

THE VEGETATION OF LIMESTONE LEDGES OF SOUTHERN ILLINOIS

JAMES E. OZMENT

Southern Illinois University, Carbondale

ABSTRACT.—A study of the plants of limestone outcroppings in southern Illinois was initiated in April, 1962, and continued through November of the following year. During this period collections were obtained from fifteen stations in six counties.

A total of 552 species of plants was recorded. Six of these were previously unknown from Illinois. These are *Panicum helleri* Nash, *Panicum longifolium* Scribn., *Panicum malacophyllum* Nash, *Panicum nitidum* Lam., *Euphorbia dictyosperma* Fisch. & Mey., and *Aster texanus* Burgess. In addition, 153 county records were obtained. Fifty-seven species constituted new records for Monroe County, forty-five for Hardin County, sixteen for Johnson County, fifteen for Union County, and ten each for Jackson and Randolph Counties.

I.

INTRODUCTION

The floristics and ecology of the sandstone areas in southern Illinois have been extensively studied and are quite well known; several publications have dealt with these subjects (Winterringer and Vestal, 1956; Mohlenbrock, 1954; and others). Although southern Illinois is one of the only parts of the state in which abundant limestone outcroppings occur, no comparable amount of study has been applied to the limestone areas as such. Aside from a few relatively accessible outcrops such as those in the Grand Tower area in

Jackson County, the Pine Hills of Jackson and Union Counties, and the hill prairies studied by Evers (1955), most have been subjected to little more than incidental collecting. The study described in this paper was undertaken in the desire to add to the available information about these areas. The objects included: (1) Compilation of an annotated list of vascular plants occurring on limestone at selected stations in southern Illinois; relatively undisturbed sites with natural vegetation were considered desirable for this purpose. (2) Comparison of the limestone floras of different areas in southern Illinois with each other and with the sandstone floras. (3) Description of the plant communities associated with limestone in the various areas.

In connection with these objects, brief descriptions of the topography, geology, animal communities, and general ecology of the southern Illinois limestone areas in general and of each station in particular were considered desirable.

Field work for this project was begun during the fall of 1961. At this time a search for suitable limestone outcroppings was conducted throughout the likely areas in the southern part of the state. Worthen (1882),

Lamar (1925; 1959), and Weller (1945) proved useful in locating the various outcrops. Further scouting was carried on during the winter of 1961-62; at this time, also, all the southern Illinois specimens in the Southern Illinois University Herbarium were examined. All those which the label indicated to have been collected definitely in association with limestone outcroppings were noted and recorded. Stations suitable for concentrated study were eventually selected. These included three areas of outcroppings in Monroe County, two in Jackson, two in Union, two in Johnson, and one in Hardin County. Systematic collecting was begun in the spring of 1962 and was continued through the summer and fall of that year. An attempt was made to visit and collect thoroughly each permanent station at least once in every three weeks. In addition, various outcroppings of lesser extent or interest were visited when convenient. Those from which specimens were collected are described here. Some additional collections were made at irregular intervals during the spring and summer of 1963. Generally only one specimen of each plant was collected, this from the station where it was first seen; wherever the plant could be unquestionably identified by sight, its presence at other localities was recorded in the field notebook. A few species, mostly common trees, were not collected from any station, although their presence was recorded; these are indicated in the annotated list of species. Specimens were pressed upon collection or soon thereafter. Identification of difficult specimens was

carried out for the most part during the winter of 1962-63 and was based on the dried material.

After being identified and recorded, specimens were deposited in the herbarium of Southern Illinois University.

II.

GENERAL LIMESTONE GEOLOGY OF THE AREA

Parts of Illinois in which limestone outcroppings occur are of limited extent as compared to the total area of the state. All the important limestone formations are relatively old, of Mississippian or greater age, and are overlain by the predominantly sandstone Pennsylvanian deposits throughout most of the state. In the north, the Pennsylvanian deposits have been removed by glacial erosion, but any older formations have been subsequently deeply buried beneath glacial drift. It is only along the western and southern edges of the state that extensive limestone outcroppings occur. Their presence here is due to a general upwarping along these borders which has allowed erosion to expose the older strata.

In general the southern Illinois outcroppings may be characterized as consisting of a more or less continuous series of massive bluffs bordering the Mississippi River floodplain on the west and facing similar bluffs on the Missouri side of the river, a discontinuous series of generally lower bluffs, often capped by sandstone, along the Ohio River in Pope and Hardin Counties to the southeast, and groups of low isolated out-

crops which occur across the state in a zone immediately south of the great block of Pennsylvanian sandstone which forms the backbone of the Shawnee Hills. None of these areas was glaciated. The common soil on the uplands is a yellowish or brownish silty loess of varying depth.

The important limestones in Illinois range in age from Mississippian to Ordovician. The Mississippian formations are much the most common and widespread in southern Illinois. During the eras of limestone deposition, several predominantly limestone formations of various character were built up, often alternating with formations in which shale or sandstone predominates. The following is a resume of the limestone formations which outcrop at the stations visited during this study; the listing is in order of increasing age, thus indicating relative position. Dotted lines indicate omissions from the total sequence of Illinois formations. The descriptions refer only to southern Illinois characters and range.

Mississippian System:

Golconda Formation—gray granular or oolitic limestones, mixed with shale, occurring from northwestern Union County in a narrow band extending to the Ohio River in Pope and Hardin Counties.

Renault Formation—gray or dark gray limestones, some oolitic and intermixed with shale. Cherty limestones occur in places. Underlies a band extending across the state from Pope and Hardin Counties to Union County and north along the Mississippi.

St. Genevieve Formation—light or dark compact limestones of high purity. Some may be cherty or oolitic. May be mixed with sandstone. Pattern of distribution gen-

erally the same as for the preceding, but outcrops only at the eastern and western sides of the state.

St. Louis Limestone—gray or dark gray compact, fine-grained limestones, cherty in places. Pattern of distribution as for the preceding.

Warsaw-Salem Limestone—light to dark, finely to coarsely granular, pure limestones with a pattern of distribution similar to the preceding.

Devonian System:

Hamilton Formation—dark, fine-grained, cherty, and siliceous limestone. Outcrops in Union and Alexander Counties and near Grand Tower in Jackson County.

Grand Tower Limestone—coarsely granular very pure limestone outcropping as in the preceding.

Clear Creek Formation—cherty and siliceous, fine-grained limestones intermixed with chert; in Union and Alexander Counties and at the south end of the Devil's Backbone in Jackson County.

Bailey Limestone—fine-grained, siliceous limestone with some chert; in Union and Alexander Counties.

Ordovician System:

Kimmswick-Plattin Formation—light-colored, crystalline, and very pure in the upper member; dark and fine-grained below; outcrops at Thebes in Alexander County and at Valmeyer in Monroe County.

III.

SELECTED STATIONS AND THEIR PLANT COMMUNITIES

In order to simplify discussion and analysis, those outcroppings which are located close to one another and which are generally ecologically similar have been grouped here. These naturally fall into the following five major groupings:

Group I—Mississippi River bluffs in Monroe and Randolph Counties.

Group II—Devil's Bake Oven and Devil's Backbone, on the Mississippi River near Grand Tower in Jackson County.

Group III—Massive bluffs at the eastern edge of the Mississippi floodplain in southern Jackson County and parts of Union County.

Group IV—Isolated interior bluffs in Johnson County.

Group V—Ohio River bluffs and interior outcroppings in Hardin County.

In the discussion which follows, the general characteristics of the outcroppings in each major group are given and the plant communities are discussed. Descriptions of individual stations follow the general discussion. Each station is given an abbreviation used to indicate locality records in the annotated list of vascular plants.

GROUP I—MONROE-RANDOLPH COUNTY BLUFFS

GENERAL DISCUSSION

The limestone bluffs in Monroe and Randolph Counties run north and south in a more or less continuous chain along the eastern side of the broad Mississippi floodplain, here commonly referred to as the American Bottoms. For the greater part of their extent, a narrow bluff road runs along the edge of the floodplain parallel to their base, separating them from the cultivated fields to the west. The wooded talus slope extends down to the edge of the road along many of the bluffs; in some places the road veers westward onto the floodplain. Above the talus slope a rock face, usually of St. Louis or Salem limestone, is exposed to a varying extent. The rock cliff is topped by heavy deposits of loess consisting of a buff-colored sandy loam; the hill prairie community occurs on the slope of this loess and on the rock ledges exposed there. The prairies are found mostly on the southern and western slopes; they do not occur on all the bluffs. In general they are most prevalent from Valmeyer, Monroe County, south to Prairie du Rocher, Randolph County. They vary greatly in condition, chiefly in proportion to the amount of grazing

to which they have been subjected. Upland woods occur above the prairies and on the hills east of the bluffs. These may extend down to the rock face, particularly at the north ends of the bluffs, or may replace the prairie over the entire bluff top. Individual bluffs are mostly one to two miles long, and 100 to 300 feet above the floodplain at their high points; some form continuous escarpments two or three miles long. Typically they terminate in narrow wooded valleys which are succeeded by other ridges. Surface streams are rare, except in these valleys during the wetter part of the year. The bluffs are regularly indented by shallow runoff channels which are dry save immediately following a rain. Where the bluffs are not shielded by trees, they are generally exposed to severely xeric conditions during the growing season. The sun strikes the bluff face directly during the better part of the day, producing intense heat. Winds, which are prevailing from the west here, sweep across the broad American Bottoms, two to four miles wide, and overtop the bluffs with considerable velocity, exerting a corresponding drying force. These conditions are probably largely responsible for the maintenance of extensive prairie areas here, over 200 miles south of the major prairie region of Illinois. No hill prairies comparable in size and diversity of species occur to the south in Illinois. Several species, both plants and animals, are restricted in Illinois to these bluffs; most of these are prairie or Ozarkian forms. Several other species reach the northern or southern limit of their Illinois range here. These bluffs were included in the Mississippi Border Division of Vestal's vegetational division of Illinois (1931). Physiographically they are part of the Salem Plateau Section of Leighton, Ekblaw, and Horberg (1948). Evers (1955) provides a more complete description, with climatological data and quantitative ecological data for the hill prairies.

PLANT COMMUNITIES

Definite communities are recognized more easily on these outcrops than on those discussed subsequently, probably because of the distinct zonation between prairie and forest types occurring here. These may be described as follows:

Mesic slope and ledge community.
This type occurs frequently on the

slopes at either end of the bluffs, or below the rock face wherever conditions are suitable to support good stands of the predominant trees, chiefly *Acer saccharum* and, to a lesser extent, *Quercus muhlenbergii*. Flowering herbs are conspicuous here only during the early spring, before the maples produce a dense shade. Characteristic plants of the rock ledges include *Aquilegia canadensis* and *Phacelia bipinnatifida*.

Talus slope community. This type is transitional between those of the rock face and of the mesic slopes. It differs from the latter chiefly in being exposed to drier conditions and in its more varied tree composition. Characteristic trees include *Quercus muhlenbergii*, *Bumelia lanuginosa*, *Cercis canadensis*, *Gymnocladus dioica*, and *Gleditsia triacanthos*. *Cornus drummondii* is abundant, as are many vines, especially *Cocculus carolinus*. Some conspicuous herbs include *Delphinium tricornis*, *Phacelia purshii*, *Tradescantia subaspera*, and *Polymnia canadensis*.

Rock face community. Several trees and shrubs grow in crevices in the bare rock face where they are exposed to extremely xeric conditions. These include most of the ones occurring in the preceding community; others are *Juniperus virginiana*, *Ptelea trifoliata*, and *Fraxinus quadrangulata*. A few herbs, among them *Pellaea atropurpurea*, *Muhlenbergia cuspidata*, *Mentzelia oligosperma*, *Phlox bifida*, and *Solidago drummondii*, seem to be largely restricted to the bare rock.

Ledge top and exposed soil community. Wherever rock ledges come to the surface on top of the bluff, they are characteristically accompanied by a level zone of bare soil of slight depth. Such a zone, varying in width from a few inches to one or two yards, is particularly evident between the edge of the bluff and adjoining hill prairies. Liverworts and lichens are abundant; a conspicuous fruticose lichen was identified by Mr. A. C. Skorepa as *Cladonia cariosa*. Several small annual herbs, some of them weedy, as well as a few perennials, are restricted largely to this zone at the stations examined. Among these are *Draba reptans*, *Hedeoma hispida*, *Androsace occidentalis*, *Galium virgatum*, *Euphorbia dictyosperma*, *Orobancha uniflora*, *Plantago virginica*, and *P. aristata*, all of which bloom early in the season and soon wither. Some of the species in evidence throughout most of the season are *Al-*

lium stellatum, *Aster patens*, *Rudbeckia missouriensis*, *Heliotropium tenellum*, *Coreopsis lanceolata*, and *C. palmata*.

Hill prairie community. This community occurs on the loess slopes above the edge of the bluff, where it may be present as a rather narrow band of a few yards width, or may cover several acres. It is typically best developed on the southwestern slopes of the loess on the highest bluffs. The grasses dominate, *Andropogon scoparius* being the most abundant species. *Andropogon gerardii*, *Sorghastrum nutans*, and *Bouteloua curtipendula* are also characteristic and abundant. Change in seasonal aspect is very marked in the prairies as various perennial herbs succeed one another in dominating the scene with their flowering. Among those species which may be sufficiently abundant and conspicuous to do so on the various bluffs are *Erigeron strigosus*, *Euphorbia corollata*, *Echinacea pallida*, *Psoralea tenuiflora*, and *Tephrosia virginiana* during the first half of the season, and various *Desmodium*, *Lespedeza*, *Aster*, and *Solidago* spp. toward its end.

Upland woods community. The upland woods community is part of the dry oak-hickory woodland found on the wooded hills of the area. Most of the tree species also occur in the slope and rock face communities. *Carya texana*, *Quercus muhlenbergii*, and other upland oaks and hickories are perhaps most characteristic. Herbs include *Veronicastrum virginicum*, *Galium circaezans*, *Aureolaria flava*, and *Helianthus hirsutus*. This community intergrades with talus slope or hill prairie at its lower border. *Celastrus scandens*, *Viburnum rufidulum*, and *Cornus drummondii* characteristically are found along this edge.

INDIVIDUAL STATIONS (LISTED FROM NORTH TO SOUTH)

1. **North Valmeyer (NVal).** This station consists of a small west-facing bluff approximately three miles north of Valmeyer, in Monroe County. The bluff, about 100 feet high, runs south for about one-half mile from a gravel road extending east across the line of bluffs. A small hill prairie, one of the northernmost seen in this stretch of bluffs, occurs on the western and southwestern slopes on top. An old cemetery, dominated by a large mausoleum of a Mills family, is centrally located at the eastern edge of the prairie. (Allen (1963))

relates the interesting and curious story of this family and describes the monument). At the time of the study, the northern one-third of the prairie had evidently been burned over early in the spring or during the preceding fall; the southern two-thirds was relatively undisturbed and apparently ungrazed. This was not considered a permanent station. It was visited three times during May and September, 1962. Species collected only here during this study include *Phacelia bipinnatifida*, *Comandra umbellata*, *Myosurus minimus*, and *Festuca octoflora*.

2. *Valmeyer (Val)*. The bluff at Valmeyer is the largest of those used for stations in Group I. It extends for two miles north from the town of Valmeyer and reaches heights of up to 250 feet above the floodplain. The cliff along its western side appears to be higher than any others along the Monroe-Randolph County series of bluffs. The bluff is composed chiefly of St. Louis and Kimmswick limestones. The Columbia Quarry Company operates a large quarry at the southern end of the bluff. This bluff is predominantly wooded. About one-third of the loess slope on top is covered by undisturbed prairie; most of this occurs at the northern end and in scattered patches in the center. The prairie at the southern end has been partially destroyed by quarrying operations. This was reckoned a permanent station and was visited nine times, during May, June, July, August, September, and October, 1962, and during April, 1963. Plants collected only at this station include *Stipa spartea*, *Carex eburnea*, *Salix humilis*, *Aster texanus*, and *Aster dumosus*.

3. *South Valmeyer (SVal)*. This bluff is the same as that described by Evers (1955) as the site of his Valmeyer hill prairie. Its north end is about three miles south of Valmeyer. The length is about one mile, and the maximum height is approximately 200 feet above the floodplain. Its structure is similar to that of most of the other Monroe County bluffs. The limestones exposed are of the St. Louis and Salem formations. Prairie, ungrazed to all appearances, occupies about one-half the area of the brow slope, chiefly at the southern end of the bluff. This was the second permanent station. It was visited eight times, during May, June, July, August, September, and October of 1962, and April of 1963. Species collected only at this station include *Muh-*

lenbergia asperifolia, *Cyperus ovularis*, *Rhamnus lanceolatus*, and *Penstemon deamii*.

4. *Fults (F)*. This station is rather similar to the South Valmeyer station (number 3). It also was the site of one of Evers' stations, which he designated as the Fults hill prairie. The north end of it is one mile south of the village of Fults and the total length is about one mile. The top of the bluff is about 300 feet above the floodplain, which is approximately three and one-half miles wide here. It is chiefly composed of Salem and St. Louis limestones. The bluffs on the Missouri side of the river are four to five miles distant. This station is perhaps the most interesting floristically of any collected during the course of the present study. The general condition of the hill prairie here is unusually good; no evidences of grazing are apparent. Almost the entire loess slope supports at least a narrow zone of prairie. This constitutes the largest area of prairie of such quality observed. Several plants rare elsewhere in Illinois occur in exceptional abundance here. These include *Galium virgatum*, *Heliotropium tenellum*, *Mentzelia oligosperma*, *Euphorbia dictyosperma*, and *Buchnera americana*. This was considered a permanent station, and was visited eleven times, during May, June, July, August, September, and October of 1962, and April, May, and June of 1963. Plants collected only at this station during the present study include *Panicum longifolium*, *Prunus angustifolia*, *Euphorbia dictyosperma*, *Ruellia strepens*, and *Lactuca ludoviciana*.

5. *Prairie du Rocher (PduR)*. From the town of Prairie du Rocher, Randolph County, a more or less unbroken cliff of limestone of the St. Louis formation extends northward for two to three miles, past the Monroe County line. Maximum height is about 300 feet. Two quarries are at present in operation in this stretch of bluff. The talus slope community is somewhat restricted in extent here, as the bluff road runs almost immediately beneath the cliff face in many places. The extent of hill prairie is relatively the same as at the stations to the north, but the prairie is of a much poorer quality and appears heavily overgrazed in places; it was at the time of writing being used as a pasture for burros. The Sampson and Phegley hill prairies, studied in detail by Evers (1955), are located on these

bluffs. Because of the relatively poor quality of the prairie and its disturbance by grazing animals, this series of bluffs was not used as a permanent station. It was visited four times, during November, 1961, and April, May, and August, 1962. Plants collected only at this station include *Panicum helleri*, *Cassia nictitans*, *Gentiana puberula*, *Asclepias amplexicaulis*, and *Physalis heterophylla*.

