

A FLORISTIC AND ECOLOGIC STUDY

OF

JASPER RIDGE

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A THESIS

SUBMITTED TO THE SCHOOL OF BIOLOGICAL SCIENCES
(NATURAL HISTORY MUSEUM) AND THE COMMITTEE ON GRADUATE
STUDY OF THE LELAND STANFORD JUNIOR UNIVERSITY IN
PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF ARTS

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December, 1935

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AIRPLANE VIEW OF
JASPER RIDGE

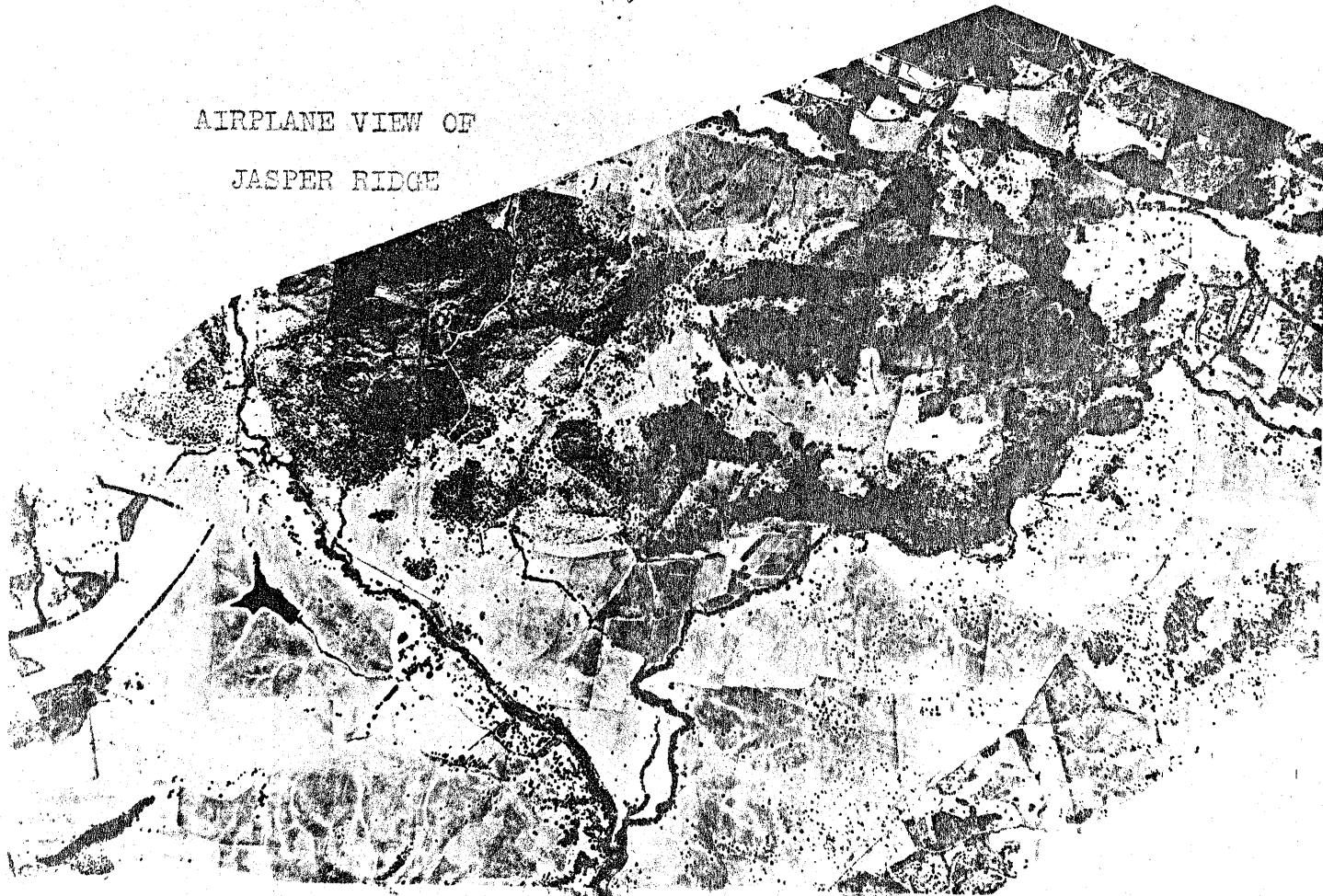


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I

INTRODUCTION

As a result of one year of study of the floristic and ecologic conditions of Jasper Ridge, I have attempted to make as complete a check-list as possible of all plants in this selected area, showing the general succession of blooming of the seed plants found here, describing the different types of vegetation, outlining some of the factors--weather, geologic, and plant association conditions--which might account for the distinct types, and indicating some of the most typical species of each type.

Because of its proximity to the campus and because of the variation of vegetation upon it, this ridge has long been a favorite place for field trips of the biology and botany classes of Stanford University, and most of the specimens I have collected have undoubtedly been collected or observed there by others; but, insofar as I am able to determine, there never before has been this type of investigation carried on there. William S. Cooper (5), in his study of the broad-sclerophyll vegetation of California, made a detailed study of a small part of this ridge, which he used as the main location of much of his investigation and experimentation, to discover the cause of diversity in the vegetation there, and to study the

chaparral and forest. I have made use of Dr. Cooper's experimental data for the determination of the ecological conditions on the ridge, and have confined my own work almost exclusively to mapping the types of vegetation and to making a detailed floristic study.

DESCRIPTION OF JASPER RIDGE

a. General Description

Jasper Ridge is the name applied to one of the higher foothills lying at the base of the Santa Cruz Mountains, and about four miles southwest of Palo Alto. It is a small ridge, the part studied extending about three and one-fourth miles as measured northwest by southeast, and three miles northeast by southwest. It is nearly surrounded by the valleys of three creeks--San Francisquito, Corte de Madera, and Los Trancos. To the northeast, the Corte de Madera Creek widens out into Searsville Lake, and the San Francisquito Creek is the continuation of the Corte de Madera beyond the dam at the north end of the lake. The range of altitude on the ridge is from 200 feet at the extreme northeast point to 800 feet at the highest point near the southeastern. The average height of the crest of the ridge is approximately 600 feet. The altitude of Searsville Lake is 318 feet, and the ridge rises abruptly to the east of this. The topography of the top of the ridge consists mainly of gently rolling slopes, but in many places these are dissected by ravines, in which during the rainy season there run streams which drain the ridge and feed the surrounding creeks or the lake. Although most of the streams are dry during the

summer, water is kept in the lake and is used for irrigating purposes at Stanford University. By the beginning of each rainy season, however, the level in the lake is very low.

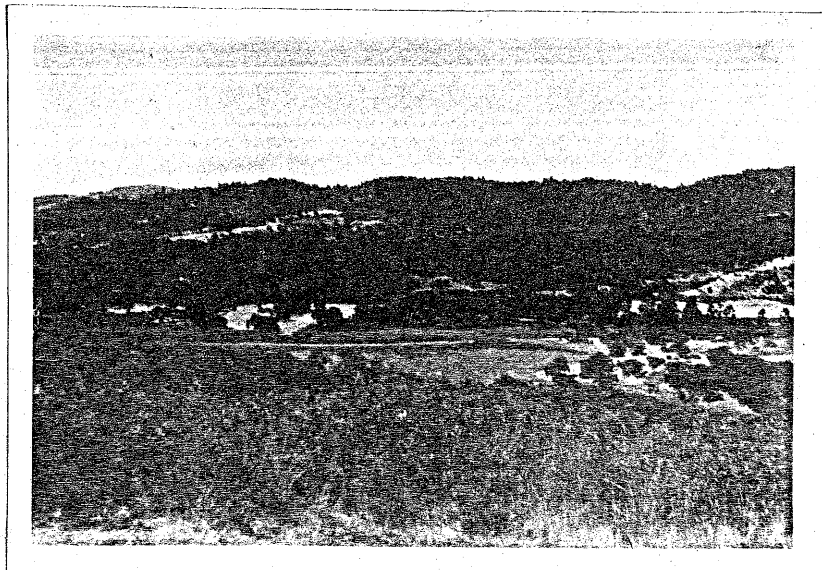
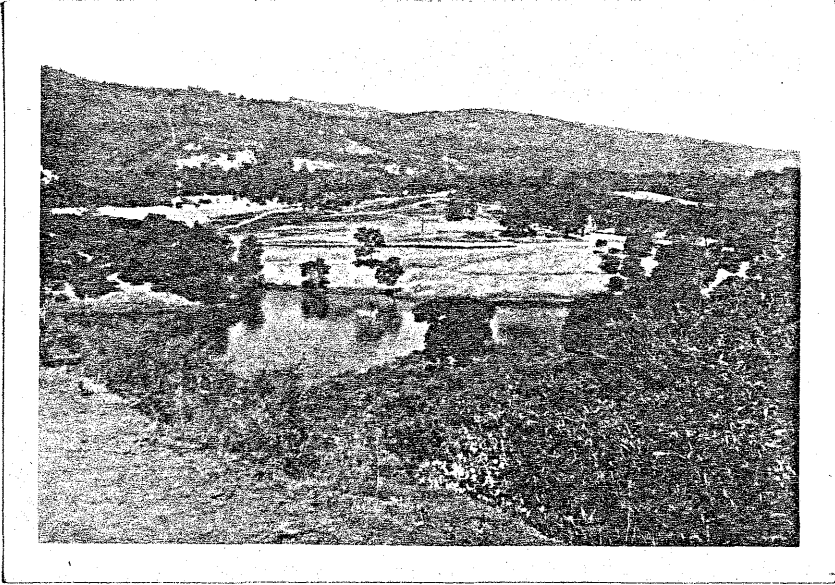
Since it is so close to civilization, the ridge has been noticeably affected by man. At the southwest end of the ridge is the little town of Portola, and near here much of the land is cultivated. Nearly surrounding the ridge, along the creeks, there are numerous camping and picnic grounds, and Searsville Lake itself is a popular camping and swimming resort in the summer. Parts of the ridge have been cleared and are used for grazing purposes; and intertwined over most of the ridge there are a number of trails of the Menlo Riding Club.

b. Vegetation

There are three main types of vegetation--chaparral, forest, and grassland. At the borders of these are transition areas, especially noticeable between the chaparral and the forest, where there are to be found "index" plants of both types growing in the same area. The forest associations are mainly on the steep slopes, especially the northward ones; the chaparral on the more gently rolling slopes, mainly the southward ones; and the grasslands on gentle slopes and level places. Probably originally there were much larger areas covered by the thick growth of the

PLATE II

Searsville Lake in June
(Santa Cruz Mountains in Background)



chaparral, but except for several large patches of this scattered over the ridge, much of it has been cleared off, leaving in its place large expanses of open hillside, dotted with occasional oaks. Many European weeds and grasses have found their way into these cleared areas, but there still remains enough of the original vegetation of the ridge to indicate its character. The types of vegetation will be discussed in more detail later.

c. Geology

The different geologic formations to be found on the ridge are shown on the map (Plate III) taken from the Santa Cruz Folio (3). The most extensive is the Chico Formation of the Cretaceous Age. This sandstone weathers into a uniform coarse yellow sand which covers large areas of the ridge. The rock is mostly composed of heavy-bedded sandstone and conglomerate, with small amounts of shale.

There are two fairly large outcrops of the Franciscan Formation, the oldest formation to be found on the ridge. It is of Pre-Cretaceous origin and is composed of sandstone, shale, and some conglomerate, with lenticular masses of limestone, jasper, chert, schist, and greenstone. It stretches from the lake, which it nearly surrounds, up into the center of the ridge, and also there is an outcrop near the southwest end of the ridge. Bordering the northern side of the Franciscan Formation near the lake, and separating it on that side from the Chico Formation, is a

MAP
OF THE
GEOLOGIC FORMATIONS ON
JASPER RIDGE

LEGEND

Santa Clara Formation



Franciscan Formation



Purissima Formation



Serpentine



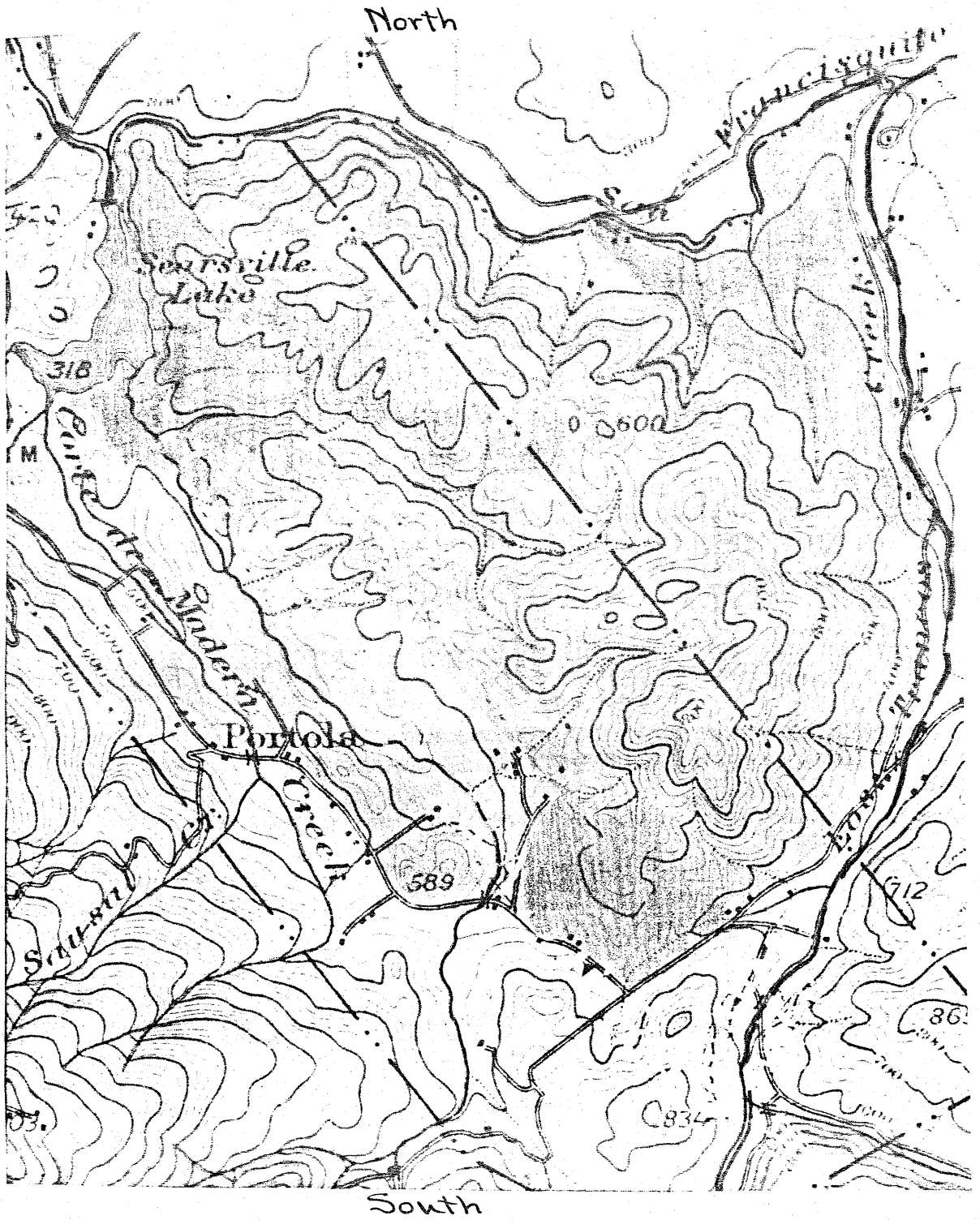
Chico Formation



Vaqueros Sandstone



PLATE III



long narrow outcrop of serpentine, which consists of altered intrusive masses and dikes of basic rocks. A broader strip of the Santa Clara Formation, the most recent one, which is of Quaternary origin, reaches nearly all along the southwest end of the ridge, although in one place an outcrop of Chico Formation divides it longitudinally. The Santa Clara Formation, which is mainly of fresh-water origin, is made up of gravel, sand, and clay. It merges with recent alluvium deposited by the streams.

