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THE WIND-POLLINATED PLANTS OF THE MISSOULA VALLEY, MONTANA,
WITH SPECIAL REFERENCE TO THE FLOWERING SEASONS

by

EUGENE E. ADDOR

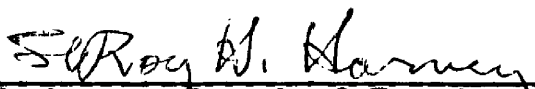
B. S. Montana State University, 1956

Presented in partial fulfillment of the requirements
for the degree of Master of Arts

MONTANA STATE UNIVERSITY

1958

Approved by:


Chairman, Board of Examiners


Dean, Graduate School

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This dissertation is not a publication.

Addor 1958. The Wind-pollinated Plants of the Missoula Valley...

ERRATA

page 86, bottom line: B. pumellianus should be B. pumpellianus.

page 124, line 19: north-racing should be north-facing.

page 161: Cronquist 1955 in the text should have been cited as Hitchcock et al 1955. The reference should then be:

Hitchcock, C. Leo, Arthur Cronquist, Marion Ownbey, and J. W. Thompson. 1955. Vascular plants of the Pacific Northwest. Part 5: Compositae, by Arthur Cronquist. 343 pp. Univ. of Washington, Seattle.

page 162: Gleason, Henry A. 1952. The new Britton and Brown illustrated flora of the Northwestern United States and adjacent Canada. This should be "... of the Northeastern United States ..."

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INTRODUCTION

In 1917, Scheppegrell reported that hayfever was common in Montana, and that the seasons were May 15 to July 15 and August 5 to September 15. Again, in 1922, he gave the same dates, reporting the grasses as the principal cause of the early (spring) season, and the ambrosias and artemisias as the principal causes of the later (fall) season (Scheppegrell 1917, 1922).

Foss, reporting from Missoula in 1927, designated three hayfever seasons for western Montana: March and April or early spring, due to trees; May and June or late spring, due to grasses; and July to frost or fall, due to "weeds such as the Russian thistle, sagebrushes and poverty weeds, which are the chief offenders" (Foss 1927).

The most important contribution to the knowledge of the hay fever plants of Montana appears to be that of Stier et al (1930). This report covered the states of Washington, Oregon, Idaho, Montana, Utah, Wyoming, and Colorado. The region was divided into seven districts on the basis of vegetation and life zones, and these districts were then discussed individually. All the species of plants in the region which were known to cause hayfever, and those with hayfever possibilities, were tabulated to show the life zone, season of pollination and relative hayfever potential in each district.

Apparently no further work was done in the Missoula

area until 1954; but in June of 1943, Gottlieb and Urbach (1943a) summarized all the available reports on a nationwide basis. These authors, too, emphasized vegetational zones. The United States was divided into nine zones, following Livingston and Shreve (1921), and a "pollination calendar" was presented for each zone. These "calendars" were based upon a summary of all the available reports for each zone or parts of it, but "only the plants of considerable importance" were listed.

Wodehouse (1945) also presented a series of calendars and a summary of the literature, but by geographical regions rather than vegetational zones. Montana was included in the Rocky Mountain Region.

Lovell et al (1953) reported that "an effort has been made to collect up-to-date information regarding the geographical distribution of grasses, trees, and weeds which produce pollens that sometimes are of clinical significance." The information was obtained from botanists, members of state departments of agriculture, and clinical allergists from various places throughout the country. It was tabulated by states, showing the occurrence of the given species in each state as "common," "rare," or "never," and the table was supplemented by notes.

Finally, in 1954, Brunett conducted the first atmospheric pollen analysis ever to be reported for Missoula

(Brunett 1956). The purpose of his study was to determine what pollens were present in the atmosphere in this area; it consisted of counting and identifying the pollen grains caught on atmospheric pollen traps; and it emphasized the clinical aspects of the local hayfever problem, without support of field observations. The pollen grains which Brunett found on his slides were classified into broad plant-groups, such as:

- ALDER included the species of Alnus present in the area, especially A. tenuifolia Nutt.
- ARTEMISIA included the species of Artemisia, such as A. tridentata Nutt., A. frigida Willd., A. ludoviciana Nutt., and A. dracunculus L., which are present in this area.
- ASH included the species of Fraxinus present.
- BIRCH included species of Betula, especially B. alba L. and B. occidentalis Hook.
- CHEENOPOD included all the members of the families Chenopodiaceae and Amaranthaceae in this area, especially etc.

This system of tabulating the daily pollen counts by broad groups is consistent with accepted practice (cf. Wodehouse 1935, Bowie 1939, Daubenmire 1940, and Brown 1949). However, as stressed by Wodehouse (1945), Gottlieb & Urbach (1943b), and others, it is necessary in hayfever studies to know what species are present in the area, the relative abundance of each, the relative pollen production of each, the flowering period, etc.; and an analysis of the literature pertinent to the Missoula Valley (discussed

above) revealed a need for a more complete knowledge of the hayfever plants of this area.

Therefore, in 1956, a study was undertaken to supplement Brunett's study with a survey of the anemophilous plants of the Missoula Valley; and to observe the relative pollen production, and flowering period of each species, and thereby attempt to judge the importance of each species as a potential hayfever plant in the Missoula Valley.

SCOPE OF THE PRESENT PROJECT

The list of plants known to cause hayfever is practically limitless. It includes algae (Heise 1949), fungi (Durham 1942; Wodehouse 1945, pp. 185f; Brown 1949, pp. 105ff; and others), and ferns (Schonwald 1937), as well as seed plants. Among the seed plants, such strictly entomophilous plants as Aesculus (Gottlieb & Urbach 1943a), Catalpa (Swineford 1940), the common dandelion (Steir et al 1930), and many others have been shown to be causes of hayfever, and Hyde (1950) found pollen of such plants as the Cruciferae, Ranunculaceae, Umbelliferae, and others which are usually regarded as purely entomophilous, to be regularly wind-borne, at least in part.

Although Hyde (1950) concluded that the great preponderance of his pollen catch could usually be related to

a local source, it is a recognized fact that pollens, including that of many entomophilous plants, may be carried great distances by air currents (Erdtman 1954, pp. 175 ff; Sack 1949; Hyde 1950). Hyde (1950) found this to be especially true for members of the family Ericaceae in Great Britain.

Thus, it would be manifestly impossible to make a detailed study of all the plants which might cause hay-fever in any given locality, and it is necessary to limit such a study, both botanically and areally.

Botanical limitations:

The works of Wodehouse (1935, 1945) provided invaluable guides throughout the course of this study, and the selection of plants to be considered in the survey was strongly influenced by them, especially the latter.

Although this report is entitled "The wind-pollinated plants. . .," some plants which are not strictly anemophilous have been included. Plant families are not necessarily included in their entirety, but genera - as they were found to be represented in our area - are; i.e., if one species of a genus was considered worthy of inclusion, then all the species of that genus were considered worthy. In general, the bases for determining which genera should be included may be outlined as follows:

1. All the genera which are easily recognized as including anemophilous species, regardless of their hayfever potential - known or unknown. Examples of this class are: Pine, reported as an allergen (Rowe 1939), but still considered unimportant (Durham 1952); Sedge, occasionally suspected of causing hayfever (Wodehouse 1945, citing Ellis & Rosendahl 1933); and cattail, which Wodehouse (1945) reports as seeming to be incapable of causing hayfever, and which I have been unable to find recorded as a cause. These are all undeniably and exclusively anemophilous, and so their inclusion here is automatic. Such genera as Eleocharis, which are only rarely abundant in our area, and produce only meagre amounts of pollen, also are in this category.
2. Genera which include species ranging from exclusively anemophilous, through various degrees of amphiphily, to entomophilous, as the maples, or to hydrophilous, as the pondweeds.
3. Genera which contain only species usually considered entomophilous, but which produce an abundance of pollen which at times becomes air-borne, and which, by reason of their abundance in this area, might be suspected of causing some hayfever. Tilia, famed as a honey tree, has been shown to be a cause of hayfever (Derbes 1941); and Salix (willow), which is "primarily insect pollinated, but (is) certainly also wind pollinated to a certain extent" (Wodehouse 1945), are examples of this class.

Species which are not anemophilous and which produce only a limited amount of pollen have not been considered in this report, even though some have been recorded as definite causes of hayfever; e.g. Catalpa (Swineford 1940) and Aesculus (Gottlieb & Urbach 1943a), both of which are cultivated to some extent in Missoula; and honey locust (Gleditsia), which Brunet (1956) recorded on his

atmospheric slides.

Only the seed plants (Spermatophyta) have been included in this study, though some of the Pteridophyta are common in the vicinity, such as bracken fern (Pteridium aquilinum var. lanuginosum Fernald) - reported as a cause of hayfever (Schonwald 1937), and several species of horsetails (Equisetum) - to my knowledge not recorded as causes of hayfever; and too, there are numerous species of fungi (Thallophyta) in our area.

The Area Defined and Described:

Plate I is a map showing the study area (the Missoula Valley) in relation to the surrounding territory. The study area lies at the southeast end of an extensive valley some 30 or 40 miles long, averaging perhaps 5 or 6 miles wide, and oriented in a northwesterly-southeasterly direction. It is bounded on the southwest and east by rather steep, well-defined mountains, and on the northeast by gradual hills which finally give way to mountains. The region embodies three major habitat types:

Coniferous forests - the predominant type in mountainous terrain. On west, south, and gentle north slopes it is mostly above about 4500 feet, but it extends to the valley floor on the steeper north and east slopes and in canyons.

Prairie or grassland type - the predominant type on the valley floor, and on west and south slopes up to about (very approximately) 4500 feet. The prairie grasses are the predominant vegetation, especially on the slopes, but grain (wheat,

barley, etc.) and sugarbeets are extensively cultivated in the valley proper. The weed flora also is mostly confined to the valley floor, wherever the grasslands have been disturbed and in places of concentrated population.

Bottomlands - includes the riverbottoms within the valley and the broader canyons adjacent to the valley, where cottonwoods, alders, etc. predominate; and moist meadows, bogs, marshes, and sloughs in the lowlands adjacent to the rivers, in which places the meadow grasses, cattails, and sedges are the predominant vegetation.

The area directly concerned in this study, and which is here defined as the Missoula Valley, is shown in red outline. As defined, the Missoula Valley encompasses an area of about 35-40 square miles, and the prairie or grassland habitat is the predominant type, though the bottomland habitat prevails in the big loop of the Bitterroot River at the southwest edge of the valley, in the indefinite course of the Clark's Fork River west of town, and of course, immediately along the river channels elsewhere.

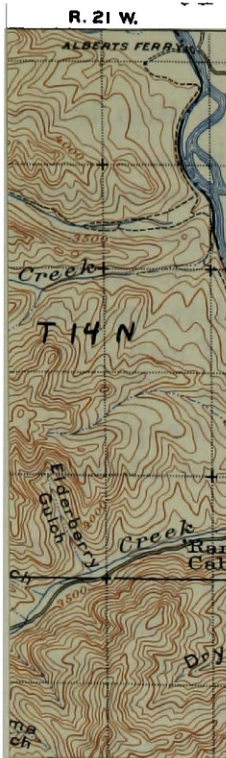
NOTE: This map is comprised of early editions of United States Geological Survey maps. Much of the cultural datum is therefore not current.

PLATE I. THE MISSOULA VALLEY AND VICINITY.

U.S. GEOLOGICAL SURVEY MAPS, Editions of 1912 (Missoula Quad.) and 1909 (Bonner Quad).
 DATUM IS MEAN SEA LEVEL AT TIME OF SURVEY.

SCALE 1:125000 (APPROX. 1/2 INCH = 1 MILE).

APPROX. NORTH

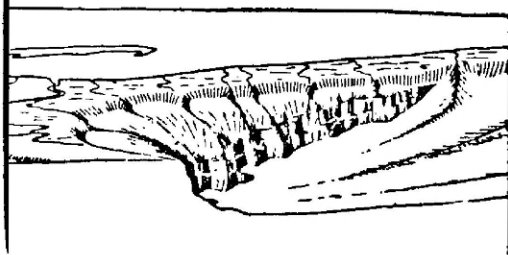


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 gradually away and forms an inclined tablework has been i
 ersed by a few shallow gullies. On the nover more than
 features is represented, directly beneath itsossessions.
 sketch, by contour lines. The maps are

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 inches. Un
 one contour and the next, is stated at the botdivided into qu
 This interval differs according to the topogneridians of lo
 mapped: in a flat country it may be as smalifferent scales, t
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 that the contours may be read more easily cerind consequentl
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 accompanied by figures showing altitude. ThOn the lower n
 points—such as road intersections, summits, howing distanc
 and benchmarks—are also given on the mapddition, the sea
 show altitudes to the nearest foot only. Mc fixed ratio bet

The sketch represents a river v
 hills. In the foreground is the se
 enclosed by a hooked sand bar.



metric maps on scales of 1/125,000 and 1/250,000.
 square miles of southeastern Alaska has been
 addition to the area covered by topographic maps,
 ted are on a scale of 1/62,500 (1 inch=nearly 1 mile)
 importance, covering about 4,300 square miles,
 ch=nearly 4 miles). For some areas of par-
 e area surveyed the maps published are on a
 (1 inch=nearly 8 miles). For most of the
 ut of the Territory has been covered by maps
 y 44 percent of its area has now been mapped.
 survey of Alaska has been in progress since
 ture.
 topographic maps, which show relief as well as
 photographs are utilized also in the making of
 ted States. By the use of stereoscopic plotting
 drainage and culture, have been made for some
 rded on the photographs, planimetric maps,
 eta is now being used in mapping. From the
 inch=nearly 4 miles), with a contour interval
 of maps on a scale of 1/125,000 (1 inch=nearly 2
 are made with sufficient detail to be used in

PROCEDURES

A. The plant survey.

This work was performed during the two-year period beginning in June of 1956. During the first season, a preliminary "plant exploration and survey" was conducted to establish an acquaintance with the flora of the area, and to determine the types of habitats within the area. The methods used for this survey are explained in detail in the preliminary report (see Preface). Briefly, it consisted of a more or less random exploration. Reasonably thorough coverage of the area was insured by the use of a street map from the Chamber of Commerce.

Anemophilous plants were collected throughout the season, and when a collection was made, the approximate stage of development (of the colony as a whole) was usually noted.

B. Selecting the colonies for observation.

During the second season of the study, 1957, though the "exploratory" technique was used to some extent, emphasis was placed upon obtaining data on the pollen-shedding seasons of the various species. For this purpose, representative "colonies" which had been located the previous year were selected, visited periodically until they were found to be in flower, and thereafter until flowering ceased. Although the previous season's observations proved a

reasonably satisfactory guide tool for many species, they did not prove so for many others. The weeds of waste places and disturbed areas, such as the chenopods and amaranths, were found to be especially transient. The sunflower (Helianthus annuus), though not anemophilous, presented a striking example: a specimen was taken in 1956 from a very extensive colony in an area which had been disturbed the previous year. The area was revisited several times during the 1957 season, and not a single sunflower plant was found! (This area was along what is now Southwest Higgins Avenue.)

In other cases, although the colonies located in 1956 were still there in 1957, better colonies were found during the latter season. In these instances, the colony of the first season was either not visited at all during the second season, or observation was discontinued on the first colony, or observation was continued on both colonies.

In many cases, after a colony had ceased to flower, another colony of that species was found still flowering. In these cases, observation was continued on the second colony. Also, many species not found in 1956 were found in 1957; and finally, in a few cases, especially with Carex and Juncus, no attempt was made to observe the species in "colonies," but rather, they were merely collected whenever and wherever they were found to be shedding pollen.

C. Definition of a "colony."

The plants of the area may be roughly grouped into three kinds - exotic trees and shrubs, native trees and shrubs, and herbs.

Exotic trees and shrubs may be either isolated individuals or small groups, e.g. green ash in this area; or they may be in rather extensive continuous plantings, as are street trees - especially Norway maple in Missoula. In these cases, a single isolated tree or a small isolated group was usually selected for observation. This choice was also influenced somewhat by the fact that the trees usually had to be climbed. Because of the large number of species concerned, this prohibited close observation of a large number of individuals of each species.

Native trees and shrubs, however, present a somewhat different problem. Streambank shrubs, e.g. Alder, grow in colonies with rather well-defined lateral limits, but with virtually no linear or altitudinal limits. Ponderosa pine and Douglas fir in this area are not limited laterally, linearly, nor altitudinally, and they grow in a diversity of habitats.

The situation with herbs is similar to that of native trees and shrubs. Frequently, weeds of waste places are in isolated patches which can be readily circumscribed, but these waste places present an infinite variety of

habitats. And prairie grasses, like the native trees, have, in our area, very broad distributions laterally, linearly, and altitudinally.

In such situations, the limits of "colonies" were determined by many rather arbitrary considerations. For the purposes of the present study, therefore, a "colony" was defined as "a plant or group of plants of a given species which is defined as such." The descriptions of these colonies are included in the preliminary report (see Preface). They are essential to a critical evaluation of the pollen seasons as given in the present report, but unfortunately, space limitations prohibit their inclusion here.

D. Voucher specimens and notes.

When a species was found to be shedding pollen, a specimen was collected as a voucher (designated the first voucher) and the approximate stage of the pollen season of the colony was noted (i.e., first day, early, a few days, or etc.). The colony was then revisited at intervals until only a very few open flowers or buds could be found, at which time another specimen (designated the second voucher) was taken. In choosing the specimens for these vouchers, an attempt was made to let the first voucher represent the most advanced stage of floral development of the colony

(i.e., the most mature fruits obtainable), and to let the second voucher represent the least advanced stage. A "calendar" of pollen-shedding seasons was kept and brought up to date at each visit, and unusual or irregular aspects of the flowering activity were noted. In many cases the colony was revisited several weeks after pollen-shedding had ceased, and specimens were taken to demonstrate mature leaves, fruits, etc.

Voucher specimens are stored in the Montana State University Herbarium, and are identified with a label entitled "Anemophilous Plants of the Missoula Valley, Montana." The notes on the seasonal progression, "peak" periods, environmental influences, and other aspects of the flowering activity of each species are included in the preliminary report (see Preface), and have provided the bases for the charts (figure I) in the present report.

E. Taxonomic considerations.

In the present work, Lawrence (1951) has been adopted as the authority for the families, except in a few cases where he implies that a separation of genera into different families may be justified. In these cases, Benson (1957) has been consulted, and if he adopted the separation, then it has been adopted here (e.g., the separation of Cannabinaceae from Moraceae).

In some cases, a particular work has been adopted as the standard reference for an entire group of plants.

These are:

Carex - Mackenzie (1931-1935, and 1940) and Davis (1952), whose treatment of the genus was adapted from Mackenzie's work, with recent emmendations by others.

Compositae - Cronquist (1955).

Cultivated plants other than trees - Bailey (1949).

Exotic trees - mostly Rehder (1947), often Bailey (1949), and occasionally others.

Grasses - Hitchcock (1950).

Native and naturalized trees - Little (1953).

For the plants not included in these special groups, various works were used as the reference, depending upon that author's taxonomic treatment of a given taxon, and whether his coverage of that taxon was adequate for this area. The works most frequently relied upon were those of Davis (1952) and Wright & Booth (1956). Others frequently consulted were Gleason (1952) and Fernald (1950). Booth (1950), Peck (1941), Kearney & Peebles (1951), Abrams (1944), and Coulter & Nelson (1909) were occasionally used; and rarely, others.

It has been assumed that every plant collected during the course of this work is assignable to a previously described species, i.e., no attempt has been made here to describe a new species. This does not imply, however, that

every species found during this work has been previously reported from this area.

THE ANEMOPHILOUS FLORA OF THE
MISSOULA VALLEY

Introduction

This catalog is based upon the results of an extensive botanical survey of the Missoula Valley (see Preface), and it includes notes on the pollen seasons, relative pollen production, and abundance of the plants within the Missoula Valley. The purpose of the catalog is to assist the practicing physician in determining what species could cause hayfever in this area, and to assist him with the botanical aspects of reporting case histories, of relating case histories from other areas to this area, of working with pollens, etc. This is a botanical report, and clinical aspects have not been considered. The reader who is interested in the clinical aspects of hayfever botany is referred to Wodehouse (1935, 1945), and to the numerous reports scattered throughout the various medical journals.

Plan of the Flora

The plant families are listed alphabetically, the genera are listed alphabetically under each family, and the species are listed alphabetically under each genus. The general format for the discussions of the species is as follows:

Scientific name

Common name

The common names are mostly from manuals. It should be remembered that common names differ from region to region, and that even "standardized" common names are not necessarily in common use, and the value of using the scientific name cannot be over-emphasized. Further, the scientific name is never complete without at least once indicating the author of the binomial.

Synonyms: Includes scientific synonyms which are in current use (i.e., are found in current manuals), and especially those synonyms which have been used in hayfever literature pertinent to our area.

Collections:

Number - Date; remarks.

The "number" is my field collection number, or, in the case of collections not my own, it is the Montana State University Herbarium accession number (e.g., MONTU 46978) of the specimen cited. The "remarks" include a brief description of the specimen and/or its stage of development when collected. A number in parentheses, e.g. (=486), indicates that the specimen being described represents the same colony as does the collection cited in parentheses.

Pollen season: Dates. Importance.

The dates given are the beginning and cessation - actual or estimated - of the flowering season, based upon direct field observation of selected colonies (see Procedures), and unless specifically stated to the contrary, refer only to the 1957 season.

"Importance" (see "Classification of importance," p. 21) refers to the apparent importance of the species as a contributor to the atmospheric pollen concentration in this area. It is an opinion, based upon the abundance and distribution of the species in this area, apparent pollen production, and other botanical considerations - not upon toxicity of the pollen or other clinical aspects.

Comments: Abundance, distribution, and habitats of the species as observed in this area, relative pollen production, and other notes, including a discussion of other common names.

Deviations from this general format do occur, and these are either self-explanatory or they are explained in the discussion.

Explanation of Terms and Symbols

1. Notes on terminology.

Technically, the following terms describing modes of pollination refer only to flowers, but they are frequently used, always erroneously so, to refer to the plants which bear such flowers. This erroneous usage is perpetuated in the present work.

amphiphilous - adapted to pollination by both insects and wind.

anemophilous - wind-pollinated.

cleistogamous - self (closed) pollinated, refers only to flowers.

entomophilous - insect pollinated; "loosely" or "imperfectly" entomophilous refers to flowers which are entomophilous but produce an abundance of pollen which may at times become air-borne.

hydrophilous - water-pollinated.

in anthesis - used in the present work in the proper sense of meaning flowers expanded, shedding pollen; and refers only to flowers, never to plants.

in flower - refers to a plant or colony of plants at some stage during its flowering period, i.e. after the first flowers have reached anthesis, but before the last flowers have. Thus, a plant may be "in flower" and yet not have flowers "in anthesis," as, for example, the grasses on a rainy day.

pollen season - that period during which a species sheds pollen, usually designated in hayfever literature as the "pollination period." The present author prefers the term "pollen season" to "pollination period" as a matter of technical accuracy, and it

is not an inconvenient term to use.

