined were collected before 1900. It is obvious that during the past thirty odd years, marked changes have taken place in the flora of the various regions of the state in response to the changing environmental factors.

In the first place, man by breaking up the vast areas of prairie sod has practically eliminated the prairie fires which formerly swept over the country destroying plants, often including seeds as well. The flora has increased very noticeably in places since the ravages of the prairie fires have been checked. (24).

On the other hand with the rapid change from stock raising to farming in large sections of Western Kansas and with the almost universal adoption of tractor farming methods, tens of thousands of acres of land have been broken up in that section of the state which has doubtless resulted in the extermination of certain species. To compensate for this, however, species that were formerly unable to establish themselves on the prairies now often successfully invade and accomplish coesis.

Still another factor, attributable largely to man, has been the accidental introduction and dissemination of new species. The spread of field bindweed, Convolvulus arvensis,

illustrates, excellently this factor; for a year seldom passes when this species is not collected in one or two counties for the first time.

The cutting down of the native woods in certain places in the eastern part of the state and the extensive planting of groves in parts of the state where woods did not occur naturally has brought about marked changes in the flora, eliminating some species and permitting others to enter and establish themselves for the first time. Over-grazing and the removal of timber from many areas with the subsequent accelerated erosion has decidedly affected the local distribution of certain species.

Several distinct types of distribution of the various genera and species of Polemoniales can be noted. First, there are those species that are found practically throughout the state. Apparently they have been able to adapt themselves to the various climatic and soil conditions found in the different regions of the state; and furthermore it is evident that they have an efficient means of vegetative propagation or seed dissemination. The case of Solanum rostratum (map No. 90) illustrates the point very well, there being herbarium specimens in the Kansas State College herbarium of this species from 101 of the 105 counties, and in all probability the plant is a native of these other four counties. Explorers and early settlers in Kansas found this species

growing extensively in buffalo wallows, and it shows a preference for such places today. Doubtless the seed, which is armed with prickles, was disseminated very widely by the bison. It was reported as early as 1900 that this species was becoming scarce in certain parts of Eastern Kansas which is just what one should expect if it was actually dependent upon the bison for the dispersal of its seed.

Convolvulus arvensis, the notorious field bindweed, is another example and a species that has a very wide distribution over the state. (Map No. 35).

A second type of distribution is one in which a species or even a genus is limited to one section of the state by such factors as temperature, length of growing season, or the amount of moisture. The genus, Gilia (Maps Nos. 12-19) for example, is found naturally only in the western third of Kansas and, for the most part, in sandy soil. Species of Gilia are found throughout the southwestern part of the United States indicating that the genus as a whole is adapted to a dry climate. An abundance of moisture may not necessarily be detrimental to its existence, but competition is probably too keen for it to survive in the central and the eastern parts of the state where there is more rainfall.

The genus, Phlox (Maps Nos. 7-11) is just as strikingly eastern in its distribution as Gilia is western. Doubtless it requires more moisture and perhaps also a different type

of soil from that found in Central and Western Kansas.

Solanum carolinense (Map No. 91) is limited exclusively in its distribution to that portion of Kansas that receives, on the average, 30 or more inches of precipitation annually.

The line marking the northern limits of Solanum elaeagnifolium (Map No. 88) coincides almost exactly with the line made by connecting the points in the state whose average dates of the first and the last killing frosts are approximately the same. This indicates that length of the growing season is the important factor limiting the distribution of this species.

The distribution of Solanum Torreyi (Map No. 89) well illustrates the role of temperature as a limiting factor in distribution.

A third type is the scattered distribution which is well illustrated by certain species of Cuscuta (Maps Nos. 37-46) and by Ipomoea lacunosa (Map No. 24). The type of distribution exhibited by Cuscuta very likely results from importing field crop seed that contains small amounts of Cuscuta seed. Such edaphic factors as the nature of the soil probably account in part, at least, for the peculiar distribution of Ipomoea lacunosa.

Vegetative Keys to the Polemoniales of Kansas

The construction of workable field keys based on vegetative characters only is a goal to be striven for but is one for the complete realization of which little hope is entertained. The value of this type of key has been pointed out elsewhere in this paper.

The making of satisfactory keys to the species was exceedingly difficult in a few genera due, (1) to the great similarity between the vegetative parts of some of the species as is illustrated in Cuscuta and Lappula, (2) to the large number of strikingly similar species, and (3) to the great variability of such characters as pubescence, leaf size and shape, and nature of the leaf margin as is found in Physalis.

In order to separate Lappula heterosperma from L. scutellaria, characters of the nutlets had to be used.

In some instances with the genus, Physalis, there seem to be intergradations between certain species indicating that the status of these so-called species is none too certain, or else that hybrids are rather abundant. The author feels that the number of species of Physalis recognized by some taxonomists may be a little too great and that insufficient attention has been paid to the ease with which some of these species are modified structurally by environmental factors.

Key to the Families

- A. Stems twining, trailing, climbing, or ascending (erect in *Evolvulus*) 3. CONVOLVULACEAE
- A. Stems occasionally ascending but usually erect (climbing in *Gelsemium* *dulcamara*) 1. POLEMONIACEAE
- B. Leaves either opposite or pinnate to pinnately parted into more or less linear or acicular segments 1. POLEMONIACEAE
- B. Leaves alternate (except in *Chamaecarpha* and sometimes in *Ellisia*), entire, or if divided, the segments not linear.
- C. Vegetative parts while green with a pungent odor characteristic of the potato. 6. SOLANACEAE
- C. Vegetative parts without a striking odor.
- D. Plants with simple, entire leaves with entire margins. 4. BORAGINACEAE
- D. Plants with entire, pinnatifid, or pinnately divided leaves with the margins dentate, serrate, or incised. 5. HYDROPHYLLACEAE

Descriptions of genera have been omitted and page references to detailed generic descriptions in "Gray's Manual of Botany" (G), Volume 3 of Britton and Brown's "Illustrated Flora" (B), and Rydberg's "Flora of the Pacific and Plains" (R) have been cited instead.

In place of comprehensive species descriptions being included, one short recognition statement about each species is given. The dates following the recognition statement refer to the time of flowering.

The family characterizations were taken from Bessey's taxonomic treatise, "The Phylogenetic Taxonomy of the Flowering Plants."

Following the name of each species is the number of the map which shows the distribution of that species.

The nomenclature followed is in part that used by Britton and Brown in their "Illustrated Flora" and in part that used by Rydberg in his "Flora of the Prairies and Plains." In the genus, Cuscuta, the species names used by Yunker in his monograph of this genus are followed exclusively.

I. POLEMONIACEAE

Herbs with alternate leaves (rarely opposite below); regular 5-merous and 5-androus flowers; ovary tricarpeillary, 3-celled, ovules one or more in each cell; capsule 3-celled, 3-valved, loculicidal; calyx persistent, imbricated. Kansas genera: *Polemonium*, *Phlox*, *Gilia*.

Key to the Genera

- A. Herbs with all their leaves simple, entire, and most of them opposite. 1. *Phlox*
- A. Herbs with pinnate, pinnatifid, pinnately divided, or some entire leaves; most of them alternate.
- B. Leaves simple, pinnatifid to pinnately parted or divided, or occasionally some entire; leaf segments linear, linear-filiform, linear-oblong, or acicular. 2. *Gilia*
- B. Leaves pinnately compound, upper ones 3-5 foliate or rarely simple; leaflets entire, oblong ovate-oblong, or lanceolate-oblong; margins entire. 3. *Polemonium*

1. *Phlox* (G:673, B:55, A:654-655.)

Key to the Species

- A. Stem usually glabrous, although sometimes puberulent

- or villous above; leaves 5-15 cm. long.
 B. Stem rather slender, 3-9 dm. high, often spotted with purple; leaves lanceolate to ovate.
 1.P. maculata
 B. Stem stout, 5-15 dm. high, not purple spotted; leaves lanceolate to oblong. 2.P. paniculata
 A. Stem pubescent or downy; leaves 3-9 cm. long.
 B. Flowering stems erect or ascending, 3-6 dm. tall, often viscid or glandular.
 C. Stems ascending or reclining, sterile shoots prostrate with oblong or ovate leaves; plant viscid. 3.P. divaricata
 C. Stems erect or ascending, often glandular, no prostrate sterile shoots; leaves linear or lanceolate, acuminate, spreading. 4.P. pilosa
 B. Flowering stems diffusely branched, often creeping, slender, and woody; 3 dm. tall or less. 5.P. bifida

1. *Phlox maculata* L. Wild Sweet-William (Map No. 7). A medium sized perennial with stems frequently purple-flecked and its corolla-lobes rounded. June-Aug. In moist woods or along streams; one specimen was taken in Leavenworth County, but it may have been a garden escape.

2. *Phlox paniculata* L. Garden Phlox (Map No. 8). Tall erect plant with long leaves and a long inflorescence with showy flowers varying from pink to purple or white; corolla lobes broadly obovate. July-Sept. In woods and thickets and freely escaped from gardens in Riley and Doniphan counties.

3. *Phlox divaricata* L. Wild Blue Phlox (Map No. 9). A finely viscid-pubescent plant with bluish corolla whose lobes are obcordate or emarginate. Apr.-June. In moist woods in

the eastern third of the state.

4. *Phlox pilosa* L. Downy or Prairie Phlox (Map No. 10). A soft downy or hairy plant with pink-purple or rose-red (rarely white) corolla. Apr.-June. In dry soil in the eastern third of the state.

5. *Phlox bifida* Beck. Cleft Phlox (Map No. 11). Low diffuse plants with pale purple corollas whose lobes are cleft about to the middle into linear or oblong segments. Apr.-June. In dry places in Ottawatic County.

2. *Gilia* (8:675 B:59 Ar658)

Key to the Species

- A. Tall plants, 5-10 dm. high; leaves crowded. 1.G. rubra
- A. Smaller plants, 1-5 dm. high.
- B. Annual (or rarely biennial), glabrous. 2.G. longiflora
- B. Biennials and perennials (*G. inaequalis* is annual); more or less puberulent (rarely glabrous) to woolly.
- C. Stem straight, stout, unbranched; woolly-tomentose. 3.G. spicata
- C. Stem more slender, branched; not woolly-tomentose.
- D. Plant 1-2 dm. tall, bushy branched; leaves 2.5 cm. or less in length, the segments acicular. 4.G. adnata
- D. Plant 1.5-5 dm. tall; leaves 2-4 cm. long, the segments linear to filiform but never acicular, acutish or obtuse.
- E. Stems several, much branched, basal leaves tufted.
- F. Viscid-glandular biennial or perennial from a deep root; leaf segments linear to filiform. 5.G. calcarea
- F. Glandular puberulent annual; leaf seg-

- ments mostly oblong, cuspidate. 5.2. Inconspicuous
 N. stems solitary, glabrous to glandular-
 pubescent above, basal leaves not tufted.
 Y. Plant 3-5 dm. high; leaves more or less
 crisp, hairy 7.6. aggregata
 N. Plant about 3 dm. high; leaves
 glabrous 8.3. laxiflora

1. *Gilia rubra* (L.) Heller. Standing Cypress (Map No. 12).
 Rather tall (.5-1 m.) plants with crowded leaves, long thyrs-
 iform inflorescences with red, pink, or white, corollas and
 scarcely spreading corolla lobes. June-Aug. Pastures and
 roadsides commonly cultivated and rarely escapes from gardens
 to roadsides and waste grounds (Naturalized from the south-
 west). Reported from Chautauque and Montgomery Counties.

2. *Gilia longiflora* (Torr.) Don. White Flowered Gilia
 (Map No. 13). Great glabrous annual with numerous large and
 showy white paniculate flowers. May-Sept. In dry soil lim-
 ited to the southwestern fourth of the state.

3. *Gilia spicata* Nutt. Spicate Gilia (Map No. 14).
 Woolly-tomentose perennials with rather stout, simple erect
 stems and small purple flowers in an elongated narrow spicate
 thyrsus. May-Aug. In dry soil in Hamilton and Scott Coun-
 ties.

4. *Gilia acerosa* (A. Gray) Britton. Needle-leaved Gilia
 (Map No. 15). Short (1-2 dm.) glandular-pubescent bushy

branched perennials with small leaves divided into 3-7 acicular entire segments and rotate corollas. Apr.-Aug. Rocky and gravelly soils in western third of the state.

5. *Gilia calcareea* Nutt. Small-flowered *Gilia* (Map No. 16). A viscid-glandular biennial or perennial with thick pinnatifid leaves, the basal tufted, and small, very numerous flowers with white tubes and blue or violet limbs. June-Aug. In sandy soil in Hamilton County.

6. *Gilia inconspicua* (Smith) Dougl. (Map No. 17). Small glandular-puberulent plants with more or less crisp pubescent or glabrate leaves with cuspidate lobes, and with very small corollas with purplish limbs and oval lobes. Feb.-Aug. Hillsides. Reported from Hamilton County.

7. *Gilia aggregata* (Pursh) Spreng. Sky-Rocket (Map No. 18). Rather tall biennials with scarlet or red tubular funnel-form corollas with spreading or recurved lobes. June-Aug. In dry soil, reported from Stevens County.

8. *Gilia laxiflora* (Doult.) Osterhout. (Map No. 19). Medium short (3 dm.) plants with white corollas tinged with blue and its lobes acute. June-Sept. Plains and table lands in Clark and Harper Counties.

3. *Polemonium* (G:676, B:63, R:654)

1. *Polemonium reptans* L. Greek Valerian Blue-bell (Map No. 20). Glabrous slender perennials with some oblong or ovate 3-5 foliate leaflets and small blue flowers. Apr.-May. In woods in Cherokee and Doniphan Counties.

II. CONVULVULACEAE

Herbs (often climbing), shrubs (and trees) with alternate leaves and pentamerous flowers; corolla-limb more or less plicate (rarely imbricated); ovary 2 (3-5) celled; ovules few; endosperm fleshy. *Evolvulus*, *Quamoclit*, *Ipomoea*, *Convolvulus*, *Cuscuta* (parasitic).

Key to the Genera

- A. Green autophytic plants with normal-sized leaves.
 - B. Stems erect or ascending.
 - C. Densely silky-pubescent or villous; stem very leafy, 1-2 dm. high 1. *Evolvulus*
 - C. Glabrous throughout; stems 6-12 dm. high.
 - 2. *Ipomoea*
 - B. Stems trailing, twining, climbing, procreant, or decumbent.
 - C. Perennials.
 - D. Leaves 3-15 cm. long.
 - E. Leaves broadly ovate, cordate at base.
 - 2. *Ipomoea*
 - E. Leaves triangular in outline, hastate at base 3. *Convolvulus*
 - D. Leaves 2.5-5 cm. long 3. *Convolvulus*
 - C. Annuals.
 - D. Glabrous or puberulent. 4. *Quamoclit*
 - D. Pubescent, occasionally hirsute and very rarely glabrous 2. *Ipomoea*
 - A. Yellowish parasitic; leaves reduced to scales.
 - 5. *Cuscuta*

1. *Evolvulus* (G:553, B:41-42, A:647)

1. *Evolvulus Nuttallianus* R. & S. (Map No. 21). A low (1.5-12.5 dm.) very hairy upright perennial with silky entire leaves. May-July. On sterile plains and prairies throughout the state except in the two eastern rows of counties.

2. *Ipomoea*. (G:570, B:43, A:648)

Key to the Species

- A. Glabrous or pubescent plants; leaves entire.
 - B. Plant bushy, not climbing; leaves linear.
 - 1.1. *leptophylla*
 - B. Plant climbing; leaves ovate, cordate.
 - 2.1. *pendurata*
- A. Plants pubescent; leaves entire or 3-lobed; stems twining or trailing.
 - B. Leaves 3-lobed.
 - C. Leaves with shallow angular lobes.
 - 3.1. *lacunosa*
 - C. Leaves with deep, ovate, or lanceolate lobes.
 - D. Leaves slender in outline, middle lobe lanceolate and conspicuously longer than lateral ones.
 - 4.1. *trichocarpa*
 - D. Leaves ovate-arbicular in outline; middle lobe ovate, not conspicuously longer than lateral ones.
 - 5.1. *hederacea*
 - B. Leaves entire.
 - C. Leaves 5-10 cm. broad, no longer than broad; stem retroscly hairy.
 - 6.1. *purpurea*
 - C. Leaves 5-10 cm. long, usually longer than broad; stem pubescent or hirsute, rarely glabrous.
 - 3.1. *lacunosa*

1. *Ipomoea leptophylla* Torr. Bush Morning-glory (Map No. 23). Glabrous perennial with an enormous fleshy root, ascending stems, linear entire leaves and purple to pink corollas. May-July. In dry, usually sandy, soil throughout

western two-thirds of the state.

2. *Ipomoea pandurata* (L.) Meyer. Wild Potato Vine (Map No. 23). Perennial from an enormous fleshy root and with broadly ovate cordate leaves and flowers ranging from white to pinkish. May-Sept. In dry soils in fields or on hills and limited to the eastern third of the state.

3. *Ipomoea lacunosa* L. Small-flowered White Morning-glory (Map No. 24). Pubescent or hirsute annual with small white funnelliform corollas. July-Sept. In moist soil, river-banks or low ground and confined to the eastern third of the state.

4. *Ipomoea trichocarpa* Mill. Small-flowered Pink Morning-glory (Map No. 25). Similar to *I. lacunosa* but with leaves divided into 3 lobes the middle one lanceolate, and the small flowers pink or purple. Flowers in late summer. Reported from Cowley County.