In the extreme northeastern part of the area studied is the Purissima Formation, of conglomerate, sandstone, and shale. Most of this part is nearly level, and is not a part of the ridge itself. Much of the land here is cultivated.

The Vaqueros sandstone (heavy-bedded sandstone and conglomerate, interbedded, especially toward the top with dark shale) does not make up a part of the region actually studied, but there is much of it along the western border of the ridge.

Most of the soil consists of sandy loams or light sands, with much variation in the amount of humus present, that being a factor dependent upon the type of vegetation in a given spot.

d. Climatic Conditions

The data to be obtained on the weather conditions are

rather limited. During the past six years a record has been kept at Searsville Lake, but the variation in rainfall is very noticeable even within comparatively short distances; so that obtained at Searsville itself, which is at an altitude of 318 feet, is not necessarily that of the top of the ridge, which averages more nearly 600 feet. However, the gauge at the lake is the closest to the ridge, and by comparing these data with those of the valley (Palo Alto) and the mountains, it is possible to get a pretty good idea of what the rainfall tends to be on the ridge.

Rainfall at Searsville Lake

(From record of Ernst M. Brandsten)

Months	Years					
	1929	1930	1931	1932	1933	1934
July	-30	-31	-32	-33	-34	-35
August		.31				
September		.17				.95
October		.84	1.77	.41	1.90	1.30
November		2.87	2.58	.80		5.90
December	3.75		12.76	4.57	6.92	3.68
January	7.06	6.02	4.54	9.09	1.32	9.60
February	3.50	1.41	4.68	1.20	5.46	1.29
March	3.66	1.31	.51	3.36		5.90
April	1.29	.40	.58	.25	.67	5.83
May	.36	1.65	.21	1.86	.65	
June		.62			.55	
Totals	19.62	15.58	27.63	21.54	17.47	34.45

The average for the six years shown here is 22.715 inches. The corresponding averages for Palo Alto and Stanford University are respectively 12.17 and 13.06 inches. In the year 1914, Dr. Cooper obtained the following rainfall records for comparison: Valley (Palo Alto) 62.15 cm. (24.48 inches). Foothills (Jasper Ridge) 103.71 cm. (41.83 inches). Mountains (King's Mountain) 169.25 cm. (66.63 inches). 1914 was an excessively wet year; from the information he gathered, he estimated the average annual precipitation at Jasper Ridge to be about 80 cm. or 31.5 inches, an average much higher than that recorded at Searsville Lake during the past six years. There was enough rainfall during the year 1934-1935 so that it was considered a "wet year."

Records of rainfall have also been kept at the Folger Ranch, at an elevation of 500 feet. Since this ranch is at a distance of only about one half mile from Searsville Lake, and the altitude is more nearly that of a large part of the ridge, a comparison of the rainfall for these two places might be valuable. Although records have been kept at the Folger Ranch since 1893, the only years for which data were obtainable for both the ranch and the lake are from 1929 to 1932 inclusive. This, however, appears to be a long enough interval of time to show the trend of the differences.

Comparison of Rainfall at Searsville Lake and
at the Folger Ranch

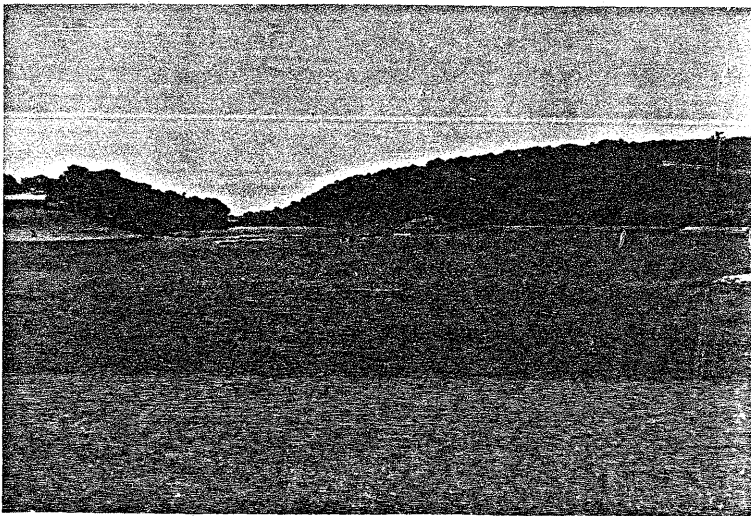
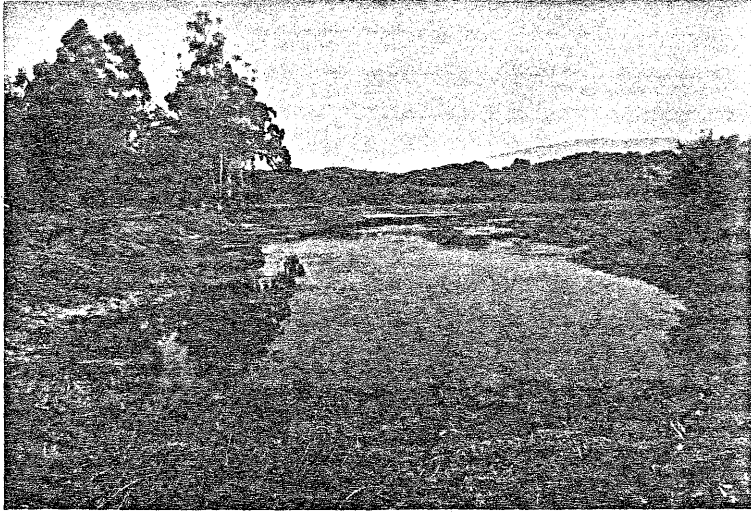
Year	Searsville Lake	Folger-Ranch
1929-30	19.62	23.63
1930-1931	15.58	16.83
1931-1932	27.63	29.43
1932-1933	21.54	26.06
Averages	21.09	22.99

Although there is a greater rainfall at the higher altitude in this case, this fact cannot be taken as proving that the rainfall is greater on the higher parts of the ridge. There is a strong probability that that at the Folger Ranch is due to its position closer to the mountains.

A brief summary of the findings of Dr. Cooper (4) will show the other climatic factors. As to fog, he concluded that there was less on the ridge than in either the valley or the mountains, because the ocean fogs rarely come that far inland, and the fogs from San Francisco Bay which are so frequent in the northern part of the valley rarely go so far from the bay. This fact was noted on many of the field trips made during this study. The average midday temperature is probably higher than that in the valley, and there is a higher evaporation rate on Jasper Ridge, which fact leads Dr. Cooper to believe that the greater rainfall is thereby neutralized, especially since he finds in the vegetation little evidence of climatic

PLATE IV

Searsville Lake in August
(Jasper Ridge in Background)



difference between the ridge and the valley. The winds are mainly from the northwest, although those accompanying rainstorms are usually from the southwest.

The ridge is generally characterized by long dry summers alternating with comparatively wet winters. This is a type of climate which is characteristic of chaparral formations.

III

METHOD

The method used in this study was chiefly one of observation, collection, and identification. Beginning on December 26, 1934, and continuing until November 18, 1935, I made fifty field trips to Jasper Ridge. During the winter the trips were at intervals of approximately one week, although the actual days on which they were made were influenced to a great extent by the rain. However, there was at least one every two weeks. In the spring, the trips were made at somewhat more frequent intervals, necessarily, because of the large number of flowers to be found all over the ridge. In the summer and in the fall, the interval was lengthened to about two weeks. An attempt was made to cover the ridge as often and as systematically as possible.

On each trip collections were made of all flowers found except in the cases where the duration of flowering was rather long. At least all of the flowers which had not been collected before were obtained, and the others were noted. Specimens of all of the plants were brought in at frequent intervals, so that the approximate length of the flowering period could be determined. Each specimen was labeled as to the place in which it grew, and the comparative abundance, as well as to the date of collection.

Identification of specimens was accomplished mainly with the use of Dr. Willis Linn Jepson's (8) Manual of the Flowering Plants of California; Dr. LeRoy Abrams' (1) Illustrated Flora of the Pacific States; and Dr. A. S. Hitchcock's ⁽⁷⁾ Manual of the Grasses. Then the identification was checked by comparing the specimens with those in the Dudley Herbarium at Stanford University.

Collections were made on the ridge only, and did not include the water plants to be found in Searsville Lake, although some were made of plants growing at the edge of the lake.

The mapping of the various types of vegetation was done on an enlarged portion of the topographical map of the Palo Alto Quadrangle, and it was assisted by the use of the airplane photograph of the ridge, taken from a larger airplane view of the entire Stanford Campus. This work was mostly done in the late summer and in the autumn, when the pressure of collecting new specimens had diminished.

There is very little literature to be found about Jasper Ridge, but as many data as possible concerning it were collected. Dr. Cooper's study was used extensively throughout this investigation.

IV

LIMITATIONS OF THE STUDY

This study is by no means complete, as to either floristic or ecologic conditions. The ridge is much too extensive to be thoroughly covered in short enough intervals of time to insure that all species growing on it were found, and because of the limited time, the tendency was to cover as much area as possible, even though rather incompletely, rather than to concentrate on one small area and find absolutely everything growing within its confines. Undoubtedly, therefore, quite a number of species were not collected. Also there are certain parts of the ridge which because of their vegetational characters are difficult to cover. There are some places in the chaparral which are almost impenetrable, and there is one rather large area near the Corte de Madera Creek which was mostly covered with water until after the flowering season of some of the plants growing there.

This year there was more rain than there had been for some time, and that probably affected the time of blooming, and the abundance and luxuriance of many of the plants. The study would have to be carried on for several years in order to determine the exact effect of this factor.

The collecting was limited to the Spermatophytes of Jasper Ridge, and they are the only plants that have been considered in the discussion.

TIME AND SUCCESSION OF FLOWERING

Altogether, 330 species of seed plants were collected and identified during the year 1935. Most of these could be classified readily as belonging to one or the other of the types of vegetation, but with some it was more difficult to do this. Some were found widely distributed all over the ridge. In the case of certain of the others, the distribution was limited, sometimes to one type of vegetational area, and other times to a limited part of one area; for example, to the meadow in the strip of serpentine. Therefore, when the plants were divided into groups, some were put into more than one group. Here, no differentiation has been made as to the limitations within each of the three formations--that has been done in the discussion on the types of vegetation.

The Succession of Flowering

The general succession of flowering on the ridge was one of the points especially observed in this study, and a record was kept of the date on which each plant found blooming was collected for the first time. Most of the flowers found on the first field trip--in December--were "left-overs," found in the chaparral, but aside from these most of the early flowers were found in the forest formation.

The accompanying table (Table I) is a summary of the number of species beginning anthesis each month, in all of the vegetational formations, and in each of them. The date upon which the species was first collected or observed in flower has been taken as the beginning of anthesis. In general this is approximately correct, but in some instances a species may not have been observed for a week or more after the first flowers appeared. Since the table represents the first time each plant was found flowering, it does not show which plants are most abundant in any one of these areas. Because of the variation in the duration of the times of flowering, the times of the greatest abundance are not necessarily in exactly the same sequence, and there may be a much larger number of flowers found in one of the areas in a given month than began anthesis in that area during that month.