2. Interpreting the pollen season.

The pollen season is generally indicated by dates; see explanation on page 18, and is in such cases based upon one or a few easily delimited, easily observed colonies. Often, however, it is given in generalized terms, and in such cases is based upon a few to several, poorly delimited colonies. These generalized seasons are indicated as follows:

May 18 (?) to June 22: the question mark following a date implies that the colony was visited at short intervals, and that the start (or finish) of the pollen season occurred between visits.

About May 18 to about June 22: the indefinite "about" implies approximately the same thing as the question mark (see above), but that the interval between visits was somewhat longer, and the dates therefore somewhat less closely estimated.

Early (or Mid-) May to late June: implies either that the season was several days advanced (or past) when the colony was first (or last) visited, and that it was estimated to have started (or finished) shedding pollen a week or more previously; or it implies that flowering was sporadic at the early (or, more often, last) part of the season, so that the dates were indefinite.

Frequently, the qualitative characteristics of the pollen season are indicated, and these seasons are almost always based upon observation of several rather large colonies.

3. Classification of "Importance."

"Importance" here is based upon botanical - not clinical - considerations; see the explanation of pollen season, etc., on page 18. The six basic classes of importance are indicated as follows:

Nil - not likely to ever become a factor in hayfever.

Negligible - if ever a factor, then only very locally.

Minor - possibly as occasional, local factor.

Secondary.

Important.

Prime importance.

? preceding the statement of importance suggests a category intermediate between that and the next lower category.

? following the statement of importance suggests a category intermediate between that and the next higher category.

ACERACEAE

Acer L. Maple

The species vary in mode of pollination from entirely entomophilous, through various degrees of amphiphily, to entirely anemophilous. Their importance as hay fever plants varies accordingly.

How many of the many species and innumerable varieties of Acer which are cultivated in North America are to be found in Missoula is not known, but those

not listed below would be so rare that they could hardly be considered hayfever plants in our area.

Acer glabrum Torr. var. douglasii (Hook.) Dipple

Mountain maple

Synonyms: Sometimes referred to the typical variety
A. glabrum Torr. var. glabrum.

Collections:

379 - 7 May 1957: in flower.
406 - 16 May 1957: (=379) very late flowers (pollen gone).

Pollen season: May 2 to about May 14. Nil.

Comments: Primarily, if not entirely, entomophilous.

The stamens are small, pollen production slight, and the flowers are visited abundantly by insects. Common along mountain streams, occasional on open hillsides, rare within the valley proper. Sometimes called "vine maple," a name which Little (1953) reserves for A. circinatum Pursh of the Pacific Coast.

Acer negundo L.

Boxelder

Collection:

363 - 30 April 1957: early flowers, staminate.

Pollen season: April 29 to May 12. Important.

Comments: Entirely wind pollinated, pollen production relatively high. Common as an ornamental, occasionally escaped. In 1958, the pollen season started about April 22.

Acer nigrum Michx. f.

Black maple

Synonyms: Sometimes cited as a var. of A. saccharum Marsh., or of A. saccharinum L.

No observations. Pollen season is about concurrent with that of A. saccharum Marsh. (Rehder 1947). Also similar to that species in pollen production and other respects. Rare, only as an ornamental. In 1958, the two trees of this species on the University Campus came into flower about May 2.

Acer platanoides L.

Norway maple

Collections:

- 365 - 30 April 1957: very early flowers.
- 366 - 30 April 1957: very early flowers.
- 376 - 7 May 1957: [var. schwedleri Nichols ?] in flower.
- 466 - 28 May 1957: (=365) expanded leaves and fruit.
- 467 - 28 May 1957: (=366) expanded leaves and fruit.
- 477 - 30 May 1957: (=376) expanded leaves and fruit.

Pollen season: April 30 to May 11. ? Minor.

Comments: Including an undetermined number of its ten or more forms and varieties, this is the most common street tree in Missoula, and often occurs as an escape. Although it is "probably entirely insect pollinated" (Wodehouse 1945), and does not shed much pollen, its adaptation to entomophily is "obviously imperfect, and some pollen is scattered and may appear in the air in sufficient quantities to become at times a factor in hayfever" (Wodehouse 1945). In 1958, trees 365 and 366 started shedding pollen on April 25.

Acer pseudoplatanus L.

Sycamore maple

Collections:

- 397 - 14 May 1957: very early flowers.
 508 - 6 June 1957: (=397) late flowers.
 511 - 6 June 1957: mid-season flowers.
 569 - 18 June 1957: (=511) very late flowers.

Pollen season: May 13 to June 19. Nil.

Comments: Very similar in pollen production to A. plat-
anoides, q.v., but only occasional in Missoula, as an
 ornamental.

Acer rubrum L.

Red maple

No observations. Considered to be amphiphilous by
 Wodehouse (1945). Listed by Wright & Booth (1956) as "cul-
 tivated" in Montana, but I have not recognized it in
 Missoula. It is probably here, uncommon or even rare.

Acer saccharinum L.

Silver maple

Collections:

- 334 - 6 April 1957: early flowers.
 475 - 30 May 1957: (=334) leaves and mature fruits.

Pollen season: Late March to April 10. Secondary.

Comments: Considered by Wodehouse (1945) to be amphiph-
 ilous. The pollen season is controlled somewhat by spring
 weather, but in 1958 (an early flower year) it coincided
 rather well with the 1957 season. Rather common as an
 ornamental.

Acer saccharum Marsh.

Sugar maple

Collections:

- 593 - 20 June 1957: leafy twigs with young fruits.
 803 - 29 July 1957: (=593) leafy twigs with nearly
 mature fruits.

Pollen season: Not observed; according to Rehder (1947), late April. Nil.

Comments: Tends to be anemophilous (Wodehouse 1945), but is uncommon in Missoula, as an ornamental.

AMARANTHACEAE

Amaranthus L. Amaranth

In view of the importance of the amaranths as hay-fever plants, and the confusion which exists in the nomenclature, it seems advisable to dwell a bit upon the taxonomy as it applies to the plants of our area.

In our area, the genus is represented by two complexes. The first of these - the A. graecizans complex - is much abused by taxonomists as well as by laymen. My interpretation of the complex will follow that of Gleason (1952), which seems to express the majority opinion of eight manuals studied, and is the most satisfactory treatment available. The complex, as it is represented in our area, is easily recognized as consisting of those amaranths with flowers in small axillary clusters. A. graecizans, as

it is interpreted here, is a prostrate plant with the branches radiating from the root and forming a mat, whereas A. albus has an erect central stem with the branches growing outward and bowing upward (incurved), giving the plant a more or less spherical shape. A. californicus (Moq.) S. Wats., which also apparently belongs to this complex, is similar in general appearance to A. graecizans. It is listed for Montana by Wright & Booth (1956), but specimens have not been collected in our area.

The names "tumbleweed" and "tumble pigweed" are frequently suggested for either or both A. graecizans and A. albus. But to call A. graecizans "tumbleweed" seems rather silly, since it is not likely that a mat-shaped plant could do much tumbling (unless it were somehow propped on edge!) A. albus could be called "tumbleweed," but this name is applied to any plant which breaks off at maturity and is rolled before the wind. The names "prostrate amaranth" and "tumbleweed amaranth" have been proposed as standard common names for these species (Kelsey & Dayton 1942) (though for the wrong species as interpreted here!) and these seem to be the most appropriate names in use.

The second complex - the A. retroflexus complex - seems to be better understood, or at least is not so befuddled by synonymy as is the first complex. But here again the common names are rendered meaningless by their diversity and by the indiscriminate application of them. The name

"pigweed" is often applied to the species of this complex.

Amaranthus albus L.

Tumbling amaranth

Synonymy: Greatly confused, see discussion of the genus.

Collections:

- 166 - 22 June 1956: early flowers.
- 167 - 22 June 1956: early flowers.
- 685 - 7 July 1957: this specimen with flowers advanced.
- 686 - 7 July 1957: (=685) this specimen with flowers advanced.
- 1014 - 16 Oct. 1957: (=685) very late flowers.

Pollen season: Mid-June to frost. Secondary.

Comments: Common in disturbed soil and waste places, and in some places abundant. It does not, however, produce as much pollen as some of the other amaranths, especially A. retroflexus, q.v. The use of the adjectival name precludes dropping of the "amaranth," thus minimizing the chances for confusing this with other "tumbleweeds."

Amaranthus graecizans L.

Prostrate amaranth

Synonymy: Greatly confused, see discussion of the genus. A. blitoides of all authors (most frequently S. Wats.) is often referred to A. graecizans.

Collections:

- 165 - 22 June 1956: early flowers.
- 641 - 1 July 1957: early flowers.
- 867B - 13 Aug. 1957: advanced flowers.
- 1013 - 16 Oct. 1957: (=867B) very late flowers.

Pollen season: Mid-June to frost. Minor.

Comments: Common in our area, usually in association with A. albus. Very similar to A. albus in pollen production, but because of the prostrate habit of the plants, the flowers are fewer and are quite close to the ground, hence the pollen is less likely to become significantly air-borne.

Amaranthus hybridus L.

Slim amaranth

Collections:

1000 - 13 Oct. 1957: in flower.

Comments: The only place this species has been collected is at the Northern Pacific Railroad Yards, opposite the Missoula Cemetery, where it is occasional. It is listed by Wright & Booth (1956) as occurring in "waste places and cultivated land," and it may be more common in our area than is implied here. Probably not abundant. The name "slim amaranth" for this species is suggested by Kelsey & Dayton (1942), but see A. retroflexus.

Amaranthus powellii S. Wats.

Powell amaranth

Collection:

262 - 24 July 1956: in flower and with mature fruits.

This specimen, from the Northern Pacific Railroad Yards across from the Missoula Cemetery, is the only plant I have been able to identify as A. powellii; it is ap-

parently a waif. A. powellii is very similar to, and sometimes cited as a synonym of A. hybridus, q.v.

Amaranthus retroflexus L.

Redroot amaranth

Collections:

- 193 - 30 June 1956: in flower.
- 256 - 23 July 1956: in flower.
- 606 - 23 June 1957: early flowers.
- 607 - 23 June 1957: (=606)
- 640 - 1 July 1957: in flower.
- 645 - 1 July 1957: in flower.
- 1008 - 15 Oct. 1957: (=606) very late flowers.

Pollen season: Late June to Sept., declining during Sept., and becoming sporadic by mid-Oct. Important.

Comments: Very common in disturbed soil and waste places and often abundant in extensive stands. Produces more pollen than other species of Amaranthus in our area. Common names are numerous for this species, but the more common ones are pigweed, pigweed amaranth, red-root, red-root amaranth, and green amaranth. These names are also applied to A. hybridus L., q.v.

BETULACEAE

Alnus B. Ehrh. Alder

Alnus sinuata (Reg.) Rydb.

Mountain alder

Synonymy: A. sitchensis (Reg.) Sarg.; and varieties of A. viridis and A. crispa of various authors.

Collections:

MONTU 15081 - J. E. Kirkwood 1081, May 30, 1922.
 MONTU 15720 - J. E. Kirkwood 1742, May 25, 1924.

Comments: No observations. Probably not present within the valley proper, but it is present along streams in the vicinity, especially at higher altitudes. Brunett (1956) recorded two rather distinct pollen seasons for alder - March 23 to May 20, and June 23 to July 12. How abundant A. sinuata is in the vicinity is not known, but both of the specimens cited above are in flower, and the possibility that Brunett's second alder season was due to this species provides interesting speculation (cf. A. tenuifolia).

Alnus tenuifolia Nutt.

River alder

Collections:

335 - 7 April 1957: in flower.
 491 - 1 June 1957: (=335) expanded leaves and fruits.

Pollen season: Very early Spring to late April or early May. Important.

Comments: This species begins to shed pollen very early at lower elevations, and flowering progresses up-canyon as the season advances. In 1958 it was observed to be shedding pollen on February 28 in Lolo Canyon, southwest of Missoula. Common, and in some places abundant, in the canyons adjacent to the valley.

Betula L. Birch

Because of the broad altitudinal distribution of at least the native birches in our area, the pollen season may be prolonged (cf. Alnus tenuifolia). My observations were limited to trees within the valley, and indicated a total season (all species) of only about thirteen days, but Brunett (1956) reported birch pollen on his slides from mid-March to mid-July.

The synonymy for most species is much more complex than is indicated in this discussion. For the most part, only those names found on specimens in our herbarium are included here.

Betula glandulosa Michx.

Bog birch

Collections:

MONTU ----- J. Kramer 56. Seeley Lake, Aug. 1937.
 MONTU 38903 - Fred A. Barkley 2402. Lolo Hot
 Springs, Missoula County, Montana.
 May 22, 1938.

Comments: This species occurs in mountain bogs, and though the two specimens cited above are the closest to Missoula, the species could be expected to occur at higher elevations in the mountains adjacent to the valley. Its pollen season would probably be later than that for the other species listed here.

Betula occidentalis Hook.

Water birch

Synonyms: B. fontinalis Sarg.; B. papyrifera var. occidentalis (Hook.) Sarg. in part, but see also B. papyrifera.

Collections:

- 359 - 27 April 1957: immature flowers.
 ? 360 - 30 April 1957: early flowers.
 382 - 7 May 1957: (=359) pollen out.
 ? 462 - 28 May 1957: (=360) expanded leaves and
 nearly mature fruits
 814 - 30 July 1957: (=359) fruits and leaves.

Pollen season: April 29 (?) to May 5 (?). Minor.

Comments: Common but rarely abundant along streams in the mountains adjacent to the valley, and along the Bitterroot River at the west edge of the valley. In 1958, the pollen season was about the same as indicated above for 1957.

Betula papyrifera Marsh.

Paper birch

Synonyms: B. subcordata Rydb. equals B. papyrifera var. subcordata (Rydb.) Sarg.; variety occidentalis (Hook.) Sarg. in part equals var. commutata, but see also B. occidentalis.

Collections:

- 350 - 27 April 1957: first flowers
 361 - 30 April 1957: (=350) very late flowers.
 364 - 30 April 1957: [var. commutata (Reg.) Fern.]
 first flowers.
 465 - 28 May 1957: (=364) leaves.
 818 - 31 July 1957: (=350) leaves and fruit.

Pollen season: April 27 to May 1. Secondary.

Comments: There are three distinct varieties of B. papyrifera native in western Montana, all of which are

represented to some extent in our area - var. papyrifera Marsh. (the typical variety, collections 350, 361, 818); var. commutata (Reg.) Fern., western paper birch (collections 364, 465); and var. subcordata (Rydb.) Sarg., northwestern paper birch (MONTU 16018 - J. E. Kirkwood 2060). It is not known, however, what proportion of the trees in our area represents each of these varieties, but they all flower about concurrently. The indicated pollen season was based upon a few trees within the valley; in 1958 these same trees started to flower a few days earlier.

Occasional along streams in the mountains adjacent to the valley, and often as an ornamental in town. There is, on the University Campus, a small specimen (about 4 ft.) of the variety humulus (Reg.) Fern. & Raup., Alaska birch. It of course has never flowered.

Betula pendula forma dalecarlica (L.) Schneid.

Weeping birch

Synonyms: - B. alba var. dalecarlica L.; B. laciniata Wahlb.

Collections:

374 - 3 May 1957: early flowers.

471 - 28 May 1957: (=374) leaves and nearly mature fruits.

Pollen season: April 30 (?) to about May 9. Important.

Comments: The 1957 season, indicated above, was based

upon a single tree. In 1958, the same tree and numerous others came into flower about concurrently, but not until May 4. This is the weeping birch common in yards throughout Missoula, and it is undoubtedly the most important birch in our area as a contributor to the atmospheric pollen count.

CALLITRICHACEAE

Callitriche L. Water starwort

Callitriche palustris L. Collection 1030 - Oct. 20, 1957: in flower. Perhaps anemophilous (Knuth 1909), but certainly not a hayfever plant in our area.

CANNABINACEAE

Cannabis L. Hemp

Cannabis sativa L.

Hemp, Marijuana

Collections:

MONTU 2634 - J. A. Hughes, Sept. 25, 1916 [as C. sativa-Indica Mollet].

Comments: Wright & Booth (1956) state that it is illegal to grow this species in Montana, but that it occurs in waste places. The specimen cited above is the only record of it for our area, and if it occurs here at all, it

is extremely rare.

Humulus L. Hop

Humulus lupulus L.

Hop

Synonym: H. americanus Nutt.

Collections:

- 728 - 14 July 1957: in flower, pistillate only.
- 868 - 16 Aug. 1957: (=728) past flowering.
- 898 - 23 Aug. 1957: in flower, pistillate only.
- 971 - 8 Oct. 1957: (=728) fruits.
- 1005 - 15 Oct. 1957: (=898) flowers and fruits.

Pollen season: Mid-July to frost. Nil.

Comments: Hop is entirely wind pollinated, but it is dioecious [the plants unisexual], and staminate plants were not seen in our area. The pollen season indicated above is based upon pollen-receptivity of the stigmas, but without staminate plants the species could not possibly cause hayfever. Uncommon in our area.

CHENOPODIACEAE

All ours are wind-pollinated. The species vary in their importance as hayfever plants according to their abundance and the amount of pollen shed, but as a group they are probably one of the most serious summer and fall offenders in our area. During August, September, and into October of 1954, the atmospheric pollen count for Artemisia

(family Compositae) was generally (not consistently) higher than the "Chenopod-Amaranth" count, but these two groups combined were higher than all others combined (Brunett 1956).

Atriplex L. Saltbush, Orache, Spearscale

Species formerly referred to the genus Obione Gaertn., which is now united with Atriplex, have not been found in our area, nor have species formerly referred to Endolepis Torr., which is now referred in part to Atriplex. Many species of Atriplex are listed for Montana (Wright & Booth 1956), several of which should be expected in our area, but I have found only one.

Atriplex patula L. Spearscale, Spear saltbush

Synonyms: A. hastata L.; A. carnosia A. Nels.; A. lapathifolia Rydb.; A. subspicata Rydb.

Collections:

280 - 1 Aug. 1956: in flower.
 835 - 5 Aug. 1957: very early flowers.
 1017 - 16 Oct. 1957: (=835) 3 sheets:
 1. very early flowers.
 2. fruits mature or nearly
 so.
 3. fruits mature or nearly
 so.

Pollen season: August 5 to mid-September, declining into mid-October. Minor.

Comments: The indicated pollen season is as it was observed during 1957. Note, however, that the season

started earlier in 1956 (cf. collections 280 and 835). Rather common in our area, rarely abundant in small colonies in waste places, otherwise as occasional individuals. The species is "highly variable and represented by several intergrading races. . ." (Gleason 1952). Our plants are apparently of the dubious variety hastata (L.) Gray.

Beta L. Beet

Beta vulgaris L.

Beet, Sugar beet

Collections:

- 268 - 26 July 1956: in flower.
- 653 - 2 July 1957: early flowers.
- 1006 - 15 Oct. 1957: (=653) in flower.

Pollen season: July 2, increasing to harvest (mid-October). Secondary.

Comments: Sugarbeet is extensively cultivated west of Missoula, especially in the area between the Clark's Fork River and Highway 10. The common garden beet and sugar beet are considered forms of the same variety (B. vulgaris L. var. vulgaris), and Swiss chard is B. vulgaris var. cicla L. (Bailey 1949). The garden beet and chard, which might be cultivated in gardens, would not normally be allowed to flower, but even if they were, they would be so few as not to contribute significantly to the pollen content of the atmosphere.

Chenopodium L. Goosefoot

Synonyms: The genus has been split many ways, but is now mostly retained as one group. The generic name Blitum L. may be encountered in the literature. For a more comprehensive survey of the synonymy, the reader is referred to Abrams (1944).

Several species are listed for Montana (Wright & Booth 1956), many of which should be expected in our area, but I have found only the following three.

Chenopodium album L. Lamb's quarters, Goosefoot

Synonyms: C. bushianum Aell.; C. berlandieri Gray, Small, Rydb.; C. lanceolatum Small, Rydb.; C. paganum Small, Rydb.

Collections:

161 - 22 June 1956: in flower.
 604 - 23 June 1957: early flowers.
 605 - 23 June 1957: early flowers.
 639 - 1 July 1957: in flower.
 654 - 2 July 1957: in flower.
 735 - 16 July 1957: (=161) in flower.
 1002 - 13 Oct. 1957: (=604) in flower.
 1007 - 15 Oct. 1957: (=654) two diminutive plants,
 one with fruits, one in flower.

Pollen season: June 20 through August, declining during September to mid-October. Important.

Comments: From the hayfever standpoint, this is the best known of the chenopods, and the one most frequently mentioned in the literature (Wodehouse 1945). It is very common in waste places and disturbed soil throughout our

area, frequently abundant. It is a highly variable species, and numerous species, varieties, and forms have been proposed. The synonymy cited above is from Gleason (1952).

Chenopodium botrys L. Jerusalem oak, Feather geranium

Collections:

275 - 29 July 1956: in flower.
 586 - 20 June 1957: (=275) in flower.
 816 - 30 July 1957: in flower.
 926 - 2 Sept. 1957: (=816) late flowers.

Pollen season: June 20 to mid-September or beyond.
 Nil.

Comments: Rare in our area, in small colonies, the location of which varies from year to year depending upon disturbance of the soil.

Chenopodium leptophyllum Nutt. Narrow-leaved goosefoot

Collection:

602 - 23 June 1957: early flowers.

Comments: The species is listed for Montana as occurring in "fields, plains, and hillsides" (Wright & Booth 1956), but the plant constituting collection 602 is the only one I have seen. (Another solitary plant was seen at the Forest Nursery, July 1958.)

Kochia RothKochia scoparia (L.) Schrad.

Summer-cypress

Collections:

- 224 - 11 July 1956: in flower.
 603 - 23 June 1957: early flowers.
 817 - 30 July 1957: [var. culata Farwell] early
 flowers.
 949 - 13 Sept. 1957: (=224) 5 small plants, very
 late flowers.
 950 - 13 Sept. 1957: (=224 & 949) large plant with
 mature fruits.
 992 - 13 Oct. 1957: (=817) past flowering.

Pollen season: June 23 to mid-August, declining to
 mid-September (var. culata continuing into early
 October). Prime importance.

Comments: Very common and frequently abundant in
 Missoula, especially in waste places and disturbed soil.
 It sheds large amounts of pollen, and in terms of pollen
 production and abundance of plants, this is the most
 important "Chenopod" in our area. The variety culata Fare-
 well (Belvedere, Burning-bush) is often cultivated in
 Missoula. It starts flowering (at least in 1957) later
 than the common form (cf. 603 & 817), and continues to
 flower later than the common form (cf. 949 & 992). Pollen
 production after mid-September is, however, rather slight.

