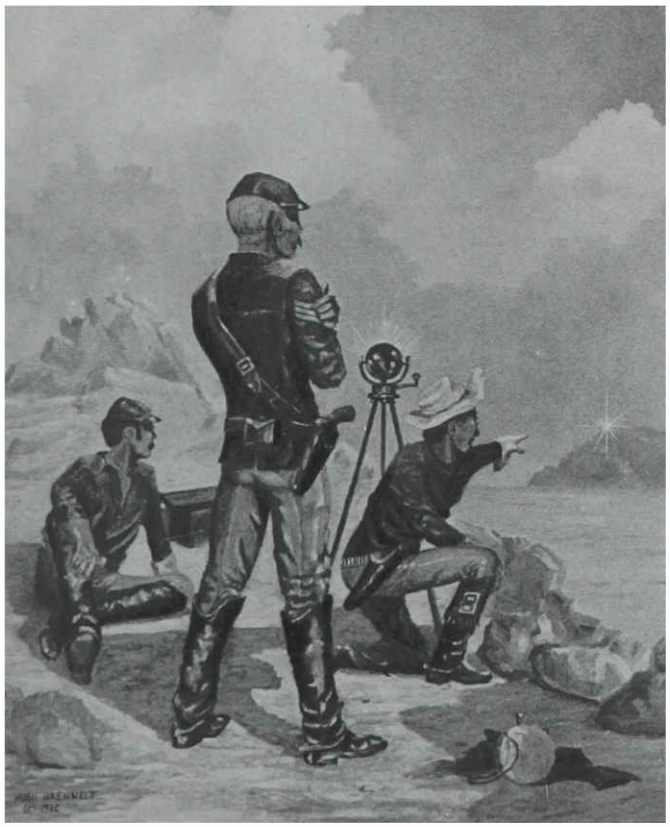
History, Geology and Vegetation of Picketpost Mountain

Frank S. Crosswhite
Boyce Thompson Southwestern Aboretum



Black and white reproduction of the color painting "Picketpost" by Hugh Haennelt, copyright © 1982. Soldiers are signaling by means of a heliograph. In recognition of the importance of Picketpost Mountain in early military history of the region, in which the heliograph figured prominently, the quartz latite lava at the top of the mountain has been given the name "Heliograph Formation."

Picketpost Mountain is a distinctive butte rising up from the desert floor about three miles southwest of Superior, Arizona. The Boyce Thompson Southwestern Arboretum lies in a hidden canyon and adjacent valley at the northern base of the mountain and holds a permit from the U.S. Forest Service for managing the vegetation of the mountain's north slope. Picketpost dominates the landscape and can be seen from a great distance.

History

In 1870 U.S. Army Colonel (later General) George Stoneman picketed troops on the flat top of the mountain to spy down on the desert trails below, hoping to discern movements of Apache Indians. Because Indians would know of the presence of the army if soldiers were garrisoned in a real camp, troops were merely "picketed" at the spy