The sum of the totals found in the vegetational formations does not check with the total for the whole ridge because of the fact that there are plants which may grow in more than one vegetational area. Many plants are found both in the grasslands and on the more openly wooded slopes, and since there is usually a transition area between two types of vegetation, it was in several cases difficult to decide just where to put the plants. As a result, perhaps some have been placed in two areas when it might have been more accurate to have placed them into

TABLE I

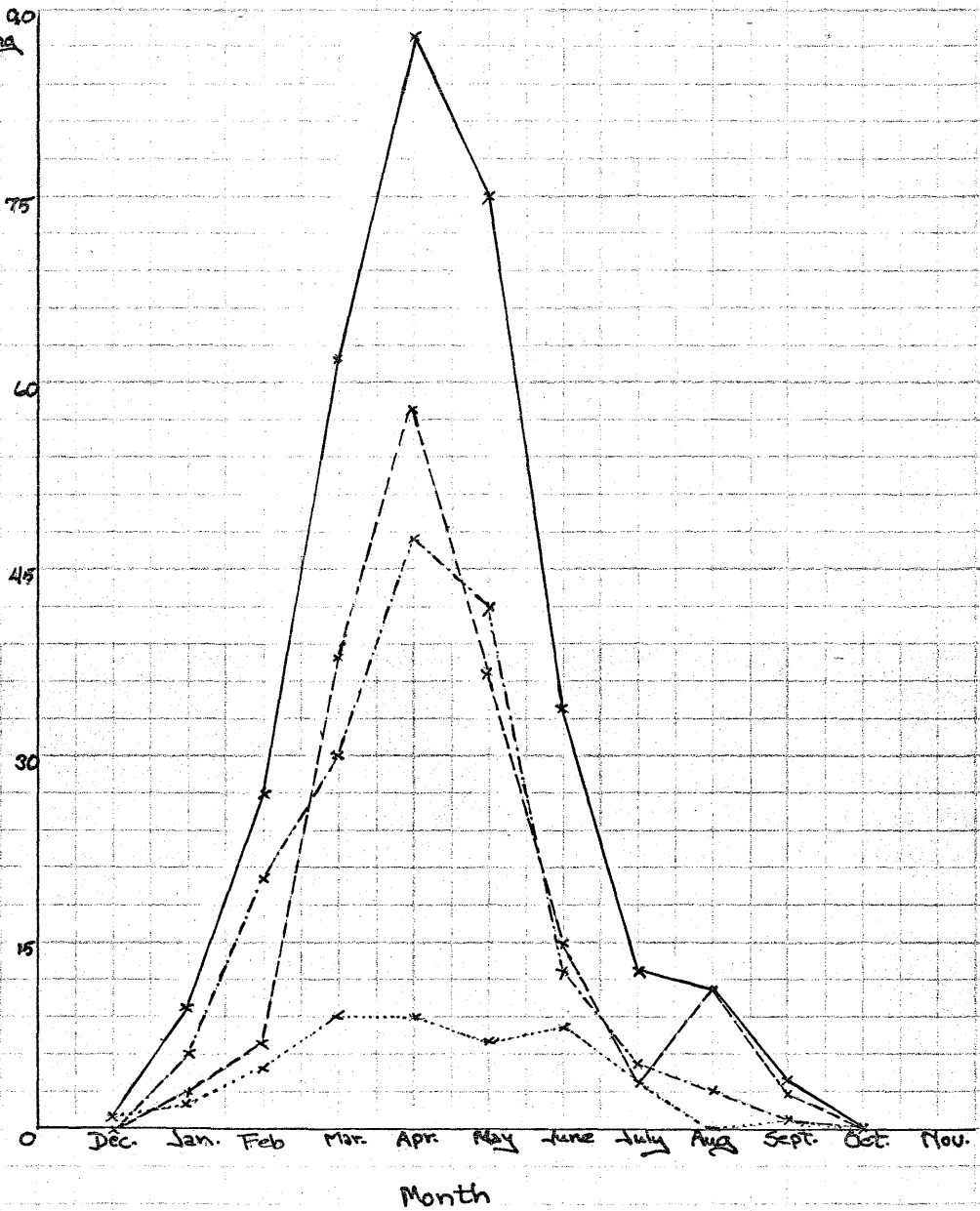
NUMBER OF PLANTS FIRST COLLECTED IN ANTHESIS
IN EACH MONTH ON THE WHOLE RIDGE, AND IN THE FOREST,
GRASSLAND, AND CHAPARRAL TYPES OF VEGETATION

Month	Ridge	Forest	Grasslands	Chaparral
December	1	0	0	1
January	10	6	3	2
February	27	20	7	5
March	62	30	38	10
April	88	47	58	10
May	75	42	37	7
June	34	13	15	9
July	13	5	4	4
August	11	3	11	0
September	4	1	3	1
October	0	0	0	0
November	0	0	0	0
Totals	326	166	176	49

CHART I

Number of Plants First Collected in Anthesis in Each Month on the Whole Ridge and in the Forest, Grassland, and Chaparral Types of Vegetation.

Number of
Species Beginning
Anthesis



Legend: ——— Whole Ridge
- - - - Forest
- · - · - Grassland
· · · · · Chaparral

only one of these groups.

The largest number of species beginning anthesis were collected in April, and this holds not only for the ridge as a whole, but also for each of the main divisions. Although there were 10 in March and 10 in May collected in the chaparral, the median for the total number in this classification falls in April. The medians for all four of the groups given fall in April, at about the middle of the month in the forest group, and slightly after the middle of the month in the others. The similarity is shown by the curves in Chart I. All of the curves except that for the chaparral rise to a peak in April; that for the chaparral reaches its high level in March, and stays near that level for four months. The per cent of species found in the chaparral beginning anthesis during the summer months (taken as from June through September) is higher than in the other areas--28.6% as compared with 18.7% in the grasslands, 13.3% in the forest, and 18.4% on the whole ridge. The chaparral is also slightly ahead during the winter months (December through February), but to a less extent; 16.3% as compared with 15.6% for the forest, 5.2% for the grasslands, and 11.3% for the whole ridge.

Comparative abundance

The following is a list, by months, of the relatively more abundant species to be found in anthesis in each of

the vegetational formations.

December

Chaparral: Ribes malvaceum.

Forest:

Grasslands:

January

Chaparral: Ribes malvaceum.

Forest: Alnus rhombifolia, Dirca occidentalis.

Grasslands:

February

Chaparral: Ribes malvaceum, Arctostaphylos crustacea,

Ceanothus cuneatus.

Forest: Ribes californicum, Dentaria integrifolia var.

californica, Pedicularis densiflora, Dodecatheon

hendersonii, Cynoglossum grande, Sequoia semper-
virens.

Grasslands:

March

Chaparral: Arctostaphylos crustacea, Ceanothus cuneatus.

Forest: Trillium sessile var. giganteum, Cardamine oligo-

sperma, Dentaria integrifolia var. californica,

Zygadenus fremontii, Luzula campestris, Quercus

kelloggii, Salix lasiolepis, Salix lasiandra,

Memphila heterophylla, Umbellularia californica,

Arbutus menziesii, Smilacina amplexicaulis.

Grasslands: Dodecatheon hendersonii, Oenothera ovata,
Nemophila menziesii var. atomaria, Ranunculus
californicus, Orthocarpus densiflorus, Plantago
erecta.

April

Chaparral: Quercus durata, Smilacina amplexicaulis,
Clematis lasiantha, Cercocarpus betuloides,
Diplacus aurantiacus, Ceanothus thyrsiflorus.

Forest: Lithophragma affinis, Diplacus aurantiacus,
Ceanothus thyrsiflorus, Quercus lobata, Quercus
douglasii, Quercus agrifolia, Rhus diversiloba.

Grasslands: Orthocarpus densiflorus, Baeria chrysostoma,
Linanthus parviflorus, Lupinus nanus, Brodiaea
capitata, Sisyrinchium bellum, Brodiaea laxa,
Trifolium tridentatum, Lotus subpinnatus, Avena
fatua, Avena barbata, Briza minor, Plantago
erecta.

May

Chaparral: Diplacus aurantiacus, Sphacele calycina,
Eriodictyon californicum, Smilacina amplexicaulis.

Forest: Stachys bullata, Trientalis europaea var. lati-
folia, Physocarpus capitatus, Brodiaea ixioides,
Symphoricarpus albus, Rosa gymnocarpa, Rhus
diversiloba.

Grasslands: Brodiaea laxa, Trifolium tridentatum, Briza

minor, Collinsia bicolor, Lotus subpinnatus,
Lotus micranthus, Orthocarpus densiflorus,
Orthocarpus purpurascens, Orthocarpus fauci-
barbatus, Brodiaea hyacinthina, Calochortus
luteus, Calochortus venustus, Godetia viminea,
Godetia quadrivulnera, Delphinium hesperium.

June

Chaparral: Adenostoma fasciculatum, Photinia arbutifolia,
Lotus scoparius, Chlorogalum pomeridianum, Del-
phinium californicum, Navarretia heterodoxa.

Forest: Silene californica, Holodiscus discolor, Micro-
meria chamissonis, Rosa californica, Monardella
villosa, Euonymus occidentalis, Grindelia rubri-
caulis.

Grasslands: Godetia amoena, Chlorogalum pomeridianum,
Madia dissitiflora, Calycadenia multiglandulosa,
Monardella villosa, Brodiaea coronaria, Cen-
taurea melitensis, Sitanion jubatum, Hordeum
nodosum, Gastridium ventricosum, Lotus americanus.

July

Chaparral: Lotus scoparius, Photinia arbutifolia,
Epilobium paniculatum.

Forest: Rosa californica, Photinia arbutifolia.

Grasslands: Hemizonia congesta var. luzulaefolia, Mon-
ardella villosa.

August

Chaparral:

Forest: Cordylanthus pilosus.

Grasslands: Hemizonia congesta var. luzulaefolia,
Eremocarpus setigerus, Eriogonum vimineum,
Eriogonum nudum, Lagophylla ramosissima,
Mentha arvensis.

September

Chaparral: Baccharis pilularis.

Forest: Baccharis pilularis, Aster chilensis.

Grasslands: Hemizonia congesta var. Luzulaefolia,
Eremocarpus setigerus, Eriogonum vimineum,
Solidago occidentalis.

October

Chaparral: Baccharis pilularis.

Forest: Baccharis pilularis.

Grasslands: Hemizonia congesta var. luzulaefolia.

November

Chaparral:

Forest:

Grasslands:

The above are far from being all of the plants blooming at these times, but I have attempted to pick out those that were the most abundant. If there were no plants that were at all common in a formation in a given

month, none were recorded.

Representative Description of Flowering

Two areas which presented a good picture of the succession of flowering are the meadow in the strip of serpentine, and the steep north slope between that meadow and San Francisquito Creek, because in both of these there was a definite and easily observable change of the most abundant forms in a very short time. In both cases, I have used the most showy herbs to describe the changes in these limited areas.

The first really abundant herb in the forest area selected was Dentaria integrifolia var. californica, which reached its maximum abundance in late February and early March. It was succeeded by Trillium sessile var. giganteum, which was very abundant there in March. In April and May the dominance passed to Smilacina amplexicaulis and Trientalis europaea var. latifolia; and in June these hillsides were reddened with Silene californica.

The meadow was a little later in getting really started, but by late March it was beginning to be colored pink and gold by Linanthus parviflorus, Orthocarpus densiflorus, Baeria chrysostoma, and Ranunculus californicus. In April these plants were still abundant, but the color of part of the meadow was changed to a lighter yellow by Layia platyglossa. Also in this month the blue color of Brodiaea laxa and Brodiaea terrestris began to appear. By

May, most of the pink had disappeared, and the meadow began to dry up. In only one place was there much color, and that was due to the yellow of the Orthocarpus fauci-
barbatus. However, it was not long before the meadow was dotted with Calochortus venustus and Calycadenia multiglandulosa, and by the time that they had disappeared, the Hayfield Tarweed (Hemizonia congesta var. luzulaefolia) had begun to flower; this flourished until late September.

Of course the plants mentioned were only a small number of those actually found in anthesis in both of these areas, but they give an idea of the general succession. The meadow was an especially interesting place to observe the succession, because for several months, it was just a slowly changing mass of color.

GROWTH-FORMS, FORMATIONS, AND HABITATS

The general types of vegetation on the ridge have already been classified as chaparral, forest, and grasslands. According to the proposition of the Commission of Phytogeographical Nomenclature, the term "formation" should be applied to "an actual expression of certain conditions of life....independent of floristic composition." Therefore, no one of the above types is a true formational unit in itself--each is a part of a much larger formation; for example, the chaparral found on Jasper Ridge is a part of the chaparral formation, which extends throughout much of California.

Warming (9) greatly emphasizes the importance of growth-forms (the more or less general type of vegetative form taken on by plants which grow together) as a means of distinguishing types of formations. "Just as species are the units in systematic botany, so are growth-forms in oecological botany." Warming's classification of growth-forms is complicated and detailed, and includes so wide a range that I have not used it exactly as it is given in his book; but by making some adaptations of it to the forms present on Jasper Ridge, I have divided these into the following six growth-forms: annual and biennial herbs, perennial herbs, woody climbers, suffrutescent shrubs, arborescent shrubs, and trees. Table II shows

MAP
OF THE
VEGETATIONAL FORMATIONS ON
JASPER RIDGE

LEGEND

Chaparral



Forest

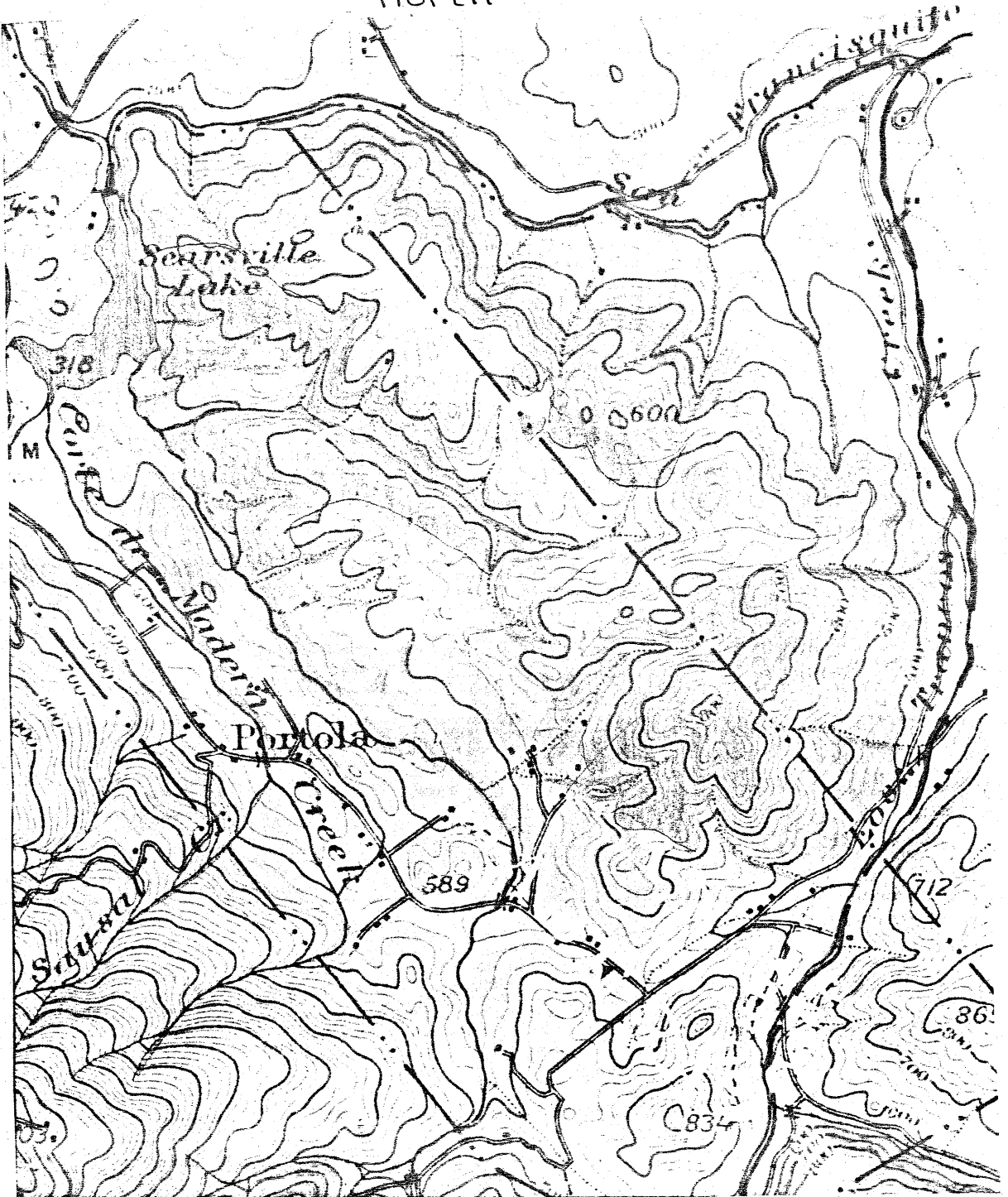


grasslands



PLATE V

North



the relative numbers of each growth-form in each of the formations, and Table III the percentages. The highest percentages of the herbs, both annual and perennial, fall in the grasslands; of the woody climbers, the suffrutescent shrubs, and the arborescent shrubs, in the chaparral; and of the trees, in the forest.