Monolepis Schrad. Poverty weedMonolepis nuttalliana (Schult.) Greene Poverty weed

Collections:

- 163 - 22 June 1956: in fruit.
 621 - 25 June 1957: in fruit.
 643 - 1 July 1957: in flower.
 644 - 1 July 1957: (=643) in fruit.
 734 - 16 July 1957: very late flowers (shade plants).

Pollen season: Mid-June (?) to mid-July. Nil.

Comments: Uncommon, in disturbed soil; and it sheds but little pollen. As "poverty weed," this is not to be confused with Iva axillaris, q.v., and others.

Salsola L.Salsola kali L. var. tenuifolia Tausch. Russian thistle

Synonyms: S. pestifer A. Nels.; S. tragus L. of American manuals, and S. tragus of authors not L.; S. kali-tragus Moq.

Collections:

- 221 - 10 July 1956: early flowers.
 642 - 1 July 1957: early flowers.
 951 - 13 Sept. 1957: very late flowers, pollen apparently gone.
 952 - 13 Sept. 1957: mature fruits.

Pollen season: July 1 to mid-August, declining to September 10 or slightly beyond. Important.

Comments: Russian thistle is frequently mentioned in hayfever literature, and has been regarded as "probably the most important cause of hayfever among the Chenopodeaceae" (Wodehouse 1945), and as the worst of all causes in

some parts of the west (Ibid.). It is common in waste places and disturbed soil throughout our area, abundant in some places. It is not, however, as abundant as Kochia scoparia, q.v., nor does it shed as much pollen.

The name "tumbleweed" and "saltwort" are also applied to this species, but see Amaranthus regarding the use of "tumbleweed."

Spinachia L. Spinach

Spinachia oleracea L.

Spinach

Collection:

294 - 4 Aug. 1956: in flower.

Pollen season: Summer. Nil.

Comments: Spinach "flowers throughout most of the summer, producing a fair amount of pollen which has hay-fever possibilities but is not considered important" (Wodehouse 1945). In Missoula, it might be grown in vegetable gardens (collection 294), but would not normally be allowed to flower. Even when allowed to do so, it would not be abundant enough to contribute to the general hayfever problem.

COMPOSITAE

In mode of pollination the Compositae vary from entirely entomophilous with limited pollen production (e.g. Aster) to entirely anemophilous with abundant pollen production (e.g. Ambrosia). The family is sometimes divided into three separate families - Ambroseaceae, Carduaceae, and Cichoriaceae. This system is in some respects convenient for students of atmospheric pollen, since the wind-pollinated species commonly grouped under "ragweed" (Iva, Ambrosia, Xanthium, etc.) are all included in the Ambrosiaceae, and the system is frequently encountered in hayfever literature. On the other hand, Artemisia, which is entirely anemophilous, is not included in the Ambrosiaceae, but rather in the Carduaceae. Few modern taxonomists accept the "3-family" separation of the Compositae.

In the present study, Wodehouse (1945) has been used as a guide to determine which genera should be considered, but Cronquist (1955) is accepted as the sole reference for the taxonomy of the family.

Ambrosia L. Ragweed

Strictly anemophilous; the most famous, perhaps, of all hayfever plants.

Ambrosia artemisiifolia L.

Low ragweed

Synonym: A. elatior L.; also, "artemisiifolia" is sometimes spelled "artemiseaefolia."

Collections:

875 - 17 Aug. 1957: early flowers.
987 - 10 Oct. 1957: (=875) in flower.

Pollen season: August 17 to mid-October. ? Minor.

Comments: Common at the Northern Pacific Railroad Yards opposite the Missoula Cemetery, but I have not seen it anywhere else in the valley. There is one previous collection from our area: MONTU 7681 & 7682 (Sheets 1 & 2, respt.) - C. E. Moore, Sept. 20. This specimen was collected on the University Campus, back of the Natural Science Building. The year of the collection is not indicated.

Ambrosia trifida L.

Giant ragweed

Collections:

321 - 24 Aug. 1956: past flowering, a specimen with aberrant flowers.
894 - 23 Aug. 1957: early flowers, a diminutive plant about 7 inches tall.
985 - 10 Oct. 1957: (=894) late flowers, a normal plant.

Pollen season: August 23 to mid-October. Nil.

Comments: Rare at the Northern Pacific Railroad Yards opposite the Missoula Cemetery. The plant has not been seen elsewhere in our area, and there are no previous reports of its being here.

Artemisia L.

Common names for the species include Sagebrush, Sage, Mugwort, Wormwood.

Brunett (1956) reported a higher atmospheric pollen count for Artemisia than for all other groups combined during the period September 11 to September 20, 1954; but his total Artemisia season for 1954 was from July 31 to October 7 (cf. Chenopodiaceae). The four most important species in our area are A. absinthium, A. dracunculus, A. frigida, A. tridentata, all of which are probably of equal importance.

Artemisia absinthium L.

Wormwood

Collections:

- 278 - 1 Aug. 1956: in flower.
- 328 - 4 Sept. 1956: late flowers.
- 726 - 13 July 1957: early flowers.
- 935 - 5 Sept. 1957: (=726) very late flowers.

Pollen season: July 13 to mid-August, declining to early September. Prime importance.

Comments: Common throughout the valley, but abundant in only a few, rather large colonies, most notably in Greenough Park.

Artemisia biennis Willd.

Biennial wormwood

Collection:

- 324 - 31 Aug. 1956: in flower.

Comments: Quite rare, and not persistent.

Artemisia campestris L. ssp. borealis (Pall.) Hall & Clem.
Field wormwood

Synonyms: Many species, subspecies, varieties, and forms have been named. For a complete synonymy as applied to plants of the Pacific Northwest, the reader is referred to Cronquist (1955). A summary is presented here: A. borealis Pall. and varieties; A. camporum Rydb.; A. canadensis Michx.*; A. caudata Michx. and varieties; A. commutata var. hookeriana Bess.; various varieties of A. desertorum Besser; A. forwoodii Wats. and varieties; A. pacifica Nutt.; A. ripicola Rydb.; A. scouleriana Rydb.; A. spithamea Pursh; and finally, various varieties of A. campestris are rejected. NOTE: See comments below.

*A. canadensis Michx. is not cited by Cronquist, but Coulter & Nelson (1909) and Wright & Booth (1956) cite several of the names listed above as synonyms of A. canadensis.

Collections:

702 - 10 July 1957: early flowers.
896 - 23 Aug. 1957: (=702) past flowering.

Pollen season: July 9 to about mid-August. Nil.

Comments: Uncommon or even rare in our area. The collections cited above came from a colony near the swimming pool in McCormick Park, where the plants were moderately abundant; and a few plants were seen in a sandy flat about seven miles west of Missoula on Mullen road. A. campestris is a "highly polymorphic species, divisible into a number of rather diverse but apparently wholly confluent taxa" (Cronquist 1955). Our plants are apparently assignable to the variety scouleriana (Bess.) Cronq. All of the

synonyms cited above are not, however, referable to this variety, and if one of them appears in the literature, Cronquist (1955) should be consulted for assigning it to the proper variety.

Artemisia dracunculus L.

Dragon sagewort

Synonyms: A. dracunculoides Pursh; A. aromatica A. Nels.; A. glauca Pall.

Collections:

299 - 8 Aug. 1956: in flower.
855 - 10 Aug. 1957: early flowers.
969 - 8 Oct. 1957: (=855) very late flowers or abortive buds.

Pollen season: August 10 to late August, declining to about mid-September. Prime importance.

Comments: Common, and in some places abundant.

Artemisia frigida Willd.

Synonyms: Absinthium frigidum Bess.

Collections:

316 - 24 Aug. 1956: in flower.
872 - 16 Aug. 1957: early flowers.
956 - 15 Sept. 1957: (=872) very late flowers.
968 - 8 Oct. 1957: very late flowers.

Pollen season: August 16 to late August, declining to mid-September, continuing very slight and sporadically to early October. Prime importance.

Comments: Very common throughout the valley, especially in sandy soils in overgrazed pastures.

Artemisia lindleyana Bess.

Synonyms: A. prescottiana Bess.; A. leibergii Rydb.; A. pumila Nutt.; A. vulgaris ssp. lindleyana Hall & Clem. (=var. lindleyana Jeps.); and, further, three varieties of A. lindleyana are rejected as not distinct.

Collections:

305 - 11 Aug. 1956: in flower.
752 - 19 July 1957: early flowers.
954 - 13 Aug. 1957: (=752) very late flowers.

Pollen season: About July 15 to mid-September. Nil.

Comments: Very rare, and not a prolific pollen producer.

Artemisia ludoviciana Nutt.

Common wormwood

Synonyms: A. atomifera Piper; A. candicans Rydb.; A. discolor var. incompta Gray; A. diversifolia Rydb.; A. floccosa Rydb.; A. flodmanii Rydb.; A. gnaphalodes Nutt. (sometimes spelled "gnaphaloides"); A. gracilentata A. Nels.; ? A. herriotii Rydb.*; A. incompta Nutt. (misspelled "incompata" in Davis 1952); A. latiloba Rydb.; A. pabularis Rydb.*; A. paucicephala A. Nels.; A. platyphylla Rydb.; A. potens A. Nels.

Also, many of these names have been assigned by various authors as either subspecies or varieties of A. vulgaris, and as such, are not to be confused with A. vulgaris L., q.v.

*Not cited by Cronquist (1955). Coulter & Nelson (1909) cite A. pabularis as a synonym of A. gnaphalodes. A. herriotii is listed by Rydberg (1954), but I have not seen the name in other manuals; a specimen in the Herbarium resembles A. ludoviciana.

Collections:

247 - 18 July 1956: in flower.
253 - 22 July 1956: in flower.
729 - 14 July 1957: early flowers.
886 - 23 Aug. 1957: (=729) very late flowers and/or abortive buds.

Pollen season: About July 13 to late July, declining to late August. Negligible.

Comments: Occasional in small, widely separated colonies. Cronquist (1955) recognizes three varieties, stating that intermediates are abundant. For the present study, varietal distinction was not attempted.

Artemisia sacrorum Ledeb.

Russian wormwood

Collections:

- 312 - 18 Aug. 1956: past flowering.
- 755 - 21 July 1957: very early flowers.
- 888 - 23 Aug. 1957: (=755) very late flowers.

Pollen season: July 21 to early August, declining to August 26. Nil.

Comments: Rare; the few shrubs cultivated at the Pom-Olive Motel (at Broadway and Van Buren Ave.) are the only ones I have seen, except for some shrubs at the Forest Nursery which were observed in July 1958.

Artemisia tridentata Nutt.

Common sagebrush

Synonyms: A. vaseyana Rydb.; A. angusta Rydb. Note: A. tridentata var. trifida of various authors belongs with A. tripartita, which has not been collected in our area.

Collections:

- 330 - 23 Sept. 1956: past flowering?
- 880 - 20 Aug. 1957: very early flowers.
- 1011 - 15 Oct. 1957: (=880) abortive buds?
- 1011a - 16 Oct. 1957: (=330) very late flowers.

Pollen season: August 20 to mid-September, declining to early October. Prime importance.

Comments: Very abundant over a large area at the west edge of the valley, rather rare elsewhere in our area.

Artemisia vulgaris L.

Common wormwood

Collections:

- 295 - 5 Aug. 1956: early flowers.
 860 - 10 Aug. 1957: very early flowers.
 970 - 8 Oct. 1957: (=860) in flower.

Pollen season: August 9 to late October. Nil.

Comments: Rare. I have seen it only in the Pharmacy School Garden (near the Heating Plant) on the University Campus, where it was undoubtedly planted, but has persisted for several years and shows evidence of being capable of spreading. This species is not to be confused with the various subspecies and varieties now assigned to other species, notably (for our area) A. ludoviciana and A. lindleyana, q.q.v.

Centaurea L. Knapweed

This genus is included in the tribe Cynareae, the thistle tribe. They are well adapted to insect pollination, but produce an abundance of pollen, and some of the thistles have been suspected of causing hayfever (Wodehouse 1945). We have three species of Centaurea: C. cyanus L. (Bachelor's button) is frequently cultivated and occasionally persists as an escape; C. diffusa Lam. is very rare in our area; C. maculosa Lam. (Knapweed) is extremely

abundant everywhere in the valley, and is the one which would be implicated in hayfever. It flowers most abundantly from late July to late August, but continues - decreasingly - to early October.

Helianthus L. Sunflower

Although sunflower is obviously entomophilous, Wodehouse (1945) considers it to be "often somewhat imperfectly" so; and Brunett (1956) reported sunflower pollen on his atmospheric slides from August 12 to September 10 (a total of 6 grains). As suggested by Brunett, these grains were probably from H. annuus L., which is common in our area, and sometimes forms rather extensive stands. It flowers most abundantly from early July to late September.

Iva L.

Iva axillaris Pursh

Poverty weed

Synonym: I. foliolosa Nutt.

Collections:

325 - 31 Aug. 1956: past flowering.
677 - 6 July 1957: (=325) in flower.
836 - 5 Aug. 1957: (=677) past flowering.

Pollen season: Mid-June to late July. Nil.

Comments: Rare in our area. As "poverty weed" this is not to be confused with Monolepis nuttalliana, q.v. (family Chenopodiaceae).

Iva xanthifolia Nutt.

Marsh-elder

Synonyms: I. paniculata Nutt.; Cyclacheana xanthifolia (Nutt.) Fresen.; Euphrosyne xanthifolia Gray.

Collections:

314 - 18 Aug. 1956: in flower.
 831 - 4 Aug. 1957: early flowers
 955 - 14 Sept. 1957: very late flowers, mostly in fruit.

Pollen season: August 4 to late August, declining to mid-September. Secondary.

Comments: Very common; often abundant in small colonies, occasionally in rather extensive stands.

Solidago L. Goldenrod

Synonyms: The genera Euthamia Nutt., Oligoneuron Small, and Petradoria Greene are included here (Cronquist 1955).

Very early in the study of atmospheric pollens, it was established that the goldenrods do not ordinarily cause hayfever (e.g., Scheppegrell 1916). Wodehouse (1945) reports that of sixteen species tested, only two could be made to yield pollen in collectable quantities, but that the pollen of these two species can often be detected in the air several miles from the fields when the plants are in flower. Vaughan & Crockett (1932) reported on a year when goldenrod became a serious problem as a result of unusually rank growth of the weeds. Finally, Wodehouse (1945) states that "such imperfectly insect-pollinated

plants as the sunflower, goldenrod and dahlia must be given some consideration in hayfever studies, but that "they should not be taken too seriously." For these reasons, a general statement on the genus is probably warranted here.

The species which I have collected in our area are: S. occidentalis (Nutt.) T & G., S. missouriensis Nutt., S. gigantea Ait., and S. canadensis L., and various varieties of these, mostly undetermined. Most of the specimens of Solidago from our area which are in the University Herbarium (variously identified) are referable to one of these four species. Two specimens from the Flathead Lake and Glacier Park regions are identified as S. multiradiata Ait. and S. confertiflora Somers, and are referable to S. spathulata DC., but I have not recognized this species in our area.

The overall flowering season for the genus in 1957 started in early July (collection 676, July 6), reached a peak within a week, and continued high until snow (collection 1032, Oct. 20).

Of the species discussed above, S. occidentalis is known from only one place (in our area), namely, in the meadows just west of Buckhouse Bridge, U. S. Highway 93 about a mile southwest of town (collection 849). It is, however, apparently well established in those meadows, but

not abundant.

S. missouriensis, in one or more of its varieties, is fairly common in our area, especially in disturbed, dry, gravelly or sandy soil of vacant lots and overgrazed pastures. The most common form in our area (variety missouriensis) is a low plant, seldom over a foot tall, and bears a relatively small inflorescence (about six inches long or less). The var. fasciculata Holz. is taller, up to two feet, but only occasional. It occurs in small, widely separated patches. Neither variety produces sufficient pollen that it is likely to become air-borne to a significant degree. They flower most abundantly in July and early August.

The remaining two species, S. gigantea and S. canadensis, including their various varieties, are tall (2-5 ft.) and produce a very large inflorescence, sometimes as much as a foot or more in diameter; and they are abundant in some places, especially along canals west of town (Mullen Road and northward). These are the species most likely to be factors in hayfever in our area. They flower most abundantly during August and September, declining somewhat into October. A variety of S. canadensis (var. salebrosa (Piper) Jones ?), however, is cultivated in Missoula as a summer hedge (e.g. at 1600 Maurice Avenue). In these cases, it could very easily become a local cause

of hayfever. In 1957, this variety came into flower on September 19, and was still flowering in abundance on October 20 (collections 964 & 1032, respct.).

Taxonomically, the genus is very complex and the list of synonyms very extensive, especially for S. canadensis. For a complete synonymy (as applicable to plants of our area) the reader is referred to Cronquist (1955). In general, any plant referred to as "goldenrod" is probably a species of Solidago, the application of the common name in this case being more consistent than the application of scientific names (a result of obvious relationship, but of uncertain degree).

Taraxacum Hall Dandelion

Dandelion has been the subject of much debate in hayfever literature (e.g., Anon. 1930). It is undeniably insect-pollinated, but the pollen apparently becomes wind-borne at times. Stier et al (1930) concluded that it must be considered important in some parts of the Pacific Northwest, and it has been considered important in Utah (Wodehouse 1945). Brunett (1956) reported it in his atmospheric samples at Missoula from April 23 to July 12, 1954 (total of 6 grains).

The common pest of lawns in our area is mostly T. officinale Weber, but T. laevigatum (Willd.) DC. may also

be present (Cronquist 1955). In 1957, the flowering began about April 11, reached a peak in late April, and continued high through May. But by June 13, flowers were rarely seen. They became common again in early July and were common through July, but by mid-August were again only occasional. Thus, the plant exhibits two distinct flowering seasons, but the first is by far the most significant, and it is then - mostly in May - that the plant is most likely to become a cause of hayfever.

Xanthium L. Cocklebur

Xanthium strumarium L.

Cocklebur

Synonyms: All species except X. spinosum L. are considered by Cronquist (1955) to be minor variations of X. strumarium L.

Collections:

- 248 - 18 July 1956: very late flowers (this specimen).
- 263 - 25 July 1956: past flowering? (this specimen).
- 730 - 14 July 1957: in flower.
- 925 - 2 Sept. 1957: (=730) very late flowers.

Pollen season: About July 4 to mid-August, declining to late August or early September. Nil.

Comments: Occasional as isolated individuals or a few diminutive plants; small colonies of vigorous plants are rare.

CUPRESSACEAE

(Juniperaceae of some manuals)

Juniperus L. Juniper

Includes Sabina Haller of some manuals. There are numerous species, varieties, and forms in cultivation, and it is unlikely that all the species to be found in Missoula are included here.

Juniperus communis L.

Common juniper

Collections:

- 386 - 11 May 1957: [var. depressa Pursh ?] twig with early staminate cones.
 417 - 23 May 1957: (=386) twig with staminate cones, pollen mostly gone.
 809 - 29 July 1957: sterile twig.

Pollen season: About May 10 to May 18 (?).
 ? Important.

Comments: The species is at most occasional as a native in the mountains adjacent to the valley, but it is extensively cultivated in Missoula in its various varieties and forms. Booth (1950) considers variety depressa Pursh and var. saxatilis Pall. to be the common ones in Montana.

Juniperus scopulorum Sarg.

Rocky Mountain juniper

Synonym: Sabina scopulorum (Sarg.) Rydb.

Collection:

- 349 - 23 April 1957: Sheet 1/2 - twig with fruits.
 Sheet 2/2 - twig with early staminate cones.

Pollen season: April 23 to May 6. Important.

Comments: Extensively cultivated in its various varieties and forms, and it is abundant in a rather extensive natural stand in the Orchard Homes District; occasional elsewhere as a native.

Thuja L. Arborvitae

Sometimes spelled "Thuya," and frequently called "Cedar."

Thuja occidentalis L.

Eastern arborvitae

Collections:

- 351 - 27 April 1957: twig with staminate cones,
pollen mostly gone.
883 - 21 Aug. 1957: (=351) twig with fruits.

Pollen season: April 23 (?) to April 26 (?).
Negligible.

Comments: Commonly cultivated in Missoula, most commonly in its tall, narrowly columnar form.

Thuja plicata Donn.

Western redcedar

Collections:

- 362 - 30 April 1957: twig with staminate cones,
pollen gone.
885 - 21 Aug. 1957: (=362) twig with fruits nearly
mature.

Pollen season: April 25 (?) to April 27 (?). Nil.

Comments: Extremely rare in our area, only as an ornamental.

CYPERACEAE

Carex L. Sedge

Some of the sedges "shed much pollen which has been occasionally suspected of causing hayfever" (Wodehouse 1945). Brunett (1956) recorded sedge pollen on his 1954 atmospheric slides sporadically (total of 5 grains) from April 23 to June 21. This would approximately coincide with what I have observed to be the most active flowering season for the genus, but some species, especially those of bogs and wet meadows, continue to flower sporadically until well into Fall - nearly or quite to frost.

To select a "colony" of a given species and observe the flowering season is very difficult, since most "colonies" consist of several species. Most species cannot be identified without mature fruits; and many cannot be distinguished in the field, especially in the immature stages. For the purposes of the present study, no "colonies" were selected, except in a few cases where it was possible to do so. Instead, the plants were collected whenever and wherever they were found in flower. Unfortunately, since most species cannot be identified without mature fruits, many of these specimens have remained unidentified.

It can be said that, in general, wherever there are wet areas, there are sedges in abundance. Within our area,

they are abundant in the lowlands west of the Bitterroot River, in the lowlands along the Clark's Fork River west of Missoula, along canals, and in lesser colonies elsewhere. There are also several species which occur in drier habitats, such as in the prairie grasslands, but these are mostly not abundant, nor are they prolific pollen producers; they shed comparatively little pollen. The exceptions might be C. douglasii and C. eleocharis, two very similar species which shed enormous quantities of pollen and are locally abundant in small colonies. There are also a few species of woodland habitats, and one of these, C. geyeri, sheds enough pollen and is itself sufficiently abundant that it could perhaps cause hayfever, especially in Pattee Canyon.

Taxonomically, the authority accepted in this study was MacKenzie (1931-1935, and 1940) and Davis (1952). The University Herbarium has been checked for Missoula records, but unless the specimen came from definitely within our area it is not cited here (few exceptions).

Since Carex is so seldom mentioned in hayfever literature, and since the synonymy is so complex, inclusion of the synonymy in a study of this sort does not seem warranted. Most recent workers use MacKenzie's work as a starting point, and the reader is referred to MacKenzie (1931-1935) for a complete synonymy, but he should

consult recent manuals for recent emmendations or additions.

