FERNS OF THE TUFA DEPOSITS ON HOT SPRINGS MOUNTAIN, HOT SPRINGS NATIONAL PARK: INVENTORY, STATUS, AND MAINTENANCE

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I. INTRODUCTION

The average person thinks of ferns as plants of delicate, graceful beauty. They bring to mind cool valleys and shaded forests. For these reasons, ferns are familiar plants in the home and garden and they are interesting to most visitors who come to sightsee and explore in the park.

The ferns of the Hot Springs tufa deposits have long attracted the attention of botanists. Among the dozen species of plants mentioned by Lesquereux (1860, pp. 341, 342) as growing in association with the thermal springs were two ferns: The Venus Maidenhair, Adiantum capillus-veneris, and the Alabama Lip Fern, Cheilanthes alabamensis. Harvey (1881) also lists these two species on the tufa deposits at Hot Springs. The subsequent plant lists of Branner and Coville (1891), Moore (1940), Demaree (1943), Smith (1978), and Taylor (1979), all contain these two species. While there are other species of ferns on and about the limestone tufa of Hot Springs National Park, these are the two most characteristic.

In his work entitled Ferns of Hot Springs National Park and Vicinity, Dr. Francis Sculley (1939) listed 26 species of ferns. Today we know of at least 38 species and hybrids growing in and around the park. This number is over 50% of the 74 taxa known to occur in the entire state of Arkansas. Hot Springs National Park possesses a rich assemblage of interesting ferns and fern allies, however, it is the purpose of this report to discuss only those species of ferns which occur on the limestone tufa deposits of Hot Springs Mountain.

II. METHODS & DESCRIPTION OF STUDY AREA

A survey of the ferns found on the limestone tufa deposits of Hot Springs Mountain was made between 8 and 10 June 1981. Locations of populations of pteridophytes observed during this survey are shown in figure 1. The area studied is a west-southwest facing slope and is bounded by the road to the summit of Hot Springs Mountain on the east, by the Hot Springs Rehabilitation Center property and Reserve Avenue on the south, by Central and Fountain Avenues on the west, and by the end of the tufa outcrops on the north. The Grand Promenade divides the study area into a drier, upper slope portion and a more mesic, lower slope portion.

The upper slope area has an open parklike aspect (fig. 2). Overstory trees here include Celtis laevigata, Ulmus americana, Quercus stellata, Juniperus virginiana, and Fraxinus americana. The current appearance of this area is due to loss of many native species because of continued disturbance and the introduction of numerous, aggressive exotic species that out-compete native plants when there is instability.

The more mesic lower slope is highly disturbed and little of the native vegetation remains (fig. 3). Plants in this area are now almost entirely alien weeds and exotic plantings. Probably the most important factor in the destruction of the ecosystem was the capping of the springs which modified the soil moisture relationships and mineral deposition in the area.

While man's activities around the hot springs have greatly altered the plant communities, two species of ferns, Adiantum capillus-veneris and Cheilanthes alabamensis, have managed to survive. These plants were collected from the area nearly 150 years ago by George Engelmann. The presence of these

two ferns in the park is interesting because they exist here as outliers from their nearest population in the Ozark Highlands of northern Arkansas. Both species are calciphiles and are essentially restricted to the limestone rocks of the Ozarks and the limestone tufa at Hot Springs (see figs. 8 and 15).

III. RESULTS AND ANNOTATED CHECKLIST

Six species of ferns were located within the boundaries of the study area. The following is an annotated alphabetical listing of the six species. Arkansas distribution maps are from Taylor (1979). Range statements are after Mickel (1979).

1. Adiantum capillus-veneris L. (fig. 4)

Common name: Venus Maidenhair Fern

Plants of A. capillus-veneris are found on the lower slope portion of the study area and are always associated with the tufa. The largest concentration of mature plants occurs behind the Ozark Bathhouse (fig. 5). Numerous young plants are found on the exposed tufa forming one side of an alleyway just behind the Hale Bathhouse (fig. 6). A few small plants are found in the rock work around the display springs (fig. 7). The Venus Maidenhair Fern is a calciphile and exists here because of the limestone tufa deposits.

STATEWIDE HABITATS: Moist to wet calcareous rock outcrops; principally in the Ozarks but also on the limestone tufa at the base of Hot Springs Mountain, Hot Springs National Park and on rocks near Magnet, Hot Spring Co.

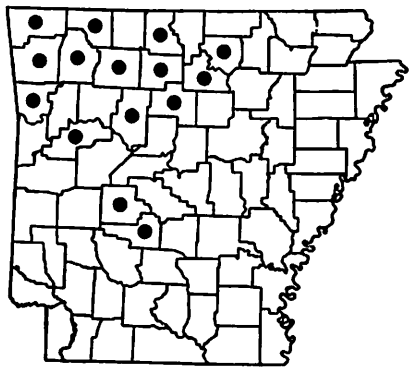

Figure 8. Distribution map of A. capillus-veneris

RANGE: Southern and western North America; widespread in tropical and warm-temperate regions of the world.

2. Asplenium platyneuron (L.) D.C. Eaton (fig. 9)

Common name: Ebony Spleenwort

A. platyneuron is scattered throughout the study area but is more often encountered in the upper slope portion (fig. 10). Plants are usually found in soil pockets on outcrops of Hot Springs sandstone but several plants also occur on De Soto Rock, a breccia.

STATEWIDE HABITATS: Moist to dry, rocky woods, hillsides, ravines, thickets, rock outcrops, stream banks, and roadsides. A. platyneuron is one of the most common and widespread ferns in Arkansas.

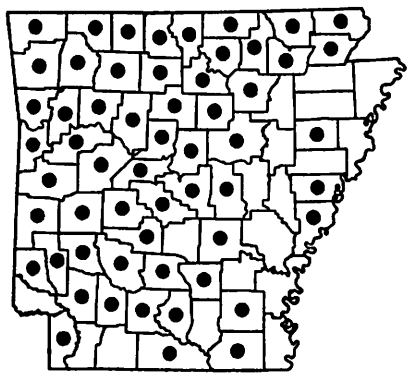

Figure 11. Distribution map of A. platyneuron

RANGE: Eastern and central United States

3. Cheilanthes alabamensis (Buckl.) Kunze (fig. 12)

Common name: Alabama Lip Fern

Plants of C. alabamensis are scattered on the lower slope portion of the study area but are always associated with tufa exposures. Some of the finest specimens of this fern to be found in Arkansas are located on the top edge of a tufa exposure forming one side of an alleyway just behind the Hale Bathhouse (fig. 13). Several plants are also located behind the Superior Bathhouse and just down slope from the intersection of the Tufa Terrace Trail

and the Grand Promenade (fig. 1). A number of smaller plants are scattered over the tufa formed by Dripping Spring (fig. 14). The Alabama Lip Fern is a calciphile and exists here because of the limestone tufa deposits.