GROUP II—DEVIL'S BAKE OVEN AND DEVIL'S BACKBONE

GENERAL DISCUSSION

Group II consists of two small and rather dissimilar outcrops found immediately north of the town of Grand Tower in southwestern Jackson County. Unlike all the other western bluffs included in this study, they abut directly on the Mississippi River and are separated from the bluffs in Missouri by a distance of only about a mile. Apparently this close proximity has allowed certain plants which find the habitat suitable to cross the river and become established here. Those that are restricted to these outcrops in the immediate area probably have been unable to cross the floodplain to the east, which separates the Devil's Backbone from the Pine Hills bluffs of Group III by about four miles at this point. Probably such plants as *Androsace occidentalis* have been independently established here and on the Monroe County bluffs. These bluffs have been placed in the same vegetational and physiographic divisions as have those in Groups I and III. Ecologically these two outcrops differ considerably. The Backbone is predominantly wooded; the Bake Oven has been cleared mostly and is disturbed frequently by fishermen, picnickers, and sight-seers. Much of the top is covered by a bluegrass sod. Many collectors have visited these sites, and the flora of both is fairly well known. Because of their dissimilarities, the plant communities of each are described in the individual discussions.

INDIVIDUAL STATIONS

6. *Devil's Bake Oven (DBO)*. This rather unique outcrop consists of an easterly tilted block of Hamilton and Grand Tower limestones about one mile north of Grand Tower, in southwestern Jackson County. The strata descend

beneath the waters of the Mississippi River at the northwest corner of the Bake Oven. Along its western edge, a narrow sandbar separates it from the river. Although it is only about one-fourth acre in area, its flora includes several interesting species, and it is the sole southern Illinois or Illinois station for a few (e.g., *Panicum malacophyllum*). This outcrop, perhaps because of its ready accessibility, has been extensively collected in the past.

Communities. The small size of this outcropping makes delimitation of plant communities difficult, although plants of widely varying nature and ecological requirements are found here. A community of plants typical of sandbars and riverbanks occurs on the low ledges coated with sand on the western and northern sides; this includes *Leptochloa filiformis*, *Eragrostis hypnoides*, and *Amorpha fruticosa*. A rock ledge community of the type characteristic of the west-facing rock faces of the river bluffs occurs on the low cliff on the west side. *Solidago drummondii*, *Phlox bifida*, *Pellaea atropurpurea*, *Cheilanthes feei*, and *Juniperus virginiana* are all found here. The south end of the flattish top is the site of a weedy community, including *Bromus tectorum*, *Poa pratensis*, *Lespedeza stipulacea*, *Trifolium procumbens*, and *Torilis japonica*. The north end is overgrown by honeysuckle (*Lonicera japonica*) climbing in *Diospyros virginiana*, *Sassafras albidum*, and a variety of other trees, most rather small. Some plants characteristic of mesic slopes, such as *Aquilegia canadensis*, occur on the northern slope. This was one of the permanent stations, and was visited nine times, during April, May, June, July, August, September, October, and December, 1962. Plants collected only at this station include *Leptochloa filiformis*, *Paspalum laeve*, *Panicum anceps*, *Panicum malacophyllum*, *Acnida tamariscina*, *Lespedeza stipulacea*, and *Sedum triphyllum*.

7. *Devil's Backbone (DBB)*. This ridge of Hamilton, Grand Tower, and Clear Creek limestones extends southward from near the Devil's Bake Oven in Sect. 24, T 10 S, R 4 W, in Jackson County, for about one-half mile to the northern limits of the town of Grand Tower. Trees cover almost all the area of the ridge, which reaches a maximum height of 150 feet. The western slope in the past has been much disturbed by quarrying and roadwork activities; a

narrow roadway runs along the base on this side separating the bluff from the river. These disturbed areas have been heavily invaded by weedy plants. A mesic slope and ledge community occurs here, chiefly on the eastern and northern slopes; *Campanula americana*, *Aquilegia canadensis*, and *Acer saccharum* are characteristic plants. This community is differentiated rather poorly from that of the drier slopes and upland woods, where oaks and hickories are the predominant trees. Additional abundant plants are *Ostrya virginiana*, *Ulmus alata*, and *Lespedeza violacea*. *Solidago drummondii* and *Phlox bifida* occur on the exposed ledges. A relict lowland community, including *Populus deltoides* which occurs on top of the ridge, has been described in Mohlenbrock and Voigt (1959). This was considered a permanent station. Collections were made here over eight visits during April, May, June, July, August, September, and October of 1962. Species collected only on the Devil's Backbone during the present study include *Paspalum ciliatifolium* (var. *stramineum*), *Panicum nitidum* (var. *nitidum*), *Agri- monia parviflora*, *Lysimachia lanceolata*, and *Helianthus maximiliani*.

GROUP III—JACKSON-UNION COUNTY RIVER BLUFFS:

GENERAL DISCUSSION

From southern Jackson County south through most of Union and parts of Alexander Counties, a series of bluffs formed of Bailey limestone follows the eastern edge of the Mississippi floodplain. These may rise to heights of 200 to 300 feet above the floodplain in the Pine Hills area. Although these bluffs resemble physiographically those discussed under the Group I heading, and are likewise placed in the Salem Plateau Section by Leighton, *et al.* (1948), and the Mississippi Border Division of Vestal (1931), they differ in several important respects. The Bailey limestone is much more cherty than is typical of the St. Louis and Salem limestones predominating in the northern bluffs. The thick loess deposits are generally not found directly above the upper limestone ledges which are surmounted instead by slopes composed largely of cherty gravel. This is derived from the upper member of the Bailey formation, a chert formerly known as the Grassy

Knob chert. Except for several expanses of barren or near-barren rock, these bluffs are shaded by trees in most places. True hill prairies are few and of small extent. The floodplain at the base of the bluffs is usually heavily forested and often swampy. Most of this region has been extensively botanized; the flora is comparatively well known.

PLANT COMMUNITIES

The following communities may be recognized:

Mesic slope and ledge community. This type of community is particularly well developed here. Many herbs, including *Cystopteris fragilis*, *Adiantum pedatum*, *Boehmeria cylindrica*, *Laportea canadensis*, *Pilea pumila*, *Uniola latifolia*, and *Impatiens biflora* and *I. pallida*, as well as most of the common woodland spring wild flowers, can be found on the low, moist, shaded ledges near the bases of slopes and cliffs. Some of the characteristic woody plants are *Hydrangea arborescens*, *Ribes cynosbati*, *Staphylea trifolia*, *Tilia americana*, and *Acer saccharum*.

Talus slope community. The talus slopes offer fairly extensive dry, unshaded areas between scattered trees and shrubs. Many have been disturbed by road construction activities and afford suitable habitat for numerous weedy species. Vines are abundant. Characteristic plants include *Polygonum scandens*, *Arctium minus*, *Chenopodium hybridum*, *Euphorbia dentata*, *E. maculata*, *Menispermum canadense*, *Ampelopsis cordata*, and *Sicyos angulatus*.

Bare rock face and slope community. This community is generally very similar to the rock face communities described for Groups I and II. Additional notable plants include *Melica nitens*, *Physalis virginiana*, *Houstonia tenuifolia*, *Croton monanthogynus*, *Hedeoma pulegioides*, *Rhus aromatica*, and *Solidago radula*.

Hill prairie community. The hill prairie community occurring here also closely resembles that found on the Monroe-Randolph County bluffs, with the *Andropogons* and *Sorghastrum* the dominant plants. The total diversity of species is, however, much reduced. *Malus ioensis*, *Kuhnia eupatorioides*, and the white and purple *Petalostemums* occur. This community has been described in Mohlenbrock and Voigt (1959).

Upland woods community. Although

the upland woods community here is associated more typically with the cherty slopes above the limestone than with the limestone outcroppings proper, it may occur on either. The upland oaks and hickories are the most abundant trees. Some of the more unique species are *Pinus echinata*, *Vaccinium vacillans*, *V. arboreum*, *Rhododendron roseum*, *R. nudiflorum*, and *Stylosanthes biflora*.

INDIVIDUAL STATIONS

8. *Pine Hills (PH)*. Included here is a series of high bluffs of the Bailey formation almost nine miles in total length, extending southward from near the southern border of Jackson County to Wolf Lake, in northern Union County. A gravel road runs from the Big Muddy River levee southward along the base of the bluff for about three miles. The LaRue Swamp lies to the west. Collecting was concentrated at selected outcroppings along this bluff road, although the entire extent of the bluffs was investigated during the course of the study. The group of bluffs as a whole was considered a single permanent station; they were visited fifteen times, during April, May, June, July, August, September, and October of 1962. Among the many species collected here only are *Diarrhena americana*, *Bromus inermis*, *Polygonum longistylum*, *Chenopodium hybridum*, *Paronychia fastigiata*, *Prunus mexicana*, *Euphorbia heterophylla*, and *Aster turbinellus*.

9. *McClure (Mc)*. The McClure station, about $2\frac{3}{4}$ miles northeast of McClure, Alexander County, and directly north of Happy Hollow, Union County, included a $1\frac{1}{2}$ mile length of bluff of Bailey limestone. In many respects the area resembles that at Pine Hills. The bluff is, however, only 150 to 200 feet high at the maximum relief and is almost completely shaded. No true hill prairie is present. The area is on the whole more mesic than the Pine Hills, and this is reflected in the kinds of plants collected there. This permanent station was visited nine times, during April, May, June, July, September, and October of 1962, and April of 1963. Notable plants collected only at this station include *Panicum perlongum*, *Brachyelytrum erectum*, *Laportea canadensis*, *Desmodium viridiflorum*, *Collinsonia canadensis*, *Ruellia pedunculata*, and *Rudbeckia bicolor*.

GROUP IV—ISOLATED INTERIOR OUTCROPPINGS

GENERAL DISCUSSION

In the interior parts of southern Illinois, away from the major rivers, massive limestone bluffs are very few. Major rock outcroppings are limited to the rugged Shawnee Hills physiographic region, which is well known for its sandstone bluffs and characteristic sandstone vegetation. In the southern part of this region, south of the main Pennsylvanian shield, limestone outcroppings are widespread, but usually occur in barely exposed seams beneath overlying sandstone. Most often the exposure is on a south-facing slope above a stream valley. The distribution of outcrops is disjunct and very irregular; all are small in extent as compared to those along the rivers. In general, therefore, their vegetation would be expected to be less uniform than that of the river bluffs and more similar to that of adjoining sandstone areas. They lie in Vestal's Shawnee Hills vegetational division and in the Shawnee Hills physiographic section of Leighton, *et al.* (1948).

As it would have been impractical to study thoroughly all the limestone outcroppings available, this investigation was limited to two relatively accessible ones located in Johnson County and presumed to be characteristic. Although these were quite similar in most respects and only about five miles apart, they showed distinct individualities in their floras. A very few plants occurred at each which were found in no other study areas and which do not appear to be characteristic of the sandstone areas. Both of these stations include small rocky prairie slopes surrounded by woods. They both occur at the ends of east-west ridges north of stream valleys; one faces southeast, the other southwest. Both are capped by thin sandstone deposits. Only sandstone outcroppings are evident to the east and west of the extent, approximately one-fourth to one-half miles, of the limestone outcrop. The limestone here belongs to the Golconda formation.

PLANT COMMUNITIES

The following communities may be recognized:

Lower mesic slope community. *Quercus muhlenbergii*, various other oaks,

Acer saccharum, and *Celtis occidentalis* are characteristic, as is *Arundinaria gigantea*.

Prairie community. The prairie community is dominated by the *Andropogons*, *Sorghastrum*, and *Bouteloua*. Variations in seasonal aspect proceeding from the succession of flowering herbs is notable, as in the Mississippi bluff prairies. *Lithospermum canescens* is one of the first conspicuous herbs, coming into flower in late April. Plants which may subsequently dominate the aspect of these prairies include *Echinacea pallida*, *Zizia aurea*, *Silphium terebinthinaceum*, *Euphorbia corollata*, *Agave virginica*, *Kuhnia eupatorioides*, *Salvia pitcheri*, and *Physostegia virginiana*.

Dry ridge top woods community. *Quercus muhlenbergii* is probably the most abundant tree. Characteristic plants include *Galactia volubilis*, *Crataegus engelmannii*, *Smilax bona-nox*, *Polypodium polypodioides*, and *Cheilanthes lanosa*.

INDIVIDUAL STATIONS

10. *Scanlin Spur (SS)*. The name for this station was derived from the U. S. Geological Survey topographic map and refers to a settlement on the Chicago, Burlington, and Quincy Railroad about one and one-fourth miles to the west. The station is in Sect. 19, T 13 S, R 3 E, in Johnson County, and is about three and one-half miles southwest of Vienna. It was located through a reference in Worthen (1882). The prairie occurs on a southeast-facing spur of a ridge reaching a height of 200 feet above a sharp bend in the Cache River. This was considered a permanent station, and was visited eleven times, during November, 1961, April, May, June, July, August, September, and October of 1962, and April of 1963. Species collected only here include *Sphenopholis nitida*, *Carex retroflexa*, *Quercus shumardii*, *Ilex verticillata*, *Fraseria carolinensis*, *Vernonia altissima*, and *Verbesina helianthoides*.

11. *Cave Creek (CC)*. This station is quite similar to the preceding. It is located immediately east of U. S. Route 45 about four miles south of Vienna in Sect. 28, T 13 S, R 3 E, in Johnson County. The prairie slope in this instance faces generally southwest, occupying a spur of a 200-foot high ridge overlooking Cave Creek. This was the site of Evers' Cave Creek hill prairie; the name is taken from his paper. This also was utilized as a permanent station; it was

visited twelve times, during November, 1961, April, May, June, July, August, September, and October of 1962, and April of 1963. Notable species collected only at this station are *Ophioglossum engelmannii*, *Rubus pennsylvanicus*, *Salvia pitcheri*, *Galium concinnum*, and *Houstonia lanceolata*.

GROUP V—HARDIN COUNTY OUTCROPS AND RIVER BLUFFS

GENERAL DISCUSSION

The outcroppings grouped for discussion here present rather varied appearances; many points of similarity may be enumerated, however. All are located in Hardin County near the Ohio River, and all characteristically consist at least in part of massive ledges or bluffs of limestone with considerable areas of smooth rock face exposed. They are composed chiefly of Mississippian limestone of the Ste. Genevieve, St. Louis, or Renault formations. The Ohio River bluffs are less uniform in nature than those along the Mississippi. They are discontinuous and of widely varying heights. Most are capped by sandstone, which often forms almost the entire exposed portion of the bluff. The main area of limestone exposure is along the Hardin County part of the river, with the highest cliff of limestone occurring at Cave-in-Rock. To the west in Pope County, and to the north in Gallatin County, the limestone usually is seen only at the base of the bluffs, where it is often subject to denudation by the river in flood; similar situations occur in places in Hardin County.

Most Hardin County bluffs face south, where they may or may not be separated from the river by a floodplain. Somewhat similar outcroppings occur away from the river toward the interior of the county; a few of these were investigated.

Trees shade the entire outcropping in most of those included in Group V. Separate communities are not well defined. The plants are typically those of mesic woodland, often southern in affinity. The following communities may be recognized:

Mesic slope community. The dominant tree is *Acer saccharum*. Stands of this tree may give way to oak- and hickory-dominated woodlands. Vines are especially conspicuous on the lower slopes. These include *Aristolochia tomentosa*, *Cocculus carolinus*, *Calyccarpon lyonii*,

Clematis pitcheri, *Vitis* spp., *Ampelopsis cordata*, *Lonicera japonica*, and *Tragia cordata*. Herbs of the moist slope include *Campanula americana*, *Cuphea petiolata*, *Dentaria laciniata*, and *Verbena urticifolia*. *Sedum ternatum* occurs on the shaded rock ledges.

Dry ridge and slope community. The tree flora is generally diverse in this community. *Quercus muhlenbergii*, *Q. alba*, *Celtis occidentalis*, and *Ulmus americana* are common. *Smilax bonanox* and *Symphoricarpos orbiculatus* may form dense tangles. In some exposed places, the herbs are chiefly weedy; these include *Bromus tectorum*, *Geranium carolinianum*, and *Specularia perfoliata*. Characteristic native herbs are *Agave virginica* and *Anemone virginiana*.

INDIVIDUAL STATIONS

12. *Shetlerville (Shet)*. This interesting study area encompasses a series of outcroppings along the Ohio River southeast of Shetlerville, in the southeast one-fourth of Sect. 35, T 12 S, R 8 E, in Hardin County. The Rich Hill of the topographic maps is included. The bluffs may reach 200 feet above the river. Most of these outcroppings, in the Renault, St. Louis, and Ste. Genevieve formations, are but slight exposures; ten- to twenty-foot ledges, however, occur in places. Two abandoned quarries are within the study area. One, formerly operated by the Shetlerville Quarry Corporation, is at its western edge. The second, a Columbia Quarry operation, is on the western side of Rich Hill. These quarrying operations, in addition to farming carried on near the edge of the bluff in a few places, have resulted in a number of weedy situations. The greater extent of the outcroppings, however, is inhabited by rich and unique native flora. This is considered to be a permanent station. It was visited eleven times, during April, May, June, July, August, September, and October of 1962, and April of 1963. Species collected only at this station include *Robinia pseudoacacia*, *Xanthoxylum americanum*, *Tragia cordata*, *Cuphea petiolata*, *Bumelia lycioides*, *Gonolobus gonocarpus*, *Dicliptera brachiata*, *Catalpa speciosa*, and *Aster shortii*.

13. *Cave-in-Rock (CiR)*. The high bluff of St. Louis limestone which rises above the Ohio River in Cave-in-Rock State Park is one of the largest solid limestone outcrops in southeastern Illinois.

Human activities in this area have resulted in great alterations in the flora. Chiefly because of this, the Cave-in-Rock bluff was visited only twice during the present study, in April and July of 1962. *Morus alba*, *Rumex crispus*, and *Cap-sella bursa-pastoris* were recorded only from this station.