5. *Ipomoea hederacea* Jacq. Ivy-leaved Morning-glory (Map No. 26). Pubescent annual with 3-lobed, long-petioled leaves and corollas with nearly white tubes and light blue or purple limbs. July-Oct. In fields and waste places, widely distributed in eastern half of the state and at scattered points in the western half.

6. *Ipomoea purpurea* (L.) Lam. Morning-glory (Map No. 37).

A pubescent annual with a retroseely hairy, twining or trailing stem, broadly ovate leaves, and large, blue, purple, pink, variegated, or white flowers. July-Oct. In waste places, commonly escaped from gardens, rather abundantly distributed in eastern half of Kansas and scattered slightly in western half.

3. *Convolvulus* (G:670, B:45, R:649)

Key to the Species

- A. Leaves oval, short petioled or uppermost sessile.
 - 1.C. *spithameus*
- A. Leaves ovate, triangular, lanceolate, or linear, never sessile.
 - 1. Plants canescent, cinereous or glabrate in age.
 - C. Main divisions of the leaf-blades linear, the basal lobes usually deeply cleft. . . 2.C. *incanus*
 - C. Main divisions of the leaf-blades ovate or oblong, the basal lobes sub-toothed or entire.
 - D. Leaf-blades ovate, oblong, or oblong-lanceolate, cordate or sagittate at the base 1.5-4 cm. long; plant not silky tomentose.
 - 3.C. *heermanniioides*
 - D. Leaf-blades ovate-oblong; or triangular-oblong, truncate or nearly so at the base, 1.5-4 cm. long; plant not silky tomentose.
 - 4.C. *ambiguus*
 - B. Plants not canescent or cinereous.
 - C. Plant glabrous or sparingly pubescent.
 - b. Leaf-blades triangular in outline, 5-12 cm. long, the basal lobes more or less angular; a climber. 5.C. *sepium*
 - b. Leaf-blades oblong or ovate-sagittate to linear-hastate, 1-5 cm. long; a sprawler.
 - 6.C. *arvensis*
 - C. Plant densely and softly pubescent; leaf-blades deltoid or hastate-ovate. . . 7.C. *repens*

1. *Convolvulus spithameus* L. Upright or Low Bindweed (Map No. 26). A low plant with an erect or ascending stem, oval short-petioled or sessile leaves, and large white flowers. May-Aug. In dry sandy or rocky fields or on banks in Douglas County and reported from Ellis County.

2. *Convolvulus incanus* Vahl. Hoary Bindweed (Map No. 29). Finely and densely canescent perennials with leaves linear to lanceolate in outline with 2-4 divergent lobes at the base; corolla white to rose-colored. Apr.-Aug. In dry soil in the extreme southwestern part of Kansas.

3. *Convolvulus hermaphroditus* A. Gray (Map No. 30). Silky-tomentose plants with medium small white flowers. Apr.-Sept. Dry plains extreme southwestern part of the state.

4. *Convolvulus ambiguus* Moench (Map No. 31). Finely cinereous or glabrate plants bearing solitary flowers which are white or with pink stripes. June-Aug. River valleys and loose soil in Ellis County.

5. *Convolvulus sepium* L. Hedge Bindweed (Map No. 32). Nearly glabrous extensively trailing or high twining plants with large (5-12 cm.) triangular, hastate leaves with divergent basal lobes. June-Aug. In fields and thickets, usually in moist soil but occurring practically throughout the state.

6. *Convolvulus arvensis* L. Field Bindweed (Map No. 33).

A glabrous sprawling perennial with ovate or oblong more or less sagittate leaves and usually 3-flowered peduncles. May-Sept. In fields and waste more or less throughout the state.

7. *Convolvulus repens* L. (Map No. 34). Densely and softly pubescent plants with deltoid or hastate-ovate leaf-blades. May-July. In sandy soil; fairly common in eastern half of the state and scattered in the western half.

4. *Quamoclit* (9:570, B:42, R:648)

Key to the Species

- A. Leaves pinnately parted into very narrow segments. 1.Q. *vulgaris*
- A. Leaves cordate; serrulate, entire, or angulate-lobed. 2.Q. *coccinea*

1. *Quamoclit vulgaris* Choisy. Cypress Vine (Map No. 35). A glabrous, slender, twining annual with leaves pinnately divided into narrow, linear segments and with scarlet, salverform corollas. July-Oct. In waste and cultivated grounds in Doniphan County.

2. *Quamoclit coccinea* (L.) Moench. Small Red morning-glory (Map No. 36). A twining or trailing annual with ovate to orbicular, deeply cordate, long acuminate leaves and red flowers. July-Oct. On river banks and in waste places occurring in several isolated groups over the state.

5. Cuscuta (0:671, B:48, A:651)

The group, Cuscuta, has been variously considered as comprising a separate family coordinate with Convolvulaceae, as a tribe of Convolvulaceae, or simply as a genus of the latter. Englemann in 1859 after 20 years of study in this country and abroad published his "Systematic Arrangement of the Species of the Genus, Cuscuta" in which he considered the whole group as belonging to one genus of the Convolvulaceae. T.C. Yunker, a student of Cuscuta and author of "A Monograph on the Revision of the North American and West Indies Species of Cuscuta", also treats the group as one genus of Convolvulaceae.

It is practically impossible to construct a vegetative key to the species of Cuscuta due to the reduction of the leaves and to the general similarity between the stems of the different species. Yunker corroborates this statement in his monograph by saying that the external characters of the stems are not constant enough to aid in specific differentiation except in a general way, and that the leaves apparently offer no characters of taxonomic value. It is true that the species have been split into three categories on the basis of stem diameter, but climatic factors alter stem diameters in the same species considerably. Also the age of the specimen and the part of the stem measured would be conflicting points.

Many species of Quercus, seem to prefer certain host plants to others, and some have been named accordingly. Englemann recognized, however, that there was no constancy in this respect and expressed his regret that he had named certain species for the genera upon which they have been found. It is true that some few species live predominately upon certain groups of plants. Quercus glomerata, for instance, lives mainly on Compositae, Q. indecora mostly on Compositae and Leguminosae, Q. cuspidata quite extensively on Ambrosiaceae and rarely on Leguminosae, and Q. chlorocarpa often on Polycornum.

In view of the fact that an attempt to construct a vegetative key was deemed impractical, or floral key modified slightly from Yunker is submitted here.

Floral Key to Species of Quercus

- A. Flowers subtended by numerous bracts; calyx-lobes free.
 - B. Flowers pedicelled, loosely paniculate. 1.C. cuspidata
 - B. Flowers sessile in more or less dense clusters.
 - C. Bracts acute, squarrose. 2.C. glomerata
 - C. Bracts obtuse, closely appressed. . . . 3.C. compacta
- A. Flowers not subtended by bracts; calyx-segments more or less united.
 - B. Capsule globose, more or less depressed (pointed in indecora).
 - C. Flowers mostly smooth, not particularly fleshy or papillate.
 - D. Corolla remaining at the base of the mature capsule.
 - E. Corolla-lobes triangular, acute; scales reduced to a few processes about the apex; mostly tetramerous. 4.C. obtusiflora
 - E. Corolla lobes acute with inflexed tips; scales prominent; pentamerous. . . 5.C. pentagona

- D. Corolla carried at the apex of the capsule like a hood; mostly tetramerous.7.C. tenuiflora
- C. Flowers fleshy, having a slightly papillate appearance due to lens-shaped scales; tips of corolla-lobes inflexed.
 - D. Flowers mostly tetramerous; scales radi-mentary.7.C. inflera
 - D. Flowers mostly pentamerous; scales prominent.8.C. pulcherrima
- B. Capsule globose-ovoid, more or less pointed.
 - C. Scales ordinarily not truncated or bifid; styles usually at least one-third the length of the capsule9.C. vulgivaga
 - C. Scales truncated or bifid; styles relatively shorter, usually about one-fourth the length of the capsule10.C. ovata

1. *Cuscuta cuspidata* Engelm. Cuspidate Dodder (Map No. 37). A yellowish, slender stemless plant with pedicelled cymose flowers, cuspidate sepals, and entire bracts. July-Sept. On coarse herbage grouped in several distinct sections of the state.

2. *Cuscuta glomerata* Choisy (G) (Map No. 38). Yellowish white plants with the sessile flowers exceedingly numerous in dense confluent clusters covering portions of the stem of the host plant. July-Sept. On composites, seri- caria, and other coarse herbage; extensively distributed in the eastern half of the state and scattered in the western portion.

3. *Cuscuta compacta* Juss. (Map No. 39). Plants with rather stout stems and large (1 mm. long) flowers in small dense clusters. July-Sept. On shrubs; reported from Doug-

and county.

4. *Cuscuta obtusiflora* Nutt. Smart-weed Dodder (Map No. 40). Plant orange-yellow with globose-shaped flowers and capsules. July-Sept. on Polygonum and other herbs in the eastern half of the state.

5. *Cuscuta pentagona* Engelm. Field Dodder (Map No. 41). Pale yellow plants with filiform stems. July-aug. On various herbs and low shrubs in scattered places in the eastern two thirds of the state.

6. *Cuscuta tenuiflora* Engelm. (Map No. 40). Yellow plants with rather coarse stems and short-pedicelled, clustered flowers. July-aug. On shrubs and tall herbs in the northeastern part of the state and also reported from Ellis County.

7. *Cuscuta latiflora* Engelm. (Map No. 45). Coarse-stemmed plants with pedicelled flowers in cymes and with triangular calyx-lobes. On the hazels and other shrubs and tall herbs in scattered isolated regions over the state.

8. *Cuscuta pulcherrima* Greene. (Map No. 44). Plants with the flowers pedicelled in loose cymes, more or less papillose. June-aug. on various herbs and low shrubs in the eastern and the southwestern parts of the state.

9. *Cuscuta vulgivaga* Engelm. (Map No. 45). Plants with yellow to orange, slender, high-climbing stems and numerous flowers in dense cymes. July-Aug. On herbs and low shrubs in the northeast section of the state.

10. *Cuscuta curta* (Engelm.) Rydb. (Map No. 45). Slender-stemmed plants with flowers in small cymes. Aug. On coarse herbs. Reported for Southwestern Kansas.

III. HYDROPHYLACEAE

Herbs with radical or alternate (rarely opposite) leaves and pentamerous flowers; corolla-limbs imbricated (or contorted). Ovary 1- or incompletely 2-celled; ovules 2 or more; endosperm fleshy.

The three genera of Hydrophyllaceae resemble one another so closely in a vegetative way that it is almost impossible to separate them by any type of key except one based on floral characters. Due to this fact and to the small number of species (5) found in Kansas, one key was provided to include all the species.

Key to the Species

- A. Plants glabrous, glabrate, or pubescent.
 - B. Perennial, 5-9 dm. tall; lower and basal leaves 15-25 cm. long. 1. *Hydrophyllum virginianum*
 - B. Annual, 1-5 dm. tall; lower and basal leaves 2.5-5 cm. long. 5. *Thalictrum dubium*

- A. Plants pubescent, rough hairy to hirsute, sometimes viscid.
- B. All the leaves pinnatifid or pinnately parted; plant never viscid.
- C. Leaves ovate-oblong in outline; upper alternate, lower opposite; leaf segments oblong or lanceolate, dentate, entire, or lobed; stem forked above.
3. *Elizia myrtacea*
- C. Leaves oblong to spatulate in outline, all the leaves alternate; leaf segments oblong, obtuse, and usually entire; stem branched from base.
4. *Amocelia hirsuta*
- B. Not all of the leaves pinnatifid; plant more or less viscid.
- C. Lower leaves pinnatifid or pinnately parted; upper ovate to orbicular, variously lobed, often palmately 5-lobed. 2. *Hydrophyllum appendiculatum*
- C. None of the leaves pinnatifid or pinnately parted, but rather all of them ovate-oblong or oblong-lanceolate, crenate-dentate. 6. *Shapelia integrifolia*

Hydrophyllum (G:676, B:65, R:660-661)

1. *Hydrophyllum virginianum* L. (Map No. 47). A perennial with the leaves (especially basal ones) very large and with white or purplish flowers. May-Aug. In woods in the northeastern part of the state and Bourbon County.

2. *Hydrophyllum appendiculatum* Michx. (Map No. 48). A rough-hairy biennial, somewhat viscid above, with violet or purple flowers in loose cymes. May-June. In woods in the northeastern section of the state.

Ellisia (G:677, B:67, R:661)

3. *Ellisia nyctelea* L. (Map No. 49). Small sparingly hirsute annuals with ovate-oblong pinnately divided leaves and very small (1 mm. long) inconspicuous corollas. Apr.-July. In moist soil throughout the state except in the southwest portion.

Phacelia (G:678, B:68, R:662)

4. *Phacelia hirsuta* Nutt. Hairy *Phacelia* (Map No. 50). Rather small hirsute-pubescent annual, branched from the base and with blue flowers. Apr.-June. In dry soil in the extreme southeastern part of the state and Saline County.

5. *Phacelia dubia* (L.) Small. Small-flowered *Phacelia* (Map No. 51). Low puberulent or glabrate annuals branching from the base and with small white or light blue flowers. Apr.-June. In moist soil in Cherokee and Chautauqua Counties.

6. *Phacelia integrifolia* Torr. Crenate-leaved *Phacelia* (Map No. 52). Annual or biennial with a very leafy and viscid-hirsute stem and a dense scorpioid cyme composed of spike-like branches and sessile flowers. Apr.-Sept. In saline soil in Barber and Harper Counties.

IV. BORAGINACEAE

Herbs, shrubs, and trees with alternate leaves and pentamerous flowers; corolla-lobes imbricated (or contorted); ovary bicarpellary, 4-celled, 4-lobed; ovules solitary in each lobe.

Key to the Genera

A. Rather tall plants, 3-12 dm. in height.

B. Glabrous herbs.

J. Fleshy, glaucous with leaves linear, linear-oblong, or spatulate, 2.5-5 cm. long. 1. *Heliotropium*

C. Not fleshy or glaucous; leaves oval to obovate, 5-12.5 cm. long. 2. *Mertensia*

D. Subscandent, hirsute, hispid, or puberulent; never glabrous.

C. Plants with most of their leaves large, 1.5-5 dm. long.

A. Upper leaves ovate-oblong or oval, never clasping. 3. *Lappula*

B. Upper leaves lanceolate, ovate-lanceolate to oblong, sessile and clasping by a cordate base 4. *Cynodactylon*

C. Plants with leaves 1.5 dm. or less in length.

D. Leaves 5-15 cm. long, upper oblong, 3-5 cm. long, or subcordate, margins repand or undulate.

1. *Heliotropium*

E. Leaves 5-12 cm. long, base not subcordate, margins entire.

A. Leaves ovate to ovate-lanceolate; stem rough, puberulent. 5. *Lithospermum*

B. Leaves linear, lanceolate, ovate-lanceolate to oblong; stem densely hispid puberulent or strigose.

F. Slender caespitose annuals, much branched; leaves 1-4 cm. long. 1. *Heliotropium*

G. Stout perennials, not caespitose; leaves 5-15 cm. long.

H. Leaves linear, lanceolate, linear-lanceolate, linear-oblong, or oblong-lanceolate.

I. Perennials, leaves long or plant

caespitose. 5. *Lithospermum*

- H. Annuals and biennials; leaves short (except in *Heliotropium*).
- I. Leaves 5-15 cm. long; plant bristly hairy. 6. *Heliotropium*
- I. Leaves 1-4 cm. long; mostly appressed pubescent.
- J. Pale leafy plants, 5-6 cm. tall. 3. *Lappula*
- J. Leaves, at least, bright green; plant 1.5-5 cm. tall . . . 5. *Lithospermum*
- G. Leaves ovate, broadly-lanceolate, or oblong. 7. *Linum medium*
- A. Rather short plants, 3 dm. or less in height.
- B. Very low herbs, branched from the base 7.5-15 cm. tall; leaves linear to linear spatulate.
- C. Perennial with silvery appressed pubescence.
- J. Annual or biennial, hirsute to densely hispid. 8. *Creosotaria*
- D. Leaves oblong, or linear-oblong, .6-2.5 cm. long. 9. *Lyosotis*
- D. Leaves linear to linear-spatulate 1.2-6.5 cm. long. 10. *Cryptantha*
- B. Herbs 15 cm. tall or more.
- J. Plants glabrous. 1. *Heliotropium*
- C. Plants not glabrous.
- D. Leaves 5-10 cm. long. 5. *Lithospermum*
- D. Leaves 5 cm. or less in length.
- E. Leaves spatulate, .6-2.5 cm. long. . . 9. *Lyosotis*
- E. Leaves not spatulate, 1.2-5 cm. long.
- F. Perennials.
- G. Branched from base; upper leaves linear, 1.2-2.5 cm. long; lower oblanceolate and somewhat longer. 8. *Creosotaria*
- G. Not branched from base, but stems sometimes clustered; leaves linear, linear-oblong to oblong 1.2-5 cm. long. 5. *Lithospermum*
- F. Annuals and biennials.
- J. Leaves bright green, appressed pubescent, lanceolate, linear, or linear-oblong. 5. *Lithospermum*
- G. Leaves pale, hispid, or appressed pubescent.
- M. Plants caespitose; leaves narrowly linear (2-4 mm. wide) or oblong to ovate. 1. *Heliotropium*
- H. Leaves linear or linear-oblong. 3. *Lappula*

1. *Heliotropium* (1:680, 1:73, 1:663)

Key to the Species

- A. fleshy perennials, glabrous and glaucous throughout; leaves spatulate. 1.H. *spatulatum*
- A. pubescent annuals, not fleshy and leaves never spatulate.
 - 1. Plants strigose-canescens; leaves 1-4 cm. long, margins entire.
 - 1. Leaves linear, sessile or lower ones petioled, narrowed at both ends. 2.H. *tenellum*
 - 2. Leaves oblong, ovate, or lanceolate, acute or obtuse at apex, short-petioled, narrowed at base. 3.H. *convolvulaceum*
 - 2. Plant more or less hirsute or hispid; leaves 5-15 cm. long with repand or undulate margins.
 - 4.H. *indicum*

1. *Heliotropium spatulatum* Ryth. Spatulate-leaved Heliotrope (Map No. 53). A fleshy, glabrous, perennial with white or bluish flowers. June-Sept. Prairies, plains and meadows in Grant and Finney Counties.