Carex angustior Mack.

Collection:

MONTU 38413 - F. H. Rose 542A. Lolo, July 19, 1938.

Carex aquatilis Wahl.

Collection:

MONTU 16305 & 15044 - J. E. Kirkwood 1032. Lolo, June 18, 1921.

Carex athrostachya Olney

Collections:

620 - 25 June 1957: various stages, some in flower.
762 - 21 July 1957: various stages, some in flower.

Comments: Not a prolific pollen producer; rarely abundant.

Carex aurea Nutt.

Golden sedge

Collections:

628 - 25 June 1957: past flowering, but fruits immature.
792 - 26 July 1957: (=628) fruits nearly mature.

Comments: Moist meadows; rare.

Carex bebbii Olney

Collection:

448 - 25 May 1957: various stages, including fruits and flowers.

Comments: Wet places. Not a prolific pollen producer; not abundant.

Carex bolanderi Olney

Collection:

MONTU 16313 - J. E. Kirkwood 1040. Missoula, Hellgate Canyon. July 11, 1921.

Carex brevior (Dewey) Mack.

Short-beak sedge

Collections:

MONTU 15725 - J. E. Kirkwood 1471. July 3, 1923.
MONTU 21415 - C. L. Hitchcock 1621. May 31, 1933.
596 - 23 June 1957: with fruits, no flowers.

Comments: Dry soil; rare. All of these specimens came from about the same place, at the foot of Mt. Sentinel on the University Campus. Pollen production slight.

Carex chimaphila Holm

Collection:

MONTU 38436 - F. H. Rose 249. Blackfoot, Missoula County. June 9, 1938.

Carex concinnoides Mack.

Collections:

MONTU 15728 - J. E. Kirkwood 1743. Clinton, Mont. May 15, 1924.
MONTU 47647 - LeRoy H. Harvey 4819. Pattee Canyon. May 20, 1952.
371 - 2 May 1957: early flowers. Pattee Canyon.
576 - 18 June 1957: (=371) fruits mature.

Pollen season: May 2 to May 10. Nil.

Comments: Woods. The individual plants shed moderate amounts of pollen, but are not common.

Carex crawfordii Fernald

Collection:

838 - 5 Aug. 1957: fruits mature, no flowers.

Comments: Dry soil, rare.

Carex disperma Dewey

Collections:

MONTU 16311 - J. E. Kirkwood 1045. Rattlesnake
Creek. May 30, 1921.
MONTU 16169 - J. E. Kirkwood 2416. Rattlesnake,
about 5 miles from Missoula. May 23,
1926.

Carex douglasii Boott

Douglas sedge

Collections:

145 - 18 June 1956: fruits advanced, no flowers.
378 - 7 May 1957: (=145) early flowers.
454 - 26 May 1957: (=145) very late flowers, pollen
mostly gone.

Pollen season: May. Negligible.

Comments: Dry soil. A prolific pollen producer, occasionally abundant in colonies as much as 100 feet across. See also C. eleocharis.

Carex eleocharis Bailey

Needleleaf sedge

Collections:

? 118 - 11 June 1956: fruits mostly advanced, no
flowers with pollen.

- ? 369 - 30 April 1957: in flower.
 389 - 11 May 1957: with flowers.
 426 - 23 May 1957: (=389) well past flowering.
 ? 451 - 26 May 1957: (=118) recently past flowering.
 623 - 25 June 1957: (=389) fruits mature.

Pollen season: About May 8 to about mid-May. Negligible.

Comments: Very similar in habit and habitat to C.

douglasii, q.v.

Carex exsiccata Bailey

Western inflated sedge

Collections:

- 708 - 11 July 1957: mostly in fruit, this stage
 predominant.
 709 - 11 July 1957: in flower.

Comments: moist meadows; abundant in the meadows
 west of Buckhouse Bridge.

Carex festivella Mack.

Ovalhead sedge

Collection:

- 615 - 25 June 1957: fruits advanced, no flowers
 with pollen.

Comments: Moist meadows; pollen production is slight
 and the plants are not abundant.

Carex filifolia Nutt.

Threadleaf sedge

Collections:

- 358 - 27 April 1957: in flower.
 557 - 11 June 1957: (=358) fruits advanced.

Pollen season: About April 24 to about May 1. Nil.

Comments: Prairie species. Occasional, rarely abundant,

pollen production slight.

Carex geyeri Boott

Elk sedge

Collections:

- 341 - 18 April 1957: very early flowers.
 428 - 23 May 1957: (=341) fruits advanced.
 577 - 18 June 1957: (=341) fruits mature.

Pollen season: April 17 to about May 1. Negligible.

Comments: Sheds moderate amounts of pollen and is common, frequently abundant, in dry soil of open woods.

Carex kelloggii Boott

Collections:

- ? 137 - 17 June 1956: past flowering.
 442 - 25 May 1957: (=137) in flower.
 446 - 25 May 1957: late flowers (this specimen).
 447 - 25 May 1957: (=446) full flower (this specimen).
 553 - 11 June 1957: (=446) past flowering.
 ? 556 - 11 June 1957: (=137) past flowering.
 795 - 28 July 1957 (=137?) fruits advanced.

Pollen season: About May 20 to June 5 (?). ? Minor.

Comments: Abundant in wet meadows and sheds rather large amounts of pollen.

Carex laeviculmis Meinsh. ?

Smooth-stemmed sedge

Collection:

MONTU 21420 - C. L. Hitchcock 1780. Miller Creek,
 12 miles from the mouth of the canyon.
 July 15, 1933.

Comment: The question mark is Hitchcock's.

Carex lanuginosa Michx.

Woolly sedge

Collections:

- 404 - 16 May 1957: early flowers.
 452 - 26 May 1957: (=404) late flowers.
 799 - 28 July 1957: (=404) fruits mature.

Pollen season: About May 14 to May 29. ? Minor.

Comments: Abundant along canals at some places;
 produces an abundance of pollen.

Carex mertensii Prescott

Collection:

MONTU 16439 - J. E. Kirkwood 2105. Rattlesnake
 Falls. July 18, 1925.

Carex microptera Mack.

Smallwing sedge

Collections:

MONTU 38502 - F. H. Rose 248. Blackfoot, June 9,
 1938.

Carex nebraskensis Dewey

Nebraska sedge

Collections:

MONTU 13217 - C. A. Nickolaus; Clinton, June 2,
 1924.
 MONTU 13168 - Esther L. Larsen; Clinton, June 2,
 1924.

Carex pachystachya Cham.

Thickheaded sedge

Collection:

MONTU 38518 - F. H. Rose 358. Near Bonner, June 24,
 1938.

Carex petasata Dewey

Collection:

MONTU 15043 - J. E. Kirkwood 1031. Missoula Campus
May 28, 1921.

Carex physocarpa Presl. ?

Collection:

101 - 7 June 1956: recently past flowering.

Carex retrorsa Schw.

Collections:

227 - 13 July 1956: late flowers.
791 - 26 July 1957: (=227) in flower, this stage
relatively common.
957 - 15 Sept. 1957: (=227) fruits advanced but
flowers present, flowers
rather rare.

Pollen season: Mostly mid-June to late July, but
sporadically into Fall. ? Minor.

Comments: Abundant in moist meadows and boggy areas,
pollen production moderate.

Carex rossii Boott

Collections:

MONTU 16328 - J. E. Kirkwood 1029. Bonner. (No
date).
MONTU 38537 and 38538 - F. H. Rose 350. South of
Bonner, June 24, 1938.

Carex rostrata Stokes

Beaked sedge

Collections:

MONTU 14643 - A. McClay. Clinton, June 3 (no year).

MONTU 15556 - J. E. Kirkwood 1523. Woodman, Mont.,
 July 28, 1923. Det. K. MacKenzie.
 ? 638 - 28 June 1957: mostly with advanced fruits,
 but a very few stems with flowers
 (not shown on this specimen).

Comments: MONTU 15556 is not from our area, but it
 very closely resembles my 638, which is otherwise un-
 identified. A prolific pollen producer, but apparently
 rare in our area. Boggy places.

Carex scoparia Schk.

Broom sedge

Collection:

790 - 26 July 1957: with flowers and mature fruits.

Comments: Pollen production slight.

Carex scopulorum Holm

Collections:

MONTU 38545 - F. H. Rose 249. Blackfoot Valley,
 June 9, 1939.

MONTU 38544 - F. A. Barkley & M. J. Reed 2401. West
 of Mt. Sentinel, May 26, 1939.

Carex stipata Muhl.

Collections:

132 - 14 June 1956: some fruits advanced, but
 flowers present.

691 - 7 June 1957: (=132) mostly with mature fruits
 but flowers present.

Comments: Not abundant, pollen production slight.

Carex vallicola Dewey

Valley sedge

Collection:

MONTU 21419 - C. L. Hitchcock 1639. Rattlesnake Valley one mile north of Missoula, June 1, 1933.

Carex xerantica Bailey

Collection:

MONTU 38574 - Fred A. Barkley 2377. Spring Gulch on north face of Mt. Sentinel, May 26, 1938.

Cyperus L. Nutgrass, Flat-sedgeCyperus aristatus Rottb.

Bearded flat-sedge

Collections:

331 - 3 Oct. 1956: most plants with both mature fruits and flowers.

912 - 24 Aug. 1957: some plants with mature fruits, all with flowers.

1026 - 20 Oct. 1957: (=912) most plants with mature fruits, all with flowers.

Pollen season: About July to the Fall rainy season.
Nil.

Comments: Rarely abundant, pollen production extremely slight.

Eleocharis R. Br. Spike-rushEleocharis acicularis (L.) R. & S.

Needle spike-sedge

Collections:

285 - 4 Aug. 1956: in flower.

769 - 21 July 1957: (=285) early flowers.

Pollen season: Late July to frost or Fall rainy season. Nil.

Comments: Abundant in the sloughs west of Buckhouse Bridge, but sheds only minute amounts of pollen.

Eleocharis engelmanni var. monticola (Fern.) Sven.
Blunt spike-sedge

Synonyms: E. monticola Fern.; E. ovata var. engelmanni Britton.

Collections:

- 911 - 24 Aug. 1957: many plants with mature fruits, but all with flowers.
1029 - 20 Oct. 1957: (=911) all plants with mature fruits, but many with flowers.

Pollen season: June or July to frost or Fall rainy season. Nil.

Comments: Rare, sheds very little pollen.

Eleocharis macrostachya Britt.

Synonyms: E. palustris (L.) R & S. for our area; E. uniglumis (Link) Schult. for our area.

Collections:

- 102 - 7 June 1956: fruits advanced.
130 - 14 June 1956: in full flower.
381 - 7 May 1957: first flowers.
408 - 16 May 1957: (=381) in full flower.
858 - 10 Aug. 1957: (=381) late flowers.
870 - 16 Aug. 1957: late flowers.

Pollen season: May 7 to mid-July, declining to mid-August. Nil.

Comments: Common, but only occasionally abundant in small colonies; pollen production rather slight.

Scirpus L. Bulrush, TuleScirpus microcarpus Presl.

Small-fruited bulrush

Collections:

- 178 - 25 June 1956: in flower.
 544 - 11 June 1957: early flowers.
 701 - 9 July 1957: (=544) past flowering.

Pollen season: About June 8 to mid-June, declining to early July. Nil.

Comments: Abundant in only a few small colonies in our area; pollen production slight.

Scirpus validus Vahl.?

Great bulrush

Collections:

- 219 - 8 July 1956: in full flower.
 547 - 11 June 1957: (=219) first flowers.
 844 - 8 Aug. 1957: past flowering.

Pollen season: June 11 to late July or early August. Nil.

Comments: Uncommon in our area; only a few plants in a few widely separated localities were seen. Pollen production slight.

ELAEAGNACEAE

Shepherdia Nutt.Shepherdia canadensis (L.) Nutt.

Buffalo-berry

Synonyms: Elaeagnus canadensis (L.) Nels.; Lepargyrea canadensis (L.) Greene

Collections:

- MONTU 15814 - J. E. Kirkwood 1214. Hellgate Canyon, one mile east of Missoula. April 20, 1921.
- MONTU 40908 - J. Smautz & J. Egeland 8. Spring Gulch seven miles north of Missoula. April 30, 1942.

Comments: May be anemophilous, but is only occasional in moist canyons and forests adjacent to the valley, and it sheds but little pollen.

FAGACEAE

Castanea Mill.

Castanea dentata Borkh.

American chestnut

Collection:

678 - 7 July 1957: early flowers.

Pollen season: early July to late July, declining to late August. Nil.

Comment: A single tree in Missoula; primarily entomophilous (see Knuth 1909, Vol. III, p. 376).

Fagus L. Beech

Fagus grandifolia Ehrh.?

American beech

There are said to be about five trees in Missoula (Howell 1958); entirely anemophilous.

Quercus L. OakQuercus bicolor Willd.

Swamp white oak

Synonym: Q. platanoides (Lam.) Sudw.

Collections:

- 411 - 18 May 1957: very early flowers.
 473 - 30 May 1957: (=411) past flowering.
 942 - 7 Sept. 1957: (=411) leaves and acorns.

Pollen season: May 18 to May 27. Nil.

Comment: About three trees on the University Campus.

Quercus coccinea Muenchh. ?

Scarlet oak

A medium-sized tree observed in Bonner Park, July 1958.

Quercus macrocarpa Michx.

Bur oak

Synonyms: Q. mandanensis Rydb., Q. olivaeformis Michx. f.

Collections:

- 410 - 18 May 1957: [var. olivaeformis (Michx. f.) Gray] very early flowers.
 472 - 30 May 1957: (=410) past flowering.
 474 - 30 May 1957: leaves.
 828 - 4 Aug. 1957: leafy twig.
 841 - 7 Aug. 1957: [var. olivaeformis (Michx. f.) Gray]
 941 - 7 Sept. 1957: (=410) mature leaves and acorns.
 943 - 7 Sept. 1957: (=474) mature leaves and acorns.

Pollen season: May 17 to May 25. Negligible.

Comment: There are several trees on the University Campus, otherwise it is rare in our area. Little (1953) does not recognize the variety olivaeformis as distinct from the species.

Quercus robur L.

English oak

Collections:

- 396 - 14 May 1957: very early flowers.
 409 - 18 May 1957: early flowers.
 430 - 24 May 1957: (=396) very late flowers.
 431 - 24 May 1957: (=409) very late flowers.
 939 - 7 Sept. 1957: (=396) leaves and acorns.
 940 - 7 Sept. 1957: (=409) leaves and acorns.

Pollen season: May 13 to May 25. Nil.

Comment: Two trees on the University Campus. In 1958, the pollen season was from May 15 to May 18 (3 days!).

Quercus rubra L.

Northern red oak

Synonym: Q. maxima (Marsh.) Ashe.; Q. borealis Michx. f. (see Little 1953).

Collections:

- 395 - 14 May 1957: early flowers.
 415 - 23 May 1957: (=395) past flowering.
 ? 433 - 25 May 1957: leafy twig.
 802 - 28 July 1957: (=395) leaves and immature acorns.
 963 - 18 Sept. 1957: (=395) leaves and mature acorn..

Pollen season: May 13 to about May 19. Nil ?

Comments: One tree on the University Campus; produces an enormous amount of pollen. In 1958, the pollen season started about May 12. Tree 433, which was also on the University Campus, was removed to accomodate a parking lot.

GINKGOACEAE

Ginkgo L.Ginkgo biloba L.

Ginkgo, Maiden-hair tree

Collection:

884 - 21 Aug. 1957: leafy twig.

Comments: Two trees in Missoula, neither of which has been known to flower; their sex is therefore unknown (Ginkgo is dioecious).

GRAMINEAE

Wodehouse (1945) considers a relatively small number of species as accounting for practically all the grass hayfever, and suggests that the governing factors in their production of hayfever are primarily their abundance, the amount of pollen shed, and its range of dispersal.

The amount of pollen which the species produce varies from very little (e.g. species of Panicum) to enormous (e.g. Secale). Most species are anemophilous, but some exhibit various degrees of cleistogamy (e.g., species of Panicum, Leersia, etc.) (Hitchcock 1950). At least one species, Poa bulbosa, is mostly proliferous. Harlan (1945) cites several references which discuss cleistogamy in various grasses or list the species which exhibit the phenomenon, but this literature has not been pursued for

the present study; all grasses are here considered to be anemophilous.

The most important genera in our area, on the basis of abundance of the plants and amount of pollen shed, are Agropyron, Agrostis, Bromus, Festuca, and Poa (not necessarily in that order, and not all species). Next in importance would appear to be Dactylis, Koeleria, and Phleum. The species of the remaining genera are either not abundant in our area, or they produce but little pollen, or both. This would hold especially for those species listed here only by MONTU numbers, i.e., those not collected during this study.

Much study has been devoted to determining the time of day during which the species shed pollen (e.g., Hyde & Williams 1945, Jones & Brown 1951, and see Pammel 1930), and though the time of day of pollen shedding has been found to be somewhat characteristic for the species, it has also been found to vary. Hyde & Williams (1945) demonstrated rather well the controlling influence of meteorological factors - primarily temperature and humidity; and in Missoula, I have observed several grasses, especially species of Bromus, to flower en masse immediately preceding thunderstorms. I did not, however, attempt to make detailed observations of this sort.

Taxonomically, the present treatment is based

entirely upon Hitchcock (1950). The synonymy in these discussions is mostly limited to those names which I have encountered in hayfever literature pertinent to our area, and those which appear on specimens in our Herbarium. The reader is referred to Hitchcock (1950) for a complete list of synonyms, at least insofar as they appear in American literature.

Agropyron Gaertn. Wheatgrass

Agropyron desertorum (Fisch.) Schult. Crested wheatgrass

Synonyms: For our purposes, A. cristatum (L.) Gaertn. is included here, though it is distinct (see comments).

Collections:

160 - 22 June 1956: early flowers.
 196 - 30 June 1956: [A. cristatum (L.) Gaertn.] in flower.
 564 - 17 June 1957: first flowers.
 724 - 13 July 1957: (=564) very late flowers.

Pollen season: June 17 to late June, declining to mid-July. Important.

Comments: Common, and in some places abundant; a prolific pollen producer. A. desertorum was listed in the first edition of Hitchcock's manual as A. cristatum, and may appear in the literature as such. In our area, A. desertorum is rather common, and A. cristatum is apparently rare.

Agropyron inerme (Scribn. & Smith) Rydb.

Beardless wheatgrass

Collections:

- 123 - 12 June 1956: in flower.
 184 - 26 June 1956: pollen mostly gone.
 532 - 10 June 1957: early flowers.
 695 - 9 July 1957: (=532) last flowers.

Pollen season: June 10 to July 9. Nil.

Comments: Occasional, rarely abundant in small colonies; and it does not appear to produce much pollen.

Agropyron repens (L.) Beauv.

Quackgrass

Synonym: A. leersianum (Wulf.) Rydb.

Collections:

- 122 - 12 June 1956: in flower, dry sandy soil.
 149 - 18 June 1956: in flower, dry loam soil.
 208 - 7 July 1956: in flower, dry sandy soil.
 212 - 7 July 1956: in flower, rather moist sandy loam.
 539 - 10 June 1957: (=208) early flowers.
 581 - 20 June 1957: early flowers, dry sandy loam, partly disturbed, partly undisturbed, partly open, partly shaded.
 611 - 23 June 1957: (=212) pollen season advanced.
 630 - 27 June 1957: (=539) late flowers.
 647 - 2 July 1957: (=581) (an awned variant).
 683 - 7 July 1957: in flower, dry leaf mold.
 725 - 13 July 1957: (=581) past flowering (undisturbed soil, cf. 736).
 736 - 16 July 1957: (=581) in flower (disturbed soil, open, cf. 725).
 750 - 19 July 1957: pollen season advanced; cultivated, irrigated loam.
 ? 759 - 21 July 1957: (=683 ?, a variant).
 824 - 1 Aug. 1957: in flower; moist sandy gravel.
 856 - 10 Aug. 1957: (=736, =581) a few days past flowering.

- 867A - 13 Aug. 1957: in flower; disturbed, dry, sandy loam.
 889 - 23 Aug. 1957: in flower; in creek bed, moist but without standing water.
 977 - 9 Oct. 1957: (=889) cleistogamous or abortive.
 1009 - 15 Oct. 1957: (=750) normal flowers ensheathed.
 1015 - 16 Oct. 1957: (=867A) in flower.

Pollen season: June 10 to June 30, declining to mid-July, and sporadically thereafter to early October.
 ? Important.

Comments: Common, sometimes in rather extensive colonies; pollen production is moderately high, but the colonies do not all flower concurrently, being somewhat controlled by environment. (See also A. smithii.)

The time of day of pollen shedding was not observed in detail, but it may be of interest to note that the plants of collection 212 were shedding in abundance when collected at 4:00 P.M. on July 7, 1956, whereas the plants of collection 581 were shedding in abundance when that collection was made in mid-morning of June 20, 1957.

Agropyron smithii Rydb.

Western wheatgrass

Collections:

- 210 - 7 July 1956: in flower; dry sandy soil.
 211 - 7 July 1956: in flower; rather dry clay loam.
 258 - 24 July 1956: in flower; loam soil overlain with sawdust.
 582 - 20 July 1957: early flowers.
 609 - 23 June 1957: (=211) first flowers.
 648 - 2 July 1957: (=582) very late (last?) flowers.
 679 - 7 July 1957: (=609) mostly with mature fruits.
 680 - 7 July 1957: in flower; dry leaf mold.
 798 - 28 July 1957: (=680) a few days past flowering.

Pollen season: About June 18 to early July, declining to about July 27. ? Important.

Comments: Similar to A. repens, q.v., in both habit and habitat, and the two are often associated. Though perhaps less abundant than A. repens, A. smithii appears to be the more prolific pollen producer of the two. Also called bluestem or Colorado bluestem.

Agropyron spicatum (Pursh) Scribn. & Smith
Bluebunch wheatgrass

Collections:

- 108 - 9 June 1956: in flower.
- 485 - 1 June 1957: very early flowers.
- 562 - 17 June 1957: (=485) very late flowers.

Pollen season: June 1 to June 17. Secondary.

Comments: Common in our area, and abundant wherever the native prairie has not been much disturbed, but it sheds relatively little pollen.

Agropyron subsecundum (Link) Hitchc. Bearded wheatgrass

MONTU 21379 and 21400 - C. L. Hitchcock 1670. July 7, 1933; shaded rocky slide near 2nd bridge above Bonner, Blackfoot Valley, Missoula County [as A. caninum (L.) Beauv.]

"This is the species which has generally been called by American botanists A. caninum (L.) Beauv.; that is a European species, differing in having 3-nerved glumes." (Hitchcock 1950). A. caninum is known in the United States only from ballast near Portland, Oregon.