To distinguish the differences due to floristic composition, the term "association" is used. This is defined by Warming as "a community of definite floristic composition within a formation." Thus, each of the formations may be divided into one or more associations, depending upon the predominance of certain species of plants found in them.

The map of the types of vegetation shows that superficially, at least, their distribution seems to agree with the topography of the ridge. On south slopes and gentle rolling slopes we find chaparral, and on the steep north slopes, and along the streams, the forest type of vegetation. The grasslands are found mainly on the level places, or rolling slopes. The map does not distinguish between the different associations within the formations.

The distribution has been modified to some extent by the clearing out of much of the chaparral growth, which at one time dominated the ridge to a much greater extent than it does now; large areas of the ridge now show the

TABLE II

DISTRIBUTION OF GROWTH-FORMS ON THE WHOLE RIDGE,
AND IN THE FOREST, GRASSLAND, AND CHAPARRAL TYPES OF
VEGETATION

Growth-form	Ridge	Forest	Grassland	Chaparral
Annual and biennial herbs	145	55	108	5
Perennial herbs	116	59	65	14
Woody climbers	6	4		2
Suffrutescent shrubs	11	5	3	9
Arborescent shrubs	35	28		16
Trees	15	15		3
Totals	328	166	176	49

TABLE III

PERCENTAGE DISTRIBUTION OF GROWTH-FORMS ON THE
WHOLE RIDGE, AND IN THE FOREST, GRASSLAND, AND CHAPARRAL
TYPES OF VEGETATION

Growth-form	Ridge	Forest	Grassland	Chaparral
Annual and biennial herbs	44.2%	33.1%	61.3%	28.6%
Perennial herbs	35.6%	35.5%	36.8%	28.6%
Woody climbers	1.8%	2.4%		4.1%
Suffrutescent shrubs	3.3%	3.0%	1.9%	18.4%
Arborescent shrubs	10.6%	16.9%		32.6%
Trees	4.5%	9.1%		6.1%
Totals	100.0%	100.0%	100.0%	100.0%

presence of what Dr. Cooper points out is characteristic secondary growth--fields of Avena fatua and Avena barbata; and more forest-like areas with Quercus douglasii, Ceanothus cuneatus, Photinia arbutifolia, Baccharis pilularis, and Rhus diversiloba.

Chaparral

In spite of the clearing away of much of it, the patches of chaparral that are left, especially those at the south-east and north-west ends of the ridge are large enough to show the original character of the vegetation, except along the edges, or where roads have been cut through--as has been done in both of the larger areas.

The characteristic habitat of chaparral involves winter rains and dry summers, in regions where the total annual rainfall is between 10 and 30 inches, and the temperature extremes are moderate. Jasper Ridge satisfies all of these conditions.

The plants are adapted to withstand the long, severe drying-out, and to make the most of what water they do get. Trees are very rare and look out of place in the chaparral. The vegetation consists almost entirely of low shrubs growing very close together. The wood is hard and the branching dense and rigid. The root system is very extensive in proportion to the size of the plant--

the roots often reaching down into the ground for a distance of as much as fifteen or twenty feet. The leaf--the part of the plant which has led to the application of the name "broad sclerophyll vegetation" to the chaparral--is small, thick, heavily cutinized, and evergreen. (75% of the arborescent shrubs in this formation are evergreen.) The leaf of the most abundant plant, Adenostoma fasciculatum, is not of this characteristic type, but bears a closer resemblance to the leaves of the conifers; it is a small evergreen leaf which is almost needlelike. This is an extreme adaptation to the xerophytic conditions.

Most of the chaparral on the ridge is found growing on the Franciscan and Chico Formations. The sandy soil is generally shallow, and the roots penetrate some distance into the rock. There is very little humus present in the soil, and what there is is mainly close to the surface. The chaparral is not found on the adobe soils at the edges of the ridge or on those formed by the decomposition of the serpentine; it grows on the sandy soils of the Altamont and Pleasanton series.

The soil becomes saturated with water as a result of the winter rains, but with the beginning of the dry season, this is rapidly depleted; so for several months, before the next rains, there is a period of very severe deficiency. Evaporation is greater in this region than in the forest.

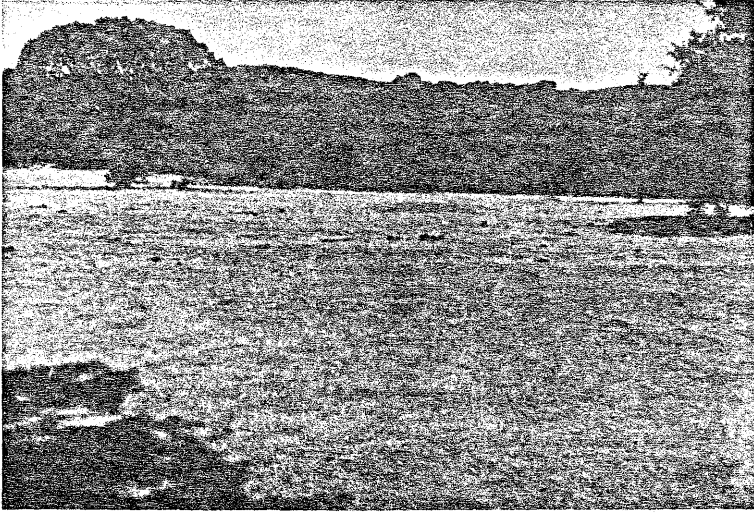
The number of plants characteristic of the chaparral is comparatively small. Adenostoma fasciculatum is by far the dominant species occurring all through it, and in fact is so abundant that its presence almost labels the place where it grows as belonging to the chaparral classification. Next in importance, perhaps, is Arctostaphylos crustacea, which is abundant only on the gentle north slopes of the chaparral. Ceanothus cuneatus and Quercus durata are also relatively abundant. Less frequent shrubs are Cercocarpus betuloides, Prunus ilicifolia, Ceanothus thyrsiflorus, and Photinia arbutifolia. In the spring Clematis lasiantha is found climbing profusely over the shrubs, and whitening the slopes in some places.

The chaparral may be divided into several more or less distinct associations--on the steeper south slopes, the Adenostoma association, in which Adenostoma is the dominant species; on the more northward slopes, the Arctostaphylos-Photinia association, which contains a greater variety of species; and possibly two other associations found near the edge of the chaparral. Near the edges, or along the disturbed parts, there are a number of plants which are not characteristically found in the middle of the chaparral associations on the ridge, and therefore probably did not originally help make up the composition of the chaparral here, but now seem definitely to belong to it. In this

PLATE VI

Vegetational Formations on Jasper
Ridge

(Chaparral at Southeast
End of Ridge)



category fall such shrubs as Eriodictyon californicum, Sphacele calycina, Diplacus aurantiacus, Ribes malvaceum, Solanum umbelliferum, and Eaccharis pilularis. Chlorogalum pomeridianum, Lotus scoparius, and Helianthemum scoparium var. vulgare also often grow at the edge of the chaparral.

Comparatively few herbs or short-lived plants grow in this vegetational formation, and those that I have included in it here are mainly found near the edge. Some that might be mentioned are Navarretia heterodoxa, Scrophularia californica, Smilacina amplexicaulis, Epilobium paniculatum, Stephanomeria virgata, Castilleja foliolosa, and Delphinium californicum. In one place Monolopia gracilens and Erodiaea capitata are very abundant.

Artemisia californica is common on several of the slopes, and perhaps should be included as one of the most abundant plants of the chaparral, forming a fourth association. However, where it grows it usually covers that particular part of the slope, and none of the other characteristic chaparral shrubs are found growing with it. It too is found mainly at the edge of the patches of chaparral.

Forest

The forest formations are found mainly on the steep north slopes of the ridge, and are characterized by much greater luxuriance of the plants than is to be found in the

chaparral. There is a great deal more low-growing, herbaceous vegetation, and trees are the rule rather than the exception, as is the case in the chaparral. There is not the adaptation for guarding against the loss of water; on most of the herbs and shrubs, the leaves are large, thin, and broad, and are not generally heavily cutinized. The trees produce the shade which is necessary for the best development of these plants. A lower percentage of the vegetation consists of evergreen plants in the forest than in the chaparral. In the forest, 35.7% of the arborescent shrubs, and 40 % of the trees are evergreen.

I have included two types of forest growth in this classification--the densely wooded, or Quercus agrifolia associations, and the openly wooded or Quercus douglasii association. The latter might almost be considered a transition area between either the chaparral and the densely wooded forest, or between the densely wooded forest and the grasslands, or a combination of all three. There are open places in which the conditions of growth are just about the same as the grasslands, and on which many of the same species of herbs are found. The trees are generally not so tall, and the growth of most of the plants is not nearly so luxuriant as in the densely wooded forests, and yet is much more so than in the chaparral.

The soil in the forest formation, too, as on most of

the ridge, is mainly decomposed sandstone, but it differs from that of the chaparral in containing a large amount of humus, which is also found to a much greater depth in this region. This increases the water-retaining capacity of the soil. Where areas of the forest formation are found along the banks of streams, there may be another difference between the soils of the forest and the chaparral, due to the deposition of alluvium by the streams. The accumulation of materials by decomposition and the washing down of soils into the ravines seem to have had more effect than the difference in geological formations. The main, or apparently most effective, difference is in the amount of humus present.

There is more water held in the soil during the wet season, and during the period of maximum growth, although by the end of the summer, the curve of water remaining in the soil has dropped approximately to that of the chaparral region.

The most characteristic tree of the openly wooded forest is Quercus douglasii. Less frequent are Quercus kelloggii, Quercus lobata, and Quercus agrifolia. In several places Aesculus californica is abundant. The most frequent shrubs here are Rhus diversiloba, Sambucus glauca, Diplacus aurantiacus, Rhamnus californica, Rhamnus crocea, Ceanothus thyrsiflorus, Ribes californicum, Rosa californica, Symphoricarpos albus, Photinia arbutifolia, and

Solanum umbelliferum. Among the most frequent herbs are a number of those found in the grasslands, and also Cynoglossum grande, Vicia americana var. linearis, Stachys bullata, Psoralea physodes, Zygadenus fremontii, Luzula campestris, Castilleja parviflora var. douglasii, Pedicularis densiflora, Plectritis ciliosa, Plectritis macrocera, Calochortus albus, Fritillaria lanceolata var. floribunda, Lithophragma affinis, Brodiaea ixioides, Potentilla glandulosa, Trifolium tridentatum, and Aquilegia truncata.

In the more densely wooded forest, the most abundant trees are Quercus agrifolia, Quercus kelloggii, Umbellularia californica, Aesculus californica, Acer macrophyllum, Acer negundo var. californicum, Arbutus menziesii, Sequoia sempervirens, Pseudotsuga taxifolia, and, on the banks of the streams, Alnus rhombifolia, Salix lasiolepis, and Salix lasiandra.

The most abundant shrubs are Rhus diversiloba, Holodiscus discolor, Physocarpus capitatus, Dirca occidentalis, Symphoricarpos albus, Corylus rostrata, Rubus vitifolius, Rosa gymnocarpa, Euonymus occidentalis, and Whipplea modesta. As to the herbs, those growing most abundantly in this association are Dentaria integrifolia var. californica, Trillium giganteum var. sessile, Trientalis europaea var. latifolia, Smilacina amplexicaulis, Smilacina sessilifolia, Silene californica, Micromeria chamissonis,

Stachys californica, and Heuchera micrantha.

In several places on the top of the ridge, mainly along the road through the chaparral at the southeast end of the ridge, Pinus radiata and Cupressus macrocarpa are planted, but since they do not grow there naturally, they are not here considered to make up a part of the forest on the ridge.

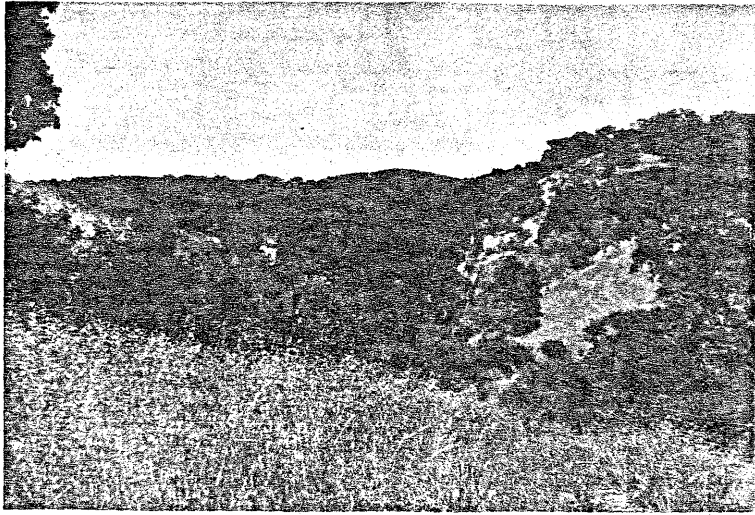
Grasslands

The grasslands are found mainly on the flat or gently rolling surfaces of the ridge which are not covered with chaparral. The vegetation consists almost entirely of herbs which start up during the wet season, flourish in the spring, and die down in the late spring and early summer. 61.3% of the number of plants found in this area are annual herbs, 36.8% perennial herbs, and only 1.9% suffrutescent shrubs. I have not considered the occasional oaks which dot the landscape as belonging to the grassland formation.

All of the open land has been included in the general classification of the grasslands, and therefore there is a difference in conditions in various places on the ridge. One set of conditions applies to that at the edge of the lake, another to the cultivated fields at the edge of the ridge, another to the open rolling slopes at the summit of the ridge, and still another to the meadow at the summit of

PLATE VII

Vegetational Formations on Jasper Ridge



(Grasslands, Forest, and
Chaparral)



(Orchard at Southeast End of
the Ridge, with Chaparral in Background)

the ridge which is in the strip of serpentine. Yet they all have somewhat the same characteristics--scarcity or absence of trees and shrubs, and the dominance of herbs which die down during the dry season.