STATEWIDE HABITATS: Moist to dry calcareous rock outcrops; principally in the Ozark Highlands but also on the limestone tufa at the base of Hot Springs Mountain, Hot Springs National Park.

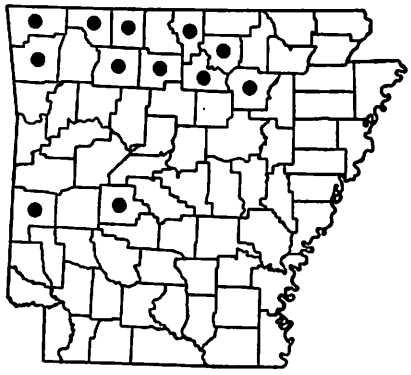

Figure 15. Distribution map of C. alabamensis

RANGE: Southern United States; northern Mexico, Jamaica

4. Pellaea atropurpurea (L.) Link (fig. 16)

Common name: Purple Stem Cliff Brake

Plants of P. atropurpurea are found on both the upper and lower slope segments of the study area. A population of perhaps 100 individuals occurs on tufa rocks along the abandoned carriage road (figs. 17 & 18). Numerous small plants are found with Adiantum capillus-veneris and Cheilanthes alabamensis on the tufa exposure behind the Hale Bathhouse. Additional specimens are found just down slope from the intersection of the Tufa Terrace Trail and the Grand Promenade (fig. 1). The Purple Stem Cliff Brake is a calciphile and exists here because of the limestone tufa deposits.

STATEWIDE HABITATS: Limestone, dolomite, or calcareous sandstone outcrops; most common in the Ozark Highlands.

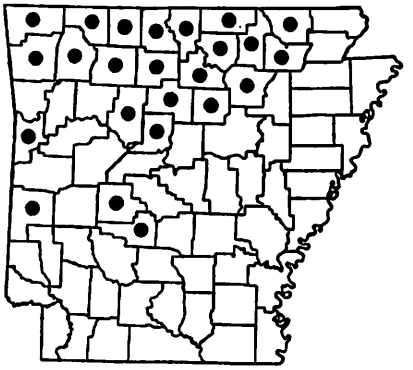

Figure 19. Distribution map of P. atropurpurea

RANGE: Eastern and central United States; south to Guatemala

5. Pteris multifida Lam. (fig. 20)

Common name: Spider Brake

Almost certainly P. multifida, an Asian species, exists here as an escape from cultivation. Plants occur on tufa exposures around the old site of the Arlington Hotel (fig. 21). This species was first noted in the Park by Chandler (1941) and has persisted here for at least 40 years. Several robust, fertile specimens were observed here in 1975, but the current survey located only a few small, sterile plants. This is the only known locality for the Spider Brake in Arkansas and the northwesternmost station for this fern in North America.

STATEWIDE HABITATS: Northwest facing limestone tufa at the base of Hot Springs Mountain, Hot Springs National Park.

Figure 22: Distribution map of P. multifida

RANGE: Southeast Texas to North Carolina; native of Asia

6. Woodsia obtusa (Spreng.) Torr. (fig. 23)

Common name: Blunt-lobed Woodsia.

Plants of W. obtusa are mostly scattered in the upper slope portion of the study area, where they are usually found in soil pockets on the Hot Springs sandstone (fig. 24). The Blunt-lobed Woodsia is one of the most common ferns in Arkansas.

STATEWIDE HABITATS: Well drained soils of woodlands, rock outcrops, along roadsides and fences.

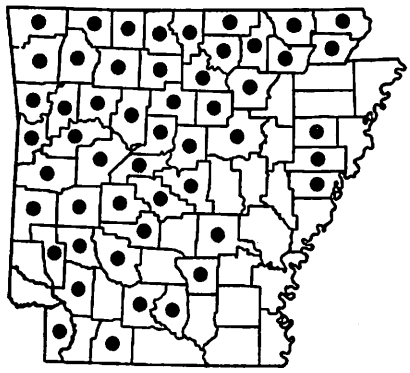

Figure 25: Distribution map of W. obtusa

RANGE: Eastern North America

Of the six species of ferns found in the study area, Cheilanthes alabamensis and Adiantum capillus-veneris are the two most significant species because of their extremely localized occurrence on the limestone tufa. Pellaea atropurpurea is also a calciphile but, in this region, it tolerates a slightly broader range of habitats and, as a result, is more widely distributed. Pteris multifida, although not a native species, is of significant occurrence here for several reasons. First, it exists as an outlier from the metropolis of its range near the coast from southeastern Texas, to North Carolina. Second, this population appears to represent the northwesternmost occurrence of this species in North America. Third, this is the only known naturalized population of Pteris multifida in Arkansas; plants having existed here for at least forty years. Asplenium platyneuron and Woodsia obtusa are both very common and widely distributed ferns of this region.

IV. COMPARISON OF FERNS IN THE STUDY AREA WITH THOSE AT WALNUT GROVE SINK AND AT MAGNET COVE SITES.

A. Walnut Grove Sink, Garland Co. (T1S, R19W, Sect. 20)

No ferns were observed at the Walnut Grove Sink. Two specimens of Asplenium platyneuron were found at an outflow ca. 300 yards southwest of the Sink.

B. Magnet Cove, Hot Spring Co.

No areas comparable to the tufa deposits in the study area were found but two sites that were examined yielded ferns.

1. A calcite quarry (T3S, R7W Sect. 19) contained specimens of Pellaea atropurpurea, Asplenium platyneuron, and Woodsia obtusa.
2. Shale Outcrops along Cove Creek (T3S, R7W, Sect. 17) supported plants of Asplenium platyneuron, Pellaea atropurpurea, Cheilanthes tomentosa (Wooly Lip Fern), Cheilanthes lanosa, (Hairy Lip Fern), and particularly fine specimens of Woodsia obtusa.