14. *East Cave-in-Rock (ECiR)*. Approximately two and one-half miles east of Cave-in-Rock, a ten- to twenty-foot high bluff of Renault limestone was selected as an additional study site. This outcropping is about one-half mile in length and faces south toward the Honey Creek bottoms and the Ohio River floodplain in Sections 16 and 17, T 11 S, R 10 E, in Hardin County. It resembles the Shetlerville study area, although of much lesser extent, and is shaded throughout. It was visited three times, during July and September of 1962, and April of 1963. Species collected only at this station include *Panicum dichotomum*, *Prunus virginiana*, and *Crataegus pruinosa*.

15. *Hogthief Creek (HC)*. Attempts were made during this study to locate sizable outcroppings in the interior of Hardin County, which is largely underlain by limestones of diverse age. The only one eventually collected is near the bridge over Hogthief Creek in the Kaskaskia Experimental Forest in the southern part of Sect. 3, T 11 S, R 8 E, in Hardin County. Here small outcrops of Ste. Genevieve limestone have been exposed by the creek in a situation representative of many small interior outcroppings. The nature of the community was decidedly mesic. The only visit was made May 12, 1962. Species seen on limestone at this station only were *Carex texensis*, *Betula nigra*, and *Valerianella radiata*.

IV.

LIMESTONE AREAS AND THE DISTRIBUTION OF ANIMALS IN SOUTHERN ILLINOIS

To what extent the distribution of animals in southern Illinois is related to that of limestone outcroppings is uncertain. Probably for most, the relationship is slight. Certainly rock outcroppings of either sandstone or limestone provide fa-

avorable habitats for many animals. The author's personal impression, after several years of experience among both types in southern Illinois, is that the limestone habitat is somewhat richer in both number of species and number of individuals. The major limestone outcrops appear to be areas of concentration of animal life. It is possible, however, that this apparent concentration is more related to conditions in adjoining areas, the presence of swamps, for instance, than to any superiority of the limestone.

Probably the outstanding examples of animals restricted to the habitats provided by limestone outcroppings are found among certain prairie species which occur in apparently relict colonies on the bluffs in Monroe and Randolph Counties; several are found nowhere else in the state. The factors responsible for the occurrence of certain peculiar animals, and plants as well, in these localities are uncertain. The populations present could represent relict colonies restricted to this area by a reduction in extent of their former range. The extent of prairie in Illinois is believed to be dwindling from a maximum associated with post-glacial conditions. On the other hand, their presence could be due to recent extension of range into a favorable habitat. Since most of the unique species are apparently Ozarkian or prairie forms, this probably would imply that they had recently entered from Missouri, surmounting the barrier presented by the Mississippi River. A group-by-group discussion follows:

1. *Invertebrates*. Undoubtedly various

invertebrates are more likely than the majority of vertebrates to be restricted to limestone outcroppings. They are in general less motile, many are in close contact with the soil and require particular conditions of temperature, moisture, and chemistry, and they may be restricted to a specific host plant. Some are well known to be calcicolous. A study of invertebrate distribution, at least that of certain groups, as it relates to the distribution of limestone, might reveal significant correlations. Unfortunately such a study was beyond the scope of the present work. Some observations were made, however. Evidently motile forms such as butterflies may be channeled northward through the Mississippi Valley and thus tend to be concentrated there and along the uplands on either side. Two southern species of unusual occurrence in southern Illinois, the dogface, *Zerene cesonia*, and the giant swallowtail, *Papilio cresphontes*, were both observed more than once on the Monroe-Randolph County bluffs. Illinois breeding populations of the latter are probably restricted to the areas on the Mississippi River bluffs where *Ptelea trifoliata* occurs. The larva feeds only upon this and other members of the Rutaceae. The larvae of another *Papilio*, the pipevine swallowtail, *P. philenor*, were found to be very abundant on *Aristolochia tomentosa* at Shetlerville; adults were conspicuous at this locality. Probably this butterfly concentrates about the limestone bluffs on which *A. tomentosa* is found. It is by no means restricted to this habitat, however; it is rather common throughout southern Illinois. Where *A. tomentosa* does not occur, the larvae may feed upon *A. serpentaria*, *Asarum reflexum*, or members of the Polygonaceae.

An abundant and conspicuous invertebrate on the bluff at Fults is the prairie scorpion, *Centrurus carolinianus*. When conditions of moisture and temperature are favorable, one or more individuals of this species may be uncovered beneath a good proportion of any of the small flat rocks of the hill prairies and talus slopes. Like several of the plants of this area, it apparently occurs here as a relict population suggestive of formerly more extensive prairie conditions.

2. *Fishes*. Fishes often are adapted to waters of a specific chemical nature; pH and calcium content are known to be important to many species, a number of which are restricted to the relatively high pH values and high calcium content

found in the waters of calcareous areas. No permanent surface waters occurred on any of the limestone outcrops visited during this study and no fish were observed. It is possible that some kinds of fish might be restricted to the limestone sinkhole ponds found in Hardin and Monroe Counties. The blind cave fish, *Chologaster agassizi*, which is abundant in springs beneath the bluffs of the Pine Hills area, is supposedly restricted to the waters of calcareous regions.

3. *Amphibians and reptiles.* The distribution of reptiles and amphibians, like that of fishes, is usually believed to be of greater zoogeographical significance than is that of birds and mammals, because of the generally greater motility of the latter. It is thus of especial interest that most of the outstanding examples of animals confined in Illinois to the Monroe-Randolph County bluffs are among these groups. The coachwhip snake, *Masticophis flagellum*, and the narrow-mouthed toad, *Gastrophryne carolinensis*, both have been found only here in Illinois. Two specimens of the latter were found under flat rocks on top of the bluff at Fults, May 25, 1962. The coachwhip was not seen during the course of this study. Although typical prairie animals, neither of these are restricted to prairie throughout their range, which includes the southeastern United States. The tiny flatheaded snake, *Tantilla gracilis*, another animal of the prairies, reaches the northeastern limit of its range in Illinois, where it occurs only on the bluffs in Monroe County and the Pine Hills. Several specimens were seen under flat rocks in both localities. It prefers talus slopes or rocky prairies. Apparently its ecological requirements are very similar here to those of the prairie scorpion. Both species are found occupying the same habitat and are likely to be seen in greatest abundance under similar conditions, chiefly when the soil has been thoroughly moistened by heavy rains. The great plains rat snake, *Elaphe guttata emoryi*, is similarly at the northeastern extent of its range here. Very few specimens are known from Illinois; all these are from the Monroe-Randolph County area or from river bluffs in the next three counties to the north. One specimen was seen dead on the bluff road at the SVal station June 3, 1963. A specimen of the prairie hognose snake, *Heterodon nasicus*, has been reported from the bluff at Fults (Smith and

Smith, 1962). The species is otherwise known east of south-central Minnesota and western Iowa only in isolated colonies in sand prairies in northern Illinois and southeastern Missouri.

Other species uncommon in Illinois noted in association with limestone in the study areas include the following:

Rana palustris, the pickerel frog. This species is found only along the Mississippi border in southern Illinois, although not restricted to the limestone bluffs there. On two separate occasions, both in June, individuals were seen atop the bluff at Fults.

Scaphiopus holbrookii, the eastern spadefoot toad. This secretive burrowing anuran is probably less rare in Illinois than present records indicate. In June, 1962, a specimen was discovered on the bluff road hopping toward the bluff at Fults, north of the previous northernmost record in the Mississippi Valley. A second specimen was discovered in similar circumstances at almost the same location June 3, 1963. Probably the permeable, loose soil of fine texture characteristic of the bluffs provides an excellent burrowing medium for this species.

Cnemidophorus sexlineatus, the six-lined racerunner. This lizard, a ground dweller of open areas, was seen at Shetlerville, Cave Creek, and Fults. The Cave Creek locality constitutes a Johnson County record for the species. At both Fults and Cave Creek, the individuals observed were in the prairie areas. The species also occurs in many dry sandstone areas, particularly along roadsides and railroad right-of-ways.

Lampropeltis dolia sypila, the red milk snake. This rarely seen, colorful snake is said by Smith (1961) to be most abundant in Illinois in the limestone bluff areas of the lower Mississippi border. Individuals were found under flat rocks in hill prairies at the NVal and PH stations; two additional specimens, one dead, were seen on the road at Pine Hills.

Several of the more common reptiles and amphibians are frequently encountered on the limestone bluffs. Many snakes, such as the pilot blacksnake, *Elaphe obsoleta*, the timber rattlesnake, *Crotalus horridus*, the copperhead, *Agkistrodon contortrix*, and the cottonmouth, *Agkistrodon piscivorus*, utilize both sandstone and limestone bluffs as sites for hibernation. In times past these may have reached their greatest numerical abundance in Illinois along the bluffs

at Pine Hills and the lower Big Muddy River. Some of the plethodontid salamanders are particularly abundant on and near the bluffs at Pine Hills. These include *Plethodon dorsalis*, *Eurycea lucifuga*, and *Eurycea longicauda*. All these amphibians and reptiles were encountered several times in the course of traversing the Pine Hills and Monroe County bluffs.

4. *Birds*. Most southern Illinois birds appear to find limestone and sandstone outcroppings equally favorable for hunting areas or nesting sites. The majority shows no particular restriction to bluffs of any kind. Exceptions might be found among the diurnal birds of prey. Many of the hawks and the turkey vulture, *Cathartes aura*, utilize the updrafts near steep bluffs for soaring and often nest on bluffs, either limestone or sandstone. The turkey vulture, the red-tailed hawk, *Buteo jamaicensis*, the red-shouldered hawk, *Buteo lineatus*, and the sparrow hawk, *Falco sparverius*, were frequently seen soaring near the bluffs visited, particularly those in Monroe County. An immature bald eagle, *Haliaeetus leucocephalus*, was observed soaring above the Pine Hills bluff on one occasion during March of 1963; probably this bird rarely strays inland in southern Illinois and so is most likely to be seen near the bluffs along the Mississippi and over the adjacent bottomland. It has been reported as having nested in the Pine Hills area in the past. The only bird which is probably largely restricted to limestone bluffs for nesting sites here is the peregrine falcon, *Falco peregrinus*. A lone individual was seen flying near the face of the high bluff at Valmeyer on a single occasion during September of 1962. This rather inaccessible bluff would seem to provide an ideal nesting site. Birds of other groups, including barn swallows and chimney swifts, often favor the updrafts near the bluffs. Flocks of domestic pigeons also may be seen frequently flying in the vicinity of the rock faces; many probably nest on the exposed ledges.

5. *Mammals*. Apparently no mammals in southern Illinois are restricted to limestone outcroppings, although several are abundant there. The Illinois wood rat, *Neotoma floridana illinoensis*, is confined almost to limestone, being found only along the bluffs of the Pine Hills area and at the sandstone Fountain Bluff in Jackson County. Whether or not some bats of the genus *Myotis* are restricted to limestone caves and mines

here is uncertain. Otherwise the mammal fauna appears to be similar to that of the sandstone areas. Conspicuous mammals such as white-tailed deer, gray and fox squirrels, chipmunks, and groundhogs are found wherever suitable cover occurs. The groundhog, *Marmota monax*, is easily the most often observed of these. The loose soil of the limestone areas apparently is especially suited to its burrowing activities.

V.

ANALYSIS OF THE FLORA

Five hundred fifty-two species of vascular plants were collected or recorded growing in association with limestone outcrops in the study areas. These represent 104 families and 300 genera. The three largest families were the Compositae, Gramineae, and Leguminosae, with 78, 66, and 39 species, respectively. The largest genera were *Panicum*, *Carex*, and *Aster*, each with 15 species.

The number of species found in each of the major groups of outcroppings varies in a manner reflecting the size and number of stations in each group. Three hundred sixteen species are listed from Group I; 73 of these were found only at the bluffs in that group. In Group II, which encompasses a much smaller area, 183 species were recorded, 27 from that area only. For the bluffs in Group III, 314 species are listed; 64 were restricted to that group. Only 163 species were found at the areas included in Group IV, which are relatively small and isolated; 22 of these were restricted to the stations in this group. Two hundred twenty-one species were found at the stations in Group V during the course of the study; of these, 47 were found only at the Group V areas.

Only 53 species were found to occur on at least one outcropping in

each of the groupings. As will be seen from the following list, the majority are common and wide-ranging species. A few, such as *Pellaea atropurpurea*, are generally thought of as typical plants of limestone areas. Others, such as *Agave virginica*, *Celtis Pumila*, and *Ulmus alata*, seem to be more characteristically regarded as typical of dry sandstone ridges.

Species occurring in all five area groupings (I-V) are:

Pellaea atropurpurea
Poa compressa
Triodia flava
Eragrostis capillaris
Uniola latifolia
Setaria viridis
Panicum capillare
Muhlenbergia sobolifera
Agave virginica
Ostrya virginiana
Quercus stellata
Quercus muhlenbergii
Quercus alba
Quercus rubra
Celtis pumila
Celtis occidentalis
Ulmus alata
Ulmus americana
Aquilegia canadensis
Anemone virginiana
Cocculus carolinus
Sassafras albidum
Arabis laevigata
Heuchera americana
 (var. *hirsuticaulis*)
Cassia fasciculata
Gleditsia triacanthos
Galactea volubilis
Lespedeza violacea
Oxalis violacea
Oxalis europaea
Euphorbia supina
Euphorbia corollata
Euphorbia maculata
Acalypha gracilens
Acalypha virginiana
Celastrus scandens
Rhus radicans
Acer saccharum
Parthenocissus quinquefolia
Hypericum punctatum
Cornus florida
Sanicula canadensis
Fraxinus americana

Ruellia humilis
Campsis radicans
Galium circaezans
Galium aparine
Campanula americana
Eupatorium altissimum
Kuhnia eupatorioides
Ambrosia artemisiifolia
Solidago ulmifolia
Erigeron strigosus

Floristic Affinities

In order to facilitate comparison between the floras of the limestone outcroppings and of those sandstone areas studied by Mohlenbrock (1954), Weber (1959), and MacMahon (1960), the plants recorded have been classified as to floristic affinity on a basis similar to that used by the latter authors. They followed a system proposed by Cowles (1929) and modified by Cain (1930). This system lends itself well to such a comparison, as well as to comparisons between the separate floras found in each of the major groupings of stations used in this paper. Its application in the table of comparisons may be briefly explained as follows. Intraneous refers to plants which are not near the limits of their range in southern Illinois. These include plants broadly ranging over most of northeastern North America (Northeastern Intraneous), and some restricted to the central states (Central Intraneous). A few are Continental Intraneous, having transeontinental ranges. Extraneous refers to plants nearing or reaching the limits of their range here. The subdivisions indicate the direction to which the major portion of the range lies with reference to southern Illinois. Introduced species are those for which the lo-

cality is not considered to be a part of their natural range.

TABLE 1 compares sandstone-area and limestone-area floras and floras at selected localities within the latter category. The floras analyzed by Mohlenbrock and the other workers are perhaps not strictly comparable with the one compiled in the present study, since in their work they attempted to collect all the plants of a given locality, without restricting themselves to particular substrates. They may, however, be considered representative of the general flora of the sandstone regions. Slight differences in categories used appear in accompanying TABLE 2; those which appear to be comparable are opposed.

In TABLE 2, the floristic affinities for each of the groups of outcroppings studied are presented. In addition, the affinities of each group

are compared with the affinities of the plants found only at the stations belonging to that particular group during this study.

The same general pattern is evident in all these analyses of geographic affinities. Intraneous species are relatively more abundant than are extraneous species and, in all cases, by far the largest category is that of the Northeastern Intraneous group. A few points of dissimilarity may be cited, however. The limestone flora as a whole contains relatively slightly fewer Intraneous and Introduced species as compared with the sandstone locality floras. Among the Intraneous species of the limestone flora, the proportion of Central to Northeastern plants is consistently slightly greater than it is in the other three floras.

Perhaps the most revealing comparisons may be made on the basis

Table 1.—Floristic Affinities of Taxa from Four Southern Illinois Stations.

	This Study		Mohlenbrock (1954)		Weber (1959)		MacMahon (1960)	
	No. Taxa	%	No. Taxa	%	No. Taxa	%	No. Taxa	%
Intraneous								
Northeastern.....	329	59.6	521	65.0	299	68.4	353	68.0
Central.....	57	10.3	45	5.5	23	5.3	21	4.0
Transcontinental.....	3	0.6			3	0.7		
Extraneous								
Transcontinental.....			6	1.0				
Northeastern.....	12	2.2	22	2.5	6	1.4	13	2.5
Northwestern.....	16	2.9	9	1.0	14 ¹	2.3 ¹	4	0.8
Southern.....	42	7.6	37	4.5	29	6.7	24	4.6
Southeastern.....	40	7.2	44	5.5	19	4.3	43	8.3
Southwestern.....	12	2.2	6	1.0	3	0.7	2	0.4
Introduced.....	41	7.4	114	14.0	45	10.2	60	11.4
Total.....	552	100.0	804	100.0	437	100.0	520	100.0

¹ Combined figures for the categories Central and Northern Extraneous.

Table 2.—Floristic affinities for each of the groups of limestone outcroppings in this study.

	GROUP I				GROUP II				GROUP III				GROUP IV				GROUP V			
	Plants collected		Restricted to Group I		Plants collected		Restricted to Group II		Plants collected		Restricted to Group III		Plants collected		Restricted to Group IV		Plants collected		Restricted to Group V	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Intraneous	194	61.4	31	42.5	117	63.9	12	44.5	211	67.2	37	57.8	115	70.6	142	64.2	21	44.7		
	39	12.3	9	12.3	14	7.6	3	11.1	32	10.2	6	9.4	16	9.8	15	6.8	2	4.2		
	2	0.6	1	1.4	1	0.6			1	0.3	1	1.6	1	0.6	1	0.5				
Extraneous	6	2.0	4	5.5	1	0.6	1	3.7	4	1.3	3	4.7	1	0.6	2	0.9	2	4.2		
	13	4.1	7	9.6	5	2.7	1	3.7	4	1.3	1	1.6	1	0.6	1	0.5				
	17	5.4	4	5.5	9	4.9	1	3.7	22	7.0	6	9.4	13	8.0	3	1.3	22	9.9		
	18	5.7	7	9.6	13	7.1	5	18.5	18	5.7	3	4.7	13	8.0	1	4.6	17	7.7		
	8	2.5	5	6.8	5	2.7	1	3.7	4	1.3	2	3.1	2	3.1		0.5	3	6.4		
	19	6.0	5	6.8	19	10.4	3	11.1	18	5.7	5	7.8	3	1.8	20	9.0	7	15.0		
Total.....	316	100.0	73	100.0	183	100.0	27	100.0	314	100.0	64	100.0	163	100.0	221	100.0	47	100.0		

of the affinities of the plants restricted to each of the respective groups; individual differences are intensified in these comparisons. As compared to the floras of the individual groups and of the limestone and sandstone areas as a whole, these show a relatively higher percentage of extraneous to intraneous species, and a comparatively low percentage of Northeastern Intraneous species. Most show a relatively high proportion of plants of southern affinity; only in the plants restricted to Group I are western affinities well represented. Other points of note are the high percentages of southern and introduced plants in Groups II and V.