Agropyron trachycaulum (Link) Malte ? Slender wheatgrass

Synonyms: A. tenerum Vasey; A. pauciflorum (Schwein.) Hitchc.

Collection:

533 - 10 June 1957: early flowers.

Pollen season: June 9 to July 5 or sporadically a few days beyond. Negligible.

Comments: Apparently rather uncommon in our area, and sheds rather little pollen.

Agrostis L. BentgrassAgrostis alba L.

Redtop

Synonym: A. palustris Huds. in American literature.

Collections:

213 - 7 July 1956: in flower.
 656 - 2 July 1957: (=213) first flowers.
 832 - 4 Aug. 1957: (=656) very late flowers.
 851 - 8 Aug. 1957: with unexpanded panicle.
 946 - 11 Sept. 1957: with unexpanded panicles.
 975 - 8 Oct. 1957: (=946) in full flower.

Pollen season: July 2 to late July, sporadically to mid-October. Prime importance.

Comments: Abundant in moist meadows and along canals; a prolific pollen producer.

Agrostis exarata Trin.

Spike bentgrass

Synonym: A. asperifolia Trin.

MONTU 0666 and MONTU 0668 - H. R. Flint; Miller Creek, Oct., 1916. [as A. asperifolia Trin.]

Agrostis idahoensis Nash

MONTU 37258 - F. H. Rose 530-A; Lolo Road, Missoula County, 19 July 1938.

Agrostis scabra Willd.

Winter bentgrass

Synonym: A. hiemalis (Walt.) B. S. P. for Montana plants (Harvey 1958).

Collections:

MONTU 36424 - L. H. Harvey 2118; Roadside, Pattee Canyon; 13 Aug. 1946. [As A. hiemalis (Walt.) B. S. P.]
293 - 4 Aug. 1956: fruits cast.

Comments: Uncommon in our area, and not a prolific pollen producer.

Alopecurus L. FoxtailAlopecurus aequalis Sobol

Short-awn foxtail

Collections:

138 - 17 June 1956: in flower.
284 - 4 Aug. 1956: in flower.
555 - 11 June 1957: (=138) early flowers.
859 - 10 Aug. 1957: (=138) late flowers
1025 - 20 Oct. 1957: (=284) in flower.

Pollen season: June 10 to late October. Nil.

Comments: Common in sloughs and slow-moving water along streams, but never abundant; pollen production slight.

Alopecurus geniculatus L.

Water foxtail

MONTU 16315 and 15034 - J. E. Kirkwood 1026; Missoula, near University, July 10, 1922. Det. A. S. Hitchcock.

Apera Adans.Apera interrupta (L.) Beauv. .

Collection:

550 - 11 June 1957: all stages of development.

Comments: Uncommon, and at best a meagre pollen producer.

Aristida L. Three-awnAristida longiseta Steud. var. robusta Merr. Red three-awn

Collections:

254 - 22 July 1956: mostly past flowering. (=671).
 671 - 6 July 1957: early flowers.
 854 - 9 Aug. 1957: (=671) late flowers.

Pollen season: About July 6 to early or mid-August.
 Nil.

Comments: Rarely abundant in small colonies; pollen production is meagre, and the flowers are apparently at least in part cleistogamous. Typical A. longiseta Steud. may be present in our area, but all my specimens are apparently the variety robusta.

Avena L. OatsAvena sativa L.

Oats

Collections:

203 - 5 July 1956: flowers in anthesis.
 608 - 23 June 1957: early flowers in anthesis.
 865 - 12 Aug. 1957: (=608) late flowers,
 cleistogamous.

Pollen season: June 23 to late July or early August.
Negligible.

Comments: Rather extensively cultivated, but most often cleistogamous. The opening of the flowers is closely controlled by weather (e.g., see Pammel 1930, p. 885). There are several varieties and forms in cultivation, but all ours are taken here to be the typical variety.

Beckmannia Host Sloughgrass

Beckmannia syzigachne (Steud.) Fernald American sloughgrass

Synonym: B. erucaeformis (L.) Host in American literature.

Collections:

204 - 5 July 1956: early flowers (=567).
567 - 17 June 1957: very early flowers.
1021 - 20 Oct. 1957: late flowers.

Pollen season: June 17 to about mid-July, sporadically into Fall. Nil.

Comments: Uncommon, never abundant; pollen production moderate. Flowering is influenced by soil moisture. Note that in 1956 colony 567 did not start until July (collection 204).

Bouteloua Lag. Grama

Bouteloua gracilis (H.B.K.) Lag.

Blue grama

MONTU 15571 - J. E. Kirkwood 1529; Fort Missoula, East of watertank, edge of upper terrace; 2 Aug. 1923.

Bromus L. Bromegrass

Bromus brizaeformis Fisch. & Mey. Rattlesnake chess

MONTU 36812 - L. H. Harvey 2095; Campus, Missoula; 11 July 1946.

Bromus carinatus Hook. & Arn. California brome

Collections:

530 - 10 June 1957: early flowers?
 591 - 20 June 1957: (=530) late flowers?
 MONTU 36819 - L. H. Harvey 2116; Roadside, Pattee Canyon; 23 July 1946.

Pollen season: Early June to late June. Nil.

Comments: Uncommon. The flowers are mostly cleistogamous (Harlan 1945), and the indicated pollen season is largely conjectural. Some flowers were in anthesis on June 10, and were seen to be so at intervals until at least June 20, but never abundantly so; pollen production is meagre.

Bromus ciliatus L. Fringed brome

Synonym: B. richardsoni Link

MONTU 0741 - H. R. Flint; Mt. Sentinel; Sept. 1916
 [as B. richardsoni Link]
 MONTU 0746 - H. R. Flint; Miller Creek; Oct. 1916
 [as B. richardsoni Link.]

Bromus commutatus Schrad. Hairy chess

MONTU 47059 - F. H. Rose 355; South of Bonner, Missoula County; 24 June 1938.

Bromus inermis Leyss.

Smooth brome

Collections:

- 107 - 9 June 1956: early flowers (=519).
 183 - 26 June 1956: early flowers ?
 519 - 10 June 1957: first flowers.
 571 - 18 June 1957: flowers in anthesis.
 696 - 9 July 1957: in flower.
 718 - 12 July 1957: (=519) a few days past
 flowering.
 800 - 28 July 1957: (=696) very late flowers.

Pollen season: June 10 to July 7, sporadically in favorable locations to late July. Prime importance.

Comments: Common, often abundant in extensive stands; a prolific pollen producer. The time of day during which this species sheds pollen was observed to vary with the weather. Most often, the flowers opened en masse before 8:00 A.M. There were, however, some notable exceptions: June 17, 1957 (cool and cloudy, clearing somewhat and becoming warmer during the afternoon) - 4:30 P.M.; June 18, 1957 (clear and warm) - 11:00 A.M.; June 27, 1957 (warm, partly cloudy) - 8:00 P.M.; June 2, 1958 - 5:30 P.M. (a very few flowers, the first of the season); June 5, 1958 (clearing and warming after a few days of rainy, cool weather) - 6:00 P.M. (in "fair" abundance); June 10, 1958 (following another rainy spell) - 5:30 P.M. (again in "fair" abundance); June 13, 1958 (after more rain) - 6:30 P.M. (in great abundance). See also B. pumellianus.

Bromus japonicus Thunb.

Japanese chess

Collections:

- 142 - 18 June 1956: flowers apparently immature (=612).
 148 - 18 June 1956: pollen season advanced.
 174 - 23 June 1956: early flowers? (=900).
 587 - 20 June 1957: pollen mostly gone.
 612 - 20 June 1957: (=142) pollen mostly gone.
 651 - 2 July 1957: pollen season advanced.
 757 - 21 July 1957: (=651) most stems with fruits mature, a few with immature panicles.
 900 - 24 Aug. 1957: (=174) mostly with mature fruits, some few-flowered panicles immature.
 924 - 2 Sept. 1957: (=900) fruits mostly mature.

Pollen season: Mid-June to late June, continuing in favorable locations to early September. Nil.

Comments: Common but rarely abundant; when so, then the plants are usually quite small. Pollen production very meagre; flowers apparently mostly cleistogamous.

Bromus marginatus Nees.

Mountain brome

Collections:

- 104 - 8 June 1956: pollen mostly gone (=568)
 182 - 26 June 1956; pollen mostly gone (=525)
 525 - 10 June 1957: first flowers.
 568 - 18 June 1957: fruits nearly mature.
 666 - 6 July 1957: (=525) mostly past flowering.
 667 - 6 July 1957: (=525) mostly past flowering.

Pollen season: Early June to mid-June, declining to early July. Nil.

Comments: Rather rare in our area. This species belongs to the section *Ceratochloa*, and is quite similar in flowering habit to B. carinatus, q.v.; the indicated pollen season is highly conjectural.

Bromus pumpellianus Scribn.

Collections:

159 - 19 June 1956: Flowers abundantly in anthesis.

Pollen season: about concurrent with B. inermis (see discussion).

Comments: This species is very similar to B. inermis, q.v., but it is either uncommon in our area or it has been misidentified as B. inermis during casual field observations. The plants of collection 159 were shedding pollen en masse as a thunderstorm approached at 4:00 P.M.

Bromus tectorum L.

Soft chess, cheat grass

Collections:

147 - 18 June 1956: smutted grains, no flowers.

489 - 1 June 1957: pollen season advanced.

650 - 2 July 1957: [var. glabratum Spenner ?]
flowers in all stages of
development.

758 - 21 July 1957: (=650), mostly with mature
fruits, but with some flowers.

947 - 11 Sept. 1957: (=489) with flowers in
anthesis and younger.

Pollen season: About mid-May to early June, continuing into September in favorable habitats. Nil.

Comments: This is the most common grass in our area, abundant everywhere. It appears, however, to be mostly cleistogamous, and was rarely observed with flowers in anthesis. Pollen production is very meagre.

Calamagrostis Adans. ReedgrassCalamagrostis canadensis (Michx.) Beauv. BluejointMONTU 16321 - J. E. Kirkwood 1010; Rattlesnake Creek,
bog; 17 July 1921. Det. A. Hitchcock.Calamagrostis rubescens Buckl. PinegrassSynonym: C. suksdorfii Scribn.MONTU 0775 - H. R. Flint; Lower end of Blackfoot
Canyon; Oct. 1916 [as C. suksdorfii Scribn.]
MONTU ----- - F. H. Rose 343; Hillside south of
Bonner; 24 June 1938.Catabrosa Beauv.Catabrosa aquatica (L.) Beauv. BrookgrassMONTU 1107 - H. R. Flint; Miller Creek; Oct. 1916.
[as Panicularia aquatica]Hitchcock (1950) cites Panicularia as a synonym of
Glyceria, but he does not list P. aquatica; Glyceria
aquatica, however, is cited as a synonym of Catabrosa
aquatica.Cinna L. WoodreedCinna latifolia (Trevir.) Griseb. Drooping woodreedMONTU 29922 - Fred A. Barkley 1881; Rattlesnake
Valley, 5 mi. north of Missoula; 7 Sept 1937.
MONTU 46577 - F. H. Rose 533; Lolo Road; 19 July
1938.Dactylis L. Orchard grassDactylis glomerata L. Orchard grass

Collections:

- 105 - 8 June 1956: early flowers.
 109 - 9 June 1956: shedding abundantly (=500).
 500 - 2 June 1957: early flowers in anthesis.
 570 - 18 June 1957: (=500) late flowers.

Pollen season: June 1 to about June 19. Prime importance.

Comments: Common, and abundant in some fields in the Orchard Homes District. Sheds an abundance of pollen. In 1958, three isolated plants in dry gravelly soil near the University were shedding pollen in abundance on May 26.

Danthonia Lam. & DC. Oatgrass

Danthonia californica Boland. California oatgrass

MONTU 0811 - Marcus E. Jones; Evaro; July 13, 1909.
 [as D. unispicata, annotated as D. californica.]

Danthonia intermedia Vasey Timber oatgrass

MONTU 46978 - F. H. Rose 501; Blackfoot Valley,
 Missoula County; 15 July 1938.

Danthonia unispicata (Thurb.) Munro ex Macoun
 One-spike oatgrass

Collection:

- 175 - 24 June 1956: various stages of development,
 mostly in anthesis.

Comments: Rare in open woods; pollen production slight.

Deschampsia Beauv. Hairgrass

Deschampsia danthonioides (Trin.) Munro ex Benth
Annual hairgrass

Collection:

552 - 11 June 1957: past flowering.

Comments: Apparently rare in our area; pollen
production meagre.

Deschampsia elongata (Hook.) Munro Slender hairgrass

MONTU 36591 - L. H. Harvey 2117; Roadside, Pattee
Canyon; 23 July 1946.

Digitaria Heister Crabgrass

Digitaria ischaemum (Schreb.) Smooth crabgrass

MONTU 28878 - V. L. Marsh 348; at southeast corner of
Natural Science Building on U. of Mont. Campus. 10
Sept. 1936.

MONTU 28881 - V. L. Marsh 767; growing in the lawn
on the south side of the Natural Science Bldg. and
on the south side of Main Hall, U. of Mont. Campus.
27 Sept. 1937.

MONTU 46971 - Duplicate of MONTU 28878.

See D. sanguinalis; Booth (1950) does not list D.
ischaemum for Montana, though Hitchcock (1950) indicates
that Montana is within its range.

Digitaria sanguinalis (L.) Scop. Crabgrass

Collections:

915 - 24 Aug. 1957: early flowers in anthesis.

989 - 13 Oct. 1957: (=915) all stages of develop-
ment, some flowers in anthesis.

991 - 13 Oct. 1957: some flowers in anthesis.

Pollen season: Mid-August to Fall. Nil.

Comments: Occasional or even rare, in lawns; a meagre pollen producer. See also D. ischaemum.

Echinochloa Beauv. Barnyardgrass

Echinochloa crusgalli (L.) Beauv. Barnyard grass

Collections:

- 194 - 30 June 1956: early flowers in anthesis.
- 236 - 15 July 1956: (=194) flowers in anthesis.
- 652 - 2 July 1957: early flowers in anthesis.
- 908 - 24 Aug. 1957: all stages of development.
- 1010 - 15 Oct. 1957: (=652) flowers in anthesis.

Pollen season: Late June to late October. Nil.

Comments: Occasional, in small (rarely extensive) colonies, the colonies often persisting only a few years dependent upon disturbance of the soil. Pollen production slight. This is a complex species with three intergrading varieties, but no attempt was made to distinguish these among my specimens.

Elymus L. Wild-rye

Elymus canadensis L. Canada wild-rye

Collections:

- 220 - 9 July 1956: flowers in anthesis (=675).
- 675 - 6 July 1957: flowers in anthesis.
- 732 - 14 July 1957: pollen season advanced.
- 897 - 23 Aug. 1957: (=675) very late flowers.
- 953 - 13 Sept. 1957: (=675) one spike with flowers.

Pollen season: Late June or early July to mid-August, sporadically to mid-September. Negligible.

Comments: Pollen production is moderate, but the plants are only occasional within the valley, in small colonies. It is, however, rather abundant eastward along the Northern Pacific Railroad tracks.

Elymus cinereus Scribn. & Merr. Giant wild-rye

Synonym: E. condensatus Presl. for plants of our area (see comments).

Collections:

201 - 5 July 1956: flowers in anthesis.
624 - 25 June 1957: early flowers in anthesis.
764 - 21 July 1957: a few days past flowering.

Pollen season: June 25 to mid-July (July 18 or 20).
Negligible.

Comments: A prolific pollen producer, but only occasional, rarely abundant. The common name "giant wild-rye," locally applied to this species (Morris et al, undated) is also applied to E. condensatus Presl., which is similar to E. cinereus, but which is confined to the coastal areas of southern California (Hitchcock 1950). The name E. condensatus has been misapplied to our plants in hay-fever literature (e.g. Steir et al 1930).

Elymus glaucus Buckl. Blue wild-rye

Collections:

180 - 26 June 1956: in flower (=588).
588 - 20 June 1957: early flowers.
738 - 16 July 1957: (=588) in flower.

- 743 - 16 July 1957: [var. jepsoni Davy].
 890 - 23 Aug. 1957: (=588) flowers in anthesis.
 978 - 9 Oct. 1957: (=588) cleistogamous ?

Pollen season: June 16 (?) to mid-July, then sporadically from mid-August to late Fall. Nil.

Comments: Pollen production moderate, but the plants are only occasional in our area, in small colonies in moist places.

Elymus macounii Vasey

Macoun wild-rye

Collections:

- 209 - 7 July 1956: mostly or entirely in fruit
 (=538).
 538 - 10 June 1957: early flowers.

Pollen season: June 10 to late June. Nil.

Comments: Pollen production moderate, but the plants apparently very rare in our area - only one clump seen.

Elymus triticoides Buckl. subsp. multiflorus Gould
 Beardless wild-rye

Collections:

- 223 - (=223a, showing compound spikes.)
 223a - 11 July 1956: flowers in anthesis.
 674 - 6 July 1957: pollen season advanced.
 751 - 19 July 1957: pollen season a few days past.

Pollen season: Late June or early July to mid-July.
 Negligible.

Comments: A prolific pollen producer, but apparently rare in our area.

Eragrostis Beauv. LovegrassEragrostis cilianensis (All.) Lutati

Stinkgrass

Collections:

- 320 - 24 Aug. 1956: fruits mostly mature (this specimen) (=1004).
 837 - 5 Aug. 1957: early flowers.
 1004 - 13 Oct. 1957: (=320) all stages of development.

Pollen season: Late July or early August to late October. Nil.

Comments: Very rare; a meagre pollen producer, and the flowers are at least in part cleistogamous.

Eragrostis poaeoides Beauv. ex Roem. & Schult.

Little lovegrass

Collections:

- 746 - 19 July 1957: in flower.
 864 - 12 Aug. 1957: (=746) all stages of development.
 1003 - 13 Oct. 1957: (=746) all stages of development.

Pollen season: Early July to late October. Nil.

Comments: Very rare (moderately abundant at the Northern Pacific Railroad Yards, not seen elsewhere), pollen production is meagre, and the flowers are at least in part cleistogamous. (A solitary plant was seen at the Forest Nursery, on Spurgin Road, July 1958.)

Festuca L. FescueFestuca elatior L.

Meadow fescue

Collections:

- 131 - 14 June 1956: flowers in anthesis (=554).
 199 - 30 June 1956: flowers in anthesis.
 554 - 11 June 1957: early flowers in anthesis.
 916 - 27 Aug. 1957: flowers in anthesis.
 990 - 13 Oct. 1957: (=916) flowers in anthesis.

Pollen season: June 11 to late June, sporadically into October. Secondary.

Comments: A prolific pollen producer, rather common in moist meadows, occasional in lawns. It is mostly in lawns and such favorable locations that it flowers after June. In 1958 a single culm of colony 916 (in the lawn at the University, the only culm to survive mowing) was shedding pollen abundantly on May 26.

Festuca idahoensis Elmer

Idaho fescue

Collection:

- 597 - 23 June 1957: very late flowers or a few days past flowering.

Pollen season: Probably mid-May to mid-June. Prime importance.

Comments: A constituent of the native prairie, it is common in favorable locations such as north slopes wherever the native grasslands have not been much disturbed; a rather prolific pollen producer.

Festuca occidentalis Hook.

Western fescue

MONTU 15707 - J. E. Kirkwood 1457; Rattlesnake Creek,
near end of road, elev. 4200 ft. 30 June 1923.

MONTU 46958 - F. H. Rose 3484; Partly shaded on mossy
site south of Bonner, Missoula County. 24 June
1938.

MONTU 46959 - F. H. Rose 356-a; South of Bonner,
Missoula County, Montana, by cabin under power line;
24 June 1938.

Festuca octoflora Walt.

Six-weeks fescue

Collections:

146 - 18 June 1956: fruits mostly mature.

549 - 11 June 1956: fruits mostly mature.

Comments: Pollen season not determined. The species
is occasionally abundant, but only very diminutive plants
have been seen in our area; pollen production is very
meagre. Our plants are apparently variety tenella (Willd.)
Fern.

Festuca ovina L.

Sheep fescue

Collections:

399 - 16 May 1957: immature flowers.

455 - 26 May 1957: (=399) early flowers in anthesis.

Pollen season: Mid-May to mid-June. Importance un-
determined.

Comments: Abundance in our area was not determined;
the species is very similar to F. idahoensis and difficult
to distinguish from it. A rather prolific pollen producer.

Festuca rubra L.

Red fescue

Collections:

- 181 - 26 June 1956: flowers in anthesis (=526).
 ? 524 - 10 June 1957: early flowers in anthesis.
 526 - 10 June 1957: early flowers in anthesis.
 664 - 6 July 1957: (=526) late flowers in anthesis.

Pollen season: June 8 to July 10. Negligible.

Comments: A moderate pollen producer, but not especially common, rarely abundant in small colonies.

Festuca scabrella Torr.

Rough fescue

Collections:

- 440 - 25 May 1957: early flowers in anthesis.
 487 - 1 June 1957: (=440) late flowers in anthesis.

Pollen season: May 24 to June 2. Prime importance.

Comments: A major associate of the native prairie, often abundant; a prolific pollen producer. In 1958, colony 440 was mostly past its pollen season on May 29.

Festuca subulata Trin.

Bearded fescue

MONTU 21341 - C. L. Hitchcock 1658; moist soil near spring, Blackfoot Valley near second bridge above Bonner, elev. 3400 ft. 7 July 1933.

Glyceria R. Br. MannagrassGlyceria borealis (Nash) Batchelder

Northern mannagrass

Collections:

- 228 - 13 July 1956: flowers in anthesis (=770).
 770 - 21 July 1957: in flower.
 905 - 24 Aug. 1957: (=770) flowers in anthesis.
 958 - 15 Sept. 1957: (=770) flowers in anthesis.
 1024 - 20 Oct. 1957: (=770) a few flowers in anthesis.

Pollen season: Early (?) July to late August, declining to mid-September, sporadically to late October. Nil.

Comments: In boggy places and sloughs, uncommon, never abundant; pollen production rather slight.

Glyceria elata (Nash) Hitchc. Tall mannagrass

Collections:

185 - 27 June 1956: flowers in anthesis (=982).
982 - 10 Oct. 1957: late flowers in anthesis.

Pollen season: About mid-June into October. Nil.

Comments: Uncommon, in wet places, rarely abundant; pollen production moderate.

Glyceria grandis S. Wats. American mannagrass

Collections:

205 - 5 July 1956: early flowers (=692).
692 - 7 July 1957: early flowers in anthesis.
846 - 8 Aug. 1957: flowers in anthesis.
878 - 20 Aug. 1957: (=692) late flowers in anthesis.
907 - 24 Aug. 1957: flowers in anthesis (this plant only).
1023 - 20 Oct. 1957: (=907) a few flowers in anthesis.