V. SUGGESTED MANAGEMENT TO PROTECT THE SIGNIFICANT FERNS ON THE LIMESTONE TUFA

Based on observations made during this study, it appears that there are three critical habitats for ferns in the study area. These three critical areas (shaded areas in figure 1) should receive special attention in order to preserve and protect the remaining plants of Adiantum capillus-veneris, Cheilanthes alabamensis, and Pteris multifida which still exist on certain outcrops of tufa. The tenuous existence and endangered status of these three taxa in the park can hardly be overstated. As can be seen in figure 1, the three critical habitats are located immediately behind and just south of the Hale Bathhouse (now Hot Springs Experience Theater & Galleria) (figs. 26 and 14), along the Tufa Terrace Trail west of or below the Grand Promenade (figs. 27 and 28), and behind the Ozark Bathhouse (fig. 29).

To protect the ferns found in these areas the following management regulations should immediately be instituted.

1. Access and visitation to the areas should be as limited as is possible.
2. Other than limited and carefully supervised removal of aggressive species around the ferns, there should be no disturbance or modification of the limestone tufa outcrops or to the plants on them.
3. Persons who must be in this area for any reason should be fully informed of the value and fragility of these plants. Maintenance personnel who lack sensitivity, understanding, or appreciation should be overseen when in these areas.
4. Herbicides should never be used in or even close to these areas. Ferns in general are quite sensitive to herbicides and one inadvertent application could completely eliminate an entire population of these plants.

VI. RESTORATION AND REESTABLISHMENT SUGGESTIONS

Just as past modifications of Hot Springs Mountain have altered the vegetation, restoration of thermal water to the area will further modify habitats in the vicinity of its flow. Observations on the occurrence of tufa ferns in the study area indicate that Cheilanthes alabamensis, Adiantum pedatum, and Pellaea atropurpurea would be found near the active tufa but not on it. The surrounding less active tufa, moistened by slowly seeping thermal waters or by vapors which have cooled and condensed on the tufa, probably would provide the most suitable habitats for these ferns. Newly created habitats which provide similar substrate and moisture relationships to those found behind the Hale Bathhouse would seem to be ideal habitats for the reestablishment of C. alabamensis, A. pedatum, and P. atropurpurea.

When planned restoration of a part of the thermal water flow is completed, suitable habitats for the species can be identified or created along this flow and spores and sporophytes can be introduced into these habitats. At this time it does not appear necessary to obtain additional plants by germinating spores under artificial conditions or by obtaining transplants from another region of the state.

If it becomes feasible to reestablish plants at other places on the tufa, this would best be done by using spores from plants found in the park. There are two reasons for this. First, mature plants of these species (especially those of Cheilanthes alabamensis and Pellaea atropurpurea) probably would not transplant well. In general, saxicolous pteridophytes are difficult to transplant and losses could be great. On the other hand, plants grown from spores seem to adapt more readily to their surroundings. Second, mature plants,

brought in from distant regions might contaminate the genetic integrity of the Hot Springs populations by inter-breeding with the native plants. While this contamination may not be obvious, future studies by ecologists, taxonomists, or population biologists might be jeopardized as any biologically significant, genetic character of these populations could be lost.

The proper handling of spores to provide transplant material is clearly described by Hoshizaki (1979, pp. 62-70). This work would also serve as a good source for additional information concerning the culturing of ferns. Should it become necessary to move plants in the park, it would be advisable to call in a specialist to direct such a move.

VII. ACKNOWLEDGEMENTS

The author of this report wishes to thank Dr. Delzie Demaree, Dr. James Peck, and Mr. Earl Adams for their assistance during this study. Special thanks are also due to Paul Nelson for the fine line drawings of the ferns.

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IX. PLATES

Figure 1. Map of fern populations observed about the tufa deposits on Hot Springs Mountain