In disturbed areas such as those along roadsides, near the lake, and near buildings--or what I have called "civilization"--there are found a large number of species of naturalized weeds, but there is a comparatively small number of these weeds that are really frequent on the part of the ridge on which most of the work was done, and even near the edges of the ridge, these plants are much less frequent than they are in the valley. A few of them, however, such as Avena fatua and Avena barbata, now dominate a large part of the ridge. The adobe soils at the edge of the ridge support the growth of the grassland formation better than those of the chaparral and the forest.

At the edge of the lake, some of the most frequent plants, other than the weeds, are Polygonum muhlenbergii, Typha latifolia, Sparganium eurycarpum, and Mentha arvensis.

The most abundant plants on the rolling slopes are a large number of grasses, of which Avena fatua and Avena barbata are the most common, Orthocarpus densiflorus, Orthocarpus purpurascens, Brodiaea laxa, Brodiaea capitata, Brodiaea coronaria, Lupinus nanus, several species of Tri-

folium, Sisyrinchium bellum, Ranunculus californicus, Plagiobothrys nothofulvus, Nemophila menziesii var. atomaria, Collinsia bicolor, Godetia viminea, Godetia amoena, Godetia quadrivulnera, Briza minor, Delphinium hesperium, Lotus micranthus, Lotus subpinnatus, Lotus americanus, Hemizonia congesta var. luzulaefolia, and Eremocarpus setigerus. The soil in this region is mainly sandy. Probably much of this area was formerly chaparral, and was cleared off. It is now used as pasture land. In this area there are occasional lone oak trees, usually Quercus douglasii.

The meadow in the strip of serpentine seems to be the one place on the ridge that is definitely affected by the geological formation underlying it. The decomposed serpentine forms a sticky adobe soil. Although in it there are a number of plants that are also found elsewhere on the ridge, there are some that grow in this meadow and nowhere else in the field of this study. (A few grow only in the soil over the serpentine, but are found in the openly wooded area at one side of the meadow.) The soil is probably little more than decomposed serpentine, and it seems to be very shallow, since in many places in the meadow there are rocky outcrops of the serpentine. Some plants that are limited to this place are Orthocarpus faucibarbatas, Allium serratum, Allium lacunosum, Mimulus

douglasii, Trifolium fucatum var. flavulum, Astragalus nigrescens, Arenaria douglasii, Juncus phaeocephalus, Layia platyglossa, Calycadenia multiglandulosa, Sitanion jubatum, Hordeum nodosum, Brodiaea terrestris, Calochortus venustus, Delphinium variegatum, and Cryptantha flaccida.

On another outcrop of serpentine a short distance away Gilia peduncularis grows, and Collinsia sparsiflora is limited to a steeper slope in this strip of serpentine.

Plantago erecta, Baccharis chrysostoma, and Linanthus parviflorus also are found here more abundantly than anywhere else on the ridge. Other plants which are abundant in this meadow are Orthocarpus densiflorus, Orthocarpus purpurascens, Eschscholtzia californica, Lomatium dasy-carpum, Brodiaea laxa, Brodiaea hyacinthina, and Eriza minor.

Transition Zones

Wherever there is a natural change from one of these areas to another, there is a zone of transition in which there are found plants characteristic of both areas--a place where the two areas blend into one another. Of course this has been affected by the clearing out of some of the chaparral, which process interfered with the natural conditions.

Summary of Ecological Factors

Jasper Ridge is characterized by dry summers, and

winters in which the rainfall averages somewhat over twenty inches. The following is a summary of Dr. Cooper's summary of the difference between forest and chaparral habitats. (5)

The humus is scanty in the chaparral, but in the forest it composes nearly two per cent by weight of the surface layer, and there is much present to a depth of one meter. There is more water in the soil of the forest in the rainy season, but as the dry season advances, the water content values approach one another. At the critical period conditions are about equally severe in both communities. The only note-worthy feature in water-retaining capacity is the relatively high value in the surface soil of the forest community, due to the presence of humus. The soil temperatures are similar in the wet season, but that in the chaparral is much higher in the dry.

Dr. Cooper dismisses rainfall, cloud, fog, and wind as being immaterial to the local problem. Light is much greater in the chaparral because of the fewer obstacles and the reflection from the light-colored soil surface.

The data on temperature and relative humidity are unsatisfactory, but their importance is largely in their effects upon evaporation. The differences in evaporation are constant throughout the year, that in the *Adenostoma* chaparral being the highest.

Dr. Cooper sums it up with, "We have here sufficient data to explain the greater size and luxuriance of the plants growing upon the north-facing slopes, and the absence of the more mesophytic species from the south-facing exposures. Many factors are indirectly involved, but fundamentally the problem is one of water-balance. During the height of the rainy season there is in both habitats an abundance of soil moisture and a minimum of evaporation. But the air and soil temperatures are low and there is consequently little growth. As the temperature rises, the rate of growth increases accordingly, but at the same time the rains are diminishing in frequency and amount, finally ceasing entirely, and the evaporation-rate is going up. Most of the growth occurs in the spring, culminating in April. The amount of actual growth during this time, other things being equal, will depend upon the ratio of water supply to water-loss, and plainly this water-balance is more favorable upon the north-facing slope inhabited by the forest. The size of the full-grown plant of a given species depends largely upon the turgor of the growing cells, and a healthy condition of turgor is conditioned upon a water-supply that will more than compensate for the loss by evaporation. If the supply is so scant or the loss so severe that the water-balance is barely maintained at equality, the plant and its organs will be small. If supply is in excess of loss, rapid growth will result. The size and luxuriance of the plants are therefore greater upon north-facing slopes, where soil moisture is more abundant and evaporation less rapid during the growing period."

Dr. Cooper did not study the grasslands, but there are certain factors which might help to account for them. One is that there is probably little humus present in the soil, and what there is does not penetrate very deeply into the soil. Since there is not so much vegetation to prevent the free circulation of air, the evaporation rate may be higher, and since the fields become dry soon after the end of the rainy season, it seems possible that the water retaining capacity of the soil is very poor. However, it may be that due to the fine adobe soil of some of the natural grass-

lands, the water-retaining capacity is too great, and the roots of the trees or shrubs that might have grown there would be drowned out or suffocated by lack of aeration.

The only place on the ridge where the geological formations seem to affect the growth is in the area underlain by serpentine, in which the adobe soil consists almost entirely of decomposed serpentine. No chaparral growth is found on the adobe soils at the edge of the ridge, either, but this soil is not to such a large extent decomposed bedrock. All the formations found on the ridge, except the serpentine formation, are very similar in composition, and perhaps the soils formed by their decomposition are too nearly the same to account for differences in vegetation upon them.

VII

SUMMARY

1. During the year 1935, 330 species of seed plants from Jasper Ridge were collected and identified. Of these, 166 can be said to grow in the forest areas, 176 in the grasslands, and 49 in the chaparral.

2. April was the month in which the greatest number of plants beginning anthesis were collected; that is, plants that had not been collected or observed in anthesis before during this year. This held true for all of the vegetational areas, although the curve for the chaparral did not rise to a peak in that month, as the other curves did.

3. The ridge can be divided into three main vegetational formations--the chaparral, forest, and grasslands. These may be further subdivided into associations, and there are transition areas between each group.

4. Superficially the distribution of these vegetational areas agrees with the topography of the ridge. The chaparral is found on the south slopes and on the gentler north-facing slopes; on the steep north slopes the vegetation is that typical of the forest; and the grasslands are mainly in the level places or on gently rolling slopes.

5. The chaparral consists almost entirely of rigid shrubs with hard bark, extensive root systems, and small,

thick, heavily-cutinized, evergreen leaves.

6. The plants of the forest can be easily divided into trees, shrubs, and herbs. The foliage is much more luxuriant than in the chaparral.

7. Herbs, both annual and perennial, constitute almost the only plants of the grasslands. Most of them die down and disappear fairly soon after the end of the rainy season.

8. The main determining factor as to the type of vegetation to be found in a given area seems to be the water-balance and its variations. This is affected by other conditions, such as the amount of humus present in the soil, the relative evaporation rates, and the air and soil temperatures. An explanation of the fact that the forest is more luxuriant than the chaparral lies in the fact that in the forest there is a greater supply of water present during the maximum growing season.

9. The only place in which the geologic formation seems to have much effect upon the growth of plants appears to be in the strip of serpentine, in which there are found a number of plants which do not appear anywhere else in the grassland associations.

10. The presence of man and "civilization" has affected the original floristic and ecologic conditions of the ridge in several ways: by the bringing in and naturalizing of

plants, some of which dominate large areas of the ridge; by the clearing off of some of the land and the use of it for pasture lands, and by the cultivation of some of the land at the edges of the ridge. However, there are comparatively large areas which appear to give an idea of the original character of the vegetation.

VIII

LIST OF SEED PLANTS FOUND ON JASPER RIDGE

The species are listed here by families in the order in which they are described by Dr. Jepson in his Manual (8), and the names are those that he has used. For each plant I have given the comparative abundance, the general location in which it grows, and the time of flowering. It should be remembered that this data applies only to this particular year, and to this area. Although the actual dates of flowering might vary, the general sequence of flowering would probably remain about the same. The abundance as given (rare, infrequent, frequent, common, abundant, and very abundant) is taken to mean that at the height of the flowering season for each plant, and therefore would fall at about the middle of the time of flowering stated.

Subkingdom Spermatophyta. Seed Plants.

Class Gymnospermae. Cone-bearing Plants.

Family Pinaceae

Pseudotsuga taxifolia (Lamb.) Britt. Douglas Fir; Douglas Spruce.

Comparatively infrequent, found on steep north slopes.

The catkins are present in March.

Sequoia sempervirens (Lamb.) Endl. Redwood.

Frequent. It is found in several places near San Francisquito Creek and near Portola. The catkins appear in

February.

Class Angiospermae. Flowering Plants

Monocotyledons

Family Typhaceae

Typha latifolia L. Common Cat-tail.

Common in the marshy places of the lake in August.
One specimen was collected at the edge of the lake.

Family Sparganiaceae

Sparganium eurycarpum Engelm.

Infrequent at the edge of the lake, near the road.
Specimens collected in May and in August.

Family Alismaceae

Alisma plantago L. Water Plantain.

Infrequent at edge of shallow part of lake. Collected
in August.

Family Gramineae

Bromus tectorum L. Downy Brome.

Rather infrequent, collected only once, in April,
in open field near picnic grounds at Searsville Park.

Bromus rubens L. Red Brome.

Frequent on open, drying hillsides from April to June.
Bromus rigidus Roth. "Ripgut" Grass.

Abundant on open hillsides and in fields, especially
near roadsides and cultivated fields or pasture lands.
April and May.

Bromus hordeaceus L. Soft Cheat.

Abundant in open fields, and openly wooded slopes (though there less frequent), in April and May.

Bromus racemosus L.

Similar to the preceding species, and often found growing near it. The distribution, abundance, and time are about the same.

Bromus commutatus Schrad.

Frequent in open fields, especially near "civilization," in April and May.

Bromus carinatus H. & A. California Brome Grass.

Frequent in open fields and on openly wooded slopes, especially near the roads or buildings. April and May.

Bromus laevipes Shear.

Infrequent, found growing on a shady slope in June.

Festuca myuros L. Rat's-tail Fescue.

Frequent in open fields, near lake, and along roadsides in April and May.

Poa annua L.

Frequent, growing near roadside in late April and May.

Poa scabrella (Thurb.) Benth. Malpais Blue Grass.

Frequent to abundant in open fields and openly wooded slopes in April and May.

Eriza minor L.

Very abundant in open fields, and openly wooded slopes, from April until late May.

Melica torreyana Scribn.

Rather infrequent in grassy field near picnic grounds at Searsville Park. April and May.

Elymus glaucus Buckl. Western Rye Grass.

Frequent in open fields and openly wooded slopes in April and May.

Sitanion jubatum J. G. Sm.

Frequent in the serpentine of the meadow, in late May and June.

Hordeum murinum L. Wall Barley; Farmer's Foxtail.

Frequent near roadsides and buildings, from March to May.

Hordeum nodosum L. Meadow Barley.

Frequent in the serpentine of the meadow in May and June.

Lolium multiflorum Lam. Italian or Australian Rye Grass.

Frequent along roadsides, and in open fields and on openly wooded slopes near roads. April and May.

Lolium temulentum L. Darnel; Cheat.

Often found growing near the preceding species, and at the same time, but not so common.

Avena fatua L. Wild Oat.

Very abundant, being the dominant form found on open hillsides. March to May.

Avena barbata Brot.

Very abundant, joining with the above species to cover the open hillsides. Range and time of flowering similar.

Aspris caryophyllea (L.) Nash.

Abundant on openly wooded slope in May.

Polypogon monspeliensis (L.) Desf. Beard Grass.

Frequent near the edges of the lake from June to August.

Gastridium ventricosum (Gouan) Schinz & Thell

Frequent in dry open fields in May and June. In many places this grass forms the only green spots on the hills at this time.

Stipa pulchra Hitch.

Frequent, growing in the serpentine of the meadow in April and May.

Family Cyperaceae

Carex sub-bracteata Mkrze.

Several growing in moist place due to overflow of watering trough. May and June.

Family Juncaceae

Juncus patens Mey. Common Rush

Abundant in comparatively moist ground, especially along roadsides. March to May.

Juncus oxymiris Engelm.

Infrequent, growing in the serpentine of the meadow in May.

Juncus phaeocephalus Engelm.

Infrequent, growing in the serpentine of the meadow in late May and June.

Luzula campestris DC. Common Wood-rush.

Frequent to abundant on openly wooded slopes throughout the ridge, starting to flower in February, and continuing until May.

Family Liliaceae

Zygadenus fremontii Wats. Star Zygadene.

Common on brushy hillsides, February to May. At first found on wooded slopes, in forest; near end of blooming season, in chaparral.

Chlorogalum pomeridianum (Ker) Kunth. Soap Plant.

Leaves are abundant in January. Flowers from May to July, beginning first in the serpentine of the meadow, and then at the edges of the chaparral.

Allium serratum Wats.

This was found on only one field trip, in May, in an openly wooded area in the strip of serpentine. It was infrequent here.

Allium lacunosum Wats.

Limited to the serpentine of the meadow, where it is found in three or four small patches only. Late April and May.

Brodiaea laxa (Benth.) Wats. Ithuriel's Spear.

Very abundant throughout grassy meadows and open places on the wooded slopes from late March until June. White flowers are not infrequent.