Pollen season: July 2 (?) to late August, sporadically into October. Negligible.

Comments: Occasional in wet places, rarely abundant in small colonies; pollen production moderate.

Glyceria striata (Lam.) Hitchc. Fowl mannagrass

Collection:

136 - 17 June 1956: immature flowers.

Comments: In wet places, apparently rare; pollen production moderate.

Hierochloë R. Br.

Hierochloë odorata (L.) Beauv.

Sweetgrass

Synonym: Torresia odorata (L.) Hitchc.

MONTU 15003 - J. E. Kirkwood 1009; Lolo Creek bottoms, meadows. 18 June 1921. Det. A. S. Hitchcock. [as Torresia odorata (L.) Hitchc.]

Hordeum L. Barley

Hordeum brachyantherum Nevski.

Meadow barley

Synonym: H. nodosum for American plants.

Collection:

156 - 19 June 1956: fruits mostly advanced.

Comments: Very rare.

Hordeum jubatum L.

Foxtail barley

Collections:

127 - 14 June 1956: in flower.
 515 - 8 June 1957: early flowers in anthesis.
 633 - 28 June 1957: [var. caespitosum (Scribn.) Hitchc.?] flowers in anthesis.

- 634 - 28 June 1957: flowers in anthesis.
 737 - 16 July 1957: (=634) flowers in anthesis.
 920 - 1 Sept. 1957: (=515) very late flowers,
 mostly the fruits are cast.
 944 - 11 Sept. 1957: (=634) flowers in anthesis.
 1034 - 3 Nov. 1957: very late flowers, possibly
 cleistogamous; spikes only
 partly exerted.

Pollen season: Late May or early June to mid-
 August, declining to mid-September, continuing
 sporadically into November. Negligible.

Comments: Common, frequently abundant in small
 colonies; but pollen production is meagre and the
 flowers are frequently cleistogamous. The occurrence of
 cleistogamy versus pollen liberation is not clear from
 my observations.

Hordeum vulgare L.

Barley

Collections:

- 217 - 8 July 1956: [var. trifurcatum (Schlecht.)
 Alefeld, Beardless barley]
 flowers in anthesis.
 218 - 8 July 1956: [Bearded barley] flowers in
 anthesis.
 731 - 14 July 1957: [2-rowed form] flowers
 cleistogamous.

Pollen season: Apparently June and July. Nil.

Comments: Extensively cultivated in the valley, but cultivated barley "appears to be harmless in hayfever" (Wodehouse 1945), since the flowers are mostly cleistogamous.

Koeleria Pers.

Koeleria cristata (L.) Pers.

Junegrass

Collections:

- 95 - 6 June 1956: flowers in anthesis (=483).
- 483 - 1 June 1957: early flowers in anthesis.
- 561 - 17 June 1957: (=483) late flowers in anthesis.

Pollen season: May 30 to June 17. Prime importance.

Comments: Common, and in some places abundant, wherever the native prairie has not been much disturbed; pollen production abundant. The name "Junegrass" is the accepted common name for this species, and should not be confused with "Junegrass" for Poa pratensis, q.v. In 1958, this species was abundantly in flower on May 30.

Lolium L. Ryegrass

Lolium multiflorum Lam.

Italian ryegrass

Collections:

- 151 - 18 June 1956: flowers in anthesis (=744).
- 744 - 16 July 1957: all stages of development, flowers in anthesis.
- 993 - 13 Oct. 1957: (=744) flowers in anthesis.
- 994 - (=993, showing variations in form, collected for classroom demonstration.)

Pollen season: Early June to late fall. Nil.

Comments: Occasionally planted in lawns, uncommon as a weed. A prolific pollen producer, but only in cases where lawns are poorly kept is it allowed to flower in abundance. In 1958, the first flowers came into anthesis on May 31.

"Domestic" ryegrass is a conglomerate of hybrids between annual and perennial types, generally called "common" ryegrass, although they are classified as L. multiflorum (Hoover et al 1948). Thus, since the lawn from which these collections were made was planted with a commercial seed mixture containing "perennial" and "domestic" ryegrass, it should contain plants of the L. multiflorum hybrids as well as L. perenne L., and in fact, all variations between the two species as well as the extremes were found, including plants with paniculate spikes approaching L. multiflorum var. ramosum Guss.

Melica L. Melicgrass

Melica subulata (Griseb.) Scribn.

Alaska oniongrass

MONTU 21368 - C. L. Hitchcock 1791; deep shade in sandy loam on moist bank of Miller Creek, about 12 miles from mouth of canyon, Missoula county. Elev. 4500 ft. 15 July 1933.

Oryzopsis Michx. RicegrassOryzopsis bloomeri (Boland.) Ricker

MONTU 28861 - V. L. Marsh 433; in an open yellow pine forest bordering the highway, 6 miles west of Frenchtown, Montana; 20 June 1937.

Frenchtown is about 30 miles northwest of Missoula on U.S. Highway 10; see Plate I.

Oryzopsis hymenoides (Roem. & Schult.) Ricker

Indian ricegrass

Synonym: O. cuspidata (Nutt.) Vasey

MONTU 16034 - J. E. Kirkwood 2077; Fort Missoula, near water tank; 9 June 1925. [as O. cuspidata (Nutt.) Vasey].

Panicum L.Panicum capillare L.

Witchgrass

Synonym: P. barbipulvinatum Nash.

Collections:

- 195 - 30 June 1956: very early flowers in anthesis.
 235 - 15 July 1956: (=195) all stages of development, flowers in anthesis.
 669 - 6 July 1957: early (?) flowers in anthesis.
 808 - 20 July 1957: all stages of development, flowers in anthesis.
 983 - 10 Oct. 1957: (=669) all stages of development, flowers in anthesis.

Pollen season: Late June or early July to late October.
 Nil.

Comments: Occasionally abundant in small colonies, the colonies frequently not persisting more than a few years.

Pollen production slight. The name "witchgrass" is proper-

ly applied to this species, and should not be confused with "witchgrass" as sometimes applied to Agropyron repens, q.v. No attempt was made to distinguish the variety occidentale Rydb. among my specimens.

Panicum dichotomiflorum Michx.

Fall panicum

Collection:

999 - 13 Oct. 1957: flowers in anthesis.

Comments: Very rare at the Northern Pacific Railroad Yards.

Panicum miliaceum L.

Corn millet

Collections:

705 - 11 July 1957: various stages of development, mostly immature; flowers in anthesis.

1019 - 20 Oct. 1957: (=705) mostly mature, but a few inflorescences with flowers in anthesis.

Pollen season: About mid-June to late October. Nil.

Comments: Extremely rare, as a waif on trash piles; pollen production meagre.

Phalaris L. Canary grass

Phalaris arundinacea L.

Reed canary grass

Collections:

187 - 27 July 1956: flowers in anthesis.
 711 - 11 July 1957: early flowers in anthesis.
 796 - 28 July 1957: (=711) very late flowers.
 825 - 4 Aug. 1957: early flowers in anthesis.
 981 - 10 Oct. 1957: flowers in anthesis.

Pollen season: Sporadically from mid-June to mid-October. Nil.

Comments: Pollen production is moderate, but the species is rare in our area. The variegated form (var. picta L.) is rarely cultivated in Missoula (seen in two places).

Phleum L. Timothy

Phleum alpinum L.

Alpine timothy

MONTU 28805 - Paul Judge 10; Missoula County, Mont., south of Missoula; 18 July 1937.

This plant differs from other specimens of P. alpinum from western Montana in being rather tall (more robust), and it resembles plants from our area, especially in the meadows west of Buckhouse Bridge, which I could not satisfactorily identify as P. alpinum, but only as P. pratense L., q.v. The only difference seems to be the more ovoid head on the questionable specimens. P. alpinum, then, is not known from our area.

Phleum pratense L.

Timothy

Collections:

188 - 27 June 1956: in flower.
 635 - 28 June 1957: early flowers.
 833 - 4 Aug. 1957: (=635) late flowers.
 861 - 12 Aug. 1957: flowers in anthesis.
 974 - 8 Oct. 1957: (=861) with flowers.

Pollen season: June 28 to mid-July, sporadically to mid-October. Prime importance.

Comments: Common, frequently abundant in small colonies, occasionally so in extensive colonies; a prolific pollen producer.

Poa L. BluegrassPoa ampla Merr.

Big bluegrass

MONTU 30244? - C. L. Hitchcock 2946; moist gravelly soil along railroad track 1 mile east of Missoula; 28 May 1936.

MONTU 47009 - F. H. Rose 362-a; ditch bank, Brandman Ranch near Bonner; 24 June 1938.

MONTU 47008 - F. H. Rose 733; McClay Bridge, Missoula County; 7 June 1939.

Poa bulbosa L.

Bulbous bluegrass

Collections:

- 153 - 19 June 1956: bulblets mature.
 400 - 16 May 1957: bulblets very immature.
 401 - 16 May 1957: (=400, but at edge of a small mound of gravel) bulblets a bit further advanced than in 400.

Comments: Proliferous (the flowers converted into bulbils); "unaltered spikelets about 5-flowered, apparently not perfecting seed" (Hitchcock 1950), but I have never seen plants with unaltered spikelets.

Poa compressa L.

Canada bluegrass

Collections:

- 157 - 19 June 1956: early flowers (these plants) in anthesis.
 169 - 23 June 1956: various stages, mostly in flower and younger.
 583 - 20 June 1957: early flowers in anthesis.
 585 - 20 June 1957: early flowers in anthesis.
 649 - 2 July 1957: (=585) very late flowers in anthesis.
 663 - 6 July 1957: (=583) very late flowers.
 690 - 7 July 1957: in flower.
 771 - 21 July 1957: various stages of development flowers in anthesis.

- 785 - 26 July 1957: (=690) very late flowers.
 923 - 1 Sept. 1957: (=771) mostly mature, but with
 a few immature inflorescences.
 948 - 11 Sept. 1957: (=771) with immature inflo-
 rescences.

Pollen season: June 19 to early July, declining to
 late July, then sporadically to early October. Prime
 importance.

Comments: Abundant, frequently in very extensive
 colonies; a prolific pollen producer.

Poa glaucifolia Scribn. & Will.

Collection:

- 575 - 18 June 1957: flowers in anthesis.

Comments: Uncommon in the woods adjacent to the valley;
 a moderate pollen producer.

Poa juncifolia Scribn. Alkali bluegrass

MONTU 46999 - F. H. Rose 368; Missoula, 24 June 1938.

Poa nervosa (Hook.) Vasey Wheeler bluegrass

Several from our area; MONTU 16164, 24422, 24482,
 15706, 9677, 9811.

Poa palustris L. Fowl bluegrass

Collections:

- 179 - 25 June 1956: immature flowers (=688).
 198 - 30 June 1956: very early or possibly immature
 flowers.
 589 - 20 June 1957: flowers immature, but panicle
 expanded.
 625 - 25 June 1957: early flowers.
 665 - 6 July 1957: in flower.
 688 - 7 July 1957: in flower.

904 - 24 Aug. 1957: (=625) very late flowers, this stage rare.

976 - 8 Oct. 1957: (=589) in flower.

Pollen season: About June 25 to mid-July, declining to mid-August, and continuing sporadically to mid-October. ? Important.

Comments: Common, frequently abundant in moist meadows; pollen production is rather slight.

Poa pratensis L.

Kentucky bluegrass

Collections:

- 87 - 1 June 1956: abundantly in anthesis.
- 117 - 11 June 1956: late flowers.
- 126 - 12 June 1956: past flowering.
- 416 - 23 May 1957: early flowers in anthesis.
- 479 - 30 May 1957: early flowers in anthesis.
- 484 - 1 June 1957: pollen season a few days advanced.
- 492 - 1 June 1957: pollen season a few days advanced, flowers in anthesis.
- 518 - 8 June 1957: (=479) very late flowers.
- 563 - 17 June 1957: (=484) very late flowers
- 566 - 17 June 1957: in flower.

Pollen season: May 23 to June 17. Prime importance.

Comments: Abundant nearly everywhere in our area except in relatively undisturbed native prairie, and it is the major component of most lawns; a prolific pollen producer. Though "Kentucky bluegrass" is the accepted name for this species, it is sometimes called "Junegrass," and as such should not be confused with Koeleria cristata, q.v. In 1958, the species was abundantly in flower nearly everywhere by May 25.

Poa scabrella (Thurb.) Benth.

Pine bluegrass

MONTU 47560 - L. H. Harvey 4959; alkali meadow 3
miles south of Lolo; 7 June 1952.

Poa secunda Presl.

Sandberg bluegrass

Synonym: P. sandbergii Vasey

Collections:

- 154 - 19 June 1956: fruits advanced.
418 - 23 May 1957: early flowers (?) abundantly in
anthesis.
439 - 25 May 1957: early flowers abundantly in
anthesis.
482 - 1 June 1957: (=439) past flowering.
499 - 2 June 1957: (=418) past flowering.

Pollen season: May 23 to May 31. Important.

Comments: Relatively common wherever the native prairie
has not been too much disturbed; a prolific pollen pro-
ducer.

Secale L. RyeSecale cereale L.

Rye

Collections:

- 96 - 6 June 1956: in flower (=493).
493 - 2 June 1957: early flowers in anthesis.
887 - 23 Aug. 1957: (=493) very late flowers in
anthesis, this stage rare.

Pollen season: May 31 to mid-July, declining to
August 23. Nil.

Comments: These collections represent a small colony
which has persisted near the University for several years.
Rye may be cultivated to some extent in our area, but I have

not noticed it. It sheds "prodigious quantities of pollen," but the large size of the grains greatly restricts its effective range (Wodehouse 1945).

Setaria Beauv. Bristlegrass

Setaria lutescens (Weigel) Hubb. Yellow bristlegrass

Synonym: S. glauca (L.) Beauv.

Collection:

748 - 19 July 1957: all stages of development, abundantly in anthesis.

Comments: Rare, found only at the Northern Pacific Railroad Yards; otherwise all comments, including pollen season, for S. viridis are applicable here.

Setaria viridis (L.) Beauv. Green bristlegrass

Synonym: Chaetochloa viridis Scribn.

Collections:

- 237 - 15 July 1956: early flowers in anthesis.
 267 - 25 July 1956: all stages of development, flowers not evidently in anthesis (=797).
 747 - 19 July 1957: some fruits nearly mature, mostly younger; flowers in anthesis.
 778 - 25 July 1957: all stages of development, a few flowers in anthesis.
 779 - 25 July 1957: (=778) a form resembling S. lutescens.
 797 - 28 July 1957: mostly in fruit.
 797a - 28 July 1957: (=797) cleistogamous.
 822 - 1 Aug. 1957: all stages of development, a few flowers in anthesis.
 895 - 23 Aug. 1957: all stages of development, a few flowers in anthesis.

986 - 10 Oct. 1957: (=747) all stages of development, a few flowers in anthesis, but mostly cleistogamous.

Pollen season: Mid-July to mid-October. Nil.

Comments: Occasional in waste places, never abundant (relatively so at the Northern Pacific Railroad Yards), frequently not persisting. Pollen production is meagre, and the flowers are frequently cleistogamous.

Sitanion Raf. Squirreltail

Sitanion hystrix (Nutt.) J. G. Smith Squirreltail

Collections:

97 - 7 June 1956: in flower.
 119 - 11 June 1956: in flower (=537).
 170 - 23 June 1956: late flowers.
 497 - 2 June 1957: early flowers in anthesis.
 537 - 10 June 1957: early (?) flowers in anthesis.
 599 - 23 June 1957: in flower.
 672 - 6 July 1957: (=599) fruits mostly mature, a few spikes with flowers.

Pollen season: Late May or early June to late June, sporadically to mid- or late July. Nil.

Comments: Occasional, rarely abundant in small colonies; pollen production is meagre, and the flowers appear to be frequently cleistogamous.

Spartina Schreb. Cordgrass

Spartina gracilis Trin. Alkali cordgrass

MONTU 47561 - L. H. Harvey 4960; alkali meadow 3 miles south of Lolo; 7 June 1952.

Stipa L. NeedlegrassStipa columbiana Macoun Columbia needlegrass

MONTU 46984 - F. H. Rose 364; Roadside, Bundaman ranch,
Bonner, Missoula County; 24 June 1938. [as var.
nelsoni (Scribn.) Hitchc.]

Stipa comata Trin. & Rupr. Needle-and-thread grass

Collections:

115 - 11 June 1956: in flower.
158 - 19 June 1956: flowers in anthesis
513 - 8 June 1957: early flowers in anthesis.
598 - 23 June 1957: (=513) very late flowers.

Pollen season: June 8 to June 23. Nil.

Comments: Common, occasionally abundant in small colonies; pollen production is meagre, and cleistogamy apparently prevalent.

Stipa richardsoni Link Richardson needlegrass

MONTU 15543 - J. E. Kirkwood 1504; Ninemile Bridge,
near road, Blackfoot Valley. Elev. 3800 ft.
21 July 1923.
MONTU 36448 - L. H. Harvey 4464; in pine woods, Black-
foot Valley, 8 miles north of Bonner; 10 July 1951.

Stipa viridula Trin. Green needlegrass

Collections:

116 - 11 June 1956: in flower.
120 - 11 June 1956: flowers in anthesis.
514 - 8 June 1957: early (?) flowers in anthesis.
565 - 17 June 1957: (=514) a few flowers in
anthesis.

Pollen season: Early June. Nil.

Comments: See S. comata, but this species is less common.

Trisetum Pers.

Trisetum canescens Buckl. Tall trisetum

MONTU 26411 - Marcus E. Jones; Evaro; 13 July 1909.

Trisetum cernuum Trin. Nodding trisetum

MONTU 36627 - L. H. Harvey 4465; in pine woods 8 miles north of Bonner; 10 July 1951.

Triticum L.

Triticum aestivum L. Wheat

Collections:

- 215 - 8 July 1956: flowers in anthesis.
- 535 - 10 June 1957: early flowers.
- 749 - 19 July 1957: flowers abundantly in anthesis.
- 866 - 12 Aug. 1957: (=535) apparently cleistogamous.

Pollen season: Early June to mid-August (?). Nil.

Comments: Extensively cultivated in the Missoula Valley, and relatively large amounts of pollen are shed when the flowers are open, but they are mostly cleistogamous.

Zea L.

Zea mays L. Corn

Collections:

- 269 - 26 July 1956: flowers in anthesis.
- 997 - 13 Oct. 1957: flowers in anthesis.

Pollen season: Early July to early September, declining into October. Negligible ?

Comments: Corn is not much cultivated as a commercial crop in our area, but it is quite common in private gardens. It sheds large amounts of pollen, which according to Wodehouse (1945) is "known to be toxic to hayfever patients and is at times a cause of hayfever, but the large size of the grains prevents it from becoming atmospheric in the sense that that of ragweed and most of the hayfever grasses is."

HIPPURIDACEAE

(Sometimes included in Haloragaceae)

Hippuris L. Mare's-tail

Hippuris vulgaris L.

Mare's-tail

Collection:

767 - 21 July 1957: in flower.

Pollen season: Mid-July to mid-August (?) Nil.

Comments: Abundant in the sloughs west of Buckhouse Bridge, but not known from elsewhere in the Valley.

Pollen production very meagre.

JUGLANDACEAE

Carya Nutt. Hickory

Carya spp.

Hickory

Collections:

- 434 - 25 May 1957: early flowers.
 ? 436 - 25 May 1957: young leaves.
 823 - 1 Aug. 1957: (=434) expanded leaves.

Pollen season: May 23 to May 27 (?). Nil.

Comments: Only two small trees known in Missoula, one of which (434) is definitely a hickory, and flowered; the other (436) appears to be a hickory.

Juglans L. Walnut

Juglans major (Torr.) Heller

(Black walnut)

Collections:

- 432 - 25 May 1957: very early flowers.
 476 - 30 May 1957: (=432) past flowering.
 820 - 31 July 1957: (=432) expanded leaves.

Pollen season: May 24 to May 29 (?). Nil.

Comments: "Black" walnut is rarely cultivated in Missoula. The tree represented by these specimens was originally secured (several years ago) from an eastern nursery as J. nigra L., but it does not appear to be that species. Most probably, the other "black" walnuts in Missoula are J. nigra. (The proper common name for J. major is "Arizona walnut," but the name "black walnut" is used here to include any of the walnuts except J. regia, q.v.)

Juglans regia L.

"English" walnut

Collection:

435 - 25 May 1957: young leaves and pistillate flowers (and staminate flowers from 1956 ?).

Comments: A single small tree known in Missoula. When collection 435 was made, pistillate flowers appeared to be receptive to pollen, but staminate flowers were not seen except a few apparently from 1956. Correctly called "Persian" walnut, this is the "English" walnut of common speech and commerce.

JUNCACEAE

Juncus L. Rush

The rushes are common in bogs and wet areas throughout the Missoula Valley, but they are seldom abundant, and in general, produce only small amounts of pollen; and further, flowering is somewhat related to soil moisture, so that it occurs sporadically over a long period of time as the water recedes from a bog, the plants seldom flowering en masse. The one exception to these generalities is J. balticus, which is sometimes abundant along canals, and then flowers en masse, releasing noticeable quantities of pollen.

For the present study, Davis (1952) has been used as

the primary reference for identification. For the most part no attempt has been made to distinguish the varieties.

Juncus balticus Willd.

Wire rush

Collections:

- 112 - 9 June 1956: very early flowers.
- 125 - 12 June 1956: in full flower.
- 502 - 2 June 1957: (=112) early flowers.
- 541 - 11 June 1957: (=112) pollen mostly gone.

Pollen season: Early June to mid-June. Negligible ?

Comments: Common, occasionally abundant along canals; pollen production moderate.

Juncus bufonius L.

Toad rush

Collections:

- 614 - 25 June 1957: some flowers, mostly fruits.
- 913 - 24 Aug. 1957: some flowers mostly fruits.
- 1027 - 20 Oct. 1957: mostly fruits, very few flowers.

Pollen season: Mid-June to frost or fall rainy season.
Nil.

Comments: Occasionally abundant in small colonies; pollen production very meagre.

Juncus confusus Cov. ?

Collections:

- 699 - 9 July 1957: mostly with fruits mature. Rare.

Juncus ensifolius Wikstr.

Collections:

- 133 - 14 June 1956: in flower.

616 - 25 June 1957: (=133) early flowers (this specimen).

Juncus longistylis Torr.

Long-styled rush

Collection:

700 - 9 July 1957: Mostly in fruit, but a few flowers with stigmas exerted.

Juncus nodosus L.

Collections:

636 - 28 June 1957: very few plants with flowers open.
 788 - 26 July 1957: mostly in flower.
 852 - 8 Aug. 1957: in flower.
 1028 - 20 Oct. 1957: with flowers.