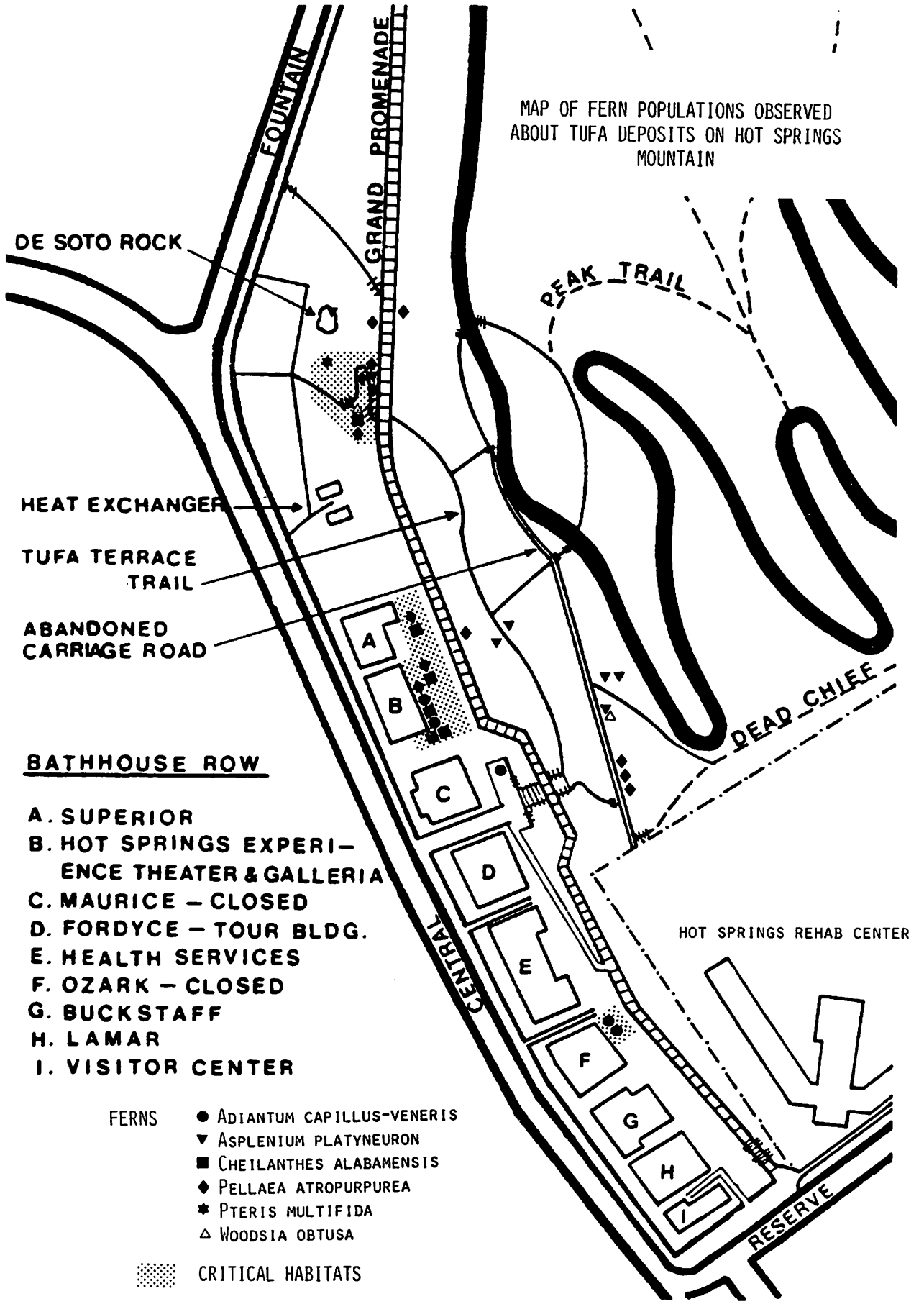

MAP OF FERN POPULATIONS OBSERVED ABOUT TUFA DEPOSITS ON HOT SPRINGS MOUNTAIN
FOUNTAIN
GRAND PROMENADE
DE SOTO ROCK
PEAK TRAIL
HEAT EXCHANGER
TUFA TERRACE TRAIL
ABANDONED CARRIAGE ROAD
DEAD CHIEF
BATHHOUSE ROW
A. SUPERIOR
B. HOT SPRINGS EXPERIENCE THEATER & GALLERIA
C. MAURICE – CLOSED
D. FORDYCE – TOUR BLDG.
E. HEALTH SERVICES
F. OZARK – CLOSED
G. BUCKSTAFF
H. LAMAR
I. VISITOR CENTER
HOT SPRINGS REHAB CENTER
CENTRAL
RESERVE
FERNS
● ADIANTUM CAPILLUS-VENERIS
▼ ASPLENIUM PLATYNEURON
■ CHEILANTHES ALABAMENSIS
◆ PELLAEA ATROPURPUREA
✱ PTERIS MULTIFIDA
△ WOODSIA OBTUSA
CRITICAL HABITATS

Figure 2. Upper slope portion of study area

Figure 2. Upper slope portion of study area

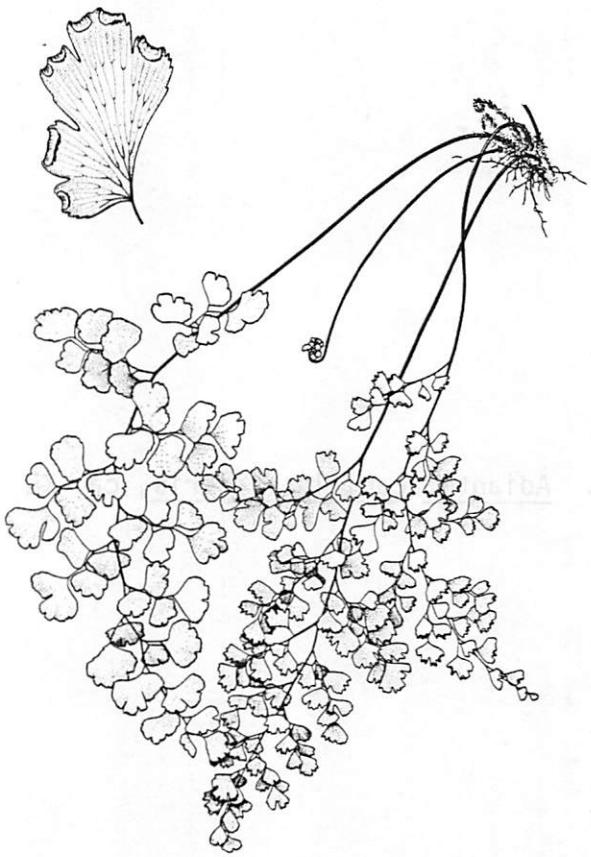
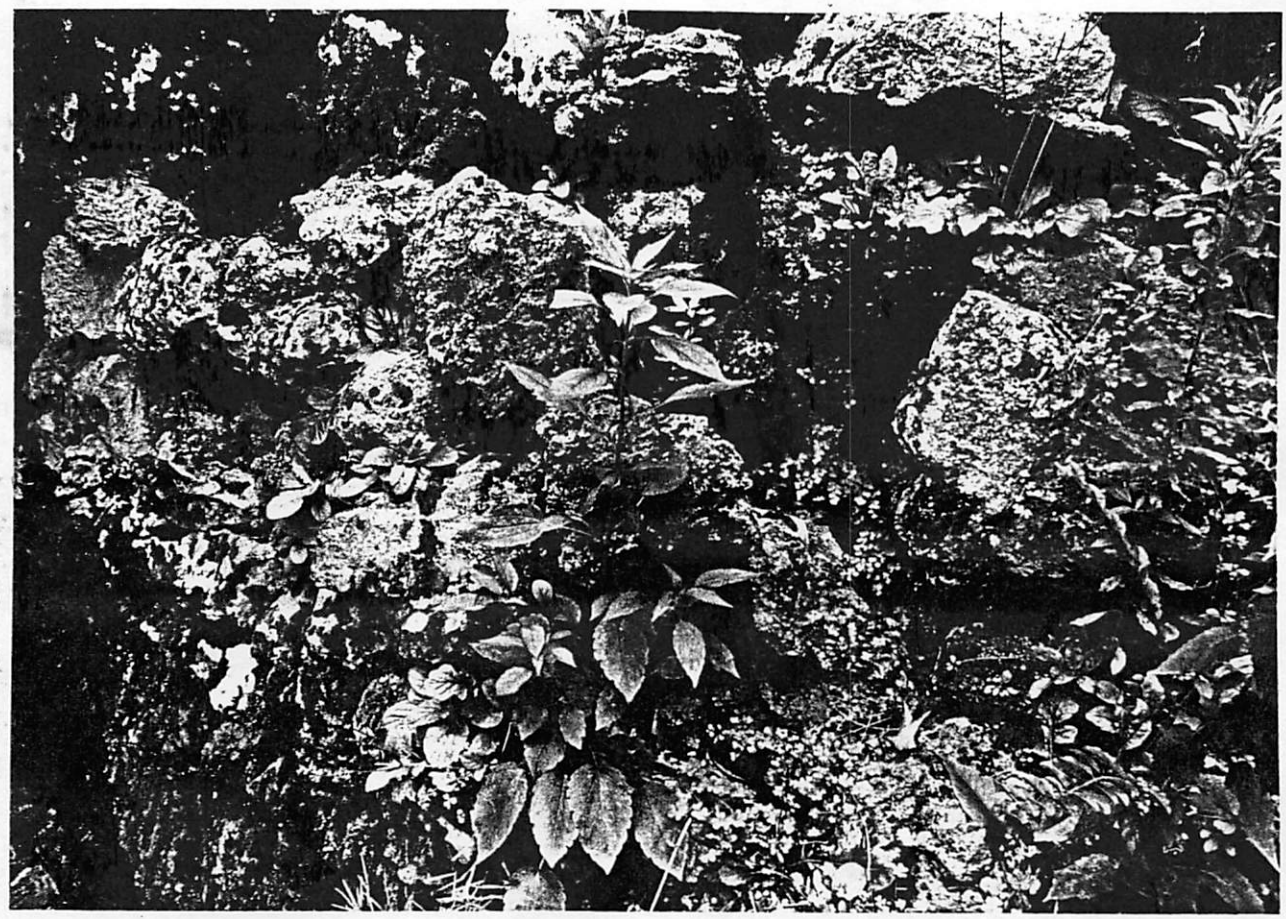