State and County Records

Of the 552 plants recorded, 135 occurred in counties for which they were not recorded in *Vascular Plants of Illinois*, by Jones and Fuller (1955), or in the supplement by Winterringer and Evers (1960). The number of county records totaled 153. Six of these were species not previously reported from Illinois. These are the following:

1. *Panicum longifolium* Scrib. A clump of this species was discovered growing on a rocky ledge in a wooded ravine on top of the bluff at Fults (Monroe County), October 25, 1962. The author was accompanied by Dr. R. H. Mohlenbrock and Mr. Wendell Crews at the time. The range of this plant is given in *Gray's Manual* as extending from Florida to Texas and north through Kentucky and southern Ohio to Nova Scotia.

2. *Panicum helleri* Nash. A specimen which seems to key best to this species was found May 25, 1962, by the author in the company of Wendell Crews on an exposed ledge on top of the bluff two miles north of Prairie du Rocher (Randolph County). The species is re-

ported from western Missouri to Louisiana, Texas, and New Mexico.

3. *Panicum nitidum* Lam. An example of this species was found on the dry top of the Devil's Backbone (Jackson County), July 3, 1963. It appears to belong to the typical variety, which has been reported from southeastern Missouri, but which otherwise is not known north of Louisiana; the range of the species is from Florida to Texas, north to Virginia and Missouri.

4. *Panicum malacophyllum* Nash. A specimen of this southern species was collected July 21, 1963, on an exposed ledge on top of the Devil's Bake Oven; it was in the autumnal phase. The species is known from Tennessee and Missouri to eastern Kansas and Texas.

5. *Euphorbia dictyosperma* Fisch. & Mey. A single specimen, in fruit, was collected from a dry rock ledge on top of the bluff at Fults on May 25, 1963, by the author, accompanied by Mr. Wendell Crews. At that time no other specimens were seen, nor were any seen later in the year at that station. Additional visits in June of 1963, however, revealed the species to be rather common in company with *Galium virgatum* on the exposed ledges back from the edge of the bluff. It ranges throughout much of the western United States.

6. *Aster texanus* Burgess. A specimen which may be referred to this species was found in the hill prairie on the bluff at Valmeyer, September 29, 1962. It is somewhat intermediate in character between *A. sagittifolius* and *A. drummondii*. The range is given as extending from southwestern Kentucky to Kansas, Louisiana, and Texas.

Among the county records, the largest number was from Monroe County, with 57. Hardin County followed with 45. There were 16 Johnson County records, 15 from Union County, and 10 each from Jackson and Randolph Counties.

VI. ANNOTATED LIST OF VASCULAR PLANTS

Here are listed all those species of plants found growing in association with limestone in the study areas described previously. This includes plants growing directly on

the limestone ledges, either barren or with a thin covering of soil, and those growing in their immediate vicinity, where scattered limestone rocks and additional ledges gave evidence of the calcareous nature of the soil. The order of listing follows that in Mohlenbrock and Voigt (1959). Nomenclature is, for the most part, in accordance with Gleason (1952). Varieties are mentioned when readily recognizable or otherwise considered significant. Habitat, relative abundance, and geographical affinities are listed for each species. The dates given indicate approximately the months of flowering or, in the case of non-flowering plants or plants for which only sterile specimens were collected, are the months of collection. Those species for which only sight records were made are indicated by an asterisk (*) in place of a date. If the specimens collected constitute county records, this information follows the date. All stations at which the species were collected or recorded are designated by the abbreviations given previously.

FAMILY OPHIOGLOSSACEAE

Ophioglossum engelmannii Prantl. Rocky prairie slopes; rare. Southern extraneous. Oct. Johnson County record. CC.

Botrychium virginianum (L.) Schwartz. Mesic slopes and ledges; occasional. Northeastern intraneous. May, Sept. PH, Shet.

FAMILY POLYPODIACEAE

Camptosorus rhizophyllus (L.) Link. Moist, shaded ledges; occasional. Northeastern intraneous. July. SVal, PH.

Adiantum pedatum L. Mesic slopes and ledges; occasional. Northeastern intraneous. June. Val, PH, Mc.

Asplenium resiliens Kunze. Exposed or shaded rock ledges and cliffs; occa-

sional. Southern extraneous. April, June, Mc.

Asplenium platyneuron (L.) Oakes. Exposed or shaded ledges and cliffs; occasional. Northeastern intraneous. June—Oct. Val, F, Shet.

Polypodium polypodioides (L.) Watt. Exposed rocks and cliffs; occasional. Southeastern extraneous. Sept., Nov. PH, SS.

Polystichum acrostichoides (Michx.) Schott. Moist, shaded ledges; occasional. Northeastern intraneous. Sept. PH, Mc, HC.

Athyrium pycnocarpon (Spreng.) Tidestr. Shaded rock ledges and cliffs; rare. Northeastern intraneous. June. Mc.

Cheilanthes lanosa (Michx.) D. C. Eaton. Exposed rocks and cliffs; occasional. Northeastern intraneous. June—Nov. SVal, Mc, CC, Shet.

Cheilanthes feei Moore. Exposed rocks and cliffs; common. Southwestern extraneous. April, Nov. Val, SVal, F, PduR, DBO, DBB, PH, Mc.

Pellaea atropurpurea (L.) Link. Exposed ledges and cliffs; common. Northeastern intraneous. May, Nov. NVal, Val, SVal, F, DBO, DBB, PH, CC, SS, Shet.

Cystopteris fragilis (L.) Bernh. Mesic slopes and ledges; common. Northeastern intraneous. July, Nov. SVal, F, PH, Mc, Shet, ECiR.

Woodsia obtusa (Spreng.) Torrey. Mesic slopes and ledges; common. Northeastern intraneous. May, June, Oct. F, PH, Mc, Shet.

FAMILY PINACEAE

Pinus echinata Mill. Dry slopes above limestone ledges; rare. Southeastern extraneous. (*). PH.

FAMILY CUPRESSACEAE

Juniperus virginiana L. Exposed ledges and bluff tops; common. Northeastern intraneous. (*). NVal, Val, SVal, F, PduR, DBO, DBB, PH, Mc, SS, CC, Shet.

FAMILY GRAMINEAE

Arundinaria gigantea (Walt.) Chapm. Mesic slopes and ledges; occasional. Southeastern extraneous. Oct. PH, CC, Shet.

Leptochloa filiformis (Lam.) Beauv. Low riverside ledges; occasional to common. Southeastern extraneous. Aug. DBO.

Bouteloua curtipendula (Michx.) Torr. Hill prairies and exposed ledges; common to abundant. Central intraneous. June, July. Val, SVal, F, PduR, PH, SS, CC.

Melica nitens Nutt. Exposed or shaded ledges; occasional to common. Northeastern intraneous. May, June. Hardin County record. Val, SVal, PH, Shet.

Poa compressa L. Hill prairies and ledges; occasional. Introduced from Europe. May, June. Monroe County record. F, PduR, DBO, PH, SS, Shet.

Poa chapmaniana Scribn. Exposed bluff top; rare. Central intraneous. May. Shet.

Poa pratensis L. Any open situation; common. Northeastern intraneous. May, June. Monroe County record. NVal, SVal, F, PduR, DBO.

Bromus tectorum L. Exposed bluff tops and ledges; common. Introduced from southern Europe. May, June, July. Hardin County record. Val, SVal, PduR, DBO, DBB, Shet.

Bromus inermis Leyss. Exposed talus slope; rare. Introduced from Europe. June. PH.

Bromus purgans L. Mesic slopes and ledges; occasional. Northeastern intraneous. May, June. Johnson County record. PH, Mc, SS, CC, Shet.

Bromus racemosus L. Exposed ledges; common. Naturalized from Europe. May—July. First record from Monroe, Randolph, Jackson, Union, and Hardin Counties. Val, SVal, F, PduR, DBO, DBB, PH, Shet.

Bromus japonicus Thunb. Exposed ledges; common. Introduced from Old World. June. Union and Hardin County records. PH, Shet.

Triodia flava L. Any open situation; occasional. Northeastern intraneous. Aug.—Oct. NVal, Val, DBO, DBB, PH, SS, Shet.

Diarrhena americana Beauv. Mesic slopes and ledges; a single large stand at Pine Hills. Central intraneous. PH.

Eragrostis hypnoides (Lam.) BSP. Low sandy ledges at the Devil's Bake Oven; common there. Northeastern intraneous. Aug. DBO.

Eragrostis capillaris (L.) Nees. Exposed ledges; common. Northeastern intraneous. July—Oct. Hardin County record. Val, F, DBO, DBB, PH, Mc, CC, Shet.

Eragrostis spectabilis (Pursh) Steud. Exposed ledges on bluff top; rare. Northeastern intraneous. Aug., Oct. F, PduR.

Uniola latifolia Michx. Mesic slopes

and ledges; occasional to common. Northeastern intraneous. July, Aug. SVal, F, DBO, DBB, PH, Mc, CC, Shet.

Festuca obtusa Spreng. Mesic slopes and ledges; occasional. Northeastern intraneous. May, June. SVal, PH, Mc, CC.

Festuca octoflora Walt. Exposed ledge; rare. Northeastern intraneous. May. NVal.

Danthonia spicata (Lam.) Beauv. Exposed ledges; occasional. Northeastern intraneous. May, June. PH, Mc, SS.

Koeleria cristata (L.) Pers. Hill prairies and ledges; occasional. Northeastern extraneous. May, June. Val, SVal, F.

Sphenopholis nitida (Spreng.) Scribn. Rocky prairie slope; rare. Northeastern intraneous. May. Johnson County record. SS.

Sphenopholis obtusata (Michx.) Scribn. Hill prairies and ledges; occasional. Northeastern intraneous. The specimens collected are var. *lobata* (Trin.) Scribn. May, June. Monroe County record. F.

Hyatris patula Moench. Shaded ledges and slopes; occasional. Northeastern intraneous. All specimens belong to the typical variety except that from Shetlerville, which is var. *bigeloviana* (Fern.) Deam. May, June. PH, Mc, CC, Shet.

Hordeum pusillum Nutt. Dry, exposed ledges; rare. Northeastern intraneous. May. Hardin County record. PH, Shet.

Elymus villosus Muhl. Mesic slopes and ledges; rare. Northeastern intraneous. June. PH.

Elymus virginicus L. Exposed or shaded slopes and ledges; occasional. Northeastern intraneous. June, July. DBB, Mc, CC, Shet.

Elymus canadensis L. Exposed or shaded slopes and ledges; occasional. Northeastern intraneous. June, July, Aug. Val, SVal, F, DBO, DBB, PH.

Setaria glauca (L.) Beauv. Exposed slopes and ledges; occasional. Naturalized from Europe. July, Aug. Val, DBB.

Setaria viridis Beauv. Exposed slopes and ledges; common to abundant. Naturalized from Eurasia. June—Sept. Val, PduR, DBO, DBB, PH, Mc, CC, Shet.

Paspalum laeve Michx. Sandy base of Devil's Bake Oven; rare. Southeastern extraneous. Oct. DBO.

Paspalum ciliatifolium Michx. Dry ridge top; rare. Southwestern extraneous. The specimen appears to be var. *stramineum* (Nash) Fern. Oct. Jackson County record. DBB.

Panicum flexile Gatt. Shaded ledge; rare. Northeastern intraneous. July. Hardin County record. Shet.

Panicum capillare L. Exposed bluffs and ledges; common. Northeastern intraneous. Sept., Oct. Monroe and Johnson County record. Val, F, DBO, PH, SS, Shet.

Panicum anceps Michx. Exposed ledge; rare. Southeastern extraneous. Aug. DBO.

Panicum longifolium Scribn. Dry, shaded ledge on bluff top; rare. Southeastern extraneous. Oct. State record. F.

Panicum perlongum Nash. Shaded ledge; rare. Northwestern extraneous. June. Union County record. Mc.

Panicum linearifolium Scribn. Moist slopes and ledges; occasional. Northeastern intraneous. May. PH, SS.

Panicum dichotomum L. Mesic slopes and ledges; rare. Northeastern intraneous. July. PH, ECiR.

Panicum huachucae Ashe. Moist and dry slopes and ledges; occasional to common. Northeastern intraneous. May—Oct. F, PduR, DBB, Mc, Shet.

Panicum helleri Nash. Dry bluff top; rare. Southwestern extraneous. May. State record. PduR.

Panicum clandestinum L. Exposed ledge; rare. Northeastern intraneous. July. DBO.

Panicum boscii Poir. Dry or moist slopes and ledges; occasional to common. Southeastern extraneous. May—Sept. DBB, PH, Mc, SS, CC, Shet.

Panicum nitidum Lam. Dry exposed ridge top; rare. Southeastern extraneous. The specimen collected is referable to the typical variety. July. State record. DBB.

Panicum oligosanthos Schult. Dry slopes and ledges; occasional. Northeastern intraneous. May—Aug. Monroe and Hardin County records. F, PduR, Shet.

Panicum malacophyllum Nash. Exposed ledge; rare. Southern extraneous. July. State record. DBO.

Panicum scribnerianum Nash. Dry, rocky slope; rare. Northeastern intraneous. July. SS.

Digitaria sanguinalis (L.) Scop. Any exposed, weedy area; occasional. Naturalized from Europe. July. Shet.

Digitaria ischaemum (Schreb.) Muhl. Exposed ledge; rare. Northeastern intraneous. Aug. DBO.

Muhlenbergia capillaris (Lam.) Trin. Exposed ledge on bluff top; rare. Southeastern extraneous. Oct. Monroe County record. F.

Muhlenbergia asperifolia (Nees & Meyen) Parodi. Exposed ledge at edge of bluff; rare. Northwestern extraneous. July, Aug. Monroe County record. SVal.

Muhlenbergia cuspidata (Torr.) Rydb. Exposed ledges at edges of bluffs; occasional. Northwestern extraneous. Aug.—Oct. Monroe, Randolph, and Union County records. Val, SVal, F, PduR, PH.

Muhlenbergia schreberi J. F. Gmel. Dry slopes and ledges; occasional. Northeastern intraneous. Sept., Oct. Shet.

Muhlenbergia sobolifera (Muhl.) Trin. Shaded slopes and ledges; occasional to common. Northeastern intraneous. July—Oct. Johnson County record. Val, F, DBB, PH, Mc, SS, Shet.

Muhlenbergia racemosa (Michx.) BSP. Shaded slopes and ledges; occasional. Northwestern extraneous. Sept., Oct. Monroe and Union County records. Val, F, DBO, DBB, Mc.

Sporobolus asper (Michx.) Kunth. Exposed ledges; rare to occasional. Northeastern intraneous. Oct. Johnson County record. Val, CC.

Sporobolus cryptandrus (Torr.) Gray. Exposed ledges; occasional. Central intraneous. July, Oct. DBO, DBB.

Sporobolus vaginiflorus (Torr.) Wood. Exposed ledges; occasional. Northeastern intraneous. Sept., Oct. Monroe and Hardin County records. NVal, Val, F, Shet.

Brachyelytrum erectum (Schreb.) Beauv. Mesic slopes and ledges; occasional. Northeastern intraneous. July, Sept. Mc.

Stipa spartea Trin. Exposed ledge on bluff top; rare. Northwestern extraneous. June. Monroe County record. Val.

Leersia virginica Willd. Mesic slopes and ledges; occasional. Northeastern intraneous. Sept. Mc.

Andropogon scoparius Michx. Hill prairies and dry ledges; common to abundant. Northeastern intraneous. Aug.—Oct. NVal, Val, SVal, F, PduR, PH, SS, CC.

Andropogon gerardii Vitman. Hill prairies and dry ledges; common to abundant. Northeastern intraneous. Aug.—Oct. NVal, Val, SVal, F, PduR, PH, SS, CC.

Andropogon virginicus L. Dry ridge tops and ledges; occasional. Southeastern extraneous. Oct. DBO, DBB, Shet.

Sorghastrum nutans (L.) Nash. Hill prairies and ledges; common to abundant. Northeastern intraneous. Sept. Oct. NVal, Val, SVal, F, PduR, PH, SS, CC.

FAMILY CYPERACEAE

Carex cephalophora Muhl. Dry slopes and ledges; occasional. Northeastern in-

traneous. June, Sept. DBO, PH, Shet.

Carex leavenworthii Dewey. Shaded rocky slope; rare. Northeastern intraneous. May, Shet.

Carex texensis (Torr.) Bailey. Mesic ledge; rare. Southeastern extraneous. May. Hardin County record. HC.

Carex retroflexa Muhl. Rocky prairie slope; rare. Northeastern intraneous. May. SS.

Carex rosea Schk. Shaded ledges; rare. Northeastern intraneous. June, July. DBB, Mc.

Carex muhlenbergii Schk. Exposed or shaded slopes and ledges; occasional to common. Northeastern intraneous. Specimens of the typical variety were collected at Fults and Cave Creek; one example of var. *australis* Olney was collected at Valmeyer; var. *enervis* Boott was collected at these and the other stations listed. May—July. Monroe County record. Val, SVal, F, DBB, PH, Mc, CC.

Carex festucacea Schk. Dry, shaded ledge on bluff top; rare. Central intraneous. June. Monroe County record. Val.

Carex jamesii Schw. Moist ledge; rare. Central intraneous. May. PH.

Carex artitecta Mack. Exposed or shaded ledges; occasional. Northeastern intraneous. April, May. NVal, PH.

Carex eburnea Boott. Exposed ledges on bluff top; rare. North transcontinental intraneous. May. Monroe County record. Val.

Carex meadii Dewey. Dry prairie slope; rare. Central intraneous. May. SS.

Carex blanda Dewey. Moist slopes and ledges; occasional. Northeastern intraneous. May, June. PduR, PH, Mc, Shet.

Carex oligocarpa Schk. Shaded ledges; occasional. Northeastern intraneous. May. PH.

Carex hirsutella Mack. Moist slopes and shaded ledges; occasional. Northeastern intraneous. May. SS, Shet.