2. *Heliotropium tenellum* (Nutt.) Torr. Slender Heliotrope (Map No. 54). A strigose-canescens slender annual with narrowly linear leaves and white flowers. Apr.-Aug. In dry soil in the southernmost corner of the state.

3. *Heliotropium convolvulaceum* (Nutt.) A. Gray. Binweed Heliotrope (Map No. 55). A strigose-canescens annual with leaves usually ovate or oblong and with numerous fragrant white rather large (about 2 cm. long) flowers. July-Sept. In dry sand soil in Southwestern Kansas.

4. *Heliotropium indicum* L. Indian Heliotrope (Map No. 56). Annual with repand or undulate leaves and blue sessile flowers in terminal, dense, knobless scorpioid spikes. May-Nov. In waste places and reported for Kansas.

2. *Mertensia* (G:666, B:66, R:671-672)

1. *Mertensia virginica* (L.) DC. Bluebells (Map No. 57). Glabrous herbs with ovate, oblong or obovate leaves and very showy blue-purple flowers. Mar.-May In low meadows and along streams; reported from Miami County.

3. *Lappula* (G:661, B:77, R:666)

It is impossible to satisfactorily separate *Lappula cchinata* from *L. heterosperma* on a vegetative basis; hence characters of the nutlets are included in the key.

- A. Leafy, hispid or appressed-pubescent annuals 1.5-6 dm. high; leaves linear, linear-oblong, or the lowest spatulate.
 - B. Prickles in 2 rows on the margins of the nutlets, distinct; branches erect. 1. *L. cchinata*
 - B. Prickles in 1 row on the margins of the nutlets, more or less confluent; branches erect or ascending or at length diffuse. 2. *L. heterosperma*
- A. Pubescent biennials, 6-12 dm. high; basal leaves ovate or nearly orbicular, stem leaves oval or ovate-oblong. 3. *L. virginiana*

1. *Lappula ciliata* Gilib. European Stickseed (Map No. 58). A pale, leafy hispid annual with small blue flowers. May-Sept. In waste places; scattered in eastern third of the state and reported from Millie County.

2. *Lappula heterostachya* hairy stickseed (Map no. 59). Very similar to the preceding species but with the margins of the leaflets cased with only a single row of prickles. Apr.-Aug. In dry soil throughout most of the state but rare in the southern portion.

3. *Lappula virginiana* (L.) Greene Virginia Stickseed (Map No. 60). A pubescent biennial with large oval or ovate oblong leaves. June-Sept. In dry woods and thickets, in the eastern half of the state and scattered in the western part.

4. *Cynoglossum* (6:681, 2:75, 1:665)

Key to the Species

- A. Stems leafy to the top; upper leaves lanceolate. 1.C. officinale
- A. Stem leafless above, upper leaves oblong or
ovate-lanceolate. 2.C. virginianum

1. *Cynoglossum officinale* L. Hound's-tongue (Map No. 61). Pubescent biennial with reddish-purple or rarely white flowers. May-Sept. In fields and waste places in the eastern third of the state.

2. *Cynoglossum virginianum* L. Wild Comfrey (Map No. 63).

A hirsute blue-flowered perennial. Apr.-May In woods; reported for Kansas.

5. *Lithospermum* (Griseb, B:37, R:373)

Key to the Species

A. Leaves linear.

B. Annual or biennial with bright green veinless leaves. 1.L. arvense

B. Perennial with distinctly veined leaves.

C. Hirsute and somewhat caespitose plants, lowest leaves often reduced. 2.L. caespitosa

C. Strigose but not caespitose.

D. Stems many 1-2 dm. high, leaves 3-4 cm. long, mostly strigose 3.L. mandanense

D. An erect solitary stem or diffusely branched from the base 1.5-6 cm. high, leaves 1.2-5 cm. long 4.L. linearifolium

A. None of the leaves linear.

B. Leaves ovate, some, at least, 2.5-5 cm. wide.

5.L. latifolium

B. Leaves not ovate, seldom if ever over 2.5 cm. wide.

C. Plant grayish and finely pubescent, stem 6-12 dm. high.

C. Plant hispid or appressed pubescent; stem 1.5-7.5 dm. high, none of the leaves over 1 cm. wide.

D. Perennial, leaves narrowly lanceolate, 5-7 cm. long 7.L. oelaei

D. Annual or biennial, leaves lanceolate or linear-oblong 1.2-3.5 long 1.L. arvense

1. *Lithospermum arvense* L. Corn. Groundwell (Map No. 63).

A bright green herb with small nearly white flowers. May-Aug. Sandy fields and roadsides in the eastern part of the state.

2. *Lithospermum canescens* (Mill.) Rehm. Hairy Puccoon (Map No. 64). A soft hairy and more or less hoary perennial with a deep orange-yellow corolla. Apr.-June. Plains and open woods in sandy soil in the northeastern part of the state.

3. *Lithospermum canadense* Spreng. (Map No. 65). A low linear-leaved perennial with the leaves mostly strigose. On dry plains in Ohio county.

4. *Lithospermum linearifolium* Goldie. Narrow-leaved Puccoon (Map No. 66). A strigose-pubescent and scabrous perennial with rather long bright yellow corollas with erose-denticulate lobes. Apr.-July. In dry soil, especially on prairies throughout the state.

5. *Lithospermum latifolium* Michx. American Groundwell (Map No. 67). A loosely branched herb with rather large ovate leaves and yellowish white or pale yellow flowers. May. In dry thickets and fields in Miami county and reported from Leavenworth.

6. *Lithospermum effluatile* L. Groundwell (Map No. 68). A finely puberulent perennial with broadly lanceolate leaves and yellowish white flowers. May-Aug. In fields and waste places, reported from Riley county.

7. *Lithospermum Guelinii* (Michx.) Hitchc. Hairy Puccoon

(Map No. 69). A hispid perennial with bristly hairs and showy orange-yellow flowers in dense short terminal leafy racemes. Apr.-June. In dry woods in the eastern half of the state.

6. *Echium* (G:688, B:93, R:676)

1. *Echium vulgare* L. Blue-weed. Viper's Bugloss (Map No. 70). An erect bristly-hairy biennial with pink flower-buds and conspicuous bright blue to violet purple flowers. June-July. In fields and waste places in Ford and Pottawatomie Counties.

7. *Onosmodium* (G:687, B:90, R:675)

Key to the Species

- A. Leaves densely soft-or silky-pubescent. 1.0. *molle*
- A. Leaves and stems strigose to hirsute.
- B. Pubescence appressed; leaves 5-7.5 cm.
 long, veins very prominent. 2.0. *occidentale*
- B. Pubescence spreading; lower leaves 5-11 cm.
 long, upper leaves often much smaller, veins
 only moderately prominent. 3.0. *hispidissimum*

1. *Onosmodium molle* Michx. Silky False Gromwell (Map No. 71). An erect perennial with medium sized (2-6 dm.), silky pubescent leaves and distinctly pitted nutlets. May-July. Barrens, reported from Douglas and Labette Counties.

2. *Onosmodium occidentale* Mackenz. Western False
Gromwell (Map No. 72). Triangular leaves with strongly veined
leaves and congested corolla and ovoid anthers. May-July.
On prairie and plains throughout the state except the ex-
treme western and the southwestern portions.

3. *Onosmodium himalaissimum* Mackenz. Shaggy False
Gromwell (Map No. 73). Spreading-hirsute plants with a long
inflorescence, numerous small leaves extending the numerous,
yellowish-white flowers and obtuse anthers distinctly con-
stricted at the base. May-July. In dry fields or thickets,
or on banks in the eastern third of the state and Adams
County.

4. *Oreocarya* (B:80, 11554)

Key to the Species

- A. Stem branched from the base and sometimes above,
strigose-pubescent or hirsute, 1.0-7.0 ft. tall;
upper leaves linear, lower oblanceolate. 1.0. suffruticosa
- A. Low, tufted plants, stems usually simple .7-1.5
dm. tall, silvery appressed pubescent or hir-
sute above; leaves linear-spatulate. . . 2.0. arctica

1. *Oreocarya suffruticosa* (Torr.) Greene. Shrubby *Oreocarya* (Map No. 74). A rather stout perennial with linear and
oblanceolate leaves and a slender, panicle raceme. May-Aug.
In dry soil in the western half of the state.

8. *Oreocarya sericea* (A. Gray) Green Low Oreocarya (Map No. 75). A low tufted silvery appressed-pubescent plant with a short thyrsoid or glomerate inflorescence. May-Sept. In dry soil in Hamilton County.

9. *Myosotis* (S:663, B:80, A:670)

1. *Myosotis virginica* (L.) B.S.P. Spring Scorpion Grass (Map No. 76). Perennate-pubescent or glabrous erect-branched annual or biennial with oblong leaves and small white flowers in a strict raceme. May-June. On dry hills and banks in the eastern part of the state and Ellis County.

10. *Cryptantha* (B:80, A:670)

1. *Cryptantha crassicaulis* (T. & G.) Greene (Map No. 77). A very low densely hispid annual with linear or spatulate leaves and large white flowers in dense spikes. June-Aug. In dry soil in the western third of the state.

V. *Schizanthus*

Herbs, shrubs (and trees) with alternate (rarely opposite) leaves and pentamerous, mostly regular, but sometimes irregular flowers; corolla-limb more or less plicate (rarely imbricated); ovary mostly 2-celled; ovules many; endosperm fleshy.

Key to the Genera

- A. Shrubs, often vining or trailing. 1. *Lycium*
- A. Herbaceous plants (*Solanum dulcamara* somewhat woody below).
 - B. Leaves mostly opposite; petioles winged. 2. *Chamaesaracha*
 - B. Leaves alternate.
 - C. Leaves rather fleshy. 3. *Quincula*
 - C. Leaves not fleshy.
 - D. Stellate pubescent herbs, or tall climbing or reclining plants 4. *Solanum*
 - D. Pubescence simple or consisting of flat forked or branched hairs; plants never climbing.
 - E. Annuals with pinnatifid leaves or perennials with tuberiferous rootstocks.
 - 4. *Solanum* (2 species)
 - E. Plants without pinnatifid leaves or tuberiferous roots.
 - F. Leaves usually less than 10 cm. long.
 - G. Leaves deltoid or rhombic and decidedly strigose beneath. 4. *Solanum* (1 species)
 - G. Leaves if at all strigose, not deltoid or rhombic. 5. *Physalis* (and *Solanum interius*)
 - F. Leaves usually more than 10 cm. long.
 - G. Leaves sinuate-dentate or lobed with points of lobes and apex blunt.
 - 6. *Nicandra*
 - G. Leaves entire or sinuate lobed; the lobes and apex acute or acuminate and sharply pointed. 7. *Datura*

1. *Lycium* (G:716, B:168, R:705)

1. *Lycium halimifolium* Mill. Matrimony Vine, Box-thorn (Map No. 78). A glabrous spiny or unarmed slender climbing or trailing shrub with purplish funnelform corollas. May-Aug. In thickets and waste places, escaped from gardens; scattered over northern part of the state and Butler County.

2. *Chamaecaracha* (G:713, B:163, A:702)

Key to the Species

1. Pubescence dense, hirsute as well as pubescent,
densely viscid. L.C. *conoides*
1. Pubescence sparse, so little slightly stellate,
scarcely if at all viscid L.C. *coronopus*

1. *Chamaecaracha conoides* (Moric.) Britton (Map No. 79).

A much branched cinereous-pubescent viscid perennial with deeply lobed leaves and white, cream-colored or violet-purplish flowers. May-sept. In dry clayey soil limited for the most part to the southwest part of the state.

2. *Chamaecaracha coronopus* (Dunal) A. Gray (Map No. 80).

A branched and diffuse perennial with linear or lanceolate leaves and white or ochroleucous flowers. May-sept. In clayey soil, reported for Kansas.

3. *Quinqua* (B:163, A:703)

1. *quinqua lobata* (Perr.) Raf. Purple-flowered Ground-Cherry (Map No. 81). A low spreading or prostrate more or less scarfy pubescent perennial with thickish leaves and purplish flowers. May-sept. On high plains in the western third of the state.

4. *Solanum* (G:712, B:164, L:706)

Go to the number

- A. Plant glaucous or pubescent but never stellate.
 - Plant covered with prickles. 1.S. citrullifolium
- B. Plant without prickles.
 - C. Plants more or less woody below; leaves hastate or 3-lobed.
 - Climbing vine. 2.S. dulcamara
 - D. Plant reclining. 3.S. triquetrum
 - C. Plants not woody below; leaves never hastate, entire to many-lobed.
 - Leaves pinnatifid. 4.S. triflorum
 - D. Leaves pinnately dentate or entire.
 - Leaves sinuate or nearly so, the blade ovate or oblong-ovate. 5.S. nigrum
 - Leaves sessile, striate beneath, the blades deltoid or rhombic. 6.S. interius
- A. Plant stellate-pubescent.
 - B. Stem armed with prickles.
 - Leaves oblong to linear, repand or entire, silvery canescent. 7.S. elaeagnifolium
 - C. Leaves oblong, ovate or oval in outline, lobed or pinnatifid, green to hoary.
 - Plant hoary; leaves sinuately 3-7 lobed. 8.S. Torreyi
 - Plant green; leaves repand, pinnately lobed or pinnatifid.
 - Annual, leaves irregularly pinnatifid, 5-7 lobed, or 1-2 pinnatifid, lobes mostly oblong-obtuse 9.S. rostratum
 - Perennial; leaves repand, lobed or pinnatifid, lobes acute or obtusish. 10.S. carolinense
- B. Stem without prickles. 7.S. elaeagnifolium

1. *Solanum citrullifolium* Acaun. Melon-leaved Nightshade (Jap No. 83). A glabrous-pubescent prickly annual with leaves resembling those of a watermelon and purple flowers with one large purple anther and four yellow ones and a prickly fruit. July-Sept. In dry soil; reported for Kans.s.

2. *Solanum dulcamara* L. Bittersweet or Climbing Nightshade (Map No. 53). Pubescent climbing or straggling plant with blue, or white flowers and the fruit, a red berry. May-Sept. In waste places or moist thickets in Cloud and Riley Counties.

3. *Solanum elaeagnifolium* Cav. (Map No. 54). Nearly glabrous scarcely climbing herb with somewhat rigid stems, purple flowers, and globose red berries. June-Sept. Thickets, reported from Kansas.

4. *Solanum triflorum* (Walt.) Out-leaved Nightshade (Map No. 55). An annual with narrow pinatifid leaves, white flowers, and green berries. May-Oct. On prairies and waste lands more or less throughout the state except the south and southeast.

5. *Solanum nigrum* L. Garden Nightshade (Map No. 56). A nearly glabrous annual with ovate or oblong-ovate leaves, white flowers, and black berries when ripe. July-Oct. In waste places usually in cultivated soil throughout the state but sparsely scattered in the western third.

6. *Solanum interior* Rydb. (Map No. 57). A medium high plant with yellowish-white corollas and greenish black berries when ripe. June-Aug. River valleys along bushes scattered over the state.

7. *Solanum elaeagnifolium* V. Silver-leaved Nightshade (Map No. 87). Shrubby, densely stellate-pubescent, silvery-green; leaves petioled with linear, oblong or lanceolate leaves and rather large blue or violet flowers. May-Sept. On dry plains and prairie in eastern and southern Kansas.

8. *Solanum Torreyi* A. Gray (Map No. 88). Shrubby stellate pubescent perennial with large ovate leaves and large showy violet flowers. On dry plains and prairie in Barber, Sumner, and Cowley Counties.

9. *Solanum rostratum* Pursh. Buffalo-bur (Map No. 89). Densely stellate-pubescent prickly shrub with 5-7 lobed or 1-2 pinnatifid leaves, yellow flowers and prickly fruit. May-sept. On prairie in every county in the state but four.

10. *Solanum carolinense* L. Horse-nettle (Map No. 91). A green stellate-pubescent prickly perennial with large opposite, lobed or pinnatifid leaves and orange-yellow berries. May-sept. In dry fields and in waste places limited to the eastern third of the state.

5. *Physalis* (5:714, 5:105-106, 4:698)

Key to the Species

- A. Pubescence more or less viscid.
- B. Leaf-blades round-ovate to nearly orbicular.