Juncus saximontanus A. Nels.

Rocky Mountain rush

Synonym: J. xiphioides var. montanus Engelm.

Collections:

MONTU 1552 - J. A. Hughes. Missoula, July 25, 1916.
 [as J. xiphioides.]

Juncus tenuis Willd.

Slender rush

Collections:

? 618 - 25 June 1957: mostly in fruit, a few plants with flowers.
 768 - 21 July 1957: fruits mature.
 787 - 26 July 1957: mostly fruits, a few plants with a few flowers.

Juncus tracyi Rydb.

Collections:

637 - 28 June 1957: early flowers.
 789 - 26 July 1957: in flower.

Luzula DC. WoodrushIncludes Juncoides.Luzula multiflora (Retz.) Lejeune

Collection:

574 - 18 June 1957: in flower.

Comments: Occasional in the woods adjacent to the valley; pollen production meagre.

Luzula parviflora (Ehrh.) Desv.

Collection:

MONTU 16440 - J. E. Kirkwood 2106. Missoula.
Rattlesnake Falls, July 18, 1925.
[as Juncoides parviflorum (Ehrh.)
Cov.]

Comments: No other records of this species for our area.

MORACEAE

Morus L. MulberryMorus alba var. tatarica (L.) Ser. Russian mulberry

Collections:

414 - 18 May 1957: early pistillate flowers.
719 - 12 July 1957: (=414) expanded leaves and
fruits.

Comments: A single small tree on the University Campus. Though this tree produced fruits, no staminate flowers were seen.

OLEACEAE

This family includes Lilac and Forsythia, both of which are extensively cultivated in Missoula, but, in our area, only Fraxinus is at all anemophilous.

Fraxinus L. AshFraxinus pennsylvanica Marsh.

Green ash

Synonyms: F. pennsylvanica var. lanceolata (Borkh.)
Sarg.; F. lanceolata Borkh.; F. viridis Michx. f.

Collections:

367 - 30 April 1957: early flowers, staminate and
pistillate.
869 - 16 Aug. 1957: (=367) mature leaves and
fruits.

Pollen season: April 29 to about May 5. Minor.

Comments: Occasionally cultivated in Missoula, usually solitary or only a few trees together. Pollen production is prodigious, but since Fraxinus is dioecious, only some of the trees produce pollen.

PINACEAE

In all the members of this family, pollen-shedding activity increases rapidly after the season starts, and reaches a peak within a few days. An enormous amount of pollen is liberated during a period of a few days, then, very abruptly, active pollen liberation ceases. Most conifers, however, and especially those of the family

Pinaceae, tend to retain pollen within the staminate cones for a time after the anthers have dehisced, and this may continue to be shaken out by wind until well into the summer or fall. This trait accounts for the extremely long pine-pollen season so characteristic of atmospheric pollen studies (e.g., Daubenmire 1940, Brunett 1956). Brunett reported pine pollen on his 1954 samples from April 13 to October 3, with the peak from May 19 to July 15, during which period the count far exceeded all other groups combined. Daubenmire (1940) found old staminate cones shedding pollen in mid-winter.

The Missoula Valley is surrounded by very extensive coniferous forests. Two of the outstanding characteristics of these forests are (1) their broad altitudinal distribution - from 3200 feet at the valley elevation to timberline at perhaps 8500 feet, and (2) their predominance in a variety of habitats - from ponderosa pine on dry west and south slopes to spruce and fir in moist north-facing canyons and at high altitudes.

It is necessary when interpreting the "pollen seasons" as they are indicated in this study, to consider all of these factors, and to keep in mind that the pollen seasons indicated here are based upon observations of a few selected plants within the valley, and the pollen season is taken as the period from the first evident shedding

of pollen to the time that an abundance of pollen is no longer easily dislodged from the majority of the cones. Or, in other words, the indicated "pollen season" more nearly represents the period of "active pollen liberation," or opening of the strobili.

The "pollen showers" in spring and the yellow scums on puddles formed by Spring rains in our area are due to pine pollen, presumably mostly of ponderosa pine, though the earliest may be of lodgepole pine. In 1958, the first of these scums was observed on May 24.

The five most important conifers in our area, in terms of abundance of the plants and pollen production, are Pinus ponderosa, P. contorta, Pseudotsuga menziesii, Larix occidentalis, and Juniperus spp. (of family Cupressaceae, q.v.).

Abies Mill. Fir

Abies concolor (Gord. & Glend.) Lindl. White fir

Collection:

810 - 29 July 1957: leafy twig.

Comments: One tree in Missoula. It is about six feet tall, and has not been known to produce cones.

Abies grandis (Doug.) Lindl. Grand fir

Comments: Not known in Missoula; it is to be expected occasionally in the more mesic canyons adjacent to the valley.

Abies lasiocarpa (Hook.) Nutt.

Sub-alpine fir

Collections:

377 - 7 May 1957: twigs with staminate cones,
shedding.

933 - 2 Sept. 1957: twig with cone axils.

Pollen season: May 6 to about May 10. Nil ?

Comments: Rare as an ornamental in Missoula, but may occur at higher elevations in the neighboring mountains, in which case the observed pollen season is probably not indicative for that of the species.

Larix Mill. Larch

Larix occidentalis Nutt.

Western larch

Collection:

346 - 23 April 1957: early strobili.

Pollen season: April 23 to May 1. Secondary ?

Comments: Occasionally cultivated in town, but more important, it is one of the predominant trees of the forests in the adjacent mountains, especially abundant in the more mesic, north-facing canyons and north slopes. In 1958, tree 346 had shed most of its pollen by April 24.

Picea A. Deitr. Spruce

Picea abies (L.) Karst.

Norway spruce

Collection:

384 - 7 May 1957: twig with early staminate flowers.

Pollen season: May 5 to about May 9. ? Secondary.

Comments: Frequent in Missoula as an ornamental, not

known outside of cultivation.

Picea engelmannii Parry

Engelmann spruce

Collections:

- 412 - Sheet 1/2 - 18 May 1957: twig with early
staminate strobili.
Sheet 2/2 - 28 Oct. 1957: twigs with mature
pistillate cones.
506 - 2 June 1957: (=412) twig with staminate
strobili, pollen mostly shed.

Pollen season: May 16 to June 1. ? Minor.

Comments: Occasional, both as an ornamental and as a native in the more mesic canyons adjacent to the valley.

Picea glauca (Moench) Voss

White spruce

Collections:

- 385 - 7 May 1957: twig with early staminate
strobili.
938 - 7 Sept. 1957: (=385) twig with mature
pistillate cones.

Pollen season: May 6 to May 10. Nil.

Comments: Only one tree known in Missoula, on the University Campus.

Picea pungens Engelm.

Blue spruce

Collections:

- 413 - 18 May 1957: twig with early staminate
strobili.
507 - 2 June 1957: (=413) twig with staminate
strobili, pollen mostly gone.

Pollen season: May 18 to about May 30. Important.

Comments: Frequent as an ornamental in town, not

known out of cultivation.

Pinus L. Pine

Pinus albicaulis Engelm.

Whitebark pine

Collections:

510 - 6 June 1957: twigs with staminate and
pistillate strobili.

882 - 21 Aug. 1957: (=510) mature cone.

Pollen season: June 5 to about June 7. Nil.

Comments: Rare as an ornamental (two trees on the University Campus); occasional at high altitudes in the adjacent mountains.

Pinus aristata Engelm.

Bristlecone pine

Collection:

857 - 10 Aug. 1957: leafy twig.

Comment: One tree about six feet tall on the University Campus; it has not been known to produce cones.

Pinus banksiana Lamb.

Jack pine

Collections:

89 - 1 June 1956: twig with immature staminate and
pistillate strobili, and mature
pistillate cone; pollen mostly
shed (this specimen).

460 - 26 May 1957: (=89) twig with staminate
strobili, pollen season advanced.

504 - 2 June 1957: (=89) twig with staminate cones,
pollen mostly out.

Pollen season: About May 24 to June 2. Nil.

Comments: One tree known in Missoula, on the University Campus.

Pinus contorta Dougl.

Lodgepole pine

Collections:

- 90 - 1 June 1956: twig with young staminate cones and mature pistillate cone, pollen mostly gone (this specimen).
 459 - 26 May 1957: (=90) twig with early staminate cones.
 505 - 2 June 1957: (=90) twig with staminate cones and mature pistillate cones, pollen mostly out.

Pollen season: About May 25 to June 3. Important.

Comments: The indicated pollen season is based upon a single tree on the University Campus and may not be representative. Lodgepole pine is occasional in town as an ornamental, but more important, it is native to western Montana, and in many places forms extensive stands, especially at middle elevations. In 1958, the pollen was mostly gone from tree 90 on May 26.

Pinus monticola Dougl.

Western white pine

Collection:

- 520 - 10 June 1957: twig with staminate cones, pollen gone.

Pollen season: About May 5 to May 8 (?). Nil.

Comments: Native to western Montana, but within our area it is rare, only as an ornamental.

Pinus mugo Turra

Mugo pine, Swiss pine

Synonym: P. montana Mill.

Collections:

- 88 - 1 June 1956: twigs with staminate and pistillate strobili, pollen mostly gone (this specimen).
 458 - 26 May 1957: twigs with early staminate and pistillate strobili.
 521 - 10 June 1957: (=458) twig with staminate cones, pollen mostly gone.

Pollen season: May 26 to June 11. Negligible.

Comments: Common, as an ornamental. In 1958, the pollen season for colony 458 was May 21 to about June 3.

Pinus ponderosa Laws.

Ponderosa pine

Synonym: P. scopulorum (Engelm.) Lemm.

Collections:

- 91 - 1 June 1956: [short-needled form] twig with staminate and pistillate strobili, pollen mostly gone (this specimen).
 92 - 1 June 1956: [long-needled form] twig with staminate strobili in peak of pollen season.
 457 - 26 May 1957: twig with early staminate cones.
 523 - 10 June 1957: (=457) twig with staminate cones, pollen mostly gone.

Pollen season: May 24 to June 9. Prime importance.

Comments: See the general discussion for the family.

The indicated pollen season is based upon a group of trees on the University Campus. In 1958, the season for these trees started about the same as in 1957, but did not last to June 9. Ponderosa pine is common within the valley, but more important, it is one of the predominant species

of the surrounding forests, and is perhaps the most predominant one of the immediate vicinity.

Pinus sylvestris L.

Scotch pine

Collections:

- 456 - 26 May 1957: twig with staminate and pistillate strobili.
 498 - 2 June 1957: (=456) shaded branches with late staminate strobili.

Pollen season: May 24 to June 3: Nil.

Comments: Occasional, only as an ornamental.

Pseudotsuga Carr. Douglas-fir

Pseudotsuga menziesii (Mirb.) Franco

Douglas-fir

Synonyms: P. taxifolia (Poir.) Britton; P. douglasii Carr.; P. glauca Mayr.

Collection:

- 368 - 30 April 1957: twig with staminate cones, pollen mostly gone.

Pollen season: April 20 (?) to May 1 (?). Prime importance.

Comments: In 1958, a group of trees in the Valley (a colony similar to 368) did not shed pollen until after April 27, but was finished by May 8. Douglas-fir is frequent in Missoula as an ornamental, but more important, it is one of the predominant trees of the forests in the mountains adjacent to the valley (cf. Pinus ponderosa, Larix occidentalis). See the general discussion for the family. Our trees are often designated as variety glauca (Beissn.)

Franco, Rocky Mountain Douglas-fir, a distinction which Little (1953) considers desirable.

Tsuga (Endl.) Carr. Hemlock

Tsuga spp.

Hemlock

A single tree is reported to be in Missoula (Howell 1958), as an ornamental. Two species are native to western Montana [T. heterophylla (Raf.) Sarg., western hemlock; and T. mertensiana (Bong.) Carr., mountain hemlock], but neither is known to occur in our vicinity.

PLANTAGINACEAE

Plantago L. Plantain

Plantago lanceolata L.

English plantain

Collections:

- 150 - 18 June 1956: in flower.
- 600 - 23 June 1957: early flowers.
- 601 - 23 June 1957: nearly mature fruits and immature spikes.
- 922 - 1 Sept. 1957: (=601) late flowers.
- 984 - 10 Oct. 1957: (=601) very late flowers.

Pollen season: Early June to mid-August, declining to early September, sporadically to October 10.
Negligible.

Comments: Occasional in lawns, rarely abundant. This is the species most often mentioned in hayfever literature, and has been called buckhorn, buckhorn plantain, ribwort, ribgrass, English plantain, and probably others. English

plantain is the preferred common name.

Plantago major L.

Broad-leaved plantain

Synonyms: P. nitrophila A. Nels.; P. asiatica L. for our area.

Collections:

- 114 - 11 June 1956: early flowers.
 509 - 6 June 1957: very early flowers.
 693A - 7 July 1957: [var. asiatica (L.) Dcne.]
 in flower, with mature fruits
 and very immature spikes.
 739 - 16 July 1957: [var. asiatica (L.) Dcne. ?]
 in flower.
 740 - 16 July 1957: (=739) in flower.
 961 - 15 Sept. 1957: in flower, with mature fruits
 and immature spikes.
 988 - 13 Oct. 1957: (=509) very late flowers, but
 still with immature spikes.

Pollen season: June 3, increasing to mid-June,
 continuing high to late August, declining to late
 September, then sporadically to snowfall. Minor ?

Comments: Common throughout the valley, abundant in
 lawns and moist places. This species, including an un-
 determined number of its named varieties, is, in our area,
 the most common plantain which could cause hayfever (cf.
P. purshii). Pollen production is moderate. Other common
 names include "common plantain" and "greater plantain."

Plantago purshii R. & S.

Woolly plantain

Collections:

- 143 - 18 June 1956: in flower.
 144 - 18 June 1956: in flower.
 548 - 11 June 1957: in flower.
 756 - 21 July 1957: in flower.

- 891 - 23 Aug. 1957: (=756) very few diminutive spikes with flowers.
 899 - 24 Aug. 1957: in flower.
 1016 - 16 Oct. 1957: (=899) in flower.
 1031 - 20 Oct. 1957: in flower.

Pollen season: Early June to late October. Nil.

Comments: This is the most common plantain in our area (cf. P. major), but pollen production is very meagre, and the flowers are described by Fernald (1950) as mostly cleistogamous.

Plantago spinulosa Dcne.?

Spindle plantain

Collections:

- 292 - 4 Aug. 1956: mostly with fruits mature, a very few flowers.
 551 - 11 June 1957: in flower.

Pollen season: Early June to about mid-August. Nil.

Comments: Resembles P. purshii, q.v., in flowering habit and pollen production; but is rare in our area.

POLYGONACEAE

In our area, only the tribe Rumiceae includes species which are anemophilous.

Rheum L. Rhubarb

Rheum rhaponticum L.

Rhubarb

Collections:

- 512 - 6 June 1957: Sheet 1/2 - leaf.
 Sheet 2/2 - portion of inflorescence, in flower.

534 - 10 June 1957: (=512) portion of inflorescence in late flower.

Pollen season: Mid-May to mid-June. Nil.

Comments: Common in back yards throughout Missoula, rarely as an escape. Pollen production is meagre, and Knuth (1909) considers the flowers to be entomophilous. Wodehouse (1945), however, discusses it as "entirely anemophilous." In either case, pollen production is slight.

Rumex L. Dock, Sorrel

Rumex acetosella L.

Sheep sorrel

Collections:

- 98 - 7 June 1956: Sheet 1/2 - staminate, in flower.
 Sheet 2/2 - pistillate, in flower.
 405 - 16 May 1957: staminate, early flowers.
 777 - 25 July 1957: (=405) staminate, very late flowers.

Pollen season: May 16 to late June, declining to mid-July, sporadically to early August. Important.

Comments: Common, frequently abundant in extensive colonies; pollen production rather high.

Rumex crispus L.

Curl dock

Collections:

- 233 - 13 July 1956: in flower.
 517 - 8 June 1957: in flower.
 661 - 6 July 1957: (=517) very late flowers.
 713 - 11 July 1957: in flower.
 848 - 8 Aug. 1957: (=713) very late flowers.

Pollen season: June, declining to late July, sporadically to mid-August. Negligible ?

Comments: Common, occasionally abundant in small colonies. Pollen production is moderate, but flowering is apparently related to soil moisture and the colonies do not flower concurrently.

Rumex maritimus L.

Bristle dock

Synonyms: R. maritimus var. fueginus (Phil.) Dusen for our area; R. fueginus Phil. for our area; R. persicarioides (various authors) for our area.

Collections:

333 - 9 Oct. 1956: (Rock Creek) very late flowers.
559 - 15 June 1957: (=333) in flower.
903 - 25 Aug. 1957: (Buckhouse meadows) in flower.
1022 - 20 Oct. 1957: (=903) fruits mature.

Pollen season: June to October. Nil.

Comments: Rare in our area; pollen production meagre.

Rumex mexicanus Meisn.

Mexican dock

Synonyms: R. triangulivalvis (Danser) Rech. f. for our area; R. salicifolius Weinm. for our area.

Collections:

129 - 14 June 1956: in flower.
230 - 13 July 1956: in flower.
486 - 1 June 1957: early flowers.
687 - 7 July 1957: (=486) late flowers.
754 - 19 July 1957: (=486) very late flowers.
712 - 11 July 1957: early flowers.
761 - 21 July 1957: in flower.
1020 - 20 Oct. 1957: (=712) very late flowers.

Pollen season: June 1 to late June, declining during July, sporadically from August to late October.
Nil.

Potamogeton L. PondweedPotamogeton gramineus L.

Collections:

225 - 13 July 1956: in flower.
706 - 11 July 1957: fruits advanced.

Pollen season: Varies (see comments). Nil.

Comments: In our area, this species is known only from the sloughs west of Buckhouse Bridge. The flowers shed an abundance of pollen, but the production of flowers varies from year to year. Colonies may remain sterile for many years, but bloom abundantly in a single year (Gleason 1952). In 1956, the plants of colony 225 were flowering abundantly on July 13; but on that date a year later, the fruits were mature and mostly cast.

Potamogeton pectinatus L.

Sago pondweed

Collection:

962 - 15 Sept. 1957: fruits mature.

Comment: Rare in our area; pollen is "water dispersed" (Fernald 1932, p. 19).

RANUNCULACEAE

In our area, only plants of the genus Thalictrum have anemophilous flowers.

Thalictrum L. Meadow rue

Though some species are considered to be primarily entomophilous, some primarily anemophilous, and others in the transition stages between these extremes (Knuth 1909, Vol. II; Pammel & King 1930), all ours produce rather large amounts of pollen which must certainly at times become wind-disseminated.

Thalictrum dasycarpum Fisch. & Lall. Purple meadow rue

Synonym: T. purpurascens L. for our area.

Collections:

- 214 - 7 July 1956: in flower.
- 323 - 24 June 1956: (=214) mature fruits.
- 610 - 23 June 1957: (=214) first flowers.
- 760 - 21 July 1957: (=610) last flowers and fruits.

Pollen season: June 23 to early July, declining to July 21. Nil.

Comments: Pollen production is rather high, but the species is rare in our area.

Thalictrum occidentale A. Gray Western meadow rue

Synonyms: T. megacarpum Torr.; T. fendleri Gray for our area.

Collections:

- 427 - 23 May 1957: very early flowers.
- 496 - 2 June 1957: in fruit.
- 573 - 18 June 1957: (=427) fruits advanced.

Pollen season: May 23 to June 3 (cf. T. venulosum). Negligible.

Comments: Common in Pattee Canyon (see also T. venu-

losum); pollen production rather slight. Wright & Booth (1956) refer Montana plants to variety palouense St. John.

Thalictrum venulosum Trel.

Veiny meadow rue

On about May 10, 1957, I was shown some plants which had been collected in Greenough Park, and which were in flower. A tally of the specimens in the Herbarium which were collected in Rattlesnake Canyon, including Greenough Park, shows two sheets of T. venulosum and four of T. occidentale, q.v., or its synonyms. Whether all of these specimens are correctly identified is unknown. My collection 496 (see T. occidentale) may belong here, though it does not appear to. If so, then the suggested pollen season is early May (cf. T. occidentale).

SALICACEAE

Populus L. Poplar

One need only look at the treatment of this genus by Rehder (1947), Bailey (1949), and Little (1953) to realize the confusion which exists in the nomenclature, and the indistinct speciation of the genus. The most that is attempted in the present report is to present the species which have been collected in the area, and to indicate the reference upon which the identification was based (e.g., "sensu Bailey 1949").

Populus alba L. sensu Bailey 1949. White poplar

Synonym: P. bolleana Lauche [equals P. a. var. pyramidalis Bunge]

Collections:

- 383 - 7 May 1957: fruits advanced, leaves just appearing.
 536 - 10 June 1957: (=383) leafy twigs.
 390 - 11 May 1957: [var. pyramidalis Bunge] young leaves.
 716 - 11 July 1957: (=390) mature leaves.

Comments: Pollen season for this species was not observed; it is about contemporaneous with or slightly earlier than other cottonwoods of our area. It is rather common as an ornamental, and occasional as an escape. Variety pyramidalis Bunge, Bolleana poplar, is occasional as an ornamental.

Populus canadensis Moench sensu Bailey 1949 Carolina poplar

Collections:

- 391 - 11 May 1957: young leaves.
 717 - 11 July 1957: (=391) expanded leaves.

Pollen season: Not observed. Nil.

Comments: A hybrid clone, staminate only; but rare in Missoula, only as an ornamental.

Populus deltoides Bartr. sensu Little 1953. Eastern cottonwood

Synonyms: (See comments)

Collections:

- 347 - 23 April 1957: early flowers.

461 - 26 May 1957: (=347) expanded leaves.

Pollen season: April 22 to April 28. Nil.

Comments: Rare in Missoula, only as an ornamental.

Since the species is rare in our area, a list of the many synonyms seems unwarranted. The interested reader is referred to Little (1953).

Populus nigra var. italica Meunchh. sensu Rehder 1947.
Lombardy Poplar

Collections:

353 - 27 April 1957: early flowers.

540 - 10 June 1957: (=353) leafy twigs.

Pollen season: April 26 to May 1. Secondary.

Comments: Common, only as an ornamental; the trees are always staminate (Bailey 1949, Little 1949).

Populus tremuloides Michx. Quaking aspen

Collections:

339 - 12 April 1957: early flowers.

478 - 30 May 1957: (=339) leafy twigs.

Pollen season: April 11 to April 16. Negligible.

Comments: Common, occasionally abundant in small colonies along streams in the canyons adjacent to the valley, in Greenough Park, and along the Bitterroot River. The colony upon which the indicated pollen season is based is atypical in habitat, and also is very limited (three trees, one staminate). Quite possibly, therefore, the pollen season may not be representative.