Carex umbellata Schk. Moist rocky slope; occasional. Northeastern extraneous. April. Shet.

Carex bushii Mack. Dry slopes and ledges; occasional. Northeastern intraneous. June, July. DBB, Shet.

Cyperus filiculmis Vahl. Hill prairies and exposed ledges; occasional. Southeastern extraneous. July—Sept. Val, SVal, F.

Cyperus ovularis (Michx.) Torr. Hill prairies and exposed ledges; occasional. Northeastern intraneous. July. SVal, DBO.

FAMILY ARACEAE

Arisaema dracontium (L.) Schott. Mesic slopes and ledges; occasional. Northeastern intraneous. April, May. F, PH, Mc, Shet.

Arisaema triphyllum (L.) Schott. Mesic slopes and ledges; occasional to abundant. Northeastern intraneous. April, May. Val, PH, Mc, Shet, ECiR, HC.

FAMILY COMMELINACEAE

Tradescantia subaspera Ker. Mesic slopes and ledges; occasional. Central intraneous. June, July. Mc, Shet, ECiR.

Tradescantia virginiana L. Dry prairie slopes and ledges; occasional. Northeastern intraneous. May. CC.

Tradescantia ohiensis Raf. Hill prairies; occasional. Northeastern intraneous. May, June. Val, SVal, F, PduR.

FAMILY JUNCACEAE

Juncus bufonius L. Dry ledge in weedy situation; occasional. Northeastern intraneous. July. Hardin County record. Shet.

Juncus interior Wieg. Dry ledges; occasional. Northwestern extraneous. July, Aug. F, DBO, Shet.

Juncus tenuis Willd. Shaded dry ledge; rare. Northeastern intraneous. June. Hardin County record. Shet.

FAMILY LILIACEAE

Uvularia grandiflora Sm. Mesic slopes and ledges; occasional. Northeastern intraneous. April, May. PH, Mc.

Trillium gleasonii Fern. Mesic slopes and ledges; occasional. Northeastern extraneous. April, May. PH, Mc.

Trillium recurvatum Beck. Mesic slopes and ledges; occasional to common. Central intraneous. April, May. NVal, PH, Mc.

Allium vineale L. Exposed ledge on bluff top; occasional. Northeastern intraneous. June. Val.

Allium canadense L. Dry slopes and ledges; occasional. Northeastern intraneous. June, July. Hardin County record. Val, Shet.

Allium stellatum Fraser. Exposed ledges; occasional. Northwestern extraneous. Aug. Monroe and Randolph County records. Val, SVal, F, PduR, PH.

Nothoscordum bivalve (L.) Britt. Dry

or moist ledges; common. Southern extraneous. May, Sept. PH, SS, CC, Shet.

Camassia scilloides (Raf.) Cory. Dry or moist exposed ledges; rare. Central intraneous. May. Monroe County record. F, PH, CC.

Asparagus officinalis L. Exposed slopes and ledges; occasional. Introduced from Europe. July, Aug. Hardin County record. DBO, DBB, Shet.

Smilacina racemosa (L.) Desf. Mesic slopes and ledges; occasional. Northeastern intraneous. May. Mc, CC.

Polygonatum biflorum (Walt.) Ell. Mesic slopes and ledges; occasional. Northeastern intraneous. May. ECiR.

Polygonatum canaliculatum (Muhl.) Pursh. Mesic slopes and ledges; occasional. Northeastern intraneous. May. Val, F, PH, Mc, Shet, HC.

Smilax bona-nox L. Dry ledges and ridge tops; occasional to abundant. Southern extraneous. May. DBO, DBB, PH, Mc, SS, CC, Shet.

Smilax rotundifolia L. Dry or moist slopes and ridge tops; occasional. Northeastern intraneous. May. Johnson County record. SS, Shet.

Smilax lasioneura Hook. Dry wooded slope; rare. Central intraneous. July (sterile). DBB.

Smilax pulverulenta Michx. Dry, rocky wooded slope on bluff top; rare. Northeastern intraneous. Sept. Val.

FAMILY DIOSCOREACEAE

Dioscorea quaternata (Walt.) Gmel. Moist exposed or shaded slopes; occasional. Southeastern extraneous. May, June. Monroe, Johnson, and Hardin County records. Val, PH, Mc, SS, CC, Shet.

FAMILY AMARYLLIDACEAE

Agave virginica L. Dry, exposed bluff tops and ledges; occasional to common. Southeastern extraneous. June, July. NVal, Val, SVal, F, PduR, DBB, PH, SS, CC, Shet.

FAMILY IRIDACEAE

Sisyrinchium albidum Raf. Hill prairies and exposed ledges; occasional. Northeastern intraneous. April, May. Union County record. NVal, Val, F, PduR, PH, SS, CC.

FAMILY SALICACEAE

Populus deltoides Marsh. Dry ridge top; rare. Northeastern intraneous. (*). DBB.

Salix humilis Marsh. Hill prairie; rare. Southeastern extraneous. July (sterile). Val.

FAMILY JUGLANDACEAE

Carya ovata (Mill.) K. Koch. Dry ridge tops; occasional. Northeastern intraneous. (*). PduR, PH.

Carya glabra (Mill.) Sweet. Dry ridge tops; occasional. Northeastern intraneous. (*). F, PH.

Carya tomentosa Nutt. Dry ridge tops; occasional. Northeastern intraneous. June (sterile). F, PH.

Carya ovalis (Wang.) K. Koch. Dry ridge tops and slopes; occasional. Northeastern intraneous. Oct. (sterile). F, PH, SS.

Carya texana Buckl. Dry ridge tops, ledges, and slopes; occasional to common. Southern extraneous. May. Val, SVal, F, PduR, DBO, PH, SS, CC.

Juglans nigra L. Dry or moist slopes and ledges; occasional. Northeastern intraneous. May (sterile). Val, F, PduR, DBO, PH, Shet.

FAMILY BETULACEAE

Corylus americana Walt. Dry and moist ledges; occasional. Northeastern intraneous. May (sterile). PH.

Betula nigra L. Moist ledge at Hogthief Creek; occasional. Northeastern intraneous. July (sterile). Hardin County record. HC.

Carpinus caroliniana Walt. Shaded ledges; rare. Northeastern intraneous. June. Val, HC.

Ostrya virginiana (Mill.) K. Koch. Dry and moist ledges and slopes; common. Northeastern intraneous. April. Val, F, DBB, PH, SS, Shet.

FAMILY FAGACEAE

Fagus grandifolia Ehrh. Mesic slopes and ledges; occasional. Northeastern intraneous. April (sterile). Mc, HC.

Quercus muhlenbergii Engelm. Dry slopes and ridge tops; common to abundant. Northeastern intraneous. Oct. (sterile). NVal, Val, F, PduR, DBO, DBB, PH, Mc, SS, CC, Shet, ECiR, HC.

Quercus shumardii Buckl. Dry, rocky

prairie slope; rare. Southeastern extraneous. July (sterile). SS.

Quercus stellata (Wang.) Dry wooded slopes and ridge tops; occasional. Northeastern intraneous. Oct. (sterile). Val, SVal, F, PduR, DBO, PH, SS, CC, Shet.

Quercus velutina Lam. Dry wooded slopes and ridge tops; occasional. Northeastern intraneous. Sept. (in fruit). SVal, F, DBO, CC.

Quercus marilandica Muench. Dry ledges and ridge tops; occasional. Northeastern intraneous. (*). DBO, CC.

Quercus imbricaria Michx. Dry ledges and ridge tops; rare. Northeastern intraneous. June (sterile). F, DBO.

Quercus alba L. Dry slopes and ridge tops; occasional to common. Northeastern intraneous. Oct. (sterile). Val, F, PduR, DBB, PH, Mc, SS, Shet, ECiR, HC.

Quercus rubra L. Dry slopes and ridge tops; occasional. Northeastern intraneous. Oct. (sterile). Val, SVal, F, PduR, DBO, PH, Mc, SS, CC, Shet, HC.

FAMILY ULMACEAE

Celtis occidentalis L. Dry slopes and ledges; occasional. Northeastern intraneous. July (sterile). Val, F, DBO, PH, Mc, SS, CC, Shet.

Celtis pumila Pursh. Dry ledges and rocky ridge tops; occasional. Southeastern extraneous. Oct. (in fruit). Jackson County record. Val, SVal, F, PduR, DBO, PH, SS, CC, Shet.

Celtis laevigata Willd. Moist ledges and slopes; occasional to rare. Southern extraneous. May (in fruit). SVal, Mc, SS.

Ulmus alata Michx. Dry ledges and ridge tops; occasional to common. Southeastern extraneous. Oct. (sterile). Monroe County record. F, DBO, DBB, PH, SS, CC, Shet, HC.

Ulmus americana L. Slopes, ledges, and ridge tops; occasional to common. Northeastern intraneous. April. SVal, F, PduR, DBB, PH, Mc, SS, Shet, HC.

Ulmus rubra Muhl. Slopes, ledges, and ridge tops; occasional. Northeastern intraneous. April. SVal, DBO, Mc, SS.

FAMILY MORACEAE

Maclura pomifera (Raf.) Schneid. Dry, rocky bluff top woods; rare. Southwestern extraneous. July (sterile). DBB, CiR.

Morus alba L. Shaded ledge; rare. Introduced from eastern Asia. May. CiR.

Morus rubra L. Mesic slopes and

ledges; occasional. Northeastern intraneous. May. DBO, Mc.

FAMILY URTICACEAE

Pilea pumila (L.) Gray. Low, moist, shaded ledges and slopes; common to abundant. Northeastern intraneous. Aug., Sept. PH, Mc, Shet.

Parietaria pennsylvanica Muhl. Moist, shaded ledges; common to abundant. Northeastern intraneous. June, July. Monroe County record. SVal, DBB, PH, Mc, Shet.

Boehmeria cylindrica (L.) Sw. Low, moist, shaded ledges; common. Northeastern intraneous. July, Aug. Mc.

Laportea canadensis (L.) Gaudich. Low, moist, shaded ledges; occasional. Northeastern intraneous. July, Aug. Mc.

FAMILY SANTALACEAE

Comandra umbellata (L.) Nutt. Hill prairie; rare. Northeastern intraneous. May. NVal.

FAMILY ARISTOLOCHIACEAE

Aristolochia serpentaria L. Mesic rocky slopes; rare. Southern extraneous. July. (sterile). Shet, ECiR.

Aristolochia tomentosa Sims. Rocky slopes and ledges; rare, except at Shetlerville, where it is common. Southeastern extraneous. May. Hardin County record. F, DBO, Shet.

Asarum reflexum Bickn. Mesic slopes and ledges; occasional to common. Northeastern intraneous. May. PH, Mc, SS.

FAMILY POLYGONACEAE

Polygonum longistylum Small. Talus slope; rare. Southern extraneous. Aug. Union County record. PH.

Polygonum virginianum L. Mesic slopes and ledges; rare. Northeastern intraneous. Aug. F, PH.

Polygonum tenue Michx. Exposed ledges on bluff top; occasional. Northeastern intraneous. Sept. Monroe County record. Val.

Polygonum convolvulus L. Talus slope; rare. Introduced from Europe. July. PH.

Polygonum cristatum Engelm. & Gray. Talus slopes and exposed ledges; occasional to common. Northeastern intraneous. July—Sept. F, PH, Shet.

Polygonum scandens L. Talus slope;

rare. Northeastern intraneous. Oct. F.
Rumex altissimus Wood. Talus slope; occasional. Northeastern intraneous. June. F.

Rumex crispus L. Shaded rock face; occasional. Introduced from Europe. May. CiR.

FAMILY CHENOPODIACEAE

Chenopodium hybridum L. Talus slope; occasional. Continental intraneous. July. Union County record. PH.

Chenopodium standleyanum Aellen. Mesic slopes and ledges; occasional to common. Northeastern intraneous. July—Oct. Monroe County record. SVal, PH, Mc, Shet.

FAMILY AMARANTHACEAE

Acnida altissima Riddell. Talus slopes; occasional. Northeastern intraneous. Aug. PH.

Acnida tamariscina (Nutt.) Wood. Sandy base of Devil's Bake Oven; occasional. Central intraneous. Aug. DBO.

FAMILY PHYTOLACCACEAE

Phytolacca americana L. Talus slopes and ledges; occasional. Northeastern intraneous. June. Mc, Shet.

FAMILY NYCTAGINACEAE

Mirabilis nyctaginea (Michx.) MacM. Exposed ledges on bluff tops; occasional. Central intraneous. Sept., Oct. Val, F.

FAMILY ILLECEBRACEAE

Paronychia fastigiata (Raf.) Fern. Exposed, dry ledges; rare. Northeastern intraneous. Sept. PH.

FAMILY PORTULACACEAE

Portulaca oleracea L. Rocky ledges on bluff top; rare. Naturalized from Europe. July. Val.

Claytonia virginica L. Mesic slopes and ledges; common to abundant. Northeastern intraneous. April. DBB, PH, Mc, Shet.

FAMILY CARYOPHYLLACEAE

Cerastium nutans Raf. var. *brachypodium* Engelm. Exposed ledges; occasional. Northwestern extraneous. May. Monroe County record. NVal, Val.

Cerastium viscosum L. Exposed ledges; occasional. Introduced from Europe. April, May. DBO, Shet.

Cerastium vulgatum L. Exposed ledges; occasional. Introduced from Europe. May. Monroe County record. F, Shet.

Stellaria media (L.) Vill. Exposed and shaded ledges; occasional. Northeastern intraneous. July, Oct. PH, Shet.

Silene antirrhina L. Exposed ledges; occasional to common. Northeastern intraneous. April, May. SVal, F, DBO, PH, Shet.

Silene stellata (L.) Ait. Shaded slopes and ledges; occasional. Northeastern intraneous. June, July. Val, SVal, Mc.

Sagina decumbens (Ell.) Torrey & Gray. Moist ledge; rare. Northeastern intraneous. May. Shet.

FAMILY MAGNOLIACEAE

Liriodendron tulipifera L. Mesic slopes and ledges; occasional. Northeastern intraneous. May. DBB, PH.

Magnolia acuminata L. Mesic slopes and ledges; rare. Southeastern extraneous. July (sterile). PH, Mc.

FAMILY ANNONACEAE

Asimina triloba (L.) Dunal. Mesic slopes and ledges; occasional to common. Northeastern intraneous. April, May. Hardin County record. Val, SVal, F, PH, Mc, Shet, HC.

FAMILY RANUNCULACEAE

Myosurus minimus L. Exposed bluff top ledge; rare. Northeastern intraneous. May. NVal.

Aquilegia canadensis L. Rock ledges and slopes; occasional to common. Northeastern intraneous. April, May. Val, SVal, F, DBB, PH, Mc, SS, Shet, CiR.

Delphinium tricornis Michx. Mesic slopes and ledges; occasional to common. Northeastern intraneous. April. Val, F, PduR, PH, ECiR.

Clematis pitcheri Torrey & Gray. Moist slopes and ledges; occasional. Central intraneous. May—July. F, CC, Shet.

Ranunculus micranthus Nutt. Mesic slopes and ledges; occasional. Northeastern intraneous. April, May. PH, CC, Shet, ECiR.

Thalictrum dioicum L. Dry, shaded slopes on bluff; rare. June. Union County record. PH.

Anemone virginiana L. Dry, rocky slopes and ridge top; occasional. July. SVal, F, DBO, Mc, SS, Shet.

FAMILY BERBERIDACEAE

Podophyllum peltatum L. Mesic slopes and ledges; occasional to common. Northeastern intraneous. April, May. PH, Mc.

FAMILY MENISPERMACEAE

Menispermum canadense L. Talus slopes and low ledges; occasional. Northeastern intraneous. Sept. (sterile). F, PH, Mc, Shet.

Cocculus carolinus (L.) DC. Mesic, wooded slopes, talus, and lower ledges; common. Southern extraneous. July. Johnson County record. Val, SVal, F, PduR, DBB, PH, Mc, CC, Shet.

Calycocarpum lyonii (Pursh) Gray. Low, rocky slopes; rare. Southeastern extraneous. June. PH, Mc, Shet.

FAMILY LAURACEAE

Sassafras albidum (Nutt.) Nees. Rocky slopes and ledges; occasional. Northeastern intraneous. May. Val, F, DBB, PH, SS, Shet.

Lindera benzoin (L.) Blume. Mesic slopes and ledges; occasional to common. Northeastern intraneous. April. PH, Mc, Shet.

FAMILY PAPAVERACEAE

Sanguinaria canadensis L. Mesic slopes and ledges; occasional. Northeastern intraneous. April. Val, PH, Mc, Shet, ECiR.

Stylophorum diphyllum (Michx.) Nutt. Mesic slopes and ledges; occasional. Central intraneous. April. PH, Mc.

FAMILY FUMARIACEAE

Corydalis flavula Raf. Mesic slopes and ledges; occasional. Northeastern intraneous. April, Sept. Val, F, PH, Mc, Shet.

Dicentra cucullaria (L.) Bernh. Mesic slopes and ledges; occasional. Northeastern intraneous. April. PH, Mc.

FAMILY CRUCIFERAE

Arabidopsis thaliana (L.) Heynh. Exposed ledges; occasional to common.

Introduced from Europe. April, May. NVal, Val, DBO, PH.

Arabis canadensis L. Rocky slopes and ledges; occasional. Northeastern intraneous. May. Hardin County record. SS, Shet.

Arabis hirsuta (L.) Scop. var. *adpressipilosa* (Hopkins) Rollins. Exposed ledges; occasional. Northwestern extraneous. May. Monroe County record. NVal, Val, F, DBO, DBB.

Arabis laevigata (Muhl.) Poir. Mesic slopes and ledges; occasional. Northeastern intraneous. April, May. PduR, DBB, PH, Mc, SS, Shet.

Arabis virginica (L.) Poir. Moist, shaded ledges; occasional. Southern extraneous. April. Shet.

Brassica nigra (L.) Koch. Exposed ledge; rare. Introduced from Eurasia. May. PH.

Capsella bursa-pastoris (L.) Medic. Exposed ledge in weedy situation; occasional. Introduced from Europe. May. CiR.

Dentaria laciniata Muhl. Mesic slopes and ledges; common. Northeastern intraneous. April. DBB, PH, Mc, Shet.

Descurainia brachycarpa (Richards) O. E. Schulz. Exposed ledges; occasional. Northeastern intraneous. April, May. Val, DBB, PH.

Draba brachycarpa Nutt. Moist ledges; occasional. Southern extraneous. April, May. Shet.