Figure 3. Lower slope portion of study area behind bathhouse row

Figure 4. Adiantum capillus-veneris, ca. X¼

Figure 5. Colony of Adiantum capillus-veneris on tufa behind the Ozark Bathhouse

Figure 6. Colony of Adiantum capillus-veneris on tufa behind the Hale Bathhouse



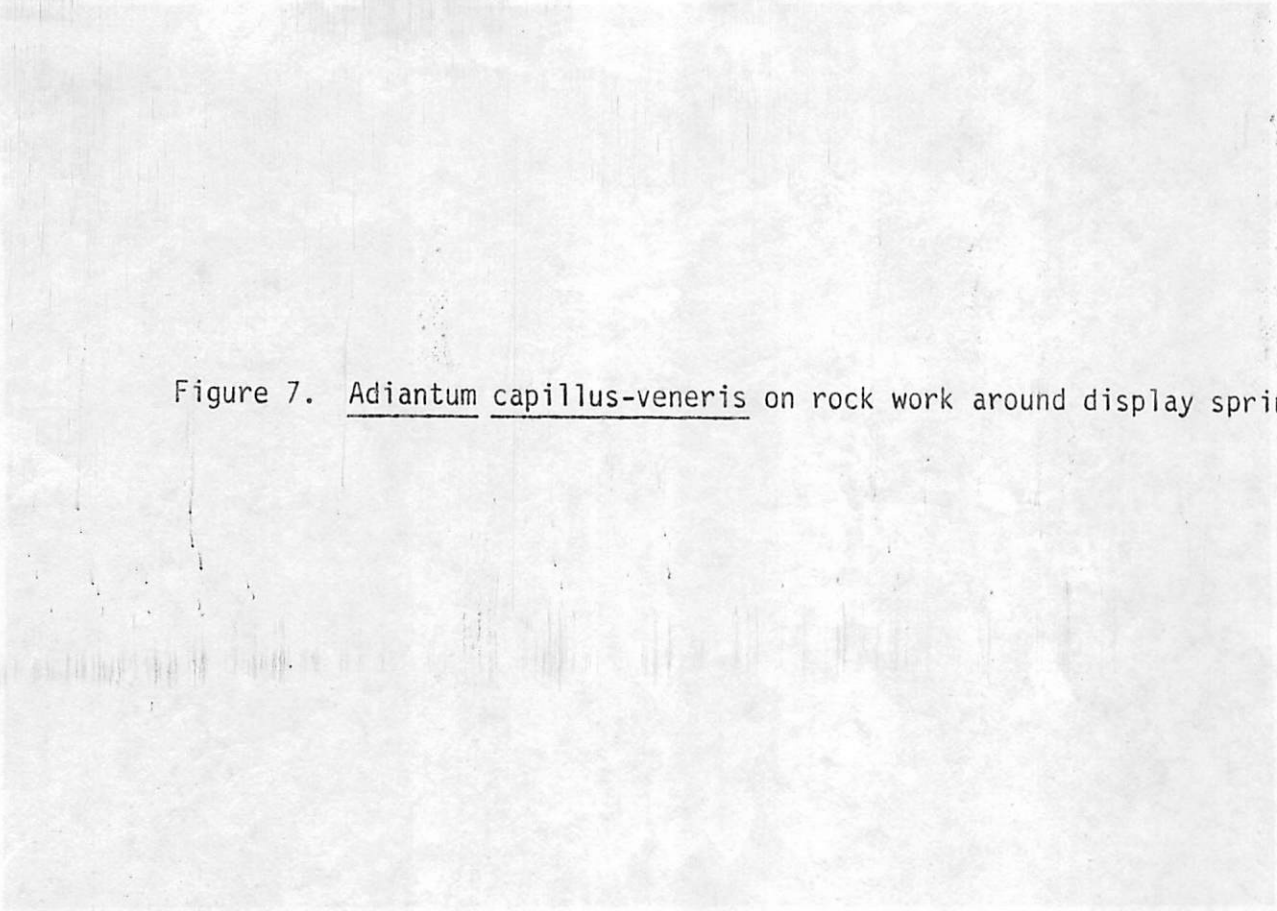