Populus trichocarpa Torr. & Gray sensu Little 1953.
Black cottonwood

Synonyms: P. trichocarpa var. hastata (Dode) Henry;
P. hastata Dode; P. balsamifera L. for our area;
P. tacamahaca Mill. for our area; P. angustifolia
James for our area.

Collections:

480 - 30 May 1957: leafy twig from pistillate tree.
481 - 30 May 1957: leafy twig from pistillate tree.
826 - 4 Aug. 1957: (special interest collection).

Pollen season: Not observed; about contemporary with
P. deltoides as reported above. In 1958, approxi-
mately the week of April 17-23. Prime importance.

Comments: Except for P. tremuloides, q.v., this is
the only species of cottonwood native to western Montana
(White 1951, Drummond 1956), and it is abundant along all
of the major streams in the area.

Salix L. Willow

Salix is cited by Wodehouse (1945) as a typical
example of a plant with flowers adapted to both insect and
wind pollination. The flowers produce nectar and are some-
times quite fragrant, but the stamens are long-exserted and
produce an abundance of pollen. They are frequently
mentioned in hayfever literature, and Brunett (1956)
recorded Salix pollen on his atmospheric slides from Missoula.

Salix alba L. Golden willow (ours)

Collections:

370 - 1 May 1957: [var. vitellina (L.) Stokes]
early flowers.

- 373 - 2 May 1957: [var. tristis Gaud.] early
flowers.
463 - 28 May 1957: (=370) leaves.
592 - 20 June 1957: (=373) leaves.

Pollen season: April 29 to May 10. Secondary.

Comments: S. alba variety vitellina is the Golden willow, and is probably the most common willow in Missoula. It is frequently cultivated and often occurs as an escape. The variety tristis is a pendulous form, and is the "golden weeping willow" commonly cultivated in Missoula. Tree 370 has been removed, but other trees observed in 1958 suggest a similar pollen season for this year.

Salix bebbiana Sarg.

Bebb willow

Synonyms: S. rostrata Richards and its varieties, not S. rostrata Thuillier; S. perrostrata Rydb. [equals var. perrostrata (Rydb.) Schneider].

Collections:

- 380 - 7 May 1957: [var. perrostrata (Rydb.)
Schneider] early flowers.
392 - 11 May 1957: [var. perrostrata (Rydb.)
Schneider] in flower, staminate
only.
407 - 16 May 1957: (=392) very recently past
flowering.
780 - 25 July 1957: (=380) leaves.
782 - 25 July 1957: (=392?) leaves.

Pollen season: About May 2 to May 15, starting at low elevations and progressing up-canyon. Negligible.

Comments: Common, occasionally abundant, along water-courses both within the valley and in the surrounding mountains. The variety perrostrata seems to be the pre-

valent form in our area.

Salix caprea L.

Goat willow

Collections:

336 - 12 April 1957: early flowers, staminate.
490 - 1 June 1957: (=336) leafy twig.

Pollen season: April 8 to April 29. Nil.

Comments: Occasional in Missoula, only as an ornamental. In 1958, shrub 336, upon which the indicated pollen season is based, started to flower on March 27.

Salix caudata (Nutt.) Heller

Whiplash willow

Collections:

MONTU 16057 - J. E. Kirkwood 2404, April 22, 1926.
(var. bryantiana Ball & Bracelin).

MONTU 16180 - J. E. Kirkwood 2521, May 27, 1926.

Salix exigua Nutt.

Sandbar willow

Synonyms: S. fluviatilis var. exigua (Nutt.) Sarg., not S. fluviatilis Nutt.; S. nevadensis S. Wats.; S. luteosericea Rydb.; S. stenophylla Rydb.; (the last three were placed as S. exigua varieties by Schneider).

Collections:

124 - 12 June 1956: flowers and fruit.
403 - 16 May 1957: (=124) early flowers.
421 - 23 May 1957: in flower.
697 - 9 July 1957: (=421) late flowers.
801 - 28 July 1957: (=124) very late flowers.
MONTU 15075 - J. E. Kirkwood 1972; Missoula, bank of Bitterroot River at Buckhouse Bridge, July 16, 1921.

Pollen season: About May 12 to early July, sporadically to July 28. Negligible.

Comments: Common, frequently abundant in rather large colonies, along streams within the valley. Pollen production rather slight.

Salix fragilis L.

Brittle willow

Collections:

- 393 - 11 May 1957: early flowers, staminate.
 429 - 23 May 1957: (=393) late flowers.
 579 - 18 June 1957: (=393) leafy twigs.

Pollen season: May 19 to May 24. Nil.

Comments: Very rare.

Salix lutea Nutt.

Yellow willow

Synonyms: S. watsoni (Bebb) Rydb.

Collections:

MONTU 15722 - J. E. Kirkwood 1409. May 17, 1923.

Salix mackenzieana (Hook.) Barratt

Mackenzie willow

Collections:

- 345 - 20 April 1957: in flower, staminate.
 815 - 30 July 1957: (=345?) leafy twigs.

Pollen season: April 16 to April 24. Negligible.

Comments: The indicated pollen season, based upon a single shrub, is probably not indicative for the species (cf. S. bebbiana), and the species is probably more common in our area than my single shrub would imply. There are two sheets in the herbarium, both from Hellgate Canyon, as follows:

MONTU 16016 - J. E. Kirkwood 2058, May 5, 1925.

MONTU 16017 - J. E. Kirkwood 2059, May 5, 1925.

Salix melanopsis Nutt.

Sandbar willow

Synonyms: S. bolanderiana Rowlee; S. exigua var. ténerrima (Henderson) Schneider, not S. exigua Nutt., q.v.

Collections:

MONTU 2183 - H. R. Flint. Missoula River at Missoula.

Comments: This specimen came apparently from approximately the same vicinity as my Salix exigua, q.v. (collections 124, 403, 801, and cf. also MONTU 15075 under S. exigua). It is very similar to that species in all respects.

Salix monochroma Ball

Collections:

387 - 11 May 1957: Sheet 1/2 - pistillate flowers. Sheet 2/2 - staminate flowers.
 420 - 23 May 1957: (=387) Sheet 1/2 - immature fruits. Sheet 2/2 - staminate flowers, past pollen-shedding.
 422 - 23 May 1957: (=387) very late staminate flowers.
 845 - 8 Aug. 1957: (=387) leafy twig.

Pollen season: About May 8 to May 23. Nil.

Comments: Apparently uncommon, along streams.

Salix pentandra L.

Bay willow

Collection:

834 - 4 Aug. 1957: leafy twig with mature fruits.

Comments: Occasional, only as an ornamental.

Salix scouleriana Barratt

Scouler willow

Synonyms: (includes various varieties.)

Collections:

- 344 - 20 April 1957: early flowers, staminate.
 355 - 27 April 1957: early flowers, staminate.
 356 - 27 April 1957: early flowers, staminate.
 781 - 25 July 1957: (=356) leafy twigs.
 783 - 25 July 1957: (=355?) leafy twig.
 813 - 30 July 1957: (=344) leafy twig with
 dehisced fruits.

Pollen season: April 18 to May 2, starting at low elevations and progressing up-canyon. Negligible.

Comments: Common, and occasionally abundant, along water-courses both within the valley and in adjacent canyons.

SPARGANIACEAE

Sparganium L. Bur-reedSparganium multipedunculatum (Morong) Rydb.

Slender bur-reed

Synonyms: S. simplex var. multipedunculatum Morong;
S. simplex "at least in part, Gray B. & B."
 (Gleason 1952), Huds., and perhaps other authors.

Collections:

- 286 - 4 Aug. 1956: in flower.
 765 - 21 July 1957: the first flowers observed,
 past anthesis.
 850 - 8 Aug. 1957: (=765) past flowering (this
 plant).
 902 - 24 Aug. 1957: (=765) very young flowers.

Pollen season: Sporadic from mid-July to mid-September.
 Nil.

Comments: In our area, known only from the sloughs west of Buckhouse Bridge. The individual plants are prolific pollen shedders, but they are not abundant (at least in 1956 or 1957), and they flower rather sporadically as the water recedes from the sloughs.

TAXACEAE

Taxus L. Yew

Taxus brevifolia Nutt. Western yew

This species is native to western Montana. It is cultivated to some extent in Missoula, and is probably to be found in the surrounding mountains. It is uncommon in either case, and not a prolific pollen producer.

Taxus cuspidata Sieb. & Zucc. Japanese yew

Collections:

342 - 19 April 1957: twig with staminate strobili.
1033 - 24 Oct. 1957: (=342) twig with fruits.

Comments: Rare (known only on the University Campus, but may be elsewhere), only as an ornamental. Pollen production very slight.

TILIACEAE

Tilia L. Linden, Basswood

Wodehouse (1945) says of basswood: "Though entirely

insect pollinated they are copious pollen shedders and their pollen can easily be demonstrated in the air at considerable distances from the flowering trees. That it could occasionally cause hayfever is to be expected." Derbes (1941) reported it as a definite cause of hayfever.

Little (1953) reduces the fifteen or more named species native to the United States to four, two of which are in Missoula as ornamentals. To cite the synonymy resulting from such reduction is far beyond the scope of the present work, and the interested reader is referred to Little (1953).

Tilia americana L.

American basswood

Synonyms: (See the discussion of the genus.)

Collections:

255 - 22 July 1956: in flower.
 694 - 9 July 1957: very early flowers.
 720 - 12 July 1957: (=722) (special collection).
 721 - 12 July 1957: early flowers.
 722 - 12 July 1957: early flowers.
 804 - 29 July 1957: (=694) very late flowers.
 819 - 31 July 1957: (=722) very late flowers
 917 - 27 Aug. 1957: (=722) Sheets 1/2 and 2/2 -
 mature fruits and crown leaves,
 mature and young sucker leaves,
 from various trees in the same
 colony.

Pollen season: July 9 to July 31, sporadically for perhaps another week. Negligible.

Comments: See the discussion of the genus. T. americana is the most common basswood in Missoula, occasionally in rather extensive street plantings (a few blocks in

extent).

Tilia cordata Mill. Little-leaf linden

Synonym: T. ulmifolia Scop.; T. parvifolia Ehrh.;
T. europaea L. in part (cf. platyphyllos).

Collections:

668 - 6 July 1957: early flowers.
776 - 25 July 1957: (=668) late flowers.

Pollen season: July 5 to about July 25. Negligible.

Comments: Nearly as common as T. americana, q.v.

Tilia heterophylla Vent. White basswood

Synonyms: (See the general discussion of the genus.)

Collections:

723 - 13 July 1957: first flowers.
821 - 31 July 1957: (=723) last flowers.

Pollen season: July 13 to July 31. Nil.

Comments: Two trees known in Missoula, on the University Campus.

Tilia platyphyllos Scop. Large-leaved linden

Synonyms: T. grandifolia Ehrh.; T. europaea L. in part (cf. T. cordata).

Collections:

594 - 20 June 1957: early flowers.
693B - 9 July 1957: (=594) very late flowers.
693B - 23 July 1957: (=594) mature fruits.

Pollen season: June 20 to about July 10. Nil.

Comments: Two trees known in Missoula, on Front Street.

TYPHACEAE

Typha L. CattailTypha latifolia L.

Common cattail

Collections:

- 206 - 6 July 1956: in flower.
 629 - 27 June 1957: early flowers.
 703 - 10 July 1957: in flower.
 727 - 13 July 1957: (=629) very recently past
 flowering.

Pollen season: About June 24 to July 11. Prime
 importance.

Comments: Very abundant in the marshy areas between
 the Clark's Fork River and Mullen Road west of Missoula,
 and common in smaller colonies throughout the valley where-
 ever suitable habitat is provided. Pollen production is
 prodigious, but no reports of it as a cause of hayfever have
 been seen.

Several plants were seen (e.g. collection 703)
 which had the general aspect of Typha angustifolia L.
 (narrowleaf cattail), and there is a specimen in the Her-
 barium (MONTU 16130 - J. E. Kirkwood 2086, July 11, 1925,
 Darby, Montana) which was annotated as "Typha angustifolia,
 V.L.M. 3/14/36." All of these, however, had or have pollen
 grains in tetrads, and therefore must be T. latifolia.

ULMACEAE

Celtis L. HackberryCeltis occidentalis L.

Hackberry

Collections:

- 375 - 7 May 1957: early flowers.
 398 - 16 May 1957: (=375) past flowering.
 1036 - 19 Dec. 1957: fruits.

Pollen season: May 4 to about May 12. Nil.

Comments: Occasional, only as an ornamental. Pollen production rather slight.

Ulmus L. Elm.

As a group, elm is one of the most important early-season plants in our area. During the period from April 11 to April 23, 1954, elm pollen on atmospheric slides in Missoula far exceeded all others combined (Brunett 1956).

Ulmus americana L.

American elm

Collections:

- 337 - 12 April 1957: early flowers.
 468 - 28 May 1957: (=337) expanded leaves and fruit.

Pollen season: April 10 to April 19, sporadically for perhaps another week. Important.

Comments: Common as an ornamental, occasionally in rather extensive plantings (e.g. around the block).

Ulmus carpinifolia Gleditsch

Smooth-leaved elm

Synonyms: U. nitens Moench; varieties of U. campestris authors not Mill.; U. glabra Mill. not Huds. (not U. glabra var. camperdownii, q.v.); and others

(see Rehder 1947).

Collections:

- 348 - 23 April 1957: early flowers.
470 - 28 May 1957: (=348) expanded leaves and fruit.

Pollen season: April 22 to April 29. Nil.

Comments: One rather sickly tree known in Missoula, on the University Campus. It is apparently variety koopmannii Bailey [equals forma koopmannii (Spaeth) Rehder].

Ulmus glabra var. camperdownii Rehd. Camperdown elm

Collections:

- 354 - 27 April 1957: past flowering.
488 - 1 June 1957: (=354) expanded leaves and fruit.

Pollen season: Undetermined, about concurrent with U. carpinifolia, q.v.

Comments: Occasional, only as an ornamental. This tree is also known as "umbrella elm."

Ulmus pumila L. Siberian elm

Collections:

- 338 - 12 April 1957: early flowers.
464 - 28 May 1957: (=338) expanded leaves and fruit.

Pollen season: April 10 to April 23, sporadically for perhaps another week. Prime importance.

Comments: Very common as an ornamental, and also frequent as an escape. A prolific pollen producer, and from the standpoint of atmospheric pollen studies, it should be considered the most important elm in our area. The 1958 pollen season was about the same as the 1957 season indicated above.

Siberian elm is "erroneously called Chinese elm, which is the common name of U. parvifolia Jacq., an autumn-flowering species" (Little 1953). U. parvifolia is not known in Missoula.

Ulmus rubra Muhl.

Slippery elm

Synonyms: U. fulva Michx.; U. americana Marsh., not to be confused with U. americana L., q.v.

Collections:

340 - 18 April 1957: early flowers.
437 - 25 May 1957: expanded leaves and fruit.
469 - 28 May 1957: (=340) expanded leaves and fruit.

Pollen season: About concurrent with U. carpinifolia, q.v.

Comments: Tree 340 flowered from April 18 to April 21, but this is doubtfully indicative of the season for the species in Missoula. Tree 437 was not observed until fruits were well advanced. Very rare in Missoula, only these two trees known (tree 340, on the University Campus, was removed during 1957).

URTICACEAE

Urtica L. Nettle

Urtica dioica L.

Stinging nettle

Synonyms: U. dioica authors not L.; U. gracilis of various authors; U. strigosissima Rydb. U. cardiophylla Rydb.; U. lyalli Wats.; U. viridis Rydb. The last three named equal variety procera Wedd.

Collections:

106 - 8 June 1956: in flower.
140 - 17 June 1956: in flower.
307 - 11 Aug. 1956: very late flowers.

495 - 2 June 1957: early flowers.
827 - 4 Aug. 1957: (=495) very late flowers.

Pollen season: About June 1, increasing to about June 8, continuing high to early July, declining to mid-July, sporadically to early August. Negligible.

Comments: Abundant in Greenough Park, occasional but rarely abundant elsewhere. Pollen production is moderate. No attempt to distinguish the varieties was made for this study.

THE POLLEN-SHEDDING PERIODS OF THE MOST IMPORTANT
POLLEN-PRODUCING PLANTS OF THE AREA

(Figure I)

In the charts on the following pages are represented the pollen-shedding seasons (for 1957) of the most important species of each of the "plant groups" as recognized by Brunett (1956), plus a few groups which he did not record (he recorded only those usually considered "hayfever plants"). The "groups" are arranged chronologically, according to the earliest-flowering species of the group; then the species are similarly arranged within the group. This arrangement was selected in preference to a straight chronological arrangement of the species for two reasons: first, it places the species of the groups so that each group may be viewed in its entirety; second, since the exact dates of the pollen-shedding season of several species is rather conjectural, and therefore a straight chronological sequence of species would also be conjectural, it was felt that an overall view of the group would be more meaningful.

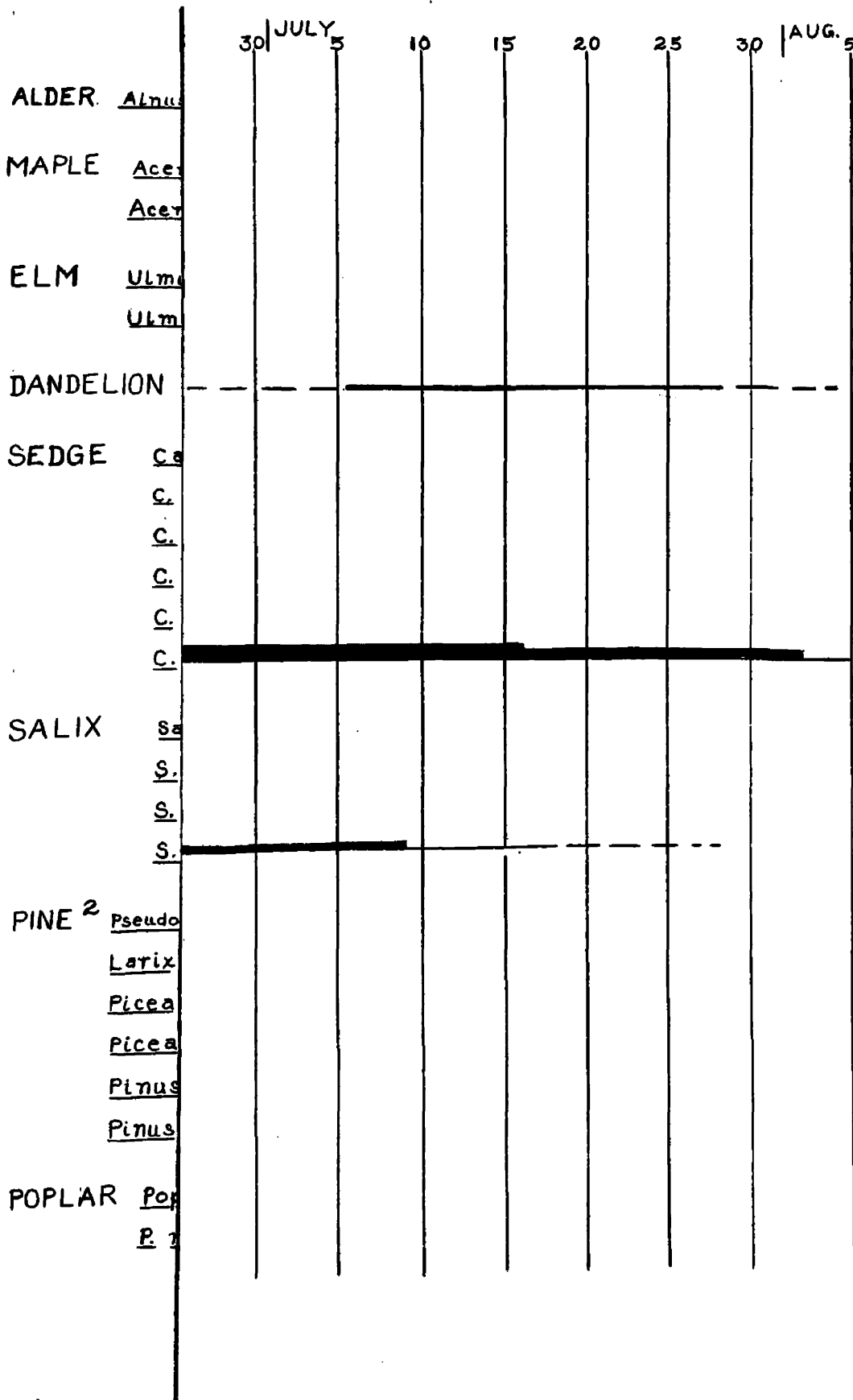
When interpreting these charts, it must be remembered that they are purely qualitative representations of the "flowering activity," and are in no way meant to suggest quantitative pollen production, though there is some suggestion as to the relative importance of the species as

a contributor to the pollen content of the atmosphere in our area. Thus, the pollen season for Pseudotsuga menziesii (Douglas-fir) is represented as being brief, with vast amounts of pollen being shed from the first to the last days (approximately), and the pollen season of Larix occidentalis (larch) is quite similar, and while the individual larch trees may shed as much pollen as those of Douglas-fir, the species as a whole is interpreted as less important in our area than is Douglas-fir.

In no case should the thickness of the bars in one plant group be compared with those of another group. Thus, Populus nigra certainly produces more pollen than does dandelion. The thickness of the bar for dandelion suggests merely that the plant flowers most abundantly during May. Within the groups, however, the species can be compared on the basis of line thickness. Thus, Populus nigra can be interpreted as less important (because of fewer trees present in the area) than P. trichocarpa. For another example, Carex lanuginosa is considered the most important pollen producer of the sedges, but that the bar for this species is not four tiers thick (for certainly it does reach a "peak" of flowering activity) suggests that it is not, however, to be considered very important as a pollen producer in our area.

Finally, it should be emphasized that the text should also be consulted when the chart is being interpreted. It should also be emphasized that only the species which have been judged the most important pollen shedders of each group are represented in these charts. The text should be studied to determine other species which flowered concurrently with those represented in the charts, or for species which may have a pollen season different from those represented in the charts.

FIGURE I. POLLEN-SHEDDING PERIODS OF THE MOST IMPORTANT SPECIES, BY GROUPS. See text for explanation.



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INDEX

Since the alphabetical arrangement of genera within families, and of species within genera, results in an alphabetical arrangement of all the species for each family, it is deemed unnecessary to index those species which are accepted in this study. The index includes: families, genera, synonyms, common names, and incidental references to the accepted species. Taxa below species (i.e. varieties and forms) are not indexed. Common names for the families are not shown in the text, but they are included in the index, and their scientific equivalents are given; so also for family synonyms insofar as they are applicable to the genera included in this study. The family to which each genus belongs is indicated. Only the main body of the text (the Flora) is indexed - the Introduction and explanatory material are not.

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