Brodiaea ixioides (Ait. f.) Wats. Golden Brodiaea.

Frequent locally in openly wooded spots from May until June. It was found late in the season at several places near the edge of the chaparral.

Brodiaea hyacinthina (Lindl.) Baker. White Brodiaea.

Infrequent on openly wooded slopes in May. In May and June it was more abundant in the serpentine of the meadow.

Brodiaea terrestris Kell.

Common in the serpentine of the meadow in April and June. Not found anywhere else.

Brodiaea coronaria (Salisb.) Jepson. Harvest Brodiaea.

Abundant in the drying open fields from late May until the end of June. It grows in approximately the same places as Brodiaea laxa, which it succeeds.

Brodiaea capitata Benth. Blue Dicks.

Most abundant at the edge of the chaparral near Searsville Lake from March until May, but is also frequent on openly wooded slopes and open hillsides.

Brodiaea pulchella (Salisb.) Greene. Ookow.

Infrequent on openly wooded slopes in May.

Calochortus luteus Dougl. Yellow Mariposa.

Frequent locally on open hillsides or openly wooded slopes in May and June.

Calochortus venustus Dougl. White Mariposa.

Frequent in the serpentine of the meadow in May and June. The range of this species scarcely overlaps that of *Calochortus luteus*, which is only rarely found in the serpentine area.

Calochortus albus Dougl. White Globe Lily; Fairy Lantern.

Rather widely scattered in openly wooded regions over the ridge, but not especially abundant anywhere. April and May.

Fritillaria lanceolata var. floribunda Benth. Checker Lily.

Flowers found only in one place on openly wooded slope near Portola, in March. Later the fruit was found in several places on shady slopes near streams.

Smilacina sessilifolia Nutt. Slim Solomon.

Mostly infrequent in shady woods near streams, and here found only locally, from late March through April.

Smilacina amplexicaulis Nutt. Fat Solomon.

Very abundant, beginning in the shady slopes in March, blooming very abundantly at the edge of the road through the chaparral above the lake in April, and some still blooming near the marshy parts of the lake as late as the end of May. The plants growing in the chaparral are much heavier, thicker, lower, and more densely tufted than those growing in the shady woods.

Trillium sessile var. giganteum H. & A. Common Trillium.

Found on shady stream banks and hillsides from February until the end of March. About the beginning of

March it is very abundant in several places on the ridge.

Family Iridaceae

Iris macrosiphon Torr. Ground Iris.

This plant was not collected during the study this year, but I did collect it in April, 1934, at the edge of the road through the chaparral above the lake.

Sisyrinchium bellum Wats. Blue-eyed Grass.

Abundant in grassy meadows, and openly wooded slopes throughout the ridge, from late March until May.

Family Orchidaceae

Habenaria elegans (Lindl.) Jepson.

Infrequent (only three specimens seen) in shady woods, in June and July.

Dicotyledons

Family Salicaceae

Salix lasiandra Benth. Yellow Willow.

Abundant near water, especially at the south end of the lake, where this species and *Salix lasiolepis* form almost a forest of willows. Flowers in March.

Salix lasiolepis Benth. Arroyo Willow.

Abundant near water, at the south end of the lake, and along streams, including those that are dry in the summer. Late February and March.

Family Betulaceae

Alnus rhombifolia Nutt. White Alder.

Abundant along the banks of San Francisquito Creek, especially at the end near the lake. It flowers in January and February.

Family Corylaceae

Corylus rostrata var. californica A. DC. California Hazel.

Frequent along the banks of San Francisquito Creek, especially where it is densely shaded. The staminate catkins were found first in February, but the pistillate ones not until March, at which time both were found in anthesis. The staminate catkins were beginning to form again in October on a few shrubs.

Family Fagaceae

Quercus lobata Nee. Valley Oak.

Comparatively infrequent on the ridge, being mostly limited to the lower parts at the edges of the ridge. It was found flowering in April.

Quercus douglasii H. & A. Blue Oak.

This oak is very abundant on this ridge, forming perhaps the principal tree on the more openly wooded slopes, but infrequent on the steep north slopes or near the streams. It was found flowering in February (one tree), and again, more abundantly, in April.

Quercus durata Jepson. Leather Oak.

Frequent shrub of the chaparral, more abundant in the patch of chaparral at the southeast end of the ridge than in the others. Flowers in April.

Quercus agrifolia Nee. Coast Live Oak.

This is the most widely distributed oak on the ridge, being found with Quercus lobata in the valleys surrounding it, on the shady slopes near streams, growing with Quercus douglasii on the less densely wooded slopes, and at the edge of the chaparral, although rarely in it. It was found flowering in March and April.

Quercus wislizenii var. frutescens Engelm.

Frequent scrub oak of the chaparral formation, especially at the southeast end of the ridge. Found flowering in April.

Quercus kelloggii Newb. California Black Oak.

Frequent, found mainly on the higher open or openly wooded slopes of the ridge, and on the shady north slopes. It flowers in February and March.

Quercus sp. ?

This form is limited to one tree, possibly a hybrid, possibly a new species, growing in the chaparral formation at the southeast end of the ridge. Flowers in April.

Family UrticaceaeUrtica gracilis var. holosericea Jepson.

Frequent along the dry banks of streams, in July. This plant was observed and identified in the field, but was not collected.

Family Loranthaceae

Phoradendron villosum Nutt. Common Mistletoe.

The mistletoe is rather an abundant parasite on oaks throughout the ridge, and was found mainly on Quercus lobata and Quercus douglasii. It was flowering when it was collected in August.

Family Polygonaceae

Polygonum muhlenbergii Wats.

This is very abundant in the lake all during the summer, covering large areas in the shallower parts. It was collected at the edge of the lake in June, and again in late August.

Rumex crispus L. Curly Dock.

Frequent along roadsides, near the lake, and near buildings, in May and June.

Rumex obtusifolius L. Bitter Dock.

Frequent along roadsides, near the lake, and near buildings, collected in June.

Rumex acetosella L. Sheep Sorrel.

Comparatively abundant in open fields, especially in those used as pasture lands. April and May.

Eriogonum vimineum Dougl.

Frequent to abundant on open hillsides. In one place in the meadow in the strip of serpentine, it is

abundant enough to tinge the ground with pink. It was found flowering in August and September.

Eriogonum nudum Dougl. Tibinagua.

Frequent on dry open hillsides, though not in the meadow in the serpentine. Flowers in August and September.

Family Portulacaceae

Calandrinia caulescens var. menziesii Gray. Red Maids.

Frequent on moist grassy slopes in March and April.

Montia perfoliata (Donn.) Howell. Miner's Lettuce.

Frequent on moist slopes, often under oaks, February and March. There is a small variation which grows in the serpentine, and was found there in March and April.

Montia spathulata (Dougl.) Howell.

Frequent on moist grassy slopes, where it was collected in March and May.

Family Caryophyllaceae

Cerastium viscosum L. Mouse-ear Chickweed.

Common in fields and on open hillsides, especially near "civilization," i.e., the lake, the farms, and the old stone quarry. Flowering from March to May.

Stellaria media (L.) Cry. Common Chickweed.

Abundant in moist fields, often growing in the shade of oak trees, also mainly near "civilization." February to May.

Arenaria douglasii Fenzl.

Comparatively infrequent, growing in the serpentine

of the meadow, and near the chaparral there, blooming in April and May.

Silene gallica L. Windmill Pink.

Abundant on open slopes and meadows throughout the ridge, from April to May.

Silene californica Dur. Indian Pink.

Frequent in the more openly wooded places of the steep north slope down to San Francisquito Creek, in June and July.

Family Ranunculaceae

Actaea spicata var. arguta Torr. Baneberry.

This was not collected at the time of flowering, but the immature fruits were found in June in a shady place at the south end of the lake, which earlier in the year had been almost inaccessible because of the overflow of water from creek and lake.

Aquilegia truncata F. & M.

Rather infrequent in moist shady places, especially on steep north slopes in April and May.

Delphinium decorum F. & M.

Frequent in one place on an openly wooded slope close to the lake, in April.

Delphinium californicum T. & G. Coast Larkspur.

Abundant near the edge of the chaparral near the lake, and on dry, openly-brushy hillsides in May and June.

Delphinium variegatum T. & G. Royal Larkspur.

Infrequent, found at the edge of the meadow in the strip of serpentine in May.

Delphinium hesperium Gray. Western Larkspur.

From frequent to abundant on dry hillsides (not in serpentine) in May.

Thalictrum polycarpum Wats.

Abundant in ravines near the lake, and near the chaparral growing there, beginning to flower in late March, and flowering abundantly in April.

Ranunculus californicus Benth. California Buttercup.

Very abundant on open hills and openly wooded hills, and meadows, including that in the serpentine. Found from February until April.

Ranunculus muricatus L.

Rare (two specimens found), growing in moist shady places near the banks of San Francisquito Creek, in May.

Clematis ligusticifolia Nutt. Yerba de Chivato.

Climbing over poison oak shrub, on bank of San Francisquito Creek. Rather rare, flowering from July to September.

Clematis lasiantha Nutt. Pipe-Stem.

Very abundant, climbing over the shrubs of the chaparral, and whitening large areas when it is blooming in March and April.

Family Berberideaceae

Berberis pinnata Lag. California Barberry.

This was not collected while it was in anthesis, but it was found budded in February. It was infrequent on a rather openly wooded part of the slope down to San Francisco Creek.

Family Lauraceae

Umbellularia californica Nutt. California Laurel.

Frequent on stream banks, and on north slopes, flowering in February and March.

Family Papaveraceae

Eschscholtzia californica Cham. California Poppy.

Comparatively infrequent on the ridge. Found in open fields and in the meadow in the strip of serpentine from February until May.

Family Cruciferae

Sisymbrium officinale (L.) Scop. Hedge Mustard.

Weed found rather infrequently on the ridge, mainly along the road, in April and May.

Raphanus sativus L. Wild Radish.

Frequent in open fields, especially along roads or near the lake, blooming to some extent nearly throughout the year. It was collected first in January, and last in November.

Brassica campestris L. "Common Yellow Mustard."

Frequent in open fields and along roads, from Jan-

uary until May.

Brassica nigra (L.) Koch. Black Mustard.

Infrequent on the ridge, found mainly close to the lake. April and May.

Radicula nasturtium-aquaticum (L.) Britt & Rendle.

Water Cress.

Found very abundantly in one place only, in ground kept moist by overflow of watering trough in openly wooded place in late May and June.

Cardamine oligosperma Nutt.

Abundant on openly wooded slopes, flowering in February and March.

Dentaria integrifolia var. californica Jepson. Milk Maids.

Abundant on steep north slopes and near the banks of streams, especially where it is densely wooded. January until May, most abundant about the end of February.

Tropidocarpum gracile Hook.

Frequent on open hillsides, especially near the edge of areas of chaparral. May.

Lepidium nitidum Nutt. Common Pepper-grass.

Frequent on open hillsides, and in the meadow in the serpentine, in March and April.

Capsella bursa-pastoris (L.) Moench. Shepherd's Furse.

Frequent in open grassy fields, and along roads, from February until April.

Athysanus pusillus (Hook.) Greene.

Infrequent on open hillside in March and April.

Thysanocarpus curvipes Hook. Fringe-pod.

Abundant in several places on openly wooded hillsides, especially near the lake. March to May.

Thysanocarpus curvipes var. elegans Rob. Lace-pod.

Frequent on openly wooded hillside, mostly not found in the same place as the species, however. March and April.

Family Crassulaceae

Tillaea erecta H. & A.

Frequent in some of the dryer and more open places in the chaparral, and in the meadow in the strip of serpentine, especially close to the chaparral. March to May.

Family Saxifragaceae

Saxifraga virginiana var. californica Jepson.

Frequent on openly wooded slopes throughout the ridge. It was found flowering from February until late April.

Lithophragma affinis Gray. Woodland Star.

Frequent on openly wooded slopes, and less frequently/^{found} on open grassy hillsides throughout the ridge. March until early May.

Heuchera micrantha Dougl.

Frequent on the banks of San Francisquito Creek, growing especially at about the level the water had reached

earlier in the year. May and June.

Whipplea modesta Torr.

Frequent on the banks of the San Francisquito Creek, found from late March (at which time it was just above the level of the water in the creek) until June.

Ribes malvaceum Sm.

Frequent to abundant in the chaparral, especially that near the lake, and less frequent on openly wooded slopes. It starts to bloom soon after the first rains; so it was already nearly at the height of its flowering season at the time that this study was started, at the end of December. One plant was found still flowering in April.

Ribes californicum H. & A. Hillside Gooseberry.

Abundant on the more openly wooded slopes throughout the ridge. It was first found flowering on the shady bank of San Francisquito Creek in January, but from then until the end of its flowering season in late March, it was more abundant at the edges of the chaparral and on openly wooded hillsides.

Ribes menziesii var. leptosmun Jepson.

Rare (three bushes found) on the banks of San Francisquito Creek, flowering in late March and April.

Family Rosaceae

Physocarpus capitatus (Pursh.) Etze. Ninebark.

Frequent on stream banks or steep shady slopes.

It was found flowering in late April and May.

Holodiscus discolor (Pursh.) Maxim. Cream Bush.

This grows mainly on steep north slopes or near streams, although by the time it flowers, in June, most of the streams are dry. It is fairly frequent.

Rubus parviflorus Nutt. Thimble-berry.

The flowers of this plant were collected in early April in 1954, but were overlooked this year. Some of the bushes were observed in August, growing close to the edge of San Francisquito Creek.

Rubus vitifolius C. & S. California Blackberry.

Growing in moist places on wooded slopes or near streams, flowering from April to June, and the berries ripening in July. Frequent.

Fragaria californica C. & S. Wood Strawberry.

Infrequent, found in February and March in rather dense shade near the creek.

Potentilla glandulosa Lindl.

Frequent on more or less openly wooded slopes in May and June.

Rosa californica C. & S. California Wild Rose.

Abundant in openly wooded places, mostly near creeks, and in several places forming small thickets, flowering from late May until November.

Rosa spithamea Wats. Ground Rose.

Abundant in one place only on the ridge--on the openly wooded slope at the top of the hill near the lake. May.

Rosa gymnocarpa Nutt. Wood Rose.

Frequent in shady woods near the streams, flowering in May and June.

Cercocarpus betuloides Nutt. Hard Tack.

A frequent shrub of the chaparral, found blooming from late March until May. There seems to be more of it in the area of chaparral closest to the lake than anywhere else.

Adenostoma fasciculatum H. & A. Chamise.

The most abundant shrub of the chaparral, being practically the index plant of this type of vegetation. It blooms in May and June.