Figure 7. *Adiantum capillus-veneris* on rock work around display springs

Figure 9. *Asplenium platyneuron*, ca. X¼

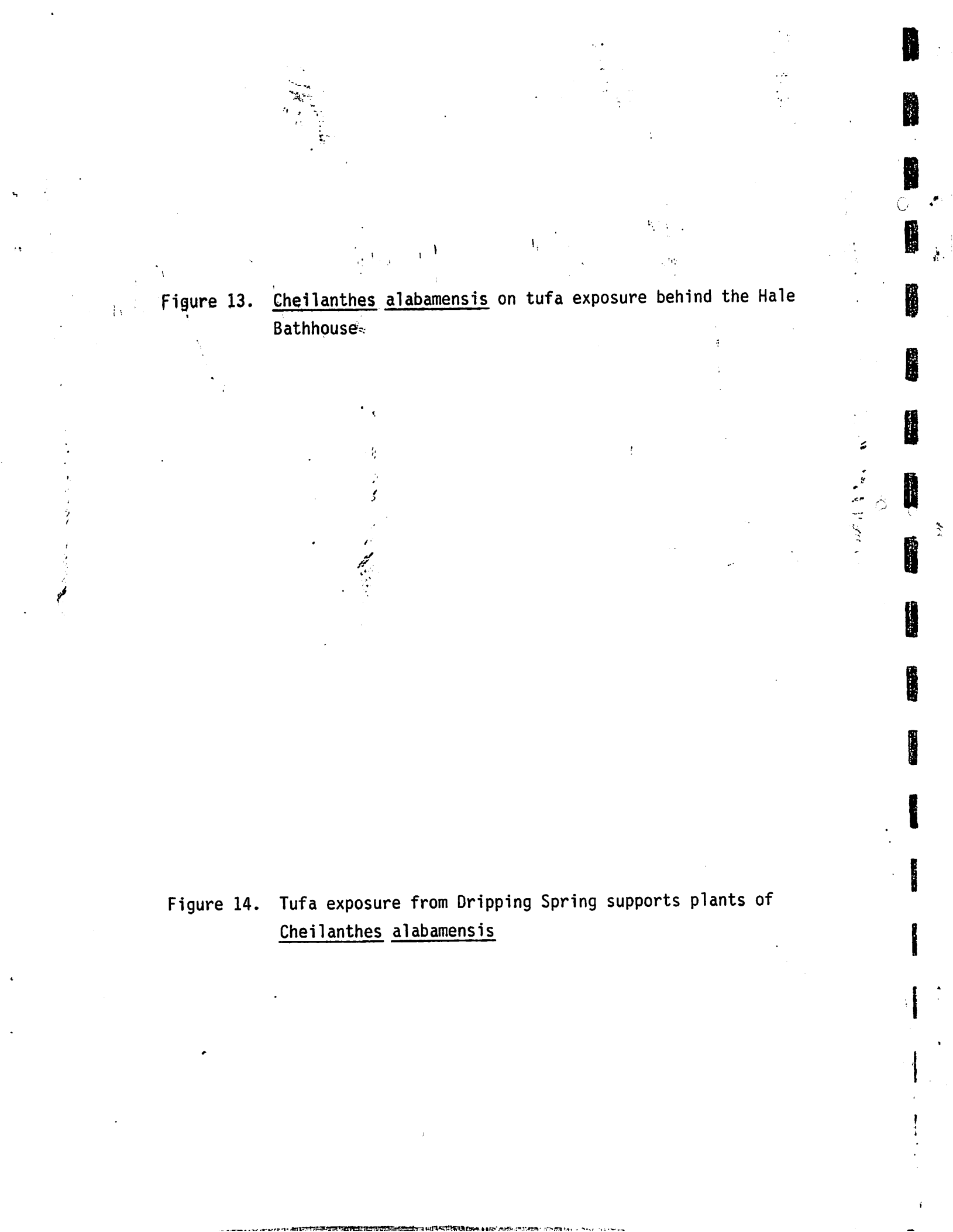
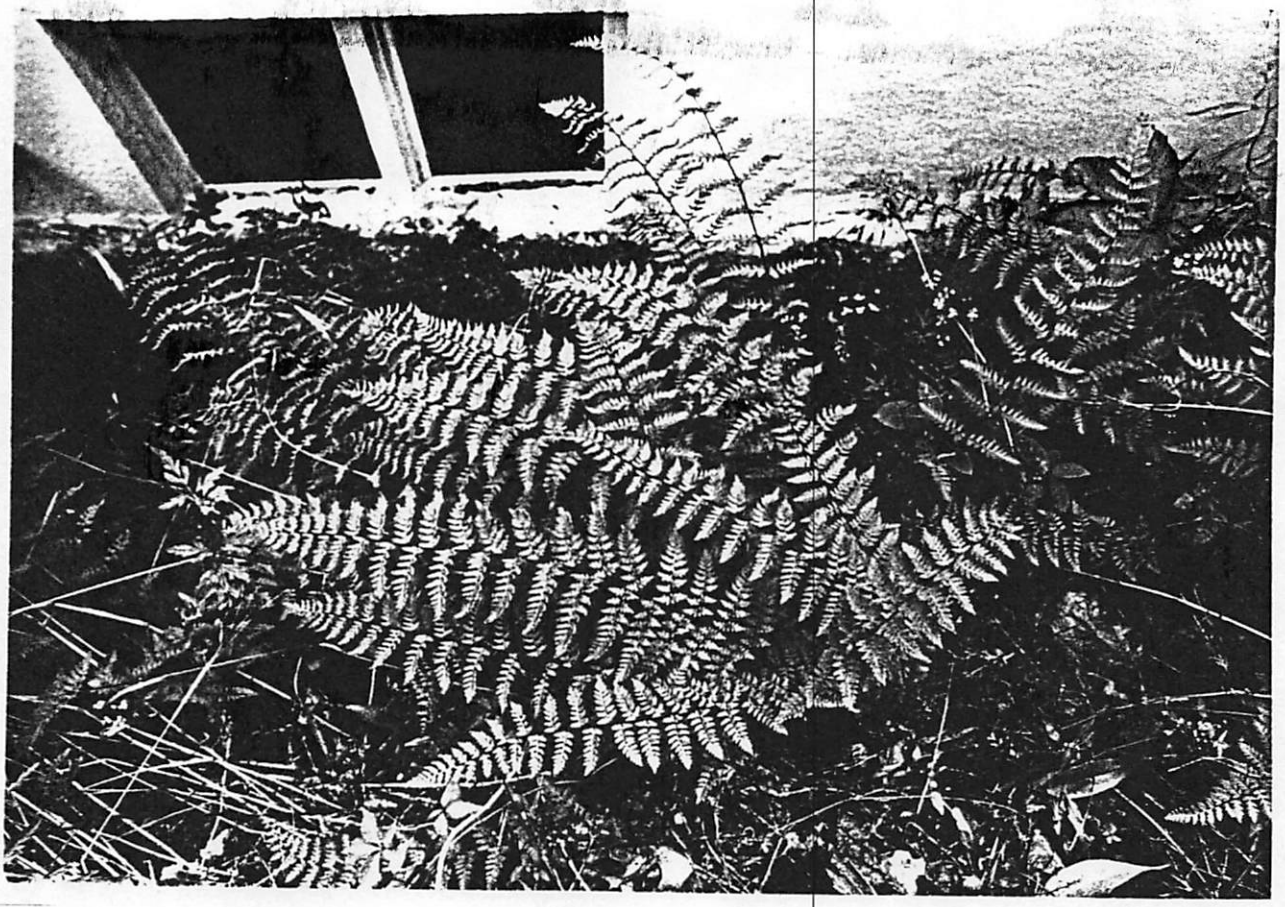


Figure 13. Cheilanthes alabamensis on tufa exposure behind the Hale Bathhouse.