Draba reptans (Lam.) Fern. Exposed ledges on bluff tops; common. Northeastern intraneous. April, May. NVal, Val, F, PduR, DBB.

Lepidium virginicum L. Exposed ledges; occasional to common. Northeastern intraneous. June—Sept. Val, F, PduR, DBO, PH, Shet.

FAMILY CRASSULACEAE

Sedum ternatum Michx. Shaded cliffs and ledges; rare to occasional. Northeastern intraneous. April. CiR, ECiR.

Sedum triphyllum (Haw.) S. F. Gray. Exposed ledges on Devil's Bake Oven. Introduced from Eurasia. July (sterile). DBO.

FAMILY SAXIFRAGACEAE

Heuchera americana L. var. *hirsuticaulis* (Wheelock) Rosend., Butt., & Lak. Exposed or shaded dry ledges; common. Central intraneous. May. Val, SVal, F, PduR, DBO, PH, Mc, SS, CC, Shet, ECiR.

FAMILY HYDRANGEACEAE

Hydrangea arborescens L. Mesic slopes and ledges; occasional. Northeastern intraneous. June. Val, PH, Mc.

FAMILY GROSSULAREACEAE

Ribes cynosbati L. Exposed or shaded moist ledges; occasional. Northeastern intraneous. Monroe County record. May, June. Val, PH, Mc.

FAMILY HAMAMELIDACEAE

Liquidambar styraciflua L. Mesic slopes and ledges; occasional. Southeastern extraneous. (*). Mc, Shet.

FAMILY PLATANACEAE

Platanus occidentalis L. Mesic slopes and ledges or hill prairie; rare. Northeastern intraneous. Oct. (sterile). Val, F, HC.

FAMILY ROSACEAE

Rubus flagellaris Willd. Talus slopes, exposed ledges, and ridge tops; occasional. Northeastern intraneous. May, DBB, PH.

Rubus occidentalis L. Moist, open ledges; occasional. Northeastern intraneous. Sept. (sterile). Mc.

Rubus pennsylvanicus Poir. Rocky prairie slope; rare. Northeastern intraneous. May. Johnson County record. CC.

Rosa carolina L. Dry, rocky slopes and wooded ridge tops; occasional. Northeastern intraneous. May—July. Monroe County record. Val, F, PH, Mc, SS, CC, ECiR.

Amelanchier arborea (Michx.f.) Fern. Exposed ledges; occasional. Northeastern intraneous. April. Val, SVal, PH, SS, CC.

Prunus serotina Ehrh. Exposed or shaded slopes and ledges; occasional. May, F, PH.

Prunus virginiana L. Dry, rocky woods; rare. Northeastern extraneous. July (sterile). Hardin County record. ECiR.

Prunus angustifolia Marsh. Hill prairies; occasional. Southern extraneous. May (sterile). Monroe County record. F.

Prunus lanata (Sudw.) Mack. & Bush. Dry slopes and ledges; occasional. Central intraneous. April. Monroe County record. Val, SVal, PH, Mc, SS, CC, ECiR.

Prunus mexicana Wats. Dry, exposed ledge; rare. Southwestern extraneous. May (sterile). PH.

Malus ioensis (Wood) Britt. Hill prairies; occasional. Central intraneous. May (sterile). PH.

Crataegus calpodendron (Ehrh.) Medic. Dry, wooded slopes and ledges; occasional. Northeastern intraneous. May. Union County record. Mc, CC.

Crataegus engelmannii Sarg. Dry, rocky ridge tops and ledges; occasional. Southeastern extraneous. May (sterile). SS, CC, Shet.

Crataegus pruinosa (Wendl.) K. Koch. Dry, rocky woods on ledge; rare. Northeastern intraneous. July (sterile). Hardin County record. ECiR.

Potentilla recta L. Exposed ledges on bluff top; occasional. Introduced from Europe. June. Monroe County record. F.

Fragaria virginiana Duch. Rocky slopes and ledges; occasional. Northeastern intraneous. May. Johnson County record. CC, HC.

Geum canadense Jacq. Shaded slopes and ledges; occasional. Northeastern intraneous. July. F, DBB, PH.

Agrimonia parviflora Ait. Dry, rocky slopes and ledges; occasional. Northeastern intraneous. Aug. DBB.

Agrimonia pubescens Wallr. Dry slopes and ledges; occasional. Northeastern intraneous. July, Aug. DBO.

Agrimonia rostellata Wallr. Dry, rocky wooded slopes; occasional. Northeastern intraneous. July. Shet, ECiR.

FAMILY LEGUMINOSAE

Cercis canadensis L. Hill prairies, ledges, exposed or shaded slopes; common. Northeastern intraneous. April. NVal, Val, F, PduR, DBO, DBB, PH, Mc, SS, CC, Shet, ECiR, HC.

Amorpha fruticosa L. Exposed base of Devil's Bake Oven; occasional. Central intraneous. June. DBO.

Amorpha canescens Pursh. Hill prairies and rocky wooded slopes; occasional. Northwestern extraneous. July. SVal.

Robinia pseudoacacia L. Dry, wooded bluff top; rare. Southeastern extraneous. May. Shet.

Gleditsia triacanthos L. Dry slopes and ledges; occasional. Northeastern intraneous. June (sterile). Val, SVal, F, DBO, PH, CC, Shet.

Gymnocladus dioica (L.) K. Koch. Talus and mesic wooded slopes; occasional. Northeastern intraneous. May. Hardin County record. F, PH, Mc, Shet.

Stylosanthes biflora (L.) Taub. Dry upland woods; rare. Southern extraneous. May. PH.

Cassia hebecarpa Fern. Mesic slopes and ledges; rare. Northeastern intraneous. July, Aug. Hardin County record. PH, Shet.

Cassia fasciculata Michx. Exposed or shaded dry slopes and ledges; common. Northeastern intraneous. July—Oct. Val, SVal, F, PduR, DBO, DBB, PH, SS, CC, Shet.

Cassia nictitans L. Dry, rocky open woods on bluff top; occasional. Northeastern intraneous. Aug. PduR.

Trifolium procumbens L. Exposed ledges; occasional. Introduced from Europe. June. DBO, Shet.

Melilotus alba L. Hill prairies and exposed ledges; occasional to common. Introduced from Europe. July, Aug. NVal, Val, SVal, F, DBO, DBB, PH, Shet.

Melilotus officinalis L. Hill prairies and exposed ledges; occasional. Introduced from Europe. May, June. Val, SVal, F, DBO, PH.

Petalostemum candidum (Willd.) Michx. Hill prairies; occasional to common. Central intraneous. June, July. NVal, Val, SVal, F, PduR, PH.

Petalostemum purpureum (Vent.) Rydb. Hill prairies; occasional to common. Central intraneous. July, Aug. NVal, Val, SVal, F, PduR, PH.

Lespedeza stipulacea Maxim. Exposed ledges; occasional. Introduced from eastern Asia. Oct. DBO.

Lespedeza hirta (L.) Hornem. Dry, rocky slopes; rare. Northeastern intraneous. Sept. PH.

Lespedeza capitata Michx. Hill prairies; common. Northeastern intraneous. The specimens from Scanlin Spur and Cave Creek belong to var. *vulgaris* Torrey & Gray, var. *stenophylla* Bissell & Fern., var. *stenophylla* forma *argentea* Fern., or the typical variety. Those from the northern bluffs are all referable to var. *stenophylla* forma *argentea*. Aug.—Oct. Val, F, PduR, SS, CC.

Lespedeza violacea (L.) Pers. Dry slopes and ledges; common. Northeastern intraneous. Aug., Sept. Val, F, DBB, PH, Mc, SS, CC, Shet.

Lespedeza intermedia (Wats.) Britt. Dry wooded slopes; rare. Northeastern intraneous. Sept. PH.

Lespedeza virginica (L.) Britt. Dry slopes and ledges; occasional. Northeastern intraneous. Aug., Sept. Val, F, PduR, PH, SS.

Lespedeza stuevei Nutt. Dry, wooded slopes; rare. Southeastern extraneous.

Aug., Sept. Union County record. DBB, PH.

Desmodium glutinosum (Muhl.) Wood. Mesic slopes and ledges; occasional. Northeastern intraneous. June, July. Val, SVal, F, Mc.

Desmodium sessilifolium (Torr.) Torrey & Gray. Hill prairies; occasional to common. Northeastern intraneous. Aug., Sept. NVal, Val, SVal, PduR, SS, CC.

Desmodium cuspidatum (Muhl.) Loud. Talus slopes and ledges; occasional. Northeastern intraneous. Aug., Sept. Randolph County record. PduR, PH.

Desmodium canescens (L.) DC. Rocky slopes; occasional. Northeastern intraneous. Sept. Mc.

Desmodium paniculatum (L.) DC. Dry slopes and ledges; occasional. Northeastern intraneous. Aug., Sept. PduR, DBO, DBB, Shet.

Desmodium ciliare (Muhl.) DC. Hill prairies; occasional to common. Southeastern extraneous. Aug., Sept. Val, F, SS.

Desmodium rigidum (Ell.) DC. Dry slopes and ledges; occasional. Northeastern intraneous. Aug., Sept. Jackson and Union County records. DBO, PH.

Desmodium viridiflorum (L.) DC. Dry slope; rare. Northeastern intraneous. Sept. Mc.

Desmodium canadense (L.) DC. Hill prairies; occasional. Northeastern extraneous. Sept. Monroe County record. NVal, SVal.

Desmodium dillenii Darl. Dry, rocky slope; rare. Northeastern intraneous. Sept. Hardin County record. Shet.

Psoralea tenuiflora Pursh. Hill prairies; occasional to common. Central intraneous. June. Val, SVal, F.

Phaseolus polystachios (L.) BSP. Dry upland woods; rare. Northeastern intraneous. July. Val.

Galactea volubilis (L.) Britt. var. *mississippiensis* Vail. Dry slopes and ledges in the open; occasional. Southern extraneous. Aug. Monroe County record. Val, F, DBB, PH, SS, CC, Shet.

Amphicarpa bracteata (L.) Fern. Dry, rocky slope; rare. Northeastern intraneous. Sept. Hardin County record. Shet.

FAMILY OXALIDACEAE

Oxalis violacea L. Exposed ledges and rocky slopes; common. Northeastern intraneous. April, Sept. NVal, Val, F, PduR, DBO, DBB, PH, Mc, SS, CC, Shet, ECIR.

Oxalis europaea Jord. Exposed ledges; common. Northeastern intraneous. Vari-

ous forms of the typical variety and var. *bushii* (Small) Wieg. were collected. June—Oct. SVal, F, DBB, PH, Mc, CC, Shet, ECiR.

Oxalis stricta L. Exposed ledges; occasional. Northeastern intraneous. May—Sept. Val, DBO, Shet.

FAMILY GERANIACEAE

Geranium carolinianum L. Exposed ledges; occasional. Northeastern intraneous. May, June. F, DBO, Shet.

Geranium maculatum L. Mesic slopes and ledges; occasional. Northeastern intraneous. May. PH, SS, CC.

FAMILY LINACEAE

Linum sulcatum Riddell. Exposed bluff top ledges and hill prairies; occasional to common. Central intraneous. July—Sept. NVal, Val, F, PduR.

FAMILY BALSAMINACEAE

Impatiens biflora Walt. Moist slopes and ledges; occasional to common. Northeastern intraneous. July, Aug. PH, Mc, Shet.

Impatiens pallida Nutt. Moist slopes and ledges; occasional. Northeastern intraneous. July, Aug. PH, Mc.

FAMILY RUTACEAE

Ptelea trifoliata L. Exposed rocky slopes and ledges, hill prairie; occasional. Northeastern intraneous. May. Val, SVal, F, PduR.

Xanthoxylum americanum Mill. Dry, rocky wooded slope; occasional. Northeastern intraneous. April. Hardin County record. Shet.

FAMILY SIMAROUBACEAE

Ailanthus altissima (Mill.) Swingle. Talus slope; occasional. Introduced from eastern Asia. May. F, PduR.

FAMILY EUPHORBIACEAE

Euphorbia supina Raf. Exposed ledges; common. Northeastern intraneous. July—Oct. Val, SVal, F, DBO, PH, SS, Shet.

Euphorbia maculata L. Talus slopes and exposed ledges; common. Northeastern intraneous. July—Oct. NVal, Val, SVal, F, DBO, DBB, PH, SS, CC, Shet.

Euphorbia corollata L. Hill prairies and dry slopes; occasional to common.

Northeastern intraneous. June—Sept. Val, SVal, F, PduR, DBO, PH, SS, CC, Shet.

Euphorbia dentata Michx. Talus slopes and exposed ledges; occasional. Central intraneous. July—Oct. Val, F, DBO, DBB, PH, Mc, Shet.

Euphorbia heterophylla L. Talus slope; rare. Central intraneous. Aug. PH.

Euphorbia dictyosperma Fisch. & Mey. Exposed ledges on bluff top; occasional. Southwestern extraneous. State record. F.

Croton monanthogynus Michx. Exposed ledges; common. Central intraneous. July—Oct. Val, SVal, F, PduR, DBO, DBB, PH, Mc, Shet.

Acalypha rhomboidea Raf. Shaded ledges; rare. Northeastern intraneous. July. F, Mc.

Acalypha gracilens Gray. Talus slopes and exposed or shaded ledges; occasional to common. Northeastern intraneous. July—Sept. Monroe County record. Val, F, DBO, PH, Mc, CC, CiR.

Acalypha virginica L. Talus slopes and exposed or shaded ledges; occasional to common. Northeastern intraneous. July—Oct. Val, DBO, DBB, PH, Mc, SS, Shet, ECiR.

Tragia cordata Michx. Rocky slopes and ledges; occasional. Southeastern extraneous. June—Sept. Hardin County record. Shet.

FAMILY HIPPOCASTANACEAE

Aesculus glabra Willd. Mesic slopes and ledges; occasional. Central intraneous. May. Val, PH, Mc.

FAMILY RHAMNACEAE

Ceanothus americanus L. Hill prairies and dry, rocky slopes; occasional. Northeastern intraneous. May. Val, SVal, F, PH, CC.

Rhamnus caroliniana Walt. Rocky slopes and ledges; occasional. Southeastern extraneous. May. Val, F, DBO, Shet.

Rhamnus lanceolata Pursh var. *glabrata* Gl. Dry slopes and ledges; rare. Central intraneous. May. Monroe County record. SVal.

FAMILY VITACEAE

Ampelopsis cordata Michx. Talus slopes and ledges; occasional. Southern extraneous. June (sterile). SVal, PH, Mc, Shet.

Parthenocissus quinquefolia (L.)

Planch. Slopes and ledges; common. Northeastern intraneous. July. NVal, Val, SVal, F, PduR, DBO, DBB, PH, Mc, SS, CC, Shet, HC.

Vitis cinerea Engelm. Dry ridge top; occasional. Central intraneous. Sept (sterile). PH.

Vitis aestivalis Michx. Dry slopes and ledges; occasional. Northeastern intraneous. May. PH, SS.

Vitis riparia Michx. Exposed ledge; rare. Northeastern intraneous. Sept. (sterile). Val.

Vitis vulpina L. Exposed ledges; occasional. Northeastern intraneous. May—June. Val, PduR, PH, Mc.

FAMILY TILIACEAE

Tilia americana L. Dry or moist slopes and ledges; occasional. Northeastern intraneous. May, June. Val, SVal, F, DBO, Mc.

FAMILY MALVACEAE

Sida spinosa L. Exposed ledge; rare. Introduced from tropical America. Sept. Shet.

FAMILY HYPERICACEAE

Hypericum punctatum Lam. Dry slopes and ledges; occasional. Northeastern intraneous. June, July. Val, F, DBO, PH, SS, Shet.

Hypericum sphaerocarpum Michx. Dry slopes and ledges; occasional. Central intraneous. June—Aug. Hardin County record. F, SS, CC, ECiR.

FAMILY VIOLACEAE

Hybanthus concolor (T. F. Forst) Spreng. Mesic slopes and ledges; occasional. Northeastern intraneous. May. PH, Mc, SS, Shet.

Viola rafinesquii Greene. Exposed ledges; occasional. Northeastern intraneous. April. PduR, DBO, DBB, PH, Shet, HC.

Viola papilionacea Pursh. Mesic slopes and ledges; occasional. Northeastern extraneous. April. DBB.

Viola pedata L. Rocky slopes; occasional. Northeastern intraneous. April. PH.

Viola sagittata Ait. Mesic slopes and ledges; occasional. Northeastern intraneous. April. DBO.

Viola sororia Willd. Mesic slopes and ledges; occasional. Northeastern intraneous. April. CC, ECiR.

FAMILY CELASTRACEAE

Euonymus atropurpureus Jacq. Wooded slopes and ledges; occasional. Northeastern intraneous. June. Val, F, PH, Mc, CC.

Celastrus scandens L. Slopes and ledges; occasional. Northeastern intraneous. May. Val, SVal, F, PduR, DBO, PH, Mc, SS, CC, Shet.

FAMILY AQUIFOLIACEAE

Ilex decidua Walt. Rocky woods and ledges; occasional. Southern extraneous. May. F, DBO, DBB, PH, SS.

Ilex verticillata (L.) Gray. Dry, rocky slope; rare. Northeastern intraneous. July (in fruit). Johnson County record. SS.

FAMILY ANACARDIACEAE

Rhus aromatica Ait. Dry ridge tops and ledges; occasional to common. Northeastern intraneous. April. NVal, Val, SVal, F, PduR, DBO, DBB, PH, SS, CC.

Rhus copallina L. Dry ridge tops; occasional. Northeastern intraneous. May. SVal, F, PduR, DBO, PH, SS.

Rhus glabra L. Dry ridge tops; occasional. Northeastern intraneous. June. Val, SVal, F, PduR, DBO, DBB, PH.

Rhus radicans L. Shaded or exposed slopes and ledges; common to abundant. Northeastern intraneous. May, June. NVal, Val, SVal, F, PduR, DBO, DBB, PH, Mc, SS, CC, Shet, CiR, ECiR, HC.

FAMILY STAPHYLEACEAE

Staphylea trifolia L. Mesic slopes and ledges; occasional. Northeastern intraneous. April. Val, PH, Mc, Shet, HC.

FAMILY ACERACEAE

Acer negundo L. Talus and rocky slopes; rare to occasional. Northeastern intraneous. Sept. (sterile). PH, CC.

Acer rubrum L. Dry ridge top; rare. Northeastern intraneous. July (sterile). DBB.