- 3. Stem diffuse or prostrate, zigzag branched; leaf blade nearly orbicular, 2-4 cm. in diam., petioles short. 11.P. rotundata
 - 4. Stem erect; leaf-blade round ovate, not over 5 cm. long; petioles as long as blades. 2.P. comata
 - 5. Leaf-blades ovate to cordate. 3.P. heterophylla
 - 6. Pubescence dense, partly of fine and short hairs, partly of long, flat, branched hairs; leaves broadly cordate; perennial 4.5-9 dm. tall. 4.P. gruinosa
 - 7. Plants villous, but without long flat jointed hairs; leaves ovate; annuals. 5.P. pubescens
 - 8. Stem stout, generally erect; leaves usually very oblique at base, deeply sinuately toothed and finely pubescent over entire surface. 6.P. missouriensis
 - 9. Stem generally diffuse or spreading; leaves hairy at least on veins, repand-dentate or nearly entire. 7.P. longifolia
 - 10. Leaf blade thin, generally entire at base and repand denticulate or entire above, acute or acuminate. 8.P. virginiana
 - 11. Leaf blade acute but not acuminate; never entire but rather repand or sinuately dentate. 9.P. macrophylla
- 12. Pubescence not viscid. 10.P. subglabrata
- 13. Hairs simple, never branched. 11.P. subglabrata
- 14. Leaves and stems more or less pubescent with spreading hairs. 12.P. longifolia
 - 15. Stem about 4.5 dm. high, at first erect, later spreading or diffuse; leaves lanceolate, oblanceolate or spatulate, usually with entire margins, rarely wavy, but never sinuately toothed. 13.P. lanceolata
 - 16. Stem 4.5-9 dm. high, erect, dichotomously branched; leaves ovate-lanceolate, generally more or less sinuately dentate. 14.P. virginiana
 - 17. Plants glabrous or only the upper parts short hairy. 15.P. macrophylla
 - 18. Perennials from a rootstock. 16.P. longifolia
 - 19. Leaves lanceolate, oblanceolate or linear; petioles 2 cm. or less. 17.P. longifolia
 - 20. Leaves broadly ovate 2.5-5 cm. wide, usually coarsely dentate; petioles 2-4 cm. long. 18.P. macrophylla
 - 21. Leaves ovate to ovate lanceolate often very oblique at base, entire or repand denticulate; petioles 2-6 cm. long. 19.P. subglabrata

D. Annuals.

- A. Leaves lanceolate to ovate-lanceolate, usually coarsely toothed. 12. *P. pendula*
- B. Leaves ovate to cordate.
 - F. Leaves ovate, somewhat sinuately toothed with long acuminate teeth 13. *P. angulata*
 - F. Leaves from ovate to cordate, entire or sinuately dentate with teeth not acuminate.
 - 14. *P. ixocarpa*
- B. Leaves with branched or more or less stellate hairs.
- C. Stem 4.5-9 dm. tall, leaves broadly ovate to oblong, never cordate, lower surface, especially, covered with branched hairs 15. *P. pumila*
- C. Stem 3-6 dm. tall, leaves rounded-cordate or the upper ovate finely stellate. 15. *P. mollis*

1. *Physalis rotundata* Rydberg. Round-leaved Ground Cherry (Map No. 93). A diffuse and spreading, zigzag branched, densely viscid-pubescent perennial with small orbicular leaves and yellow flowers with brownish centers. July-Sept. On dry plains scattered all over the state except the southeast.

2. *Physalis comata* Rydberg (Map No. 93). An erect perennial with round-ovate, repand-dentate leaves and greenish yellow corollas with brown centers. Hillsides in Rooks and Riley Counties.

3. *Physalis heterophylla* Nees Cherry Ground-Cherry (Map No. 94). A viscid-glandular, villous perennial with broadly cordate leaves, greenish yellow corollas with brownish or purplish centers and yellow berries. In rich soil throughout eastern two thirds of the state and Sheridan County.

4. *Physalis pruinosa* L. Tall Hairy Ground Cherry (Map

No. 95). A tall villous, somewhat viscid, annual with large cordate leaves with very oblique bases and deeply sinuate-toothed margins. July-Sept. In cultivated soil in three widely separated counties.

5. *Physalis pubescens*. L. Low Hairy Ground-Cherry (Map No. 96). A low diffuse or spreading much-branched annual with yellow corollas, purplish anthers, and pyramidal fruiting calyx. July-Sept. In sandy soil scattered in eastern part of the state and Cooks County.

6. *Physalis missouriensis* Mack. and Bush (Map No. 97). A villous, zigzag branched annual with yellow flowers and round-ovoid ocreary 5-10 angled fruiting calyx. July-Sept. In the eastern third of the state.

7. *Physalis lanceolata* Michx. Prairie Ground Cherry (Map No. 98). A perennial with lanceolate, oblanceolate, or spatulate leaves and dullish yellow corollas with brownish centers. July-Sept. On dry prairies throughout the state.

8. *Physalis virginiana* Mill. (Map No. 99). A more or less strigose-hairy dichotomously branched perennial with sulfur-yellow corolla with purplish spots. July-Sept. In rich soil especially in open places in eastern two thirds of the state.

9. *Physalis longifolia* Nutt. Long-leaved Ground Cherry

(Map No. 100). A glabrous perennial with long narrow leaves with entire margins and all berries yellow. July-Sept. In rich soil throughout the state.

10. *Physalis macrophysa* Rydb. (Map No. 101). A perennial with large ovate leaves and a large fruiting calyx deeply sunken at the base. In rich soil sparsely scattered over the state.

11. *Physalis subglabrata* Mack. and Nash (Map No. 102). A tall (7.5-14 dm.) erect, dichotomously branched perennial with large ovate-lanceolate leaves and a large red or purple berry. July-Sept. Scattered all over the state by sparsely in the west.

12. *Physalis pendula* Rydberg (Map No. 103). A glabrous annual with coarsely toothed lanceolate or ovate-lanceolate leaves, a wholly yellow corolla, and a rounded ovoid fruiting calyx. July-Sept. Limited to the eastern third of the state.

13. *Physalis angulata* L. (Map No. 104). A much-branched erect annual with ovate long-sinuately toothed leaves and a purple veined fruiting calyx. July-Sept. In rich soil in Riley and Marion Counties.

14. *Physalis ixocarpa* Brot. Strawberry Tomato (Map No. 105). A much branched annual with cordate to ovate leaves with oblique bases, and with bright yellow corollas with pur-

ple throats. Cultivated, but frequently escaped, and maintains itself in several places in western Kansas.

15. *Physalis pusilla* Nutt. (Map No. 106). A perennial with a hirsute, obscurely angled stem, and branched hairs on the leaves. July-Sept. Plains and prairies in the eastern part of the state and Wallace County.

16. *Physalis mollis* (Nutt.) Stellate Ground Cherry (Map No. 107). A perennial with some rounded-cordate and finely stellate leaves. Thickets and banks in Barber County. (Common in Southwestern United States.)

5. *Nicotiana* (G:716, B:166, H:698)

1. *Nicotiana physaloides* (L.) Britton Apple-of-Peru (Map No. 108). A large glaucous annual with large leaves and white flowers. July-Sept. In waste places, frequently escaped from gardens. In Clay and Riley Counties.

7. *Datura* (G:717, B:169, H:706)

Key to the Species

- A. Densely and finely glandular pubescent; leaves entire or undulate, rounded or sub-cordate at the base. 1.D. metel
- A. Glabrous, or young parts sparingly pubescent; leaves irregularly sinuate-lobed, mostly narrowed at the base 2.D. stramonium

1. *Datura metel* L. (Map No. 109). A glandular pubescent annual with very large white flowers and globose, prickly, pubescent capsules. July-Sept. In waste places escaped from gardens in Riley, Cloud and Morris Counties.

2. *Datura stramonium* L. Jinson seed (Map No. 110). A glabrous annual with large white or violet flowers and ovoid, prickly capsules. June-Sept. In fields and waste places widely distributed in eastern half of the state and in Hamilton County.

QUESTIONABLE SPECIES

There are some species which have been recorded as occurring in Kansas but whose presence is doubtful. In a few cases the herbarium specimens have been incorrectly named. Many of the reports are based on identifications made many years ago before adequate keys to this region had been prepared. The species thus recorded are often out of this range. For this reason, in most cases, no provision for these species was made in the key.

Phlox maculata has a range distinctly east of Kansas, yet there is one specimen in the herbarium of Kansas University that has been identified as *P. maculata*; hence this species has been provided for in the key and a distribution map made of it. The specimen may have been a garden escape,

as it may really occur naturally in DeWenworth County; in the third place, the specimen may be P. paniculata, for according to Britton and Brown the latter is very variable and consists of many races.

Ipomoea ciliolata was reported from Greenwood County in 1881, but there is no herbarium specimen for it and there has been no subsequent report of it; hence the author is inclined to seriously doubt the correctness of the original identification. This case is paralleled by the report of Convolvulus catesbeiana from Marshall County in 1872. Neither of these species is recognized in standard keys for this reason; and hence no provision was made for them in the keys.

Convolvulus spithameus has been provided for in the keys and a map made showing its distribution due to the fact that there is a specimen in the herbarium of Kansas University identified as C. spithameus. The author doubts whether this species is really present in Kansas because its range as given in the standard floras is decidedly east of this state. Also the leaves of C. arvensis are exceedingly variable in shape, some of them often being oblong just like those of C. spithameus; hence it is probable that this is another case of misidentification.

Nyberg gives Lithospermum breviflorum for Kansas; however no herbarium specimen of it was found by the author, and inasmuch as it is known to be a sub-alpine species, its

presence in the state seems very doubtful.

Onosmodium virginianum was reported for Douglas and Ellis Counties in 1872, but the range of this species is decidedly east of Kansas. Nydberg does not even provide for it in his "Flora of the Prairies and Plains of Central North America." Nyctotis palustris was reported from Miami County in 1879 and Lycopsis arvensis from Franklin County in 1881 but both records remain entirely unsupported to this day.

Physalis mollis, a southern species common in Texas and the Southwest, is represented in the herbarium of Kansas University from Barber County. There was one specimen from Bourbon County in the Kansas State College herbarium labeled P. mollis, but the author re-identified it as P. pusilla. In the opinion of the author the most valuable point by which to distinguish the two species is the shape of the leaf rather than different degrees of stellateness.

In the Kansas University herbarium is a specimen labeled Physalis barbadensis, followed by a question mark. The habitat of this species is along the seashore; hence its presence in Greenwood County is extremely doubtful.

SUMMARY

The present study of the Polemoniales of Kansas was based on representatives of the order found in the herbaria of Kansas State College, Kansas University, and Fort Hays Kansas State College. The work was done during 1931-1932 at Kansas State College as a part of the requirement for a Master's Degree.

The order, Polemoniales, is represented in Kansas by a total of 104 wild species distributed among 5 families (Polemoniaceae, Convolvulaceae, Hydrophyllaceae, Boraginaceae, and Solanaceae).

Keys based on vegetative characters in so far as possible were made to separate the families, genera, and species.

A brief recognition statement characterizing each species is given together with a map of its distribution in the state by counties.

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66. Distribution of *Lithospermum linearifolium*.
67. Distribution of *Lithospermum latifolium*.
68. Distribution of *Lithospermum officinale*.
69. Distribution of *Lithospermum Gmelini*.
70. Distribution of *Schium vulgare*.
71. Distribution of *Oenothera mollis*.

Map No.

72. Distribution of *Crucianella occidentalis*.
73. Distribution of *Crucianella nigridiscum*.
74. Distribution of *Crucianella suffruticosa*.
75. Distribution of *Crucianella paniculata*.
76. Distribution of *Crucianella virginica*.
77. Distribution of *Cryptantha crassifolia*.
78. Distribution of *Lycium halimifolium*.
79. Distribution of *Chamaeserapha confinis*.
80. Distribution of *Chamaeserapha coronopus*.
81. Distribution of *Quibula lobata*.
82. Distribution of *Solanum citrullifolium*.
83. Distribution of *Solanum dulcamara*.
84. Distribution of *Solanum tripartitum*.
85. Distribution of *Solanum triflorum*.
86. Distribution of *Solanum nigrum*.
87. Distribution of *Solanum integrifolium*.
88. Distribution of *Solanum elaeagnifolium*.
89. Distribution of *Solanum Torreyi*.
90. Distribution of *Solanum rostratum*.
91. Distribution of *Solanum carolinense*.
92. Distribution of *Physalis reticulata*.
93. Distribution of *Physalis comata*.
94. Distribution of *Physalis heterophylla*.
95. Distribution of *Physalis pruinosa*.
96. Distribution of *Physalis pubescens*.

Map No.

97. Distribution of *Physalis alkekengi*.
98. Distribution of *Physalis alkekengi*.
99. Distribution of *Physalis virginiana*.
100. Distribution of *Physalis longifolia*.
101. Distribution of *Physalis macrophysa*.
102. Distribution of *Physalis subglobata*.
103. Distribution of *Physalis pendula*.
104. Distribution of *Physalis angulata*.
105. Distribution of *Physalis ixocarpa*.
106. Distribution of *Physalis pumila*.
107. Distribution of *Physalis mollis*.
108. Distribution of *Nicandra physalodes*.
109. Distribution of *Datura metel*.
110. Distribution of *Datura stramonium*.

Explanation of Maps

indicates that there is a herbarium specimen available.

indicates that there is no herbarium specimen available.

indicates that the species is represented in the herbarium of Kansas University only.

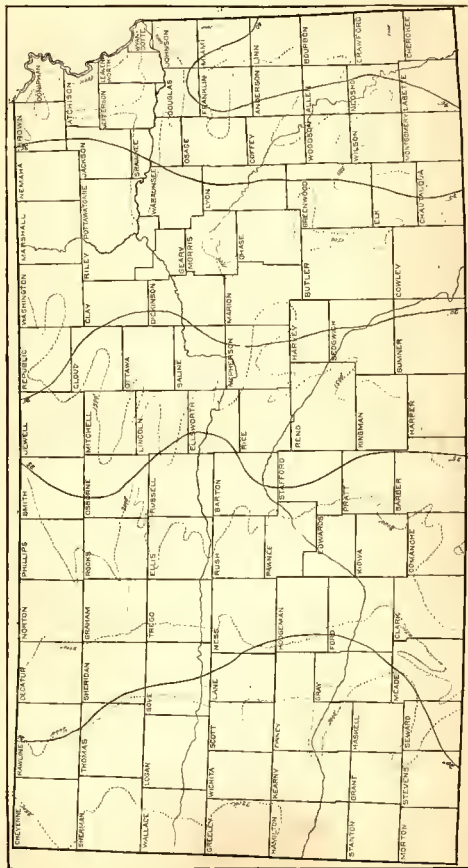
indicates that the species is represented in the herbarium of Fort Hays Kansas State College only.

If the species is represented in the herbarium of Kansas

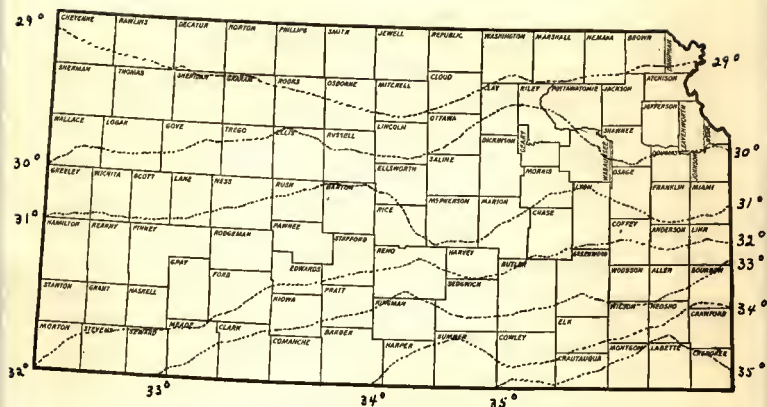
State College, no symbol occurs with the solid square.

The numbers appearing in the line-squares refer to the articles in the reference list in which the species is reported.

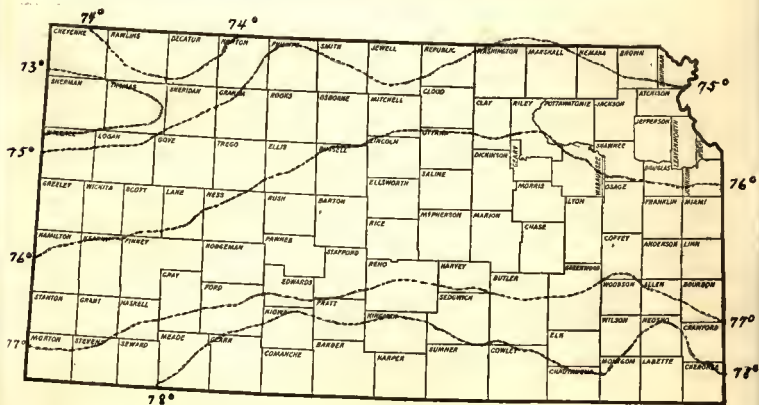
Map No. 1. - Annual Rainfall and Elevation.



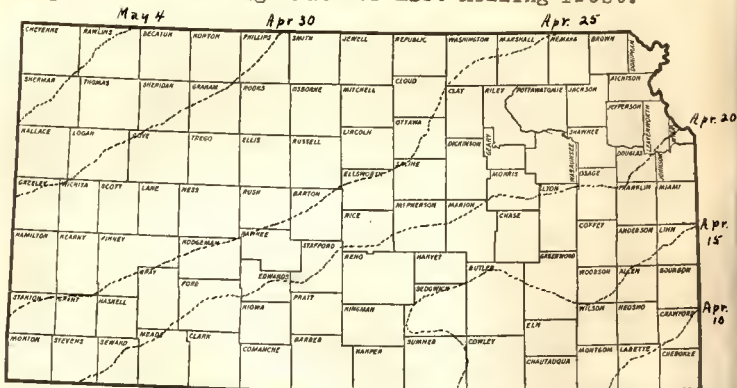
Map No. 2. - Mean Winter Temperatures.