Figure 14. Tufa exposure from Dripping Spring supports plants of Cheilanthes alabamensis



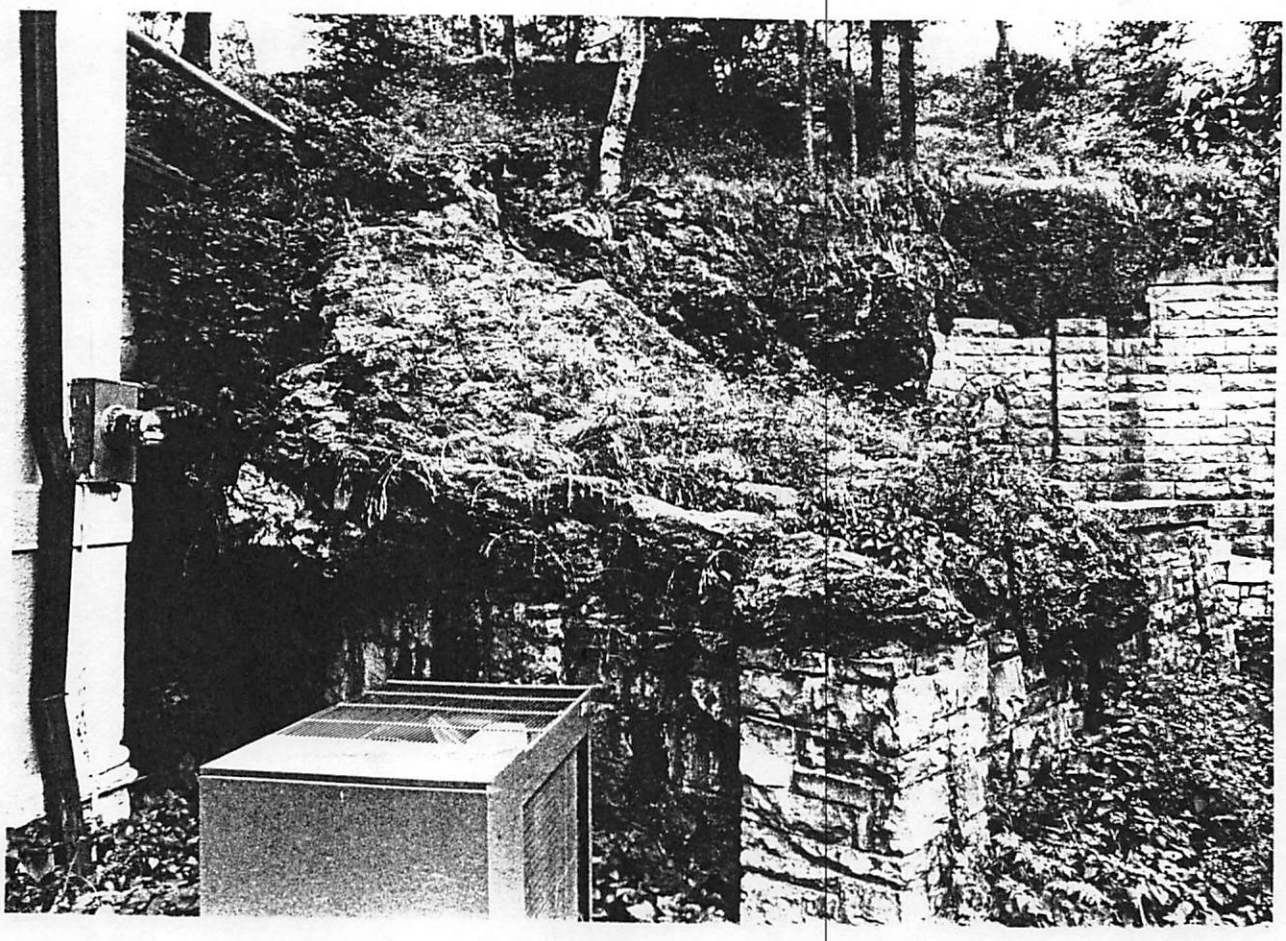


Figure 16. Pellaea atropurpurea, ca. X¼

Figure 17. Tufa rocks along abandoned carriage road support plants of Pellaea atropurpurea