Acer saccharum Marsh. Dry or moist slopes and ledges; common. Northeastern intraneous. April. NVal, Val, SVal, F, PduR, DBB, PH, Mc, SS, CC, Shet, ECiR, HC.

FAMILY LYTHRACEAE

Cuphea petiolata (L.) Koehne. Shaded.

rocky slopes; rare. Northeastern intraneous. Sept. Shet.

FAMILY PASSIFLORACEAE

Passiflora lutea L. Dry slopes and ledges; occasional. Southern extraneous. June, July. Val, F, DBO, PH, Mc, Shet.

FAMILY CACTACEAE

Opuntia rafinesquii Engelm. Exposed ledges; occasional. Northeastern intraneous. June. SVal, F, PduR, DBO, DBB, PH.

FAMILY LOASACEAE

Mentzelia oligosperma Nutt. Exposed ledges on bluff tops; occasional. Southwestern extraneous. June, July. SVal, F, PduR.

FAMILY CUCURBITACEAE

Sicyos angulatus L. Talus slopes; occasional. Northeastern intraneous. Sept., Oct. Val, F, PH, Mc.

FAMILY ONAGRACEAE

Oenothera biennis L. Exposed slopes and ledges; occasional. Northeastern intraneous. Aug. Val, DBO, DBB.

Oenothera laciniata Hill. Exposed ledges on bluff tops; occasional. Northeastern intraneous. May, June. F, PduR.

Gaura biennis L. Hill prairies; occasional. Northeastern intraneous. Aug. SVal.

Circaea latifolia Hill. Mesic slopes and ledges; occasional. Northeastern intraneous. June. PH, Mc.

FAMILY CORNACEAE

Cornus florida L. Exposed or shaded slopes and ledges; occasional. Northeastern intraneous. April, May. NVal, Val, SVal, F, PduR, DBO, DBB, PH, Mc, SS, CC, Shet.

FAMILY NYSSACEAE

Nyssa sylvatica Marsh. Slopes and ledges; occasional. Northeastern intraneous. May. PH, Mc.

FAMILY ARALIACEAE

Aralia spinosa L. Mesic slopes and ledges; occasional. Southeastern extraneous. Sept. (in fruit). PH.

FAMILY UMBELLIFERAE

Sanicula canadensis L. Shaded slopes and ledges; occasional to common. Northeastern intraneous. May. F, PduR, DBO, DBB, PH, CC, Shet, ECiR.

Torilis japonica (Houtt.) DC. Exposed slopes and ledges; rare. Naturalized from Eurasia. June, July. DBO, DBB, PH, Mc.

Daucus carota L. Exposed slopes and ledges; rare. Naturalized from Europe. July, Aug. DBO, DBB.

Zizia aurea (L.) Koch. Rocky prairie slopes; occasional. Northeastern intraneous. May. SS, CC.

Taenidia integrissima (L.) Drude. Dry, rocky woods; occasional. Northeastern intraneous. May. PH, Mc, CC.

Polytaenia nuttallii DC. Hill prairies; occasional. Central intraneous. May, June. SVal, F, PH.

FAMILY ERICACEAE

Vaccinium vacillans Torr. Dry, rocky woods above limestone ledges; occasional. Northeastern intraneous. May. PH.

Vaccinium arboreum Marsh. Dry woods above limestone ledges; occasional. Southern extraneous. May. PH.

Rhododendron roseum (Loisel) Rehd. Dry woods and bluff top ledges; rare. Northeastern extraneous. May. PH.

Rhododendron nudiflorum (L.) Torr. Dry woods and bluff top ledges; rare. Northeastern extraneous. May. PH.

FAMILY PRIMULACEAE

Androsace occidentalis Pursh. Exposed bluff top ledges; occasional. Northwestern extraneous. April. Jackson County record. Val, F, DBO.

Samolus parviflorus Raf. Low, moist ledge; rare. Northeastern intraneous. July. Mc.

Dodecatheon meadia L. Dry, shaded bluff top ledges and slopes; occasional. Northeastern intraneous. April, May. DBB, PH, Mc, SS, CC, ECiR, HC.

Lysimachia ciliata L. Talus slope; occasional. Northeastern intraneous. June. PH.

Lysimachia lanceolata Walt. Shaded ledges; occasional. Northeastern intraneous. July. DBB.

FAMILY GENTIANACEAE

Gentiana puberula Michx. Dry bluff top woods; rare. Central intraneous. Oct. Randolph County record. PduR.

Frasera carolinensis Walt. Rocky prairie slope at Scanlin Spur station; occasional. Northeastern intraneous. May. SS.

FAMILY SAPOTACEAE

Bumelia lanuginosa (Michx.) Pers. Dry slopes and ledges; occasional. Southwestern extraneous. July. Val, F.

Bumelia lycioides (L.) Gaertn. Dry slopes and ledges; occasional. Southern extraneous. July. Shet.

FAMILY EBENACEAE

Diospyros virginiana L. Dry slopes and ledges; occasional. Northeastern intraneous. May. Val, F, DBO, PH, SS, CC.

FAMILY OLEACEAE

Fraxinus americana L. Dry or moist slopes and ledges; occasional. Northeastern intraneous. (*). Val, F, PduR, DBO, PH, Mc, SS, CC, Shet.

Fraxinus quadrangulata Michx. Exposed ledges and dry slopes; occasional. Central intraneous. April. Monroe County record. Val, SVal, F, PH.

FAMILY APOCYNACEAE

Amsonia tabernaemontana Walt. Moist or dry rocky slopes; occasional. Southern extraneous. May. Shet, ECiR, HC.

Apocynum cannabinum L. Dry slopes and ridge tops; occasional. Northeastern intraneous.

FAMILY ASCLEPIADACEAE

Gonolobus gonocarpus (Walt.) Perry. Shaded dry ledge; rare. Southern extraneous. July. Shet.

Ampelamus albidus (Nutt.) Britt. Shaded dry ledges; occasional. Southern extraneous. July. Shet.

Asclepias tuberosa L. Prairies and dry ridge top woods; occasional. Northeastern intraneous. June, SVal, DBO, DBB, PH, SS.

Asclepias amplexicaulis Sm. Hill prairie; rare. Northeastern intraneous. May. PduR.

Asclepias verticillata L. Rocky prairie slopes; occasional. Northeastern intraneous. June. SS, CC.

Acerates viridiflora (Raf.) Eaton. Prairie slopes and ledges; occasional. Southeastern extraneous. June—Aug. Val, SVal, F, PH, CC.

FAMILY CONVULVACEAE

Ipomoea pandurata (L.) Meyer. Dry slopes and ledges; occasional. Northeastern intraneous. June. PH, Shet.

FAMILY POLEMONIACEAE

Phlox bifida Beck. Exposed ledges and talus slopes; occasional to common. Central intraneous. April—Oct. F, PduR, DBO, DBB, PH.

Phlox divaricata L. Mesic slopes and ledges; occasional. Northeastern intraneous. April, May. Val, F, PH, Mc, CC, ECiR.

Phlox pilosa L. Prairie slopes; occasional. Northeastern intraneous. May. SS, CC.

FAMILY HYDROPHYLLACEAE

Hydrophyllum appendiculatum Michx. Mesic slopes and ledges; occasional. Northeastern intraneous. May. Mc.

Phacelia bipinnatifida Michx. Mesic slopes and ledges; occasional. Southeastern extraneous. May. NVal.

Phacelia purshii Buckley. Talus slopes; occasional to common. Central intraneous. May, June. F, PH.

FAMILY BORAGINACEAE

Onosmodium hispidissimum Mack. Dry ridge tops; rare. Central intraneous. July. DBO, Shet.

Heliotropium tenellum (Nutt.) Torr. Dry bluff top ledges and prairies; occasional to common. Southern extraneous. July, Aug. SVal, F.

Hackelia virginiana (L.) I. M. Johnston. Talus slopes; occasional. Northeastern intraneous. July, Aug. Monroe County record. F, PH.

Myosotis macrosperma Engelm. Mesic slopes and ledges; occasional. Southeastern extraneous. May. PH, Shet.

Myosotis verna Nutt. Exposed ledges; occasional. Northeastern extraneous. April, May. NVal, Val, PH, DBB.

Lithospermum canescens (Michx.) Lehm. Prairie slopes; occasional to common. Central intraneous. April, May. NVal, Val, F, PduR, PH, Mc, SS, CC.

Lithospermum incisum Lehm. Exposed ledges on bluff top; occasional. Northeastern extraneous. April—June. F.

Lithospermum arvense L. Exposed ledges on bluff top; occasional. Introduced from Europe. May. Val, F.

FAMILY VERBENACEAE

Verbena canadensis (L.) Britt. Dry bluff top ledges; occasional. Southeastern extraneous. April—Oct. F, PH.

Verbena simplex Lehm. Exposed ledges on bluff tops; occasional. Northeastern intraneous. May—July. Val, SVal, F, PduR.

Verbena stricta Vent. Exposed ledges; occasional. Central intraneous. June—Aug. SVal, F, PduR, DBO, DBB.

Verbena urticifolia L. Talus slopes and dry ledges; occasional. Central intraneous. June, July. PH, Shet.

FAMILY PHRYMACEAE

Phryma leptostachya L. Shaded talus slopes and ledges; occasional. Northeastern intraneous. July. PH.

FAMILY LABIATAE

Salvia pitcheri Torr. Rocky prairie slope; common. Northwestern extraneous. Sept. Johnson County record. CC.

Leonurus cardiaca L. Talus slopes and low ledges; rare. Introduced from central Asia. July, Dec. PH, DBO.

Scutellaria elliptica Muhl. Dry woods; occasional. Northeastern intraneous. Aug. Randolph County record. PduR, Shet.

Scutellaria parvula Michx. Dry ledges on bluffs; occasional. Northeastern intraneous. All specimens appear to be var. *parvula*. May. Monroe County record. SVal, PduR, PH, CC.

Scutellaria ovata Hill. Dry slopes and ledges; occasional. Northeastern intraneous. The large var. *versicolor* (Nutt.) Fern. was found on shaded slopes at DBB, Mc, and Shet. The smaller var. *rugosa* (Wied) Fern. occurred in more exposed situations at Val, F, and PH. June—Aug. Val, F, DBB, PH, Mc, Shet.

Monarda bradburiana Beck. Rocky slopes; occasional. Central intraneous. May. SVal, F, PH, SS, CC.

Monarda fistulosa L. Rocky slopes; occasional. Northeastern intraneous. June, July. Val, SVal, DBB, PH, SS.

Marrubium vulgare L. Talus slopes; rare. Naturalized from Europe. May—July. PH.

Lamium amplexicaule L. Exposed ledges; occasional. Introduced from Eurasia. April. Hardin County record. Shet, CiR.

Blephilia ciliata (L.) Benth. Rocky slopes and ledges; occasional. Northeastern intraneous. June. Hardin County record. DBO, Shet.

Blephilia hirsuta (Pursh) Benth. Shaded rocky slope; rare. Northeastern intraneous. July. CiR.

Stachys palustre L. var. *nipigonensis* Jennings. Talus slope; rare. Northeastern extraneous. Aug. F.

Cunila origanoides (L.) Britt. Dry slopes above limestone ledges; rare on limestone. Northeastern intraneous. Sept. PH, Mc.

Pycnanthemum pilosum Nutt. Exposed ledges; occasional. Central intraneous. Aug. NVal, SVal, F.

Teucrium canadense L. Exposed ledges; occasional. Northeastern intraneous. July. DBO, DBB.

Collinsonia canadensis L. Shaded ledge; rare. Northeastern intraneous. Sept. Mc.

Physostegia virginiana (L.) Benth. Prairie slopes; occasional to common. Northeastern intraneous. Sept. Oct.

Hedeoma hispida Pursh. Exposed ledges on bluff top; common. Northeastern intraneous. April. F.

Hedeoma pulegioides (L.) Pers. Dry slopes and ledges; occasional. Northeastern intraneous. Aug., Sept. PH, Shet.

Isanthus brachiatus (L.) BSP. Exposed ledges; occasional. Northeastern intraneous. Aug. Val, SVal, F, DBO, PH.

FAMILY SOLANACEAE

Physalis heterophylla Nees. Hill prairie; rare. Northeastern extraneous. May. Randolph County record. PduR.

Physalis pubescens L. Exposed ledges; occasional. Southern extraneous. July—Sept. Monroe and Hardin County records. SVal, F, PH, Mc, Shet.

Physalis virginiana Mill. Exposed ledges and prairie slopes; occasional. Northeastern intraneous. May, Sept. PH, SS, CC.

Solanum carolinense L. Exposed ledges; occasional. Northeastern intraneous. June. Shet.

Solanum nigrum L. Shaded or exposed ledges and talus slopes; occasional. Introduced from Eurasia. Several of the author's specimens are referable to *S. americanum* Mill., but since the distinctions between these species are not clearly marked among the specimens collected, all are here included in *S. nigrum* L. Aug.—Oct. Monroe and Hardin County records. F, PH, Mc, CC, Shet.

FAMILY SCROPHULARIACEAE

Veronica peregrina L. Exposed ledges; occasional. Northeastern intraneous. May. DBB, PH, Mc, Shet.

Veronica arvensis L. Exposed ledges; occasional. Introduced from Europe. May. NVal, Val, Shet.

Seymeria macrophylla Nutt. Dry slopes and talus; occasional. Central intraneous. July. DBB, PH, Shet.

Aureolaria flava (L.) Farwell. Dry ridge top woods; occasional. Northeastern intraneous. Aug. Monroe County record. Val, F, PduR, PH, Mc.

Gerardia aspera Dougl. Hill prairies; rare. Northwestern extraneous. Sept. NVal, Val.

Gerardia tenuifolia Vahl. Exposed ledges and hill prairies; occasional. Northeastern intraneous. Sept., Oct. Val, F, PduR.

Scrophularia marilandica L. Talus slopes and lower ledges; occasional. Northeastern intraneous. July, Aug. Hardin County record. F, PH, Shet.

Penstemon pallidus Small. Dry slopes and ledges; occasional. Northeastern intraneous. May, June. F, PH, Mc, SS, CC.

Penstemon deamii Pennell. Exposed ledge; rare. Central intraneous. June. Monroe County record. SVal.

Penstemon digitalis Nutt. Wooded slopes; occasional. Northeastern intraneous. June. Shet.

Buchnera americana L. Hill prairies and ledges; occasional. Southeastern extraneous. June—Aug., Oct. Randolph County record. SVal, F, PduR.

Veronicastrum virginicum (L.) Farwell. Ridge top woods; occasional. Northeastern intraneous. July, Aug. Val, SVal, F.

Verbascum thapsus L. Exposed ledges and talus slopes; occasional. Introduced from Europe. June, July. Val, SVal, F, PH.

FAMILY ACANTHACEAE

Ruellia humilis Nutt. Hill prairies and exposed ledges; occasional to common. Northeastern intraneous. June—Aug. Val, SVal, F, DBO, PH, CC, Shet.

Ruellia strepens L. Talus slope; occasional. Northeastern intraneous. Oct. (in fruit). Monroe County record. F.

Ruellia carolinensis (Walt.) Steud. Wooded slopes; occasional. Southeastern extraneous. May, Sept. Monroe and Johnson County records. F, CC, Shet.

Ruellia pedunculata Torr. Shaded ledge; rare. Southeastern extraneous. June. Mc.

Dicliptera brachiata (Pursh) Spreng. Shaded rocky slopes; occasional. Southern extraneous. Sept., Oct. Shet.

FAMILY OROBANCHACEAE

Epifagus virginiana (L.) Barton. Dry upland woods; rare. Northeastern intraneous. Sept. (in fruit). Mc.

Orobanche uniflora L. Exposed bluff top ledges; occasional to rare. Northeastern intraneous. May, June. Monroe County record. NVal, F.

FAMILY BIGNONIACEAE

Campsis radicans (L.) Seem. Exposed ledges; common. Northeastern intraneous. June, July. Monroe County record. Val, SVal, F, PduR, DBO, DBB, PH, Mc, CC, Shet, CiR.

Bignonia capreolata L. Dry slopes and ledges; occasional. Southern extraneous. May. Mc, SS, Shet, CiR, ECiR.

Catalpa speciosa Warder. Dry bluff top; rare. Southern extraneous. July. Shet.

FAMILY PLANTAGINACEAE

Plantago aristata Michx. Exposed ledges; occasional. Northeastern intraneous. June. F, DBB.

Plantago virginica L. Exposed ledges; occasional. Northeastern intraneous. May. NVal, F, Shet.

FAMILY RUBIACEAE

Galium circaeazans Michx. Dry wooded slopes; occasional. Northeastern intraneous. May—Sept. Val, F, DBB, PH, SS, Shet, ECiR.

Galium concinnum Torrey & Gray. Prairie slope; rare. Northeastern intraneous. July. CC.

Galium virgatum Nutt. Exposed ledges; occasional to common. Southern extraneous. April. F.

Galium aparine L. Slopes and ledges; occasional. Northeastern intraneous. May. NVal, Val, F, DBO, PH, Mc, CC, SS, Shet.

Galium lanceolatum Torr. Wooded ridge; rare. Northeastern intraneous. Oct. (in fruit). F.

Galium pilosum Ait. Dry ridge top woods; occasional. Northeastern intraneous. June, July. F, PH, SS.

Houstonia nigricans (Lam.) Fern. Hill prairies and exposed ledges; common. Southern extraneous. June—Aug. Val, SVal, F, PH.

Houstonia lanceolata (Poir.) Britt. Prairie slope; rare. Northeastern intraneous. May. CC.

Houstonia longifolia Gaertn. Prairie

slope; rare. Northeastern intraneous. May. SS.

Houstonia tenuifolia Nutt. Hill prairies and exposed ledges; occasional. Southeastern extraneous. May. Val, F, PH.

FAMILY CAPRIFOLIACEAE

Symphoricarpos orbiculatus Moench. Dry, wooded slopes and bluff tops; occasional. Northeastern intraneous. July. Union County record. Val, SVal, F, PH, SS, Shet.

Lonicera japonica Thunb. Slopes and ledges; occasional. Naturalized from Asia. June. Hardin County record. DBO, PH, SS, Shet.

Viburnum rufidulum Raf. Exposed ledges and dry bluff tops; occasional. Southern extraneous. May. NVal, Val, SVal, F, PduR, DBO, DBB, PH.

FAMILY CAMPANULACEAE

Specularia biflora (Ruiz & Pavon) Fisch. & Mey. Exposed ledges; rare. Southern extraneous. Monroe and Union County records. SVal, PH.