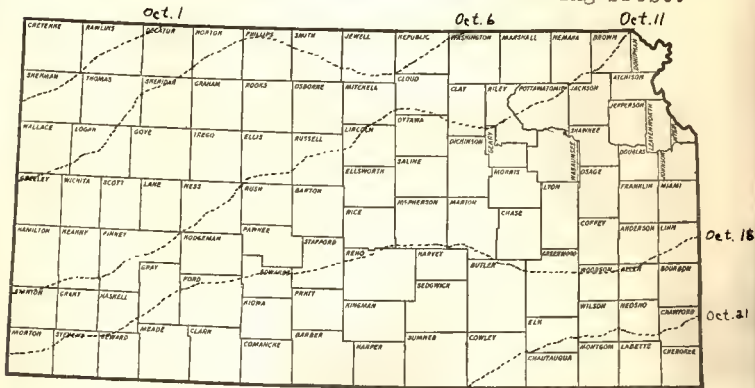
Map No. 3. - Mean Summer Temperatures.

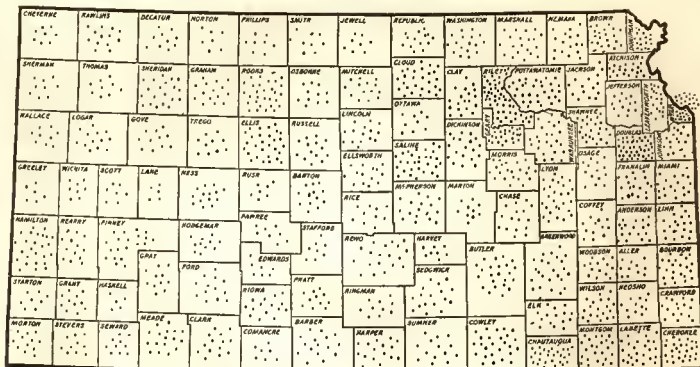


Map No. 4. - Average Date of Last Killing Frost.

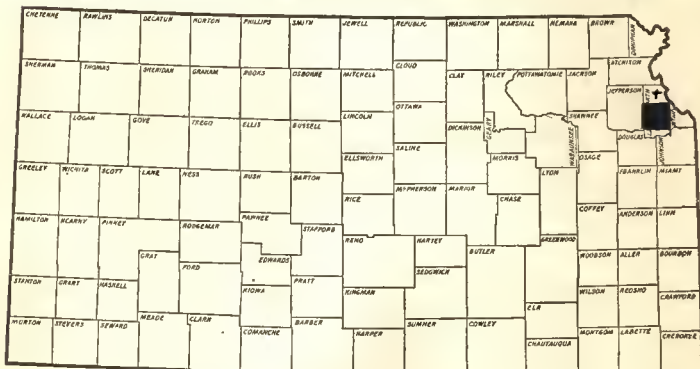


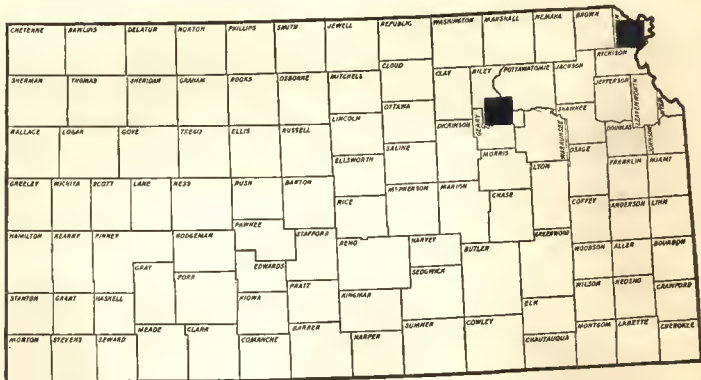
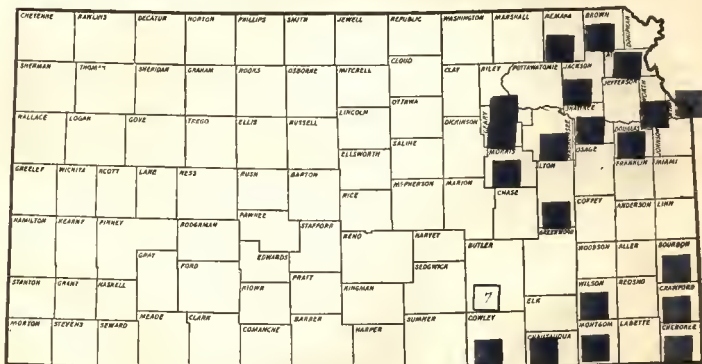
Map No. 5. - Average Date of First Killing Frost.



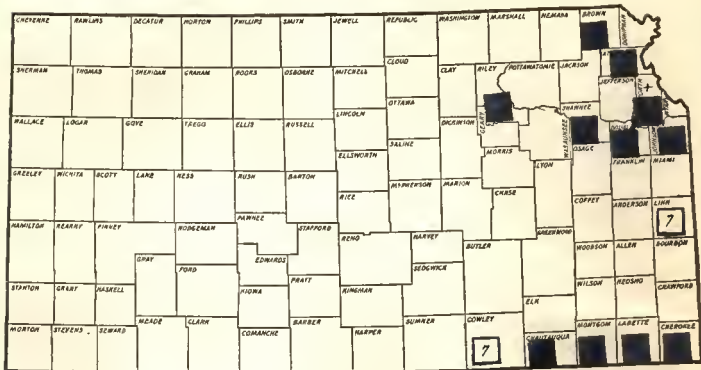
Map No. 6. - Distribution of the species of *Polemoniales*.

A dot in a county represents a species present.

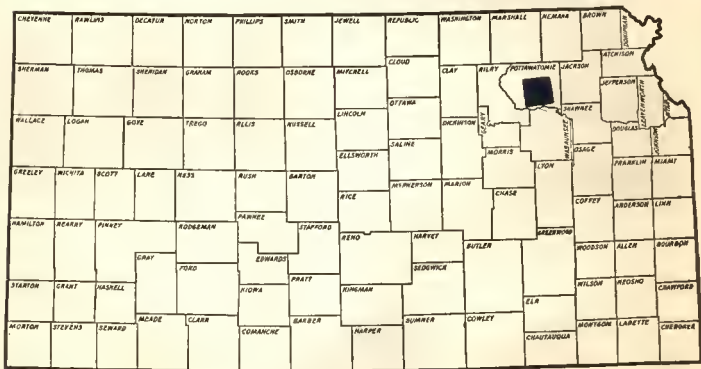
Map No. 7. - Distribution of *Phlox maculata*.

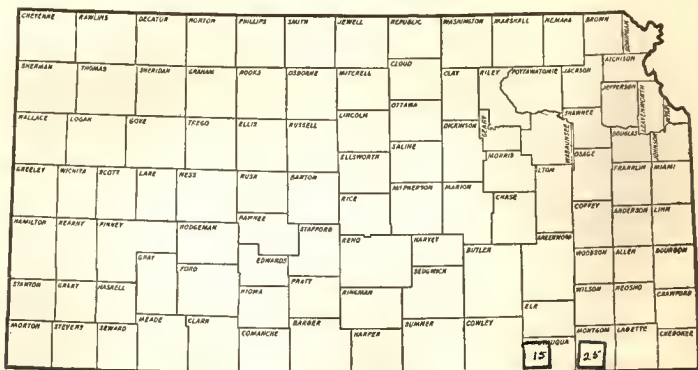
Map. No. 8. - Distribution of *Phlox paniculata*.Map No. 9. - Distribution of *Phlox divaricata*.

Map No. 10. - Distribution of *Phlox pilosa*.

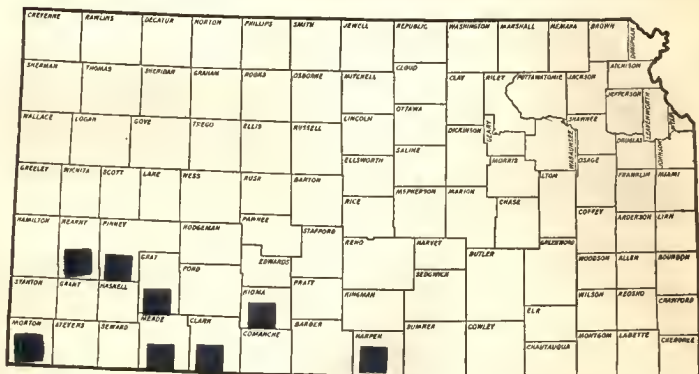


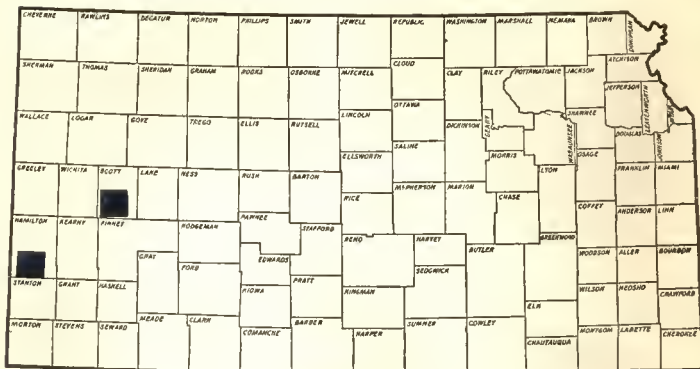
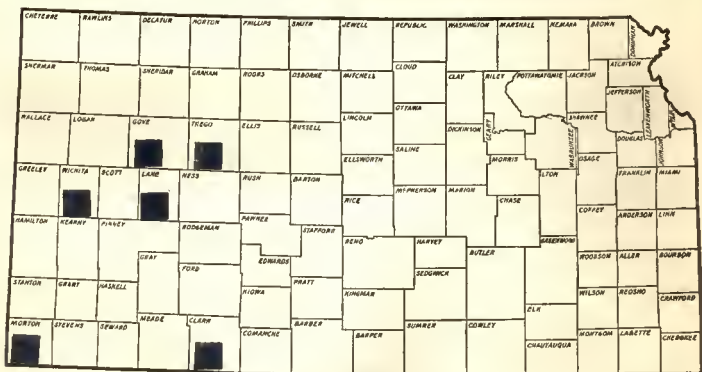
Map No. 11. - Distribution of *Phlox bifida*.

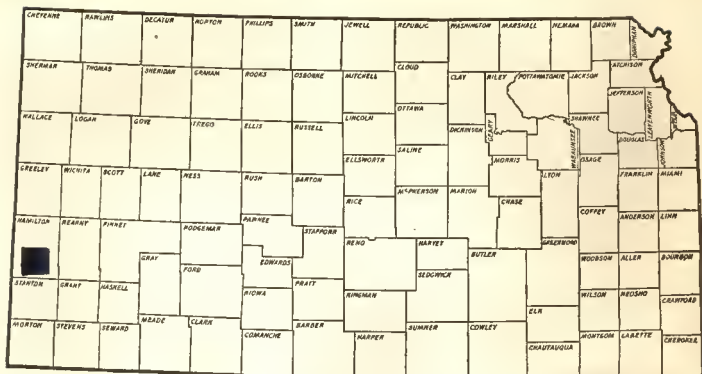
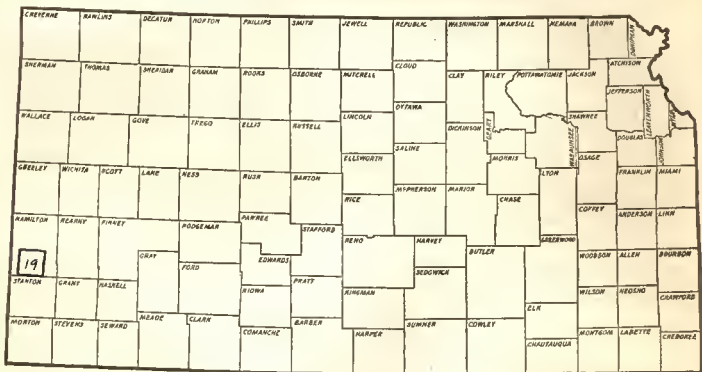


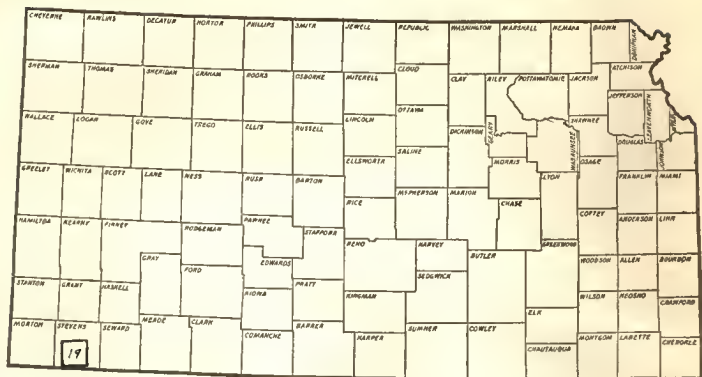
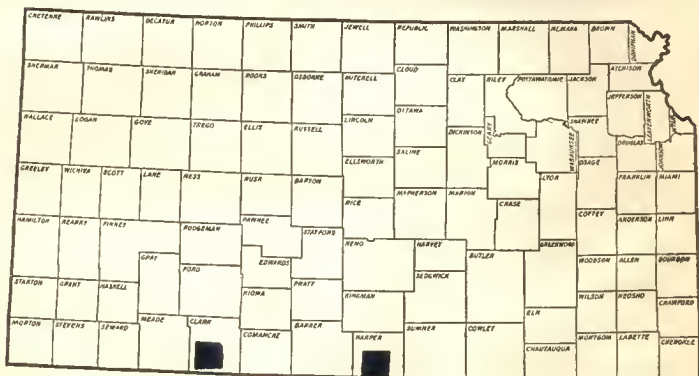
Map No. 12. - Distribution of *Gilia rubra*.

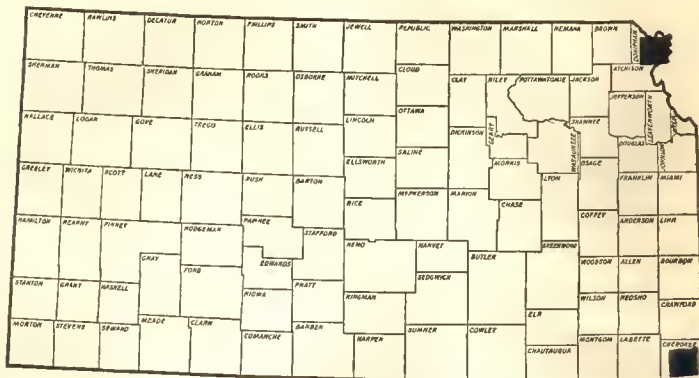
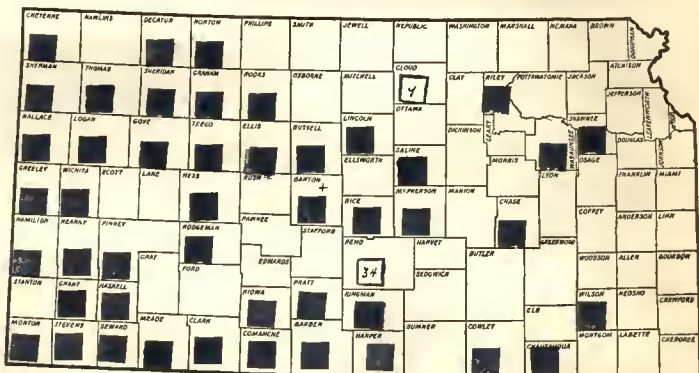
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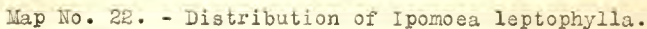
Map No. 13. - Distribution of *Gilia longiflora*.

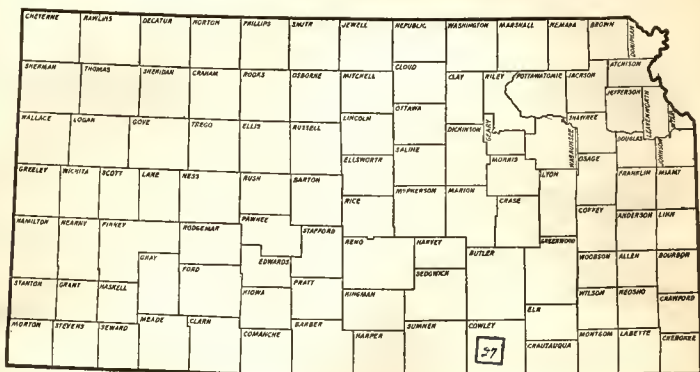
Map No. 14. - Distribution of *Gilia spicata*.Map No. 15. - Distribution of *Gilia acerosa*.