Figure 18. Pellaea atropurpurea on tufa rocks along abandoned carriage road

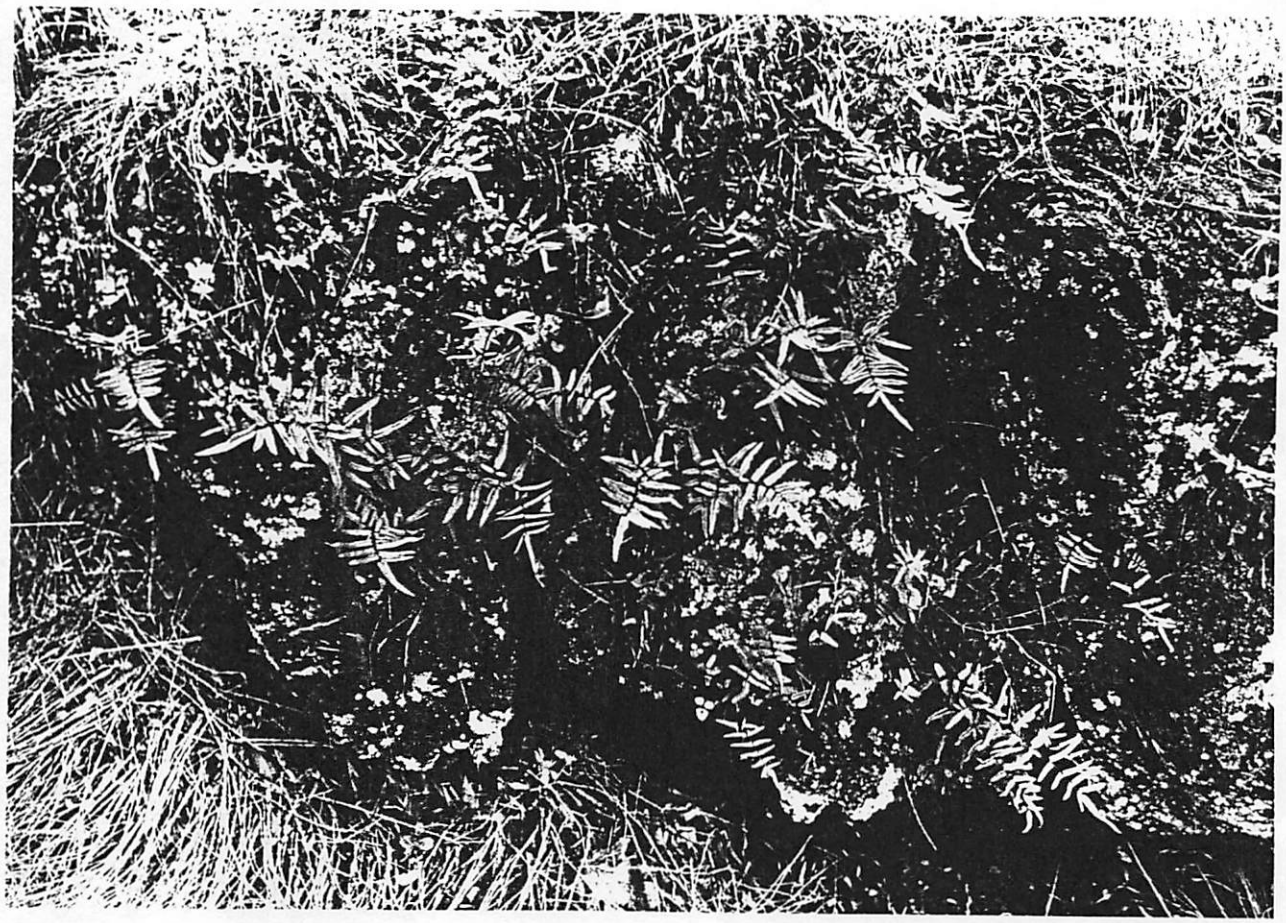


Figure 20. Pteris multifida, ca. X¼

Figure 21. Pteris multifida on tufa exposure near the old site of the Arlington Hotel

Figure 23. Woodsia obtusa, ca. X¼

Figure 24. Woodsia obtusa and Asplenium platyneuron in soil pockets of wall constructed with Hot Springs sandstone

Figure 26. Critical habitat for Adiantum capillus-veneris and Cheilanthes alabamensis behind the Hale Bathhouse

Figure 27. Critical habitat for Cheilanthes alabamensis and Pellaea atropurpurea near Tufa Terrace Trail below Grand Promenade

Figure 28. Critical habitat for *Cheilanthes alabamensis* and *Pellaea atropurpurea* along Tufa Terrace Trail below Grand Promenade

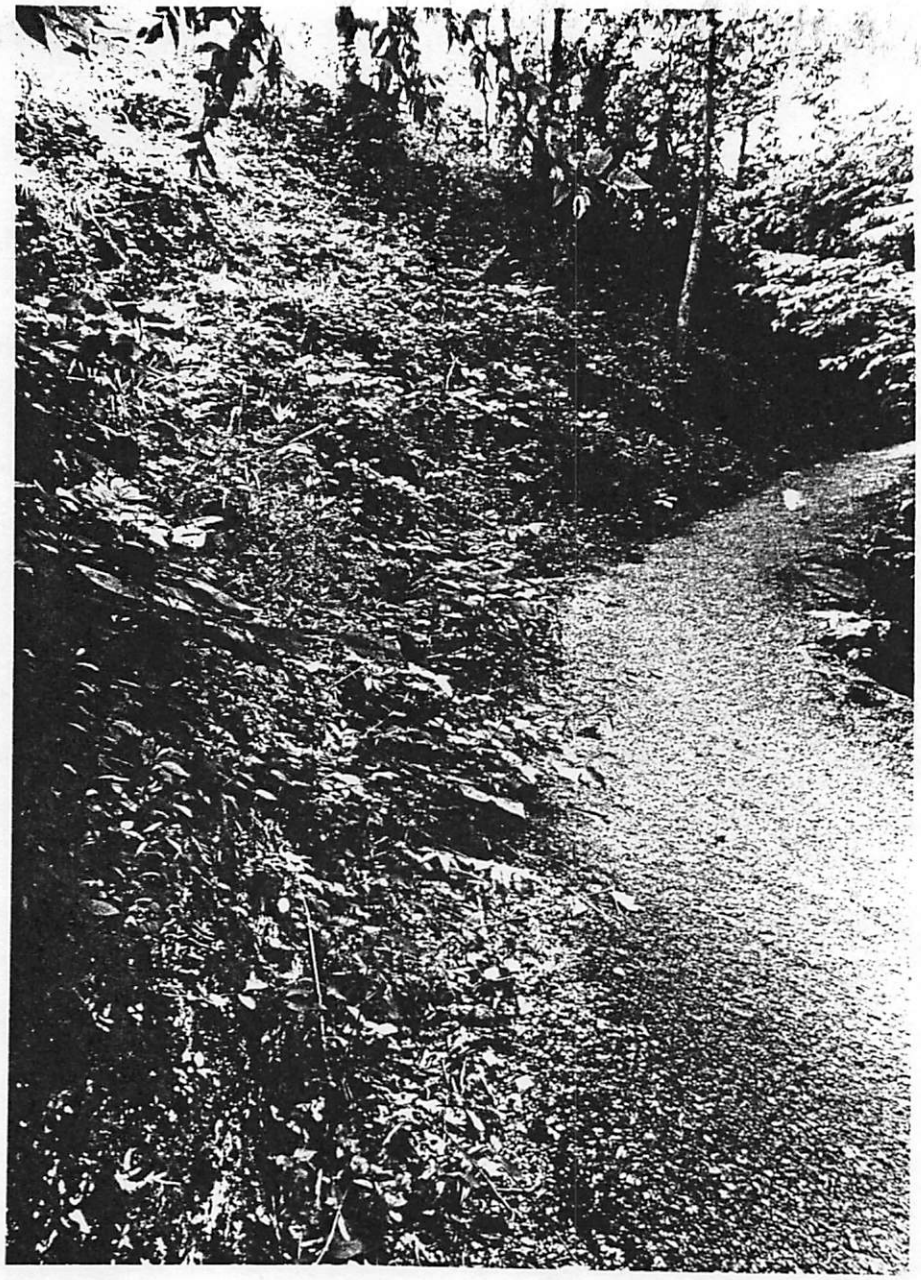


Figure 29. Critical habitat for Adiantum capillus-veneris behind the Ozark Bathhouse