Osmaronia cerasiformis (T. & G.) Greene. Oso Berry.

Frequent at the edge of the chaparral near the lake, especially on a north slope there. It was first found in anthesis on a shady north slope in February, and was more abundant on the more open slope near the chaparral in March. The fruit ripened in June.

Prunus ilicifolia Walp. Holly-leaf Cherry.

Frequent in the chaparral and on shady slopes near the lake, flowering in May. The "cherries" ripen in September.

Photinia arbutifolia Lindl. Christmas Berry; Toyon.

Frequent shrub, nearly throughout the ridge, especially in chaparral, and on openly wooded slopes. It flowers in June and July, and the berries start turning red in October.

Family Leguminosae

Lupinus densiflorus Benth.

Frequent on grassy hillside in ravine, flowering in April and May. Not found elsewhere on the ridge.

Lupinus succulentus Dougl.

Rare (only one plant found), growing on grassy hillside near Portola, in March.

Lupinus nanus Dougl.

The most abundant lupine on the ridge, growing on grassy hills, in all parts of the ridge, but nowhere really abundant. March and April.

Lupinus bicolor var. microphyllus C. P. Sm.

Infrequent, growing on an open grassy slope near the lake, and flowering in April.

Lupinus formosus Greene

Infrequent (one collected), on roadside by orchard at Portola, in June.

Medicago sativa L. Alfalfa.

Very infrequent on the ridge, being found in one or two places along the road bordering it, in May and June.

Medicago hispida Gaertn. Eur Clover.

Abundant on the parts of the ridge near "civilization" --near the road, on moist grassy hillsides, and near the lake. Found from March until May.

Melilotus indica All. Yellow Melilot.

Rather infrequent on the ridge, being found only in several places along the road, and near the lake, in May and June.

Trifolium fucatum var. flavulum Jepson.

Infrequent, found only in the meadow in the strip of serpentine in April and May.

Trifolium tridentatum Lindl. Tomcat Clover.

The most abundant and conspicuous clover to be found on the ridge, growing mainly in open fields, and on openly wooded slopes. April and May.

Trifolium variegatum Nutt. White-tip Clover.

Frequent in grassy fields, especially where it is still rather moist in April and early May.

Trifolium barbigerum Torr.

Abundant on the more openly wooded slopes, and also found less frequently in open fields. April and May.

Trifolium microcephalum Pursh.

Abundant on openly wooded, grassy slopes throughout the ridge. April and May.

Trifolium bifidum var. decipiens Greene.

Frequent on open grassy hillsides in April and May.

Trifolium ciliatum Nutt. Tree Clover.

Frequent on open grassy hillsides in April and May.

Trifolium gracilentum T. & G. Pin-point Clover.

Frequent in open fields, and on openly wooded hillsides, in April and May.

Lotus micranthus Benth.

Abundant on grassy hillsides, and on openly wooded slopes throughout the ridge from April until June.

Lotus subpinnatus Lag.

Abundant on grassy hillsides, and found, though not so frequent, in open places in the chaparral. Often found with Lotus micranthus. March to June.

Lotus americanus (Nutt.) Bisch. Spanish Clover.

Very abundant on openly wooded slopes and in open fields, blooming from May to September.

Lotus scoparius (Nutt.) Ottley. Deerweed.

Abundant in open places in the chaparral areas, especially along the road through the chaparral above the lake, flowering from May until November.

Psoralea physodes Dougl. California Tea.

Abundant on wooded slopes, especially the more openly wooded ones throughout the ridge, from April until June.

Glycyrrhiza lepidota (Nutt.) Pursh.

Infrequent in field that was dry, but close to the marshy part of the lake. May and June.

Astragalus nigrescens Nutt.

Frequent but limited to the area in the strip of serpentine, where it is found both in the meadow and in the openly wooded part, in April and May.

Vicia sativa L. Common Vetch.

Frequent in fields bordering the ridge to the south, near Portola. March to June.

Vicia exigua Nutt. California Vetch.

Frequent to abundant on openly wooded hills in April and May.

Vicia americana var. linearis Wats.

Frequent on shady hillsides, especially the more openly wooded ones. March to April.

Lathyrus vestitus Nutt.

Frequent on shady hillsides, the range and the abundance and time of flowering being similar to those of the preceding species.

Family LinaceaeLinum micranthum Gray.

Not collected during this study. There is a specimen in the Herbarium that was collected on Jasper Ridge in 1920, at the edge of the chaparral.

Family GeraniaceaeGeranium dissectum L. Common Geranium.

Frequent in moist shady woods near an old quarry, and

in the moist land at the edge of the lake, in April and May.

Erodium botrys Bertol.

Abundant on open hills, where it blooms almost throughout the year, though most abundantly from March to June.

Erodium circutarium L'Her. Red-stem Filaree.

Range, abundance, and time of anthesis about the same as those of the preceding species. Both are very abundant in pasture lands all over the ridge.

Family Polygalaceae

Polygala californica Nutt.

Infrequent, found growing under the shade of some of the chaparral shrubs growing on a slightly northward slope, in June.

Family Euphorbiaceae

Eremocarpus setigerus Benth. Turkey Mullein.

Abundant, in some places nearly carpeting the ground, in open fields nearly throughout the ridge, including the meadow in the serpentine strip. It flowers from late July until October.

Family Anacardiaceae

Rhus diversiloba T. & G. Poison Oak.

One of the most abundant and luxurious shrubs to be found on the ridge, growing almost everywhere, on thickly

wooded north slopes, on openly wooded slopes; scattered here and there in the fields, and at the edge of the chaparral. In some moist places at the bases of hills it forms dense thickets. It flowers in April and May.

Family Celastraceae

Euonymus occidentalis Nutt. Western Burning Bush.

Frequent along the shady banks of the larger streams (after some of them had dried), flowering in June.

Family Aceraceae

Acer macrophyllum Pursh. Big-leaf Maple.

This was not collected while it was flowering, but a leaf was collected in September. There are several of these trees along the banks of the larger streams.

Acer negundo var. californicum Sarg. Box Elder.

This tree is found frequently along the banks of the larger streams. It flowers in April.

Family Sapindaceae

Aesculus californica (Spach.) Nutt. Buckeye.

Abundant near streams, or mainly on the north slopes of hills, flowering in May and June.

Family Rhamnaceae

Rhamnus californica Esch. Coffee Berry.

Frequent shrub of openly wooded slopes, flowering in May and June, and fruiting in September.

Rhamnus crocea Nutt. Red-berry.

This shrub was overlooked at the time of its flowering, but the berries were collected in August. It is a rather infrequent shrub of the more openly wooded slopes. Ceanothus thyrsiflorus Esch. Blue Blossom; California

Lilac.

Frequent shrub of the transition area between forest and chaparral, and found to some extent in the chaparral near the lake. Found blooming in late March and April.

Ceanothus cuneatus (Hook.) Nutt. Euckbrush.

Abundant shrub of the chaparral regions, and found less frequently on openly wooded slopes mainly near patches of chaparral. Flowers from late January through March.

Family Malvaceae

Malva parviflora L. Cheeseweed.

Infrequent weed of the roadsides and waste places near the lake, flowering from March to September.

Sidalcea malvaeflora Gray. Checker Bloom.

Rather infrequent in open fields, mainly close to the road, in March and April.

Sphaeralcea arcuata (Greene) Arthur.

Infrequent shrub found flowering along the sides of the road through the chaparral above the lake from June to August.

Family Cistaceae

Helianthemum scoparium var. vulgare Jepson. Rush-Rose.

Frequent in chaparral areas, blooming in May and June. One flower was found as late as October.

Family Cucurbitaceae

Echinocystis fabacea Naud. Common Man-Root; Wild Cucumber.

Frequent almost throughout the ridge, spreading over the ground on moist shady slopes, or growing over the chaparral shrubs. Found flowering from February until April.

Family Thymelaeaceae

Dirca occidentalis Gray. Western Leatherwood.

Abundant on shady north slopes, especially close to one or another of the streams, blooming from January through March.

Family Onagraceae

Epilobium paniculatum Nutt.

Frequent along sides of road through chaparral above lake, in July and August.

Epilobium watsonii var. franciscanum Jepson.

Infrequent on moist ground near the lake. Found in May, and again in August.

Clarkia elegans Dougl.

Abundant in one place only--an openly wooded slope near the road, in June.

Godetia amoena (Lehm.) Lilja. Farewell to Spring.

Abundant on dry hills, both open and openly wooded, from June until August.

Godetia viminea Spach.

In several places very abundant on dry open hillsides, in May and early June.

Godetia quadrivulnera (Dougl.) Spach.

Common on openly wooded hillsides in May and June.

Cenothera ovata Nutt. Golden Eggs.

Frequent in meadows, including the one in the strip of serpentine, and on open hillsides, in February and March.

Family Umbelliferae

Eryngium jepsonii C. & R. Button-Thistle.

Rare (one found) in field on the summit of the ridge in late July.

Sanicula menziesii H. & A. Gamble Weed.

Frequent on moist or shady slopes, found from March until May.

Sanicula bipinnatifida Dougl. Purple Sanicle.

Frequent on open, grassy hillsides and meadows throughout the ridge, including the meadow in the strip of serpentine.

Sanicula laciniata H. & A. Coast Sanicle.

Comparatively infrequent, growing along the sides of a road cut through the chaparral. February to April.

Anthriscus vulgaris (L.) Pers. Bur Chervil.

Abundant on openly wooded, moist hillsides, in April and May.

Conium maculatum L. Poison Hemlock.

Frequent to abundant in shady, moist places throughout the ridge, especially near the lake, overflows of watering troughs, or streams. Found from April until August.

Carum kelloggii Gray.

Infrequent, found on dry open hillsides in July and August.

Velaea kelloggii (Gray) C. & R.

Infrequent, growing on an openly wooded slope, and flowering in March and April.

Heracleum lanatum Michx. Cow Parsnip.

Infrequent, growing occasionally along the sides of the creeks, flowering in April and May.

Lomatium utriculatum (T. & G.) C. & R.

Frequent on grassy slopes, and more or less wooded slopes, from March until May.

Lomatium dasycarpum (T. & G.) C. & R.

Very abundant in the meadow in the strip of serpentine, and on open slopes, from March until June.

Family Cornaceae

Cornus californica C. A. Mey. Creek Dogwood.

Rare (one shrub found) on the bank of the San Francisco Creek in May.

Cornus glabrata Benth.

Frequent in comparatively moist places--near watering trough and at marshy part of lake--flowering in May and June.

Family Ericaceae

Arbutus menziesii Pursh. Madrono.

Rather infrequent, growing mainly on north slopes, flowering in March, and the fruit ripening in September and October.

Arctostaphylos tomentosa (Pursh.) Lindl.

(More correctly, Arctostaphylos crustacea Eastw.)

Frequent in the chaparral formations, growing there mainly on the gentle northward slopes, flowering from January until March.

Family Primulaceae

Dodecatheon hendersonii Gray. Mosquito Bills; Sailor Caps.

Abundant on openly wooded and grassy slopes throughout the ridge, flowering from February until April.

Trientalis europaea var. latifolia Torr. Star-flower.

From frequent to abundant on shady north slopes or stream banks, in April and May.

Anagallis arvensis L. Poor Man's Weather-glass.

Frequent in open fields or along roads, blooming to

some extent almost all year, but especially from March to April. It was found on the first field trip, in December, and again in October.

Family Gentianaceae

Microcala quadrangularis (Lam.) Griseb.

Abundant in openly wooded area near the base of the ridge on the south-east side, and also found at the edge of the meadow in the serpentine, in May.

Centaureum exaltatum var. davyi Jepson.

Frequent on openly wooded slopes, often found with the preceding species, but somewhat more widely distributed. May.

Family Convolvulaceae

Convolvulus occidentalis var. cyclostegius Jepson.

Infrequent, growing over shrubs in chaparral near the lake. First collected in June.

Convolvulus luteolus Gray.

Infrequent, growing over shrubs at the edges of the chaparral near the lake. April and May.

Convolvulus arvensis L. Bindweed; Orchard Morning-glory.

Frequent, especially along the borders of the ridge, in cultivated lands, or near the lake. From May to October.

Family Polemoniaceae

Phlox gracilis (Hook.) Greene.

Infrequent on openly wooded hillside, found in April.

Navarretia heterodoxa (Gray) Greene.

Abundant at the edges of the chaparral almost all over the ridge. June and July.

Gilia multicaulis Benth.

Infrequent, growing on open slope just above the lake, and at the edge of the wooded slope. April.

Gilia peduncularis Eastw.

Infrequent on rocky outcrop of serpentine at the edge of a patch of chaparral. Collected only once, and at that one place, in May.

Linanthus androsaceus (Benth.) Greene.

Infrequent at the edge of the lake in April, and much more frequent on openly wooded slopes in May.

Linanthus parviflorus (Benth.) Greene.

Very abundant in the meadow in the strip of serpentine, and in open places on hillsides from March until May. The color variations were mainly pink and white, with occasionally a yellow flower. There was more of a tendency to find patches of pink and patches of white flowers than to find the two colors growing together.

Linanthus bicolor (Nutt.) Greene.

Frequent in the more open spots in openly wooded hills, generally blooming a little later than Linanthus parviflorus, but the time overlapping. Found in May.

Family Hydrophyllaceae

Nemophila aurita Lindl. Fiesta Flower; Climbing Nemophila.

These flowers were found growing at the base of a large rock, in a moist and shady place, and they were not collected anywhere else on the ridge. April.

Nemophila menziesii var. atomaria Chandler. Pale Baby Blue-eyes.

Abundant on moist grassy hillsides, from March until May.

Nemophila heterophylla F. & K. Small White Nemophila.

Frequent on wooded slopes and shady stream banks throughout the ridge. March and April.

Phacelia californica var. imbricata Jepson.

Frequent on dry rocky hillsides in May and June.

Eriodictyon californicum (H. & A.) Greene. Yerba Santa; Mountain Balm.

Frequent shrub of the chaparral, being found especially near the edges or along the roads through the chaparral. It flowers from April to June.

Family Boraginaceae

Heliotropium curassavicum L. Chinese Pusley.

Only one plant was found--spreading along the side of the road very close to the lake. August and September.

Cynoglossum grande Dougl. Western Hound's Tongue.

From frequent to abundant on openly wooded hillsides and shady stream banks. It was flowering from February until April.

Pectocarya pencillata (H. & A.) A. DC.

This species was not collected during this study, but in the Dudley Herbarium there is a specimen which was collected in 1911. The location is just given as "Jasper Ridge."

Ansinckia douglasiana DC. Buckthorn Weed.