Specularia perfoliata (L.) A. DC. Exposed ledges and talus slopes; occasional. Northeastern intraneous. May. F, PH, Shet.

Lobelia spicata Lam. Prairie slopes; occasional. Northeastern intraneous. July. Johnson County record. CC.

Campanula americana L. Mesic slopes and ledges; occasional. Northeastern intraneous. July—Oct. SVal, F, DBB, PH, Me, CC, Shet.

Valerianella radiata (L.) Dufr. Dry ledge in a weedy situation; occasional. Southern extraneous. May. Hardin County record. HC.

FAMILY COMPOSITAE

Krigia oppositifolia Raf. Rocky, wooded slopes; occasional. Southern extraneous. May. Shet.

Hieracium gronovii L. Dry upland woods; rare on limestone. Northeastern intraneous. July. Me.

Lactuca scariola L. Exposed ledges; occasional. Introduced from Europe. Aug. SVal, DBB.

Lactuca floridana (L.) Gaertn. Mesic slopes and ledges; occasional. Northeastern intraneous. July—Sept. Hardin County record. DBB, PH, Shet.

Lactuca ludoviciana (Nutt.) DC. Exposed ledge; rare. Northwestern extraneous. Aug. Monroe County record. F.

Tragopogon porrifolius L. Exposed ledge; rare. Introduced from Europe. May (in fruit). Monroe County record. F.

Erigeron annuus (L.) Pers. Slopes and ledges; occasional. Northeastern intraneous. June, July, Sept. Val, SVal, DBB, PH, Me.

Erigeron strigosus Muhl. Prairies and dry slopes; occasional to common. Northeastern intraneous. May—Sept. Val, F, DBO, PH, CC, Shet.

Erigeron philadelphicus L. Talus slopes; occasional. Northeastern intraneous. May. Val, F, PH.

Erigeron canadensis L. Exposed ledges and talus slopes; occasional. Northeastern intraneous. Aug. Val, F, DBO, DBB, PH.

Eupatorium altissimum L. Hill prairies and dry slopes; occasional. Central intraneous. Aug., Sept. Hardin County record. Val, F, PduR, DBB, PH, SS, CC, Shet.

Eupatorium rugosum Houtt. Mesic slopes and ledges; occasional. Northeastern intraneous. July—Oct. Val, F, DBB, PH, Me, Shet.

Eupatorium serotinum Michx. Exposed ledge; rare. Southeastern extraneous. Aug. DBO.

Xanthium commune Britt. Sandy ledges at base of Devil's Bake Oven; rare on limestone. Northeastern intraneous. Aug. Jackson County record. DBO.

Cirsium altissimum (L.) Spreng. Dry slope; rare. Northeastern extraneous. Sept. PH.

Cirsium discolor (Muhl.) Spreng. Dry slopes and ledges; occasional. Northeastern intraneous. Aug. Hardin County record. DBB, Shet.

Liatris cylindracea Michx. Hill prairies and ledges; occasional. Northeastern extraneous. Aug., Sept. Union County record. Val, SVal, F, PH.

Liatris aspera Michx. Hill prairies and ledges; occasional. Northeastern intraneous. Sept. Val, PH.

Liatris scabra (Greene) K. Schum. Prairie slopes; occasional. Southern extraneous. Sept. SS, CC.

Aster anomalus Engelm. Dry wooded or exposed slopes and ledges; occasional. Southwestern extraneous. Sept. Val, PH, Me.

Aster shortii Lindl. Rocky wooded slopes; occasional. Central intraneous. Sept., Oct. Hardin County record. Shet.

Aster drummondii Lindl. Prairie slopes; occasional. Central intraneous. Oct. F.

Aster texanus Burgess. Dry bluff top; rare. Southwestern extraneous. Sept. State record. Val.

Aster sagittifolius Wedemeyer. Dry, rocky slopes and ledges; occasional. Northeastern intraneous. Sept., Oct. Val, SS, CC.

Aster azureus Lindl. Exposed ledges and hill prairies; occasional. Central intraneous. Sept., Oct. NVal, Val, F.

Aster laevis L. Prairie slopes; occasional. Northeastern intraneous. Monroe County record. SS, Val.

Aster patens Ait. Exposed ledges and prairie slopes; occasional. Northeastern intraneous. Aug.—Oct. Val, PduR, SS, CC.

Aster oblongifolius Nutt. Exposed ledges and prairie slopes; occasional to common. Central intraneous. July—Oct. Val, SVal, F, PduR, SS, CC.

Aster lateriflorus (L.) Britt. Dry wooded slope; rare. Northeastern intraneous. Sept. Hardin County record. Shet.

Aster pilosus Willd. Exposed ledges; occasional. Northeastern intraneous. Oct. Val, F, DBB.

Aster turbinellus Lindl. Exposed ledges; occasional. Southwestern extraneous. Sept. PH.

Aster ericoides L. Exposed ledges; occasional. Northeastern intraneous. Sept., Oct. Monroe, Jackson, and Hardin County records. Val, DBO, Shet.

Aster exiguus (Fern.) Rydb. Exposed ledges; occasional. Northeastern intraneous. Sept. Val.

Aster dumosus L. Exposed ledges and prairie slopes; occasional. Northeastern intraneous. Oct. Monroe County record. Val.

Kuhnia eupatorioides L. Prairie slopes and ledges; common. Southern extraneous. July—Oct. Val, F, PduR, DBO, PH, SS, CC, CiR.

Vernonia altissima Nutt. Prairie slopes; occasional. Southern extraneous. Sept. SS.

Vernonia baldwinii Torr. Dry slopes and ledges; occasional. Southwestern extraneous. July, Aug. SVal, PduR, DBB.

Echinacea pallida Nutt. Prairie slopes; occasional to common. Central intraneous. May, June. NVal, Val, SVal, PduR, F, PH, SS, CC.

Bidens bipinnata L. Exposed ledges; occasional. Northeastern intraneous. July—Sept. Monroe County record. F, DBB, PH, Shet.

Polymnia canadensis L. Talus slopes and ledges; occasional to common. Northeastern intraneous. June—Oct.

Hardin County record. Val, F, PH, ECiR.

Verbesina virginica L. Rocky wooded slopes; occasional. Southern extraneous. Sept. Hardin County record. SS, CC, Shet.

Verbesina alternifolia (L.) Britt. Talus slopes; occasional. Northeastern extraneous. Oct. F.

Verbesina helianthoides Michx. Rocky wooded slopes; occasional. Central intraneous. May. SS.

Silphium terebinthinaceum Jacq. Prairie slopes; occasional to common. Northeastern extraneous. Aug., Sept. Val, SS, CC.

Silphium integrifolium Michx. Prairie slopes and ledges; occasional. Central intraneous. July—Sept. Val, SVal, F, PduR, PH, CC.

Heliospis helianthoides (L.) Sweet. Exposed and shaded rocky slopes and ledges; occasional. Northeastern intraneous. July—Sept. Val, PH.

Helianthus divaricatus L. Rocky slopes and ledges; occasional. Northeastern intraneous. July—Sept. PH, Mc.

Helianthus hirsutus Raf. Dry slopes and ledges; occasional. Northeastern intraneous. July—Sept. Val, SVal, F, DBB, PH, Mc, SS, CC.

Helianthus mollis Lam. Dry slopes and ledges; occasional. Central intraneous. Sept. Johnson County record. CC.

Helianthus maximiliani Schrad. Exposed ledge; rare. Northwestern extraneous. Oct. Jackson County record. DBB.

Coreopsis lanceolata L. Exposed ledges and hill prairies; occasional. Southeastern extraneous. May—July. SVal, F.

Coreopsis palmata Nutt. Exposed ledges and hill prairies; occasional. Northwestern extraneous. June, July. Val, SVal.

Coreopsis tripteris L. Ridge top woods; rare. Northeastern intraneous. Sept. Val.

Ambrosia artemisiifolia L. Exposed ledges and talus slopes; occasional. Continental intraneous. Aug.—Oct. Val, F, PduR, DBO, DBB, PH, CC, Shet.

Ambrosia trifida L. Exposed ledges; occasional. Northeastern intraneous. Aug. DBB, Mc.

Senecio aureus L. Exposed ledges; occasional. Northeastern intraneous. May. PH.

Senecio glabellus Poir. Shaded rocky slopes; rare on limestone. Southern extraneous. May. Shet.

Senecio plattensis Nutt. Exposed ledges; occasional. Northeastern intra-

neous. May. Val, F, PduR.

Achillea millefolium L. Exposed ledges and prairie slopes; occasional. Introduced from Europe. May, June. Val, F, DBO, DBB, PH.

Cacalia atriplicifolia L. Talus slopes; occasional. Northeastern intraneous. Aug. Monroe County record. SVal.

Artemisia annua L. Exposed ledges; occasional. Naturalized from Europe. Sept., Oct. Shet.

Gnaphalium obtusifolium L. Hill prairies and ledges; occasional. Northeastern intraneous. Sept., Oct. NVal, Val, F, DBB.

Antennaria plantaginifolia (L.) Hook. Dry, wooded slopes; occasional. Northeastern intraneous. April, May. Val. PH.

Solidago rigida L. Hill prairies; occasional. Central intraneous. Oct. Val, SVal, PH.

Solidago radula Nutt. Exposed ledges and slopes; occasional to common. Southern extraneous. July—Sept. Val, F, PduR, PH.

Solidago nemoralis Ait. Hill prairies and dry slopes; occasional. Northeastern intraneous. Sept., Oct. Val, F, PH.

Solidago juncea Ait. Exposed ledges and slopes; occasional. Northeastern intraneous. July. PH.

Solidago altissima L. Day, Wooded slopes; occasional. Northeastern intraneous. Sept. Val, CC.

Solidago canadensis L. Dry ledge; rare. Northeastern extraneous. Oct. DBB.

Solidago ulmifolia Muhl. Wooded, rocky slopes or prairies; occasional. Northeastern intraneous. Aug.—Oct. Val, F, DBB, PH, Mc, SS, CC, Shet.

Solidago drummondii Torrey & Gray. Exposed ledges and rock faces; occasional to common. Central intraneous. Aug.—Nov. NVal, Val, SVal, F, PduR, DBO, DBB, PH, Mc.

Solidago speciosa Nutt. Hill prairies; occasional. Northeastern intraneous. Sept., Oct. Val.

Ratibida pinnata (Vent.) Bernh. Dry, rocky slopes and prairies; occasional. Central intraneous. June, July. Val, SVal, SS, Shet.

Rudbeckia hirta L. Dry, rocky slopes; occasional. Northeastern intraneous. June, July. SVal, F, DBB.

Rudbeckia bicolor Nutt. Dry, rocky slope, rare. Southern extraneous. June. Mc.

Rudbeckia triloba L. Wooded, rocky slope; occasional. Northeastern intraneous. Sept. Hardin County record. Shet.

Rudbeckia missouriensis Engelm. Exposed bluff top ledges and prairies; occasional to common. Southern extraneous. July—Oct. Val, SVal, F, PduR.

Arctium minus (Hill) Bernh. Talus slopes; occasional. Naturalized from Europe. July. PH.

ADDITIONAL VASCULAR PLANTS REPORTED TO BE ASSOCIATED WITH LIMESTONE IN SOUTHERN ILLINOIS

I. Specimens of the following species in the Southern Illinois University Herbarium bear labels indicating that they were collected in direct proximity to limestone. Seven additional plants in the Herbarium labelled "Limestone area" were not included because of the indefinite nature of the allocation.

Cystopteris bulbifera (L.) Bernh. Fountain Bluff.

Eragrostis ciliaris (All.) Link. Fults.

Panicum depauperatum Muhl. Renault, Monroe County.

Carex frankii Wahl. Pine Hills.

Smilax glauca Walt. Pine Hills.

Belamcanda chinensis (L.) DC. Prairie du Rocher.

Phoradendron flavescens (Pursh) Nutt. Cave-in-Rock.

Polygonum erectum L. Wolf Lake.

Anemonella thalictroides (L.) Spach. E. of Belknap, Johnson County.

Cardamine arenicola Britt. Roaring Springs. Union County.

Cardamine pennsylvanica Muhl. Hardin County limestone bluff.

Cardamine hirsuta L. Hardin County limestone bluff.

Draba cuneifolia Nutt. Fults.

Draba verna L. Hardin County.

Ribes missouriensis Nutt. Monroe County bluff.

Cardiospermum halicacabum L. Fults.

Viola triloba Schwein. E. of Belknap, Johnson County.

Onosmodium molle Michx.

Scutellaria leonardii Epling (*Scutellaria parvula* var. *leonardii* (Epling) Fern.). Cave-in-Rock.

Penstemon hirsutus (L.) Willd. Pine Hills, Cave-in-Rock.

Linaria vulgaris Mill. Cave-in-Rock.

Eupatorium purpureum L. Fults.

Eupatorium incarnatum Walt. Bluff Lake, Union County.

Bidens cernua L. Bluff Lake, Union County.

Polymnia uvedalia L. Fults.

Solidago buckleyi Torrey & Gray (labelled *S. petiolaris*). Prairie du Rocher.

Solidago latifolia L. Pine Hills.

II. The following additional species are cited as occurring on limestone in Mohlenbrock and Voigt (1959):

Juncus secundus Beauv. Devil's Bake Oven (BS 2467).

Smilax hispida Muhl. Talus at Pine Hills.

Urtica chamaedryoides Pursh. Limestone bluff at Grand Tower (BS 584).

Cerastium arvense L. Limestone bluffs in Gallatin, Pope, and Saline Counties.

Philadelphus pubescens Loisel. Near Golconda.

Euphorbia obtusata Pursh. Talus at Pine Hills.

Ampelopsis arborea (L.) Koehne. "Near Mississippi River."

Melothria pendula L. Near Thebes, Alexander County.

Pycnanthemum incanum (L.) Michx. "Southern counties."

III. R. A. Evers (1955) records additional species for certain of the stations which were identical to those he visited during his study. These stations are indicated in the following list by the abbreviations used previously in this paper.

Spiranthes cernua (L.) Rich. PduR.

Heuchera richardsonii R. Br. SVal, PduR, PH.

Lespedeza simulata Mack. & Bush. F. *Polygala verticillata* L. PduR.

Lechea stricta Leggett. SVal.

Onosmodium occidentale Mack. CC.

Scutellaria leonardii Epling (*Scutellaria parvula* var. *leonardii* (Epling) Fern.). CC.

Gerardia gattingeri Small. SVal, F, PduR.

Diodia teres Walt. PduR.

Aster sericeus Vent. SVal, F, PduR.

Cacalia tuberosa Nutt. PduR.

Helianthus rigidus (Cass.) Desf. SVal.

Helianthus strumosus L. SVal.

Lactuca canadensis L. PduR.

Vernonia missurica Raf. F, PduR.

VII. SUMMARY

A study of the plants of the limestone outcroppings in southern Illinois was initiated in April, 1962, and continued through November of the following year. During this

period collections were obtained from fifteen stations in six counties.

A total of 552 species of plants was recorded. Six of these were previously unknown from Illinois. These are *Panicum helleri* Nash, *Panicum longifolium* Scribn., *Panicum malacophyllum* Nash, *Panicum nitidum* Lam., *Euphorbia dictyosperma* Fisch. & Mey., and *Aster texanus* Burgess. In addition, 153 county records were obtained. Fifty-seven species constituted new records for Monroe County, forty-five for Hardin County, sixteen for Johnson County, fifteen for Union County, and ten each for Jackson and Randolph Counties.

LITERATURE CITED

- ADAMS, C. C. 1902. Southeastern United States as a Center of Geographical Distribution of Flora and Fauna. Marine Biol. Bull. No. 3.
- CAIN, S. A. 1950. Certain Floristic Affinities of the Trees and Shrubs of the Great Smoky Mountains and Vicinity. Butler Univ. Bot. Stud. 1:129-150.
- EVERS, R. A. 1955. Hill Prairies of Illinois. Ill. Nat. Hist. Surv. Bull. 26:367-446.
- FERNALD, M. L. 1950. Gray's Manual of Botany, Eighth Ed., New York, American Book Co.
- GLEASON, H. A. 1952. Illustrated Flora of the Northeastern United States and Adjacent Canada. 3 vols. Lancaster Press, Inc.
- JONES, G. N. 1950. Flora of Illinois. Second Ed. South Bend, Univ. of Notre Dame Press.
- , and G. D. FULLER. 1955. Vascular Plants of Illinois. Urbana, Univ. of Ill. Press.
- KREY, F., and J. E. LAMAR. 1925. Limestone Resources of Illinois. Ill. State Geol. Surv. Bull. No. 46.
- LAMAR, J. E. 1959. Limestone Resources of Extreme Southern Illinois. Ill. State Geol. Surv. Report of Investigations 211.
- LEIGHTON, M. M., G. E. EKBLAW, and L. HORBERG. 1948. Physiographic Divisions of Illinois. Jour. Geol. 56:16-33.

- MACMAHON, R. R. 1960. A Flora of Panther's Den Ravine, Union County, Illinois. Unpublished M. S. Thesis, Southern Illinois University.
- MOHLENBROCK, R. H. 1954. The Vegetation of Giant City State Park: A Floristic and Ecological Study. Unpublished M. S. Thesis, Southern Illinois University.
- , and J. W. VOIGT, 1959. A Flora of Southern Illinois. Carbondale, Southern Illinois University Press.
- SMITH, P. W. 1961. The Amphibians and Reptiles of Illinois. Ill. Nat. Hist. Surv. Bull. 28:1-298.
- , and H. M. SMITH. 1962. The Systematic and Biogeographic Status of Two Illinois Snakes. Occas. Papers Adams Ctr. Ecol. Studies No. 9.
- VESTAL, A. G. 1931. A Preliminary Vegetation Map of Illinois. Ill. State Acad. Sci. Trans. 23:204-17.
- WEBER, W. R. 1959. The Flora of Piney Creek Ravine. Unpublished M. S. Thesis, Southern Illinois University.
- WELLER, J. M. 1945. Geologic Map of Illinois. State of Ill., Division of the State Geol. Surv.
- WINTERRINGER, G. S., and A. G. VESTAL. 1956. Rock-Ledge Vegetation in Southern Illinois. Ecol. Monog. 26:105-130.
- , and R. A. EVERS. 1960. New Records for Illinois Plants. Ill. State Mus. Scientific Papers Series. 11:1-135.
- WORTHEN, A. H. 1882. Economical Geology of Illinois. 2 vols. Springfield, State of Illinois.

Manuscript received September 19, 1966.