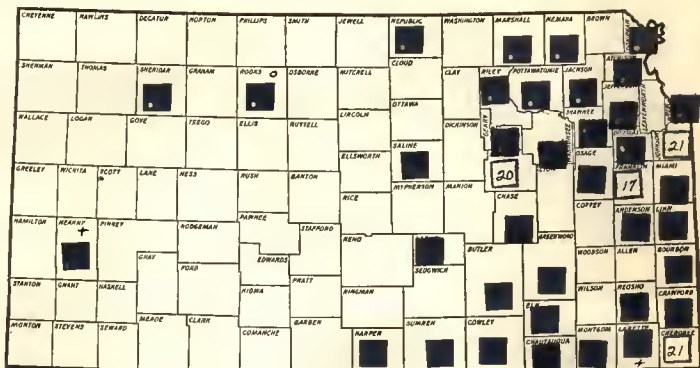
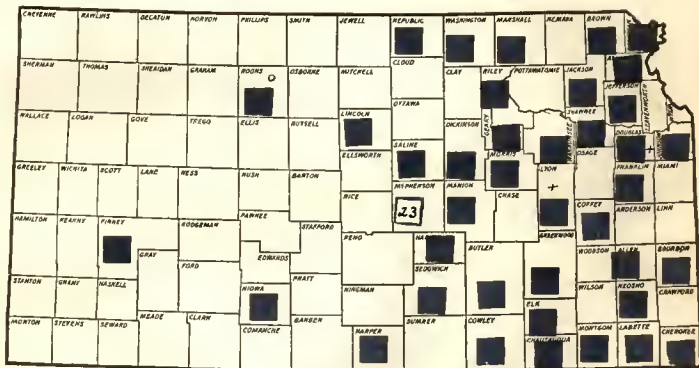
Map No. 16. - Distribution of *Gilia calcarea*.Map No. 17. - Distribution of *Gilia inconspicua*.

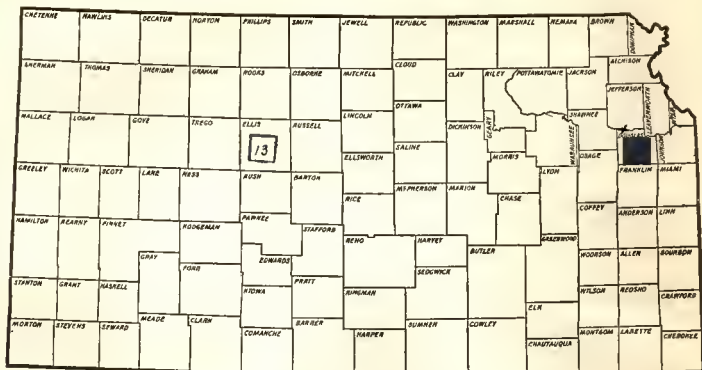
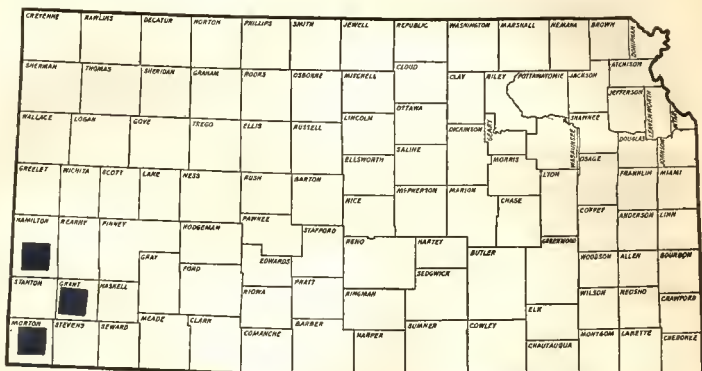
Map No. 18.- Distribution of *Gilia aggregata*.Map No. 19. - Distribution of *Gilia laxiflora*.

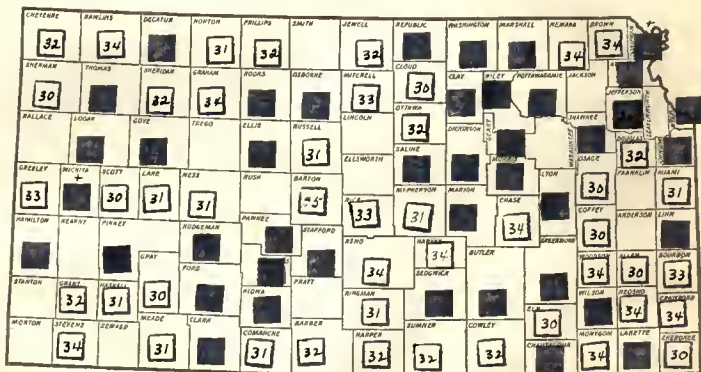
Map No. 20. - Distribution of *Polemonium reptans*.Map No. 21. - Distribution of *Evolvulus Nuttallianus*.

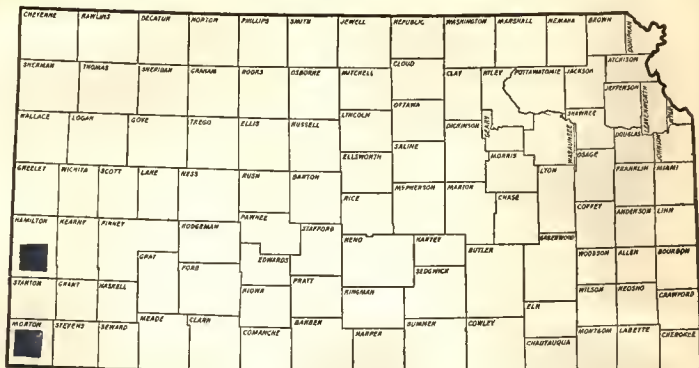
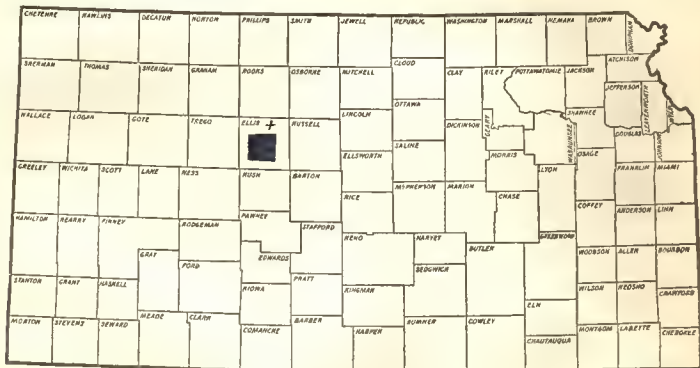


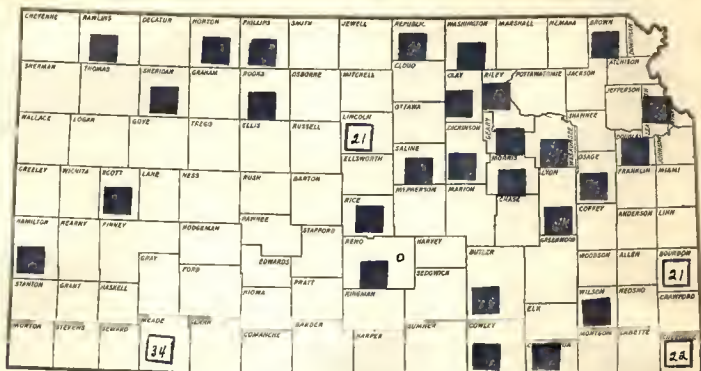
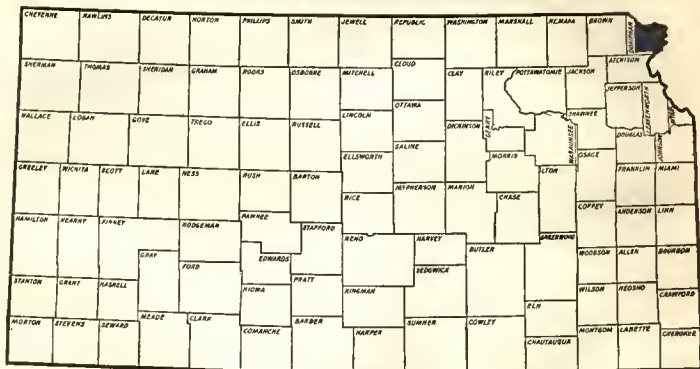
Map No. 24. - Distribution of *Ipomoea lacunosa*.Map No. 25. - Distribution of *Ipomoea trichocarpa*.

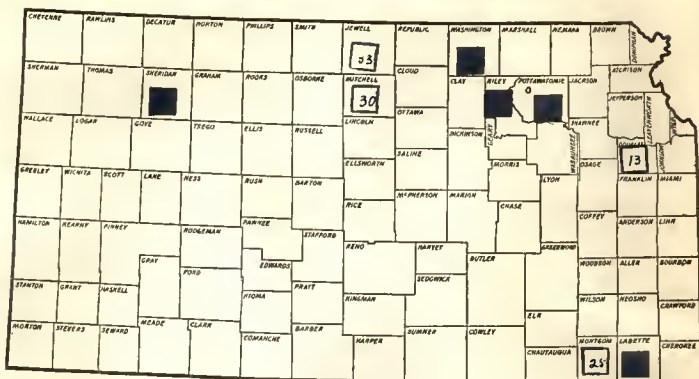
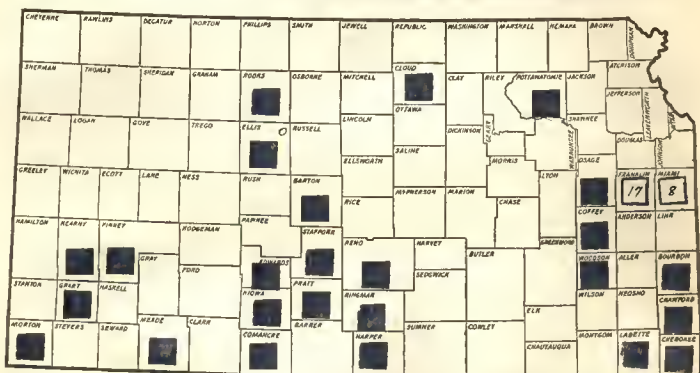
Map No. 26. - Distribution of *Ipomoea hederacea*.Map No. 27. - Distribution of *Ipomoea purpurea*.

Map No. 28. - Distribution of *Convolvulus Spithameus*.Map No. 29. - Distribution of *Convolvulus incanus*.

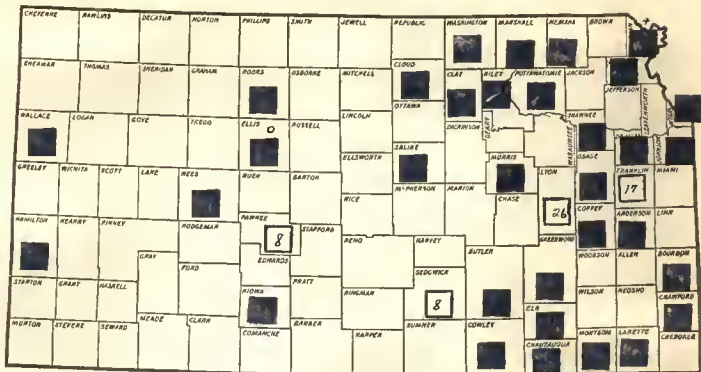


Map No. 30. - Distribution of *Convolvulus hermannioides*.Map No. 31. - Distribution of *Convolvulus ambigens*.

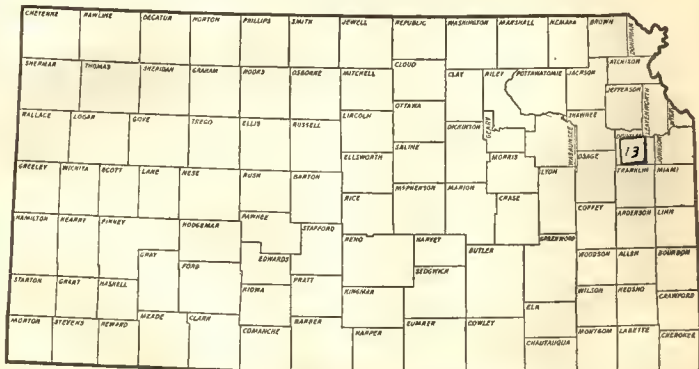
Map No. 34. - Distribution of *Convolvulus repens*.Map No. 35. - Distribution of *Quamoclit vulgaris*.

Map No. 36. - Distribution of *Quamoclit coccinea*.Map No. 37. - Distribution of *Cuscuta cuspidata*.

Map No. 38. - Distribution of *Cuscuta glomerata*.



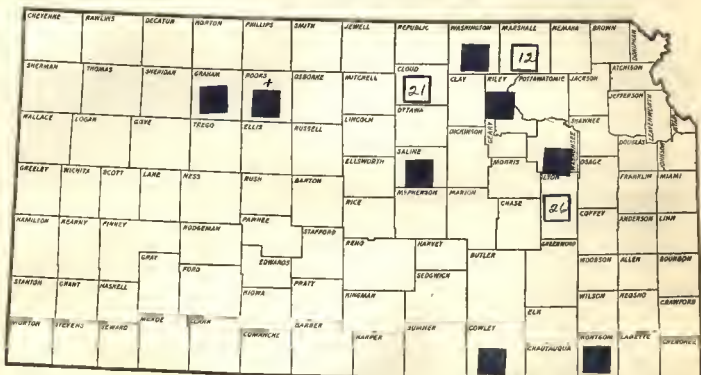
Map No. 39. - Distribution of *Cuscuta compacta*.

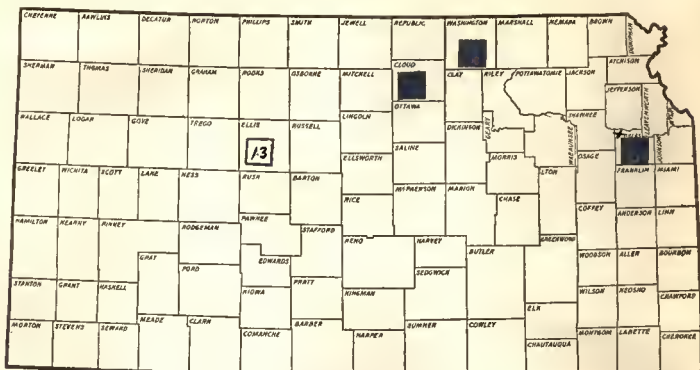


Map No. 40. - Distribution of *Cuscuta obtusiflora*.



Map No. 41. - Distribution of *Cuscuta pentagona*.

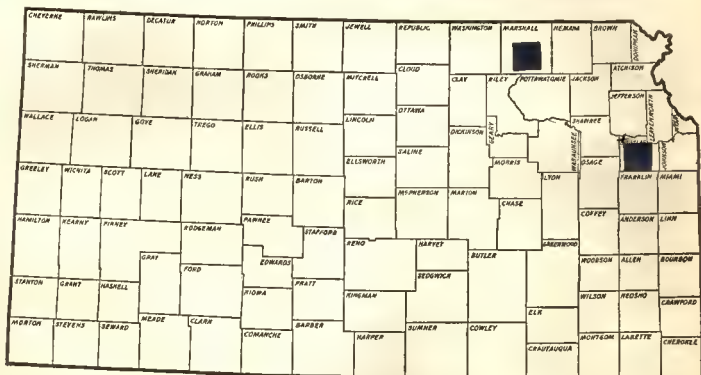


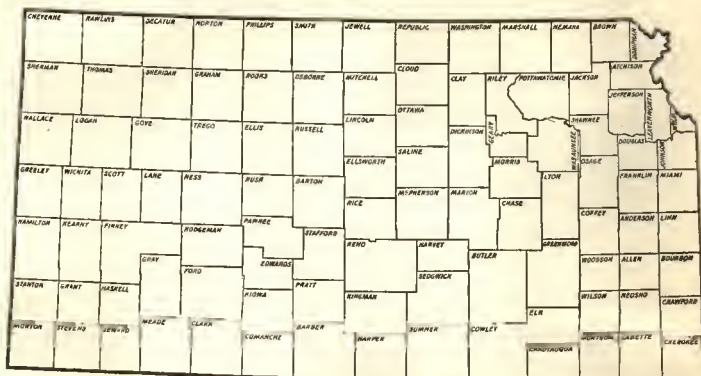
Map No. 42. - Distribution of *Cuscuta tenuiflora*.Map No. 43. - Distribution of *Cuscuta inflexa*.

Map No. 44. - Distribution of *Cuscuta pulcherrima*.

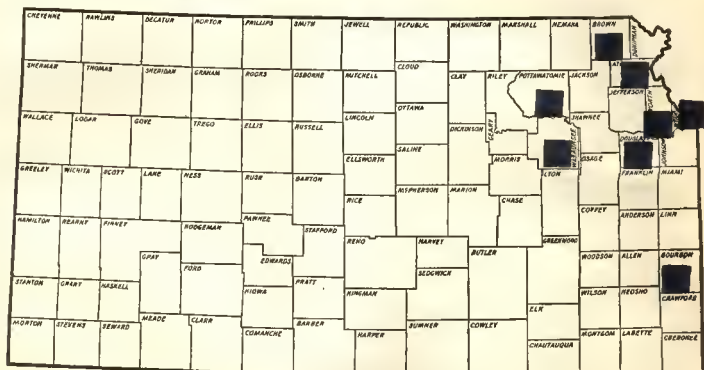


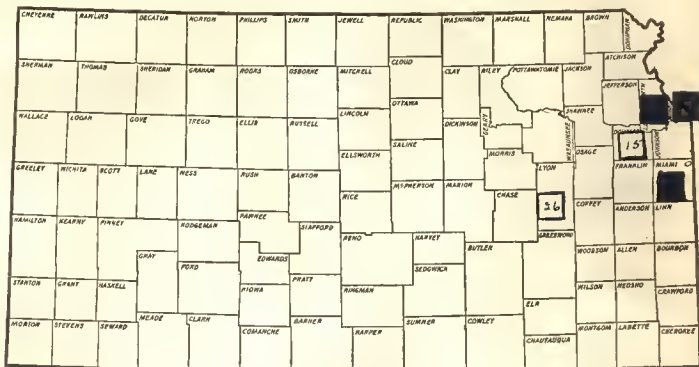
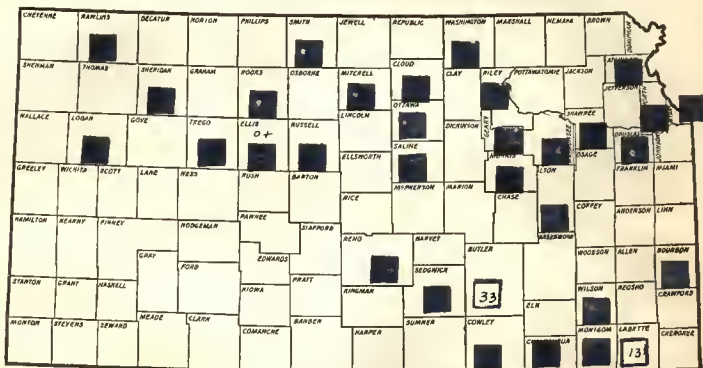
Map No. 45. - Distribution of *Cuscuta vulgivaga*.