Frequent in open fields, especially those at the edges of the ridge. March and April.

Cryptantha flaccida (Dougl.) Greene.

Frequent near rocky outcrop of serpentine, in April and May.

Cryptantha leiocarpa (F. & M.) Greene.

Frequent in the more open places in the chaparral; collected in April.

Plagiobothrys nothofulvus Gray.

Abundant on open hillsides in March and April.

Family Verbenaceae

Verbena prostrata R. Br. Common Vervain.

Frequent in open places near San Francisquito Creek and the lake. May to September.

Family Labiatae

Scutellaria tuberosa Benth. Blue Skull-cap.

Frequent in openly wooded places on slopes, often found growing with Mimulus douglasii, but with a wider range and a longer time of flowering--March to May.

Marrubium vulgare L. - Common Horehound.

Infrequent on the ridge, a few plants being found near a dirt road at the side of an orchard at Portola in June.

Micromeria chamissonis (Benth.) Greene. Yerba Buena.

Abundant in shady woods, especially near streams. Blooms in May and June.

Sphacele calycina Benth.

Frequent shrub of the chaparral and of the transition areas between chaparral and forest, blooming in April and May. One flower was found on the first field trip, in December, but it was not observed to be blooming at any other time outside the range given.

Stachys californica Benth.

Frequent only in the very shady woods near streams, where it flowers from May to July.

Stachys albens Gray.

Infrequent, being found in only one place on the ridge--an open field kept somewhat moist by the nearby overflow of a watering trough. June.

Stachys pycnantha Benth.

Rare, found at the edge of the lake in September.

Stachys bullata Benth.

Abundant on openly wooded slopes in April and May. The most abundant and widely distributed of the mints on the ridge.

Monardella villosa Benth. Coyote Mint.

Abundant on dry open slopes, and openly wooded hillsides from May until August.

Mentha arvensis L. Tule-Mint.

Frequent in moist places--near the overflow from the watering trough, and at the edge of the lake (not found elsewhere). July to September.

Family Solanaceae

Solanum umbelliferum Esch. Blue Witch.

Frequent to abundant in chaparral, especially at the edge or along roads through it; in the transition areas between chaparral and forest; and on openly wooded slopes. The main season of flowering seems to be from February until June, but it was found flowering on the first field trip in December, and again the next November, in the chaparral, even though at these times there were no leaves left on the plants.

Family Scrophulariaceae

Antirrhinum vagans Gray.

Rare, growing at the edge of the shady area at the margin of the lake. Three specimens found, in June and July.

Linaria canadensis Dum. Toad Flax.

Rather infrequent in sandy soil on dry hillside near chaparral, flowering in April and early May.

Collinsia bicolor Benth. Chinese Houses.

Abundant locally throughout the ridge on moist open stream banks, and open places near woods, in April and May.

Collinsia sparsiflora F. & M.

Common in one place on the ridge--steep, moist, open hillside above San Francisquito Creek in late March and April. Not found anywhere else.

Scrophularia californica Cham. California Bee Plant.

First found along road through chaparral above lake in March; then abundant on moist slopes and near streams and lake until June.

Diplacus aurantiacus Jepson. Bush Monkey-flower.

Common at the edge of the chaparral, and on dry, openly wooded hillsides, flowering from March until July.

Mimulus douglasii Gray.

Infrequent in the serpentine of the meadow in March, when the meadow was still very wet.

Mimulus guttatus DC. Common Monkey-flower.

Common in moist open places in rich soil along streams, from April to June.

Castilleja parviflora var. douglasii Jepson. Indian Paint Brush.

Openly wooded hillsides throughout the ridge, from March until June. Frequent.

Castilleja foliolosa H. & A. Woolly Painted Cup.

Frequent on dry hillsides, especially in exposed or rocky places, and at the edge of the chaparral. Although the time of blooming of this and the preceding species are approximately the same (this being just a little later) the locations in which they grow do not overlap.

Orthocarpus faucibarbatus Gray.

Abundant in one place on the moist soil of the meadow in the strip of serpentine, in late April and May. There are color variations passing from white, through pinkish-white, to yellow, with the yellow predominant.

Orthocarpus attenuatus Gray. Valley Tassels.

Frequent on grassy hillsides in April and May, but infrequent in the fields on the strip of serpentine.

Orthocarpus densiflorus Benth. Owl's Clover.

Very abundant on grassy hillsides and meadows all over the ridge, including the meadow in the strip of serpentine, often coloring large areas in April and early May. Found from March through May.

Orthocarpus purpurascens Benth. Escobita.

Abundant in April and May, often being found with Orthocarpus densiflorus in large numbers.

Cordylanthus pilosus Gray.

Frequent on openly wooded slopes and open fields in August and September.

Bellardia trixago (L.) All.

Rare, only two specimens found, in level field near road in May.

Pedicularis densiflora Benth. Indian Warrior.

Very abundant on wooded hills in the early spring. Found from January through March. In some places it colors fairly large areas on the hills in February.

Family CrobachaceaeCrobanche fasciculata Nutt.

Infrequent on dry open hillside in May. About four specimens found, parasitic on Eriogonum.

Family PlantaginaceaePlantago lanceolata L. Ribwort; English Plantain.

Infrequent along roadsides, and on open hillsides in April and May.

Plantago erecta Morris.

Very abundant in the serpentine of the meadow, and on open spots in the wooded hills, from March until May.

Family RubiaceaeGalium aparine L. Goose Grass.

Common on shady and grassy slopes, often forming mats in fairly moist places. March and April.

Galium trifidum L. Croup-weed.

Frequent in shady woods in May.

Galium nuttallii Gray.

Common, growing mainly on shrubs in the chaparral formation, flowering from February until April.

Family Caprifoliaceae

Sambucus glauca Nutt. Blue Elderberry.

A common shrub or small tree of the transition area; found mainly at the edge of the chaparral and forest, as well as along stream banks. Flowers from late April until August, and the berries begin to ripen in July, so that there are often both flowers and ripe berries upon the shrub at the same time.

Symphoricarpos albus (L.) Blake. Snow Berry.

Common shrub of densely and openly wooded slopes, flowering in May and June, and the berries ripening in September.

Lonicera involucrata var. ledebourii Jepson.

Rare, two shrubs on the bank of San Francisquito Creek, flowering in late April and May.

Lonicera hispidula var. californica Jepson. California Honeysuckle.

Frequent in openly wooded places and near streams. It flowers in June and July, and the berries turn scarlet in August.

Family Dipsaceae

Dipsacus fullonum L. Fuller's Teasel.

Frequent in one or two places near "civilization," near a farm, and along a road; found in anthesis in June.

Family ValerianaceaePlectritis macrocera T. & G.

Abundant in open fields and on openly wooded slopes; especially close to the lake, in April.

Plectritis ciliosa Jepson.

Frequent in openly wooded area in April. It is not so abundant as, and the range is more limited than that of the preceding species.

Family CampanulaceaeSpecularia biflora (R. & P.) Gray.

Infrequent, found in one place only--open spot between chaparral and wooded slope at top of hill above lake, in May.

Family CompositaeTribe CichorieaeMicroseris douglasii Gray.

Frequent on grassy slopes, especially near disturbed areas, in April and May.

Picris echinoides L. Bristly Ox-tongue.

Frequent in disturbed areas, July to September.

Rafinesquia californica Nutt.

Infrequent on openly wooded slopes. First found in June.

Hypochoeris glabra L. Smooth Cat's-ear.

Abundant in fields and openly wooded slopes. First found in April, in disturbed area.

Stephanomeria virgata Benth.

Frequent along the road through the chaparral above the lake, from June to August.

Sonchus oleraceus L. Common Sow-thistle; Hare's Lettuce.

Frequent along roadsides, at the edge of the lake, and on shady slopes. It blooms to some extent almost all through the year--it was found on the first field trip, in December.

Sonchus asper L. Prickly Sow-thistle.

Similar to the above species in comparative abundance, places in which it grows, and in the tendency to flower to some extent almost all through the year. It was first collected in May, but had been blooming for some time before it was collected.

Agoseris grandiflora (Nutt.) Greene.

Frequent on openly wooded slopes, or open places near creek beds, in May and June.

Hieracium albiflorum Hook.

Frequent at the side of the road through the chaparral above the lake, in June and July.

Tribe AsteraeGrindelia robusta var. davyi Jepson.

Infrequent, only one plant being collected, at the edge of the lake in August.

Grindelia rubricaulis DC. Red-stem Grindelia.

Frequent on openly wooded hillsides throughout the ridge, in May and June.

Grindelia camporum Greene.

Infrequent. Found growing on dry open hillside in October, but apparently it had already been flowering for several weeks.

Solidago occidentalis Nutt. Western Golden-Rod.

Frequent along the edges of the lake, especially near the road, flowering from August until October.

Solidago californica Nutt. Common Golden-Rod.

Comparatively infrequent, being found only in one place--on an openly wooded slope. July to September.

Lessingia leptoclada var. hololeuca Jepson.

Frequent on open hillsides in September and October, in several places abundant enough to color the hillsides. This plant started to bloom later than any others collected on the ridge during this study.

Aster chilensis Nees. Common Aster.

Frequent on wooded hillsides and roadsides in August and September.

Aster radulinus Gray. Broad-leaf Aster.

Rather infrequent, growing on openly wooded slopes. July and August.

Erigeron philadelphicus L. Skevish.

Rare--only one plant was found, and that was on an

open hillside near the bank of a drying stream in May.

Baccharis pilularis DC. Coyote Brush; Chaparral Broom.

Abundant near the edge of patches of chaparral, on openly wooded hillsides, and along roadsides, occasionally much of it growing together. On the first field-trip, in December, these shrubs were fruiting, and as a result were nearly covered with white pappus. Although a few "left-over" flowers were found then, the main season of flowering was from September until November.

Baccharis douglasii DC.

Frequent in moist open places, mainly close to the lake, and along the roads near the lake. August and September.

Tribe Inuleae

Micropus californicus F. & M.

Abundant on dry hillsides, both open and openly wooded, from March until May.

Psilocarphus tenellus Nutt.

Frequent, although easily overlooked, on openly wooded slopes in May.

Gnaphalium purpureum L. Purple Cudweed.

Frequent on openly wooded slopes from April to June.

Anaphalis margaritacea (L.) B. & H. Pearly Everlasting.

Frequent on open hillsides, openly wooded hillsides, and at the edge of the chaparral, from April until August.

Tribe HeliantheaeWyethia angustifolia Nutt.

Frequent in open fields, including the meadow in the strip of serpentine. April and May.

Helianthella californica Gray.

Infrequent, on openly wooded slopes, flowering in April and May.

Tribe MadieaeHemizonia congesta var. luzulaefolia Jepson. Hayfield Tarweed.

Very abundant in open fields from June to November. It was especially abundant in the meadow in the serpentine, and in the more or less cultivated soils to the east of the ridge.

Hemizonia corymbosa (DC.) T. & G. Coast Tarweed.

Rather infrequent, on open and openly wooded slopes in May and June.

Calycadenia multiglandulosa DC.

Abundant in the meadow in the serpentine, flowering from May to August.

Madia sativa Molina. Chile Tarweed.

Frequent along roadsides, and at the edge of the lake, from June to August.

Madia dissitiflora (Nutt.) T. & G. Gunweed.

Frequent to abundant on open or openly wooded slopes

throughout the ridge. May and June.

Madia exigua (Sm.) Greene.

Infrequent on openly wooded slopes throughout the ridge. May and June.

Layia platyglossa (F. & M.) Gray. Tidy Tips.

Abundant in the meadow in the strip of serpentine in April and May.

Lagophylla ramosissima Nutt.

Frequent on dry, open hillsides from June to August.

Achrychaena mollis Schauer. Blow-wives.

Frequent on open slopes and fields especially near the edges of the ridge. April and May.

Tribe Ambrosieae

Xanthium canadense Mill. Cockle Bur.

Frequent just at the edge of the water in the lake. August and September.

Tribe Helenieae

Baeria chrysostoma F. & M. Gold-fields.

Very abundant in open fields and on gentle wooded slopes, especially abundant in the meadow in the serpentine. March to May.

Monolopia gracilens Gray.

Abundant in one place--near the edge of the chaparral above the lake. April and May.

Eriophyllum confertiflorum Gray.

Frequent on openly wooded slopes, near the edge of the chaparral, and on dry open slopes, flowering from May to August.

Helenium puberulum DC. Rosilla.

Infrequent. Found in place kept comparatively moist by the overflow of a nearby watering trough. June and July.

Tribe Anthemideae

Anthemis cotula L. Mayweed.

Infrequent on the ridge. Found on grassy slope in the strip of serpentine, and near orchards. May.

Achillea millefolium var. lanulosa Piper. Common Yarrow.

Frequent on openly wooded slopes throughout the ridge in April and May.

Matricaria suaveolens (Pursh.) Buch. Pineapple Weed.

Infrequent, found near the lake, and near buildings or roadsides. April and May.

Artemisia californica Less. California Sagebrush; Old Man.

Very abundant on many of the slopes, in some places associated with the chaparral; in others on openly wooded hillside.

Artemisia vulgaris var. heterophylla Jepson. California Mugwort.

Frequent along shady roadsides and the banks of streams in July.

Tribe SenecionidaeSenecio aronicoides DC.

Infrequent, growing on openly wooded slopes. May and June.

Senecio vulgaris L. Common Groundsel.

Frequent to abundant in moist grassy fields, especially near roadsides and buildings. March and April.

Arnica discoidea Benth.

Rare. One plant was found on an openly wooded slope, and another at the edge of a patch of chaparral, in June.

Tribe CynareaeSilybum marianum Gaertn. Milk Thistle.

Frequent along roadsides. In one place, on a flat near San Francisquito Creek, this thistle is very abundant. It was found flowering in January, but the main time of flowering seems to be from May to August.

Cirsium lanceolatum (L.) Scop. Bull Thistle.

Rather infrequent, found growing on wooded slope near road in June.

Cirsium edule Nutt. Indian Thistle.

Frequent in moist places in May and June. It was collected in a place kept moist by the overflow of a watering trough.

Cirsium occidentale var. venustum Jepson.

Rather infrequent on the dry, more openly wooded

slopes of the ridge. May and June.

Centaurea melitensis L. Napa Thistle; Tocalote.

Very abundant on the dry open slopes of the ridge, flowering in May and June.

Centaurea solstitialis L. Yellow Star Thistle; Barnaby's Thistle.

Rare, only one plant found, and that was along the road to the east of the ridge in August.

Centaurea calcitrapa L. Purple Star Thistle.

Rare; the only plant found was at the side of a road near an orchard, in June.

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