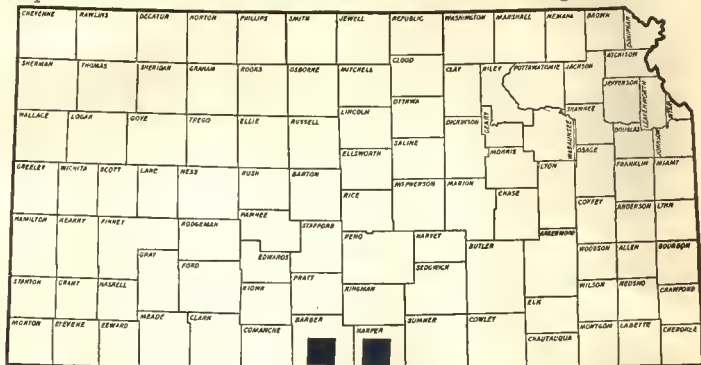
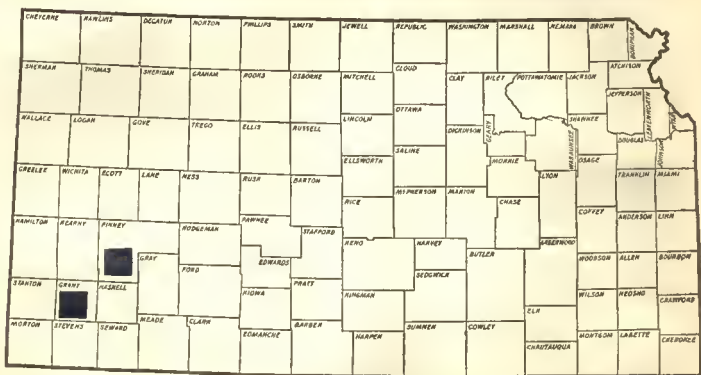


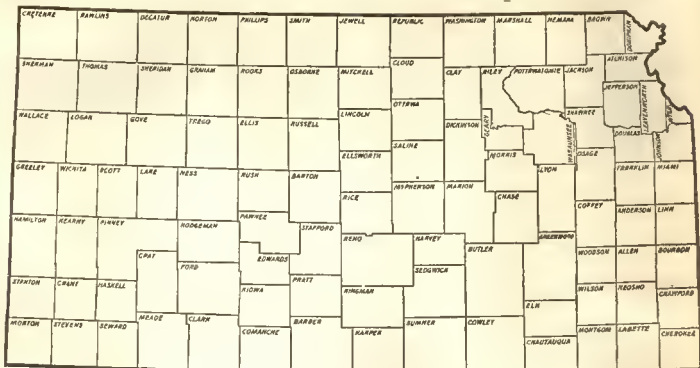
Map No. 46. - Distribution of *Cuscuta curta*.

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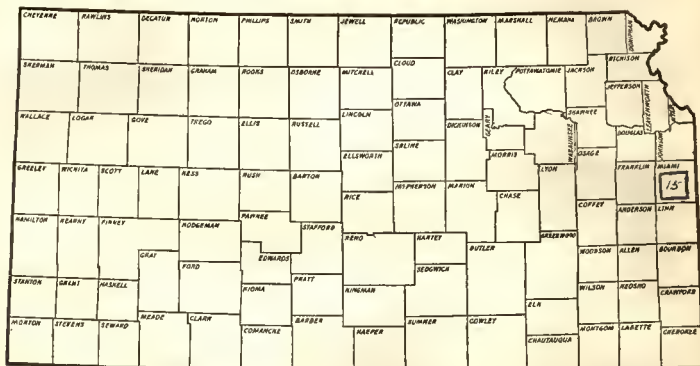
Map No. 47. - Distribution of *Hydrophyllum virginianum*.

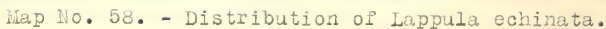
Map No. 48. - Distribution of *Hydrophyllum appendiculatum*.Map No. 49. - Distribution of *Ellisia nyctelea*.

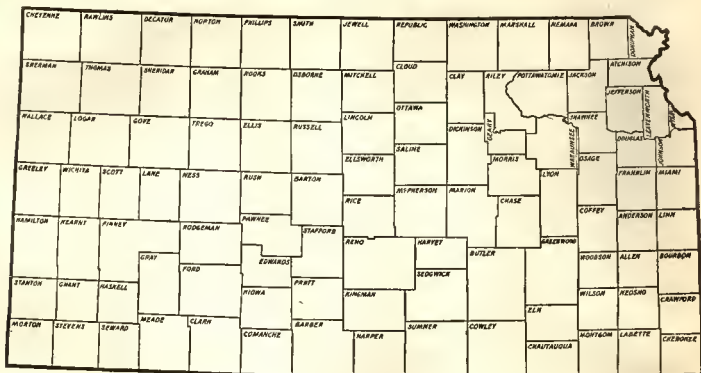
Map No. 52. - Distribution of *Phacelia integrifolia*.Map No. 53. - Distribution of *Heliotropium spathulatum*.

Map No. 56. - Distribution of *Heliotropium indicum*.

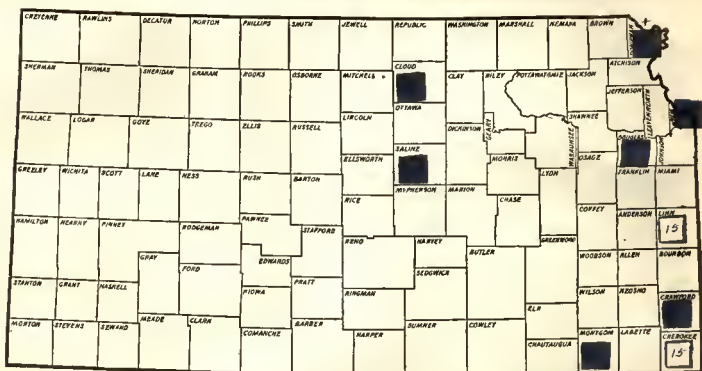
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Map No. 57. - Distribution of *Mertensia virginica*.

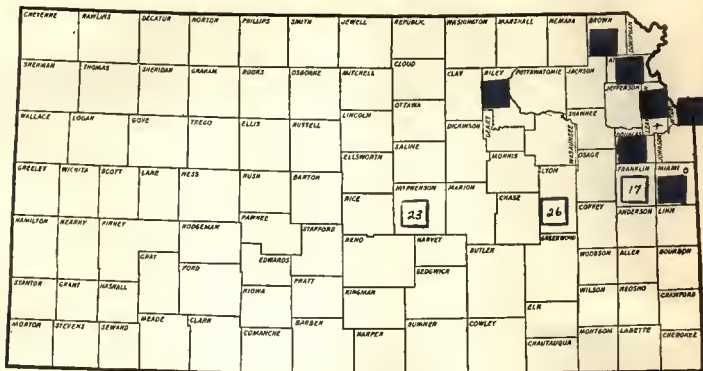


Map No. 62. - Distribution of *Cynoglossum virginianum*.

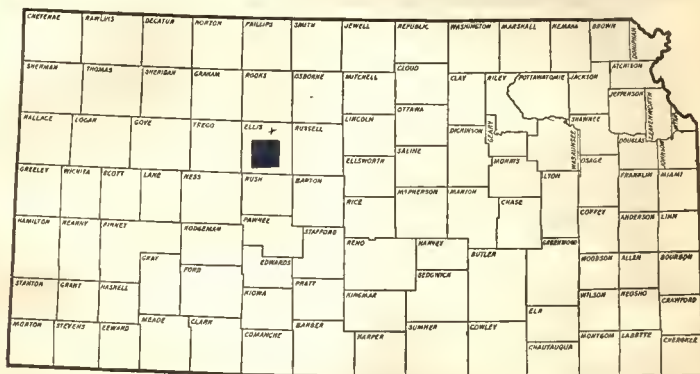
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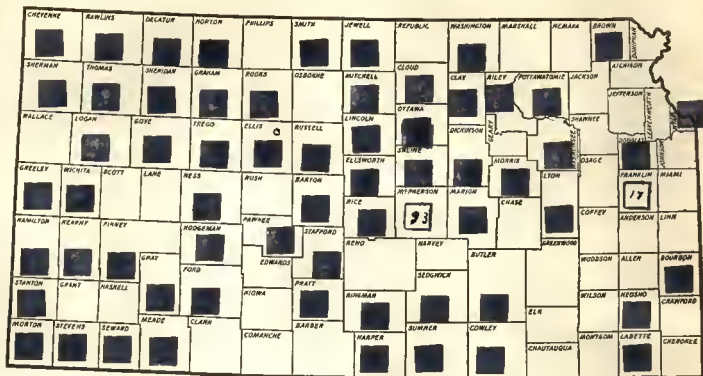
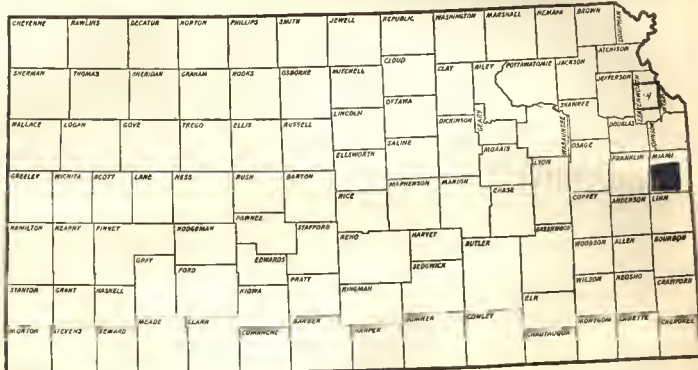
Map No. 63. - Distribution of *Lithospermum arvense*.

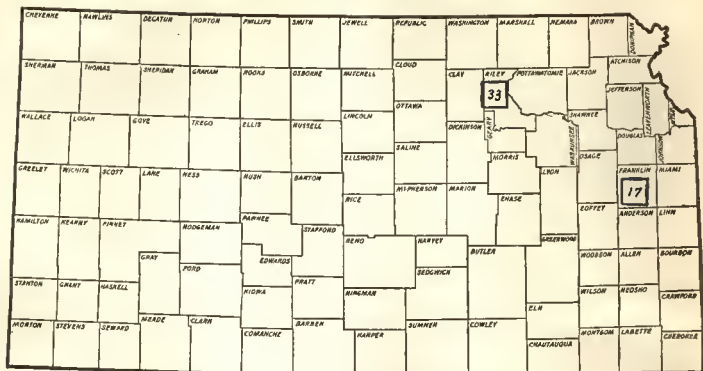
Map No. 64. - Distribution of *Lithospermum canescens*.



Map No. 65. - Distribution of *Lithospermum mandanense*.



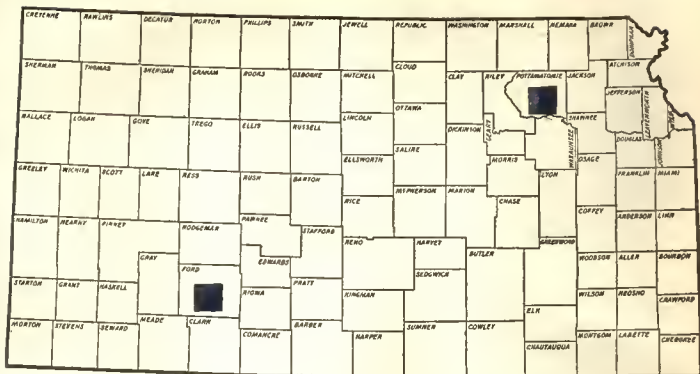
Map No. 66. - Distribution of *Lithospermum linearifolium*.Map No. 67. - Distribution of *Lithospermum latifolium*.

Map No. 68. - Distribution of *Lithospermum officinale*.

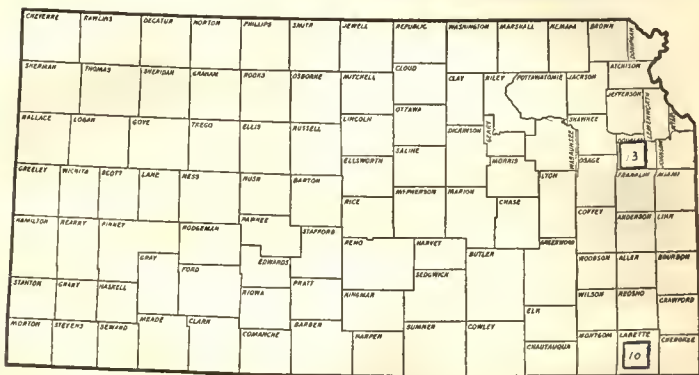
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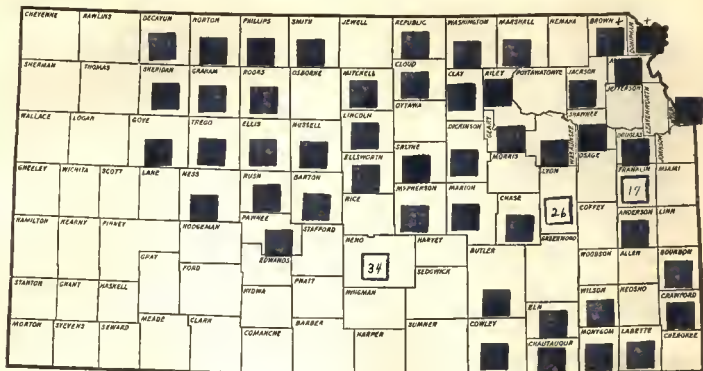
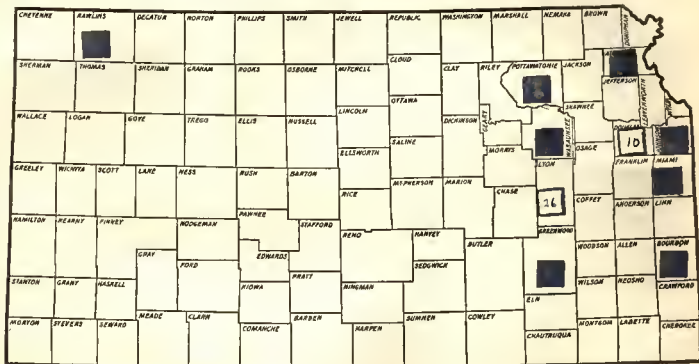
Map No. 69. - Distribution of *Lithospermum Gmelini*.

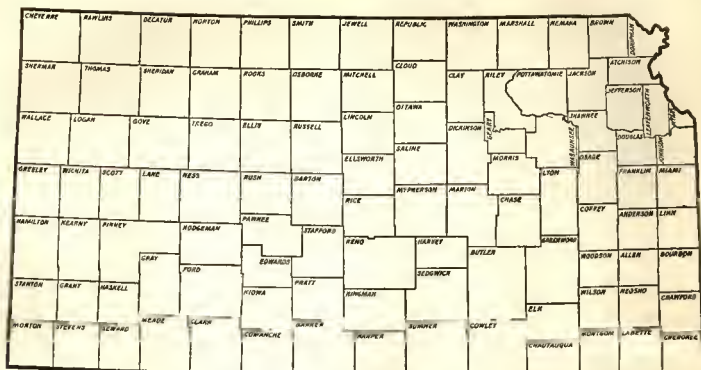
Map No. 70. - Distribution of *Echium vulgare*.



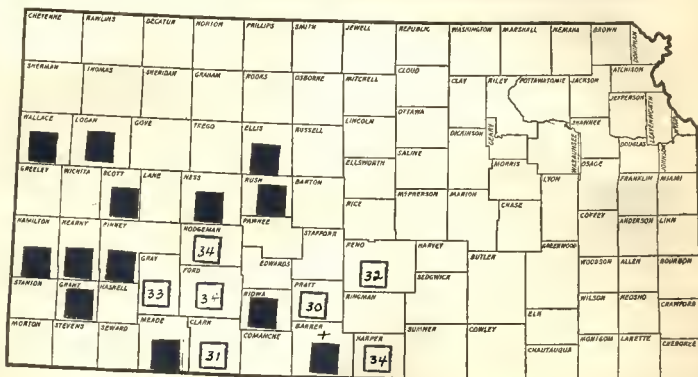
Map No. 71. - Distribution of *Onosmodium molle*.

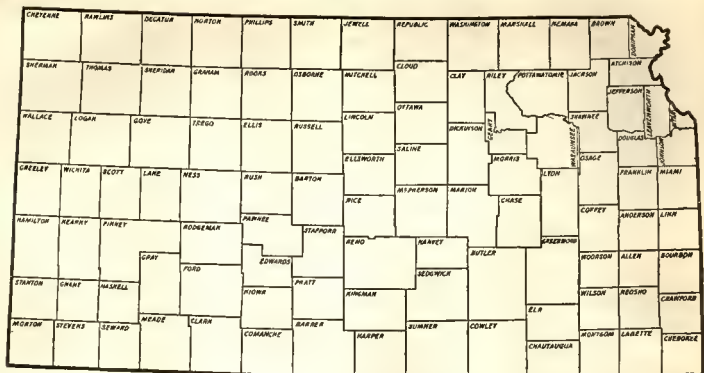


Map No. 72. - Distribution of *Onosmodium occidentale*.Map No. 73. - Distribution of *Onosmodium hispidissimum*.

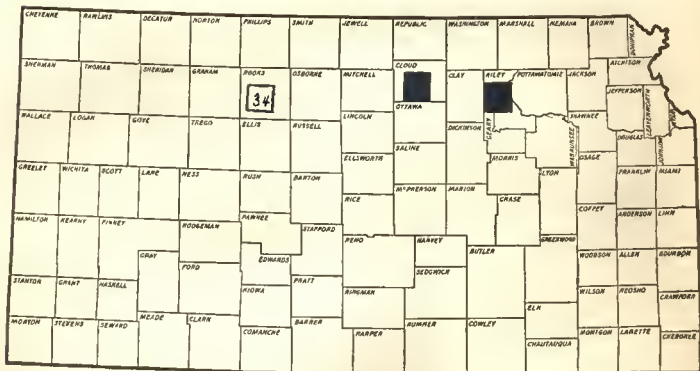
Map No. 80. - Distribution of *Chamaesaracha Coronopus*.

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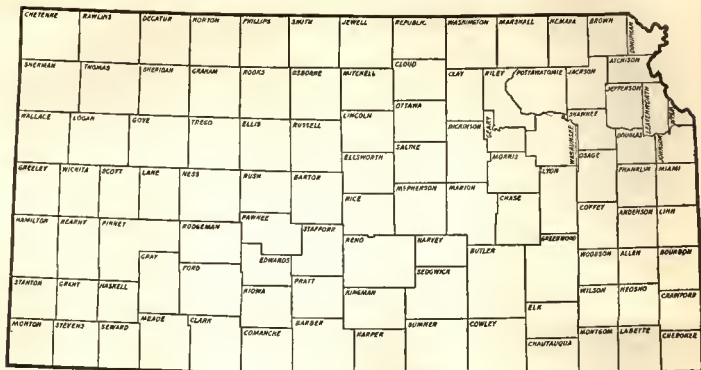
Map No. 81. - Distribution of *Quincula lobata*.

Map No. 82. - Distribution of *Solanum citrullifolium*.

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Map No. 83. - Distribution of *Solanum dulcamara*.

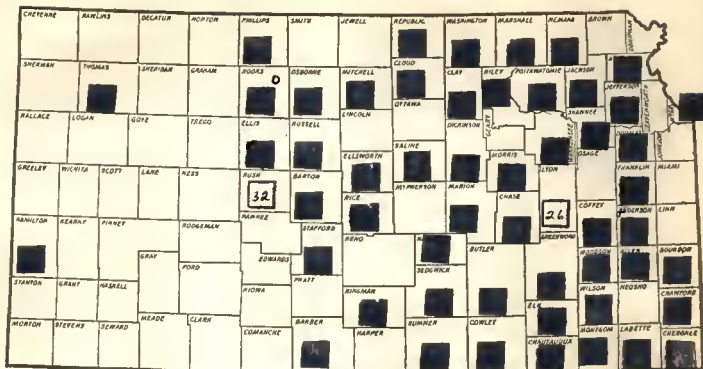
Map No. 84. - Distribution of *Solanum triquetrum*.



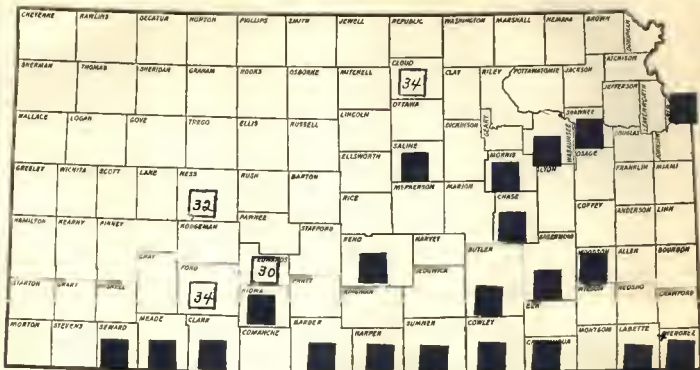
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Map No. 85. - Distribution of *Solanum triflorum*.

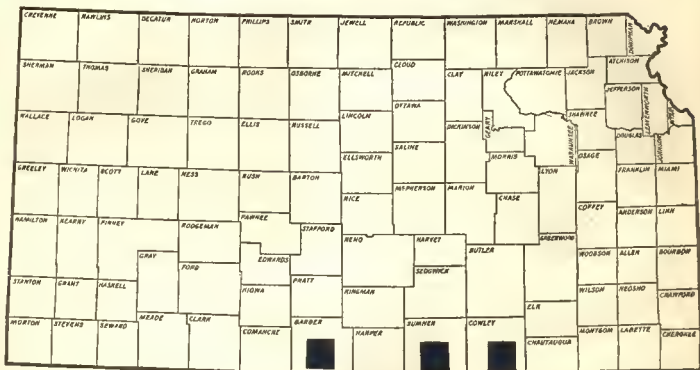


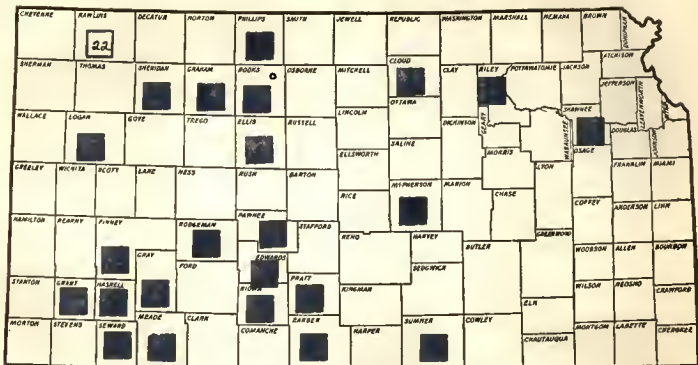
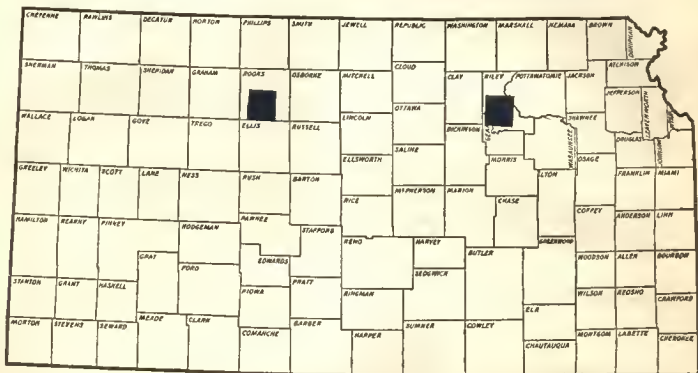
Map No. 86. - Distribution of *Solanum nigrum*.Map No. 87. - Distribution of *Solanum interius*.

Map No. 88. - Distribution of *Solanum elaeagnifolium*.

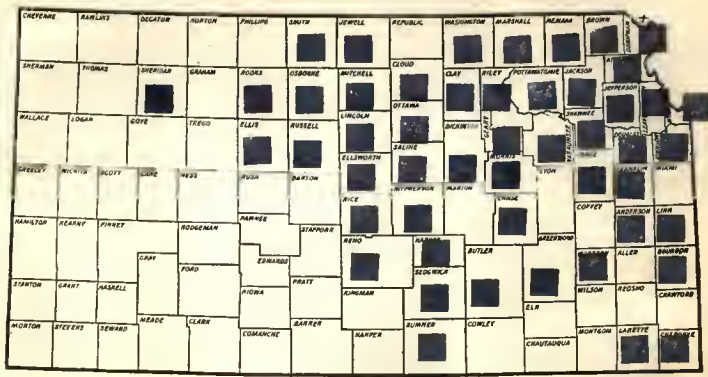


Map No. 89. - Distribution of *Solanum Torreyi*.

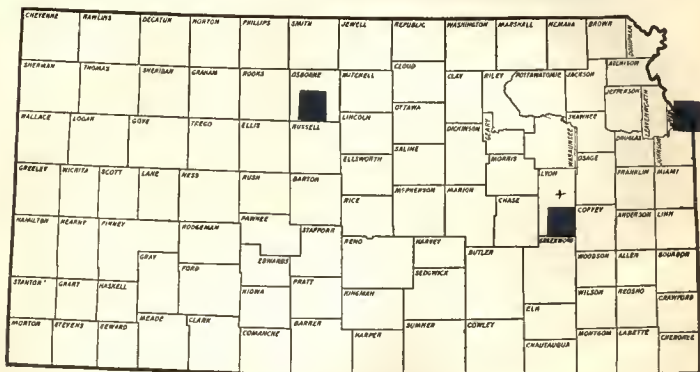


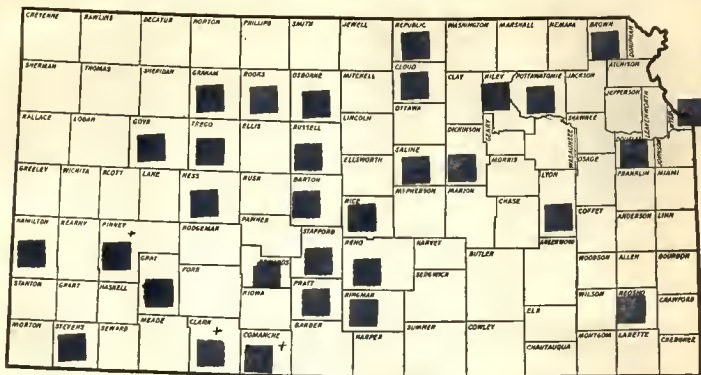
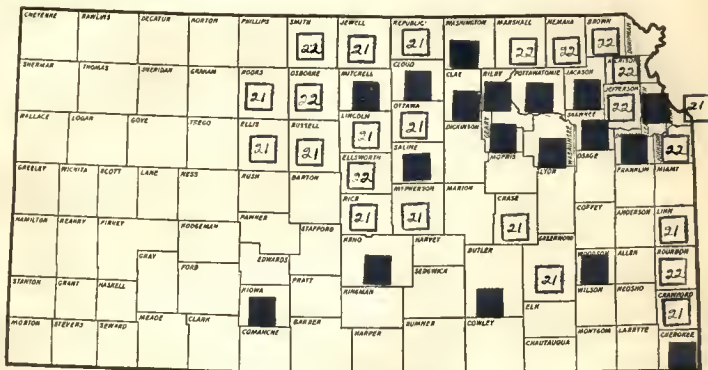
Map No. 92. - Distribution of *Physalis rotundata*.Map No. 93. - Distribution of *Physalis comata*.

Map No. 94. - Distribution of *Physalis heterophylla*.

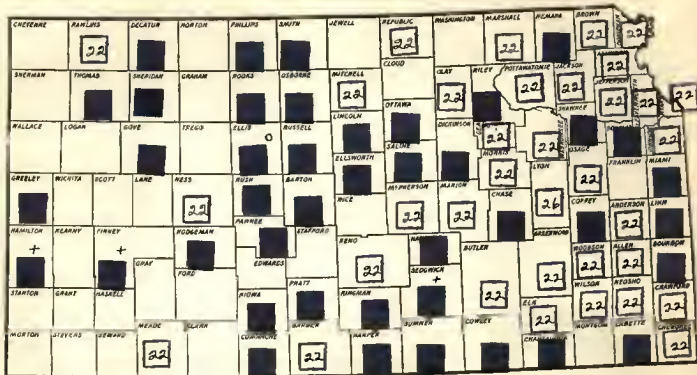
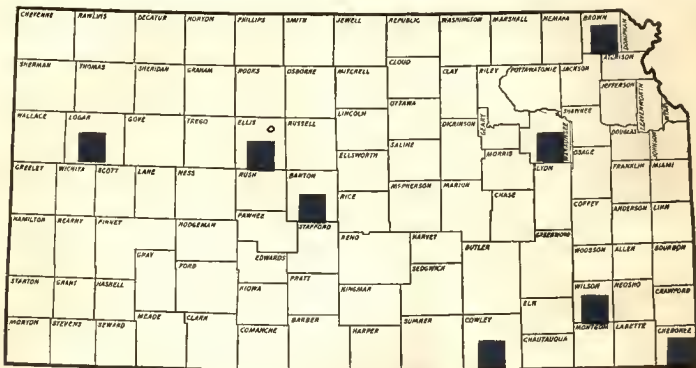


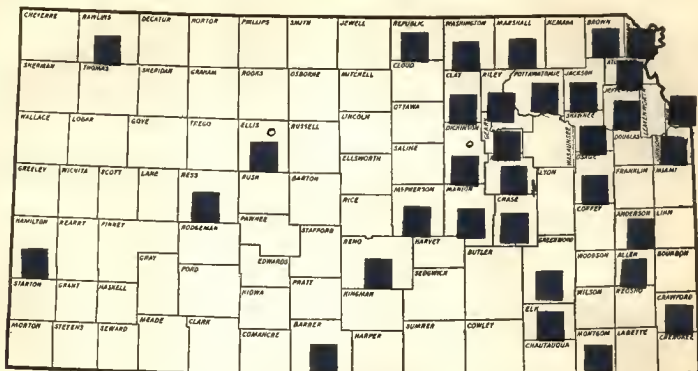
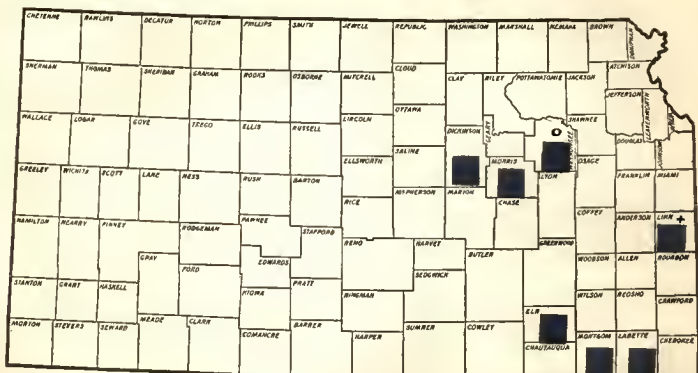
Map No. 95. - Distribution of *Physalis pruinosa*.

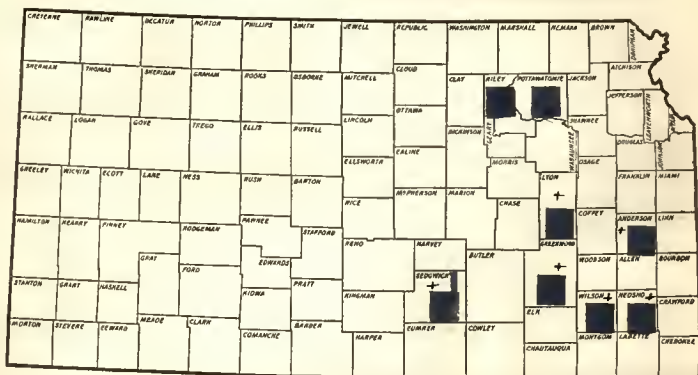


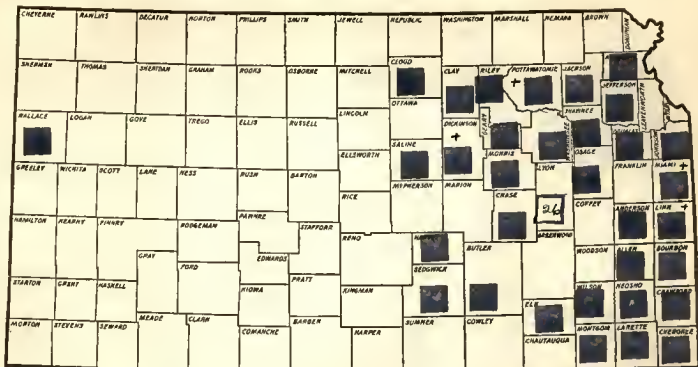
Map No. 98. - Distribution of *Physalis lanceolata*.Map No. 99. - Distribution of *Physalis virginiana*.

Map No. 100. - Distribution of *Physalis longifolia*.

Map No. 101. - Distribution of *Physalis macrophysa*.

Map No. 102. - Distribution of *Physalis subglabrata*.Map No. 103. - Distribution of *Physalis pendula*.

Map No. 104. - Distribution of *Physalis angulata*.Map No. 105. - Distribution of *Physalis ixocarpa*.

Map No. 106. - Distribution of *Physalis pumila*.Map No. 107. - Distribution of *Physalis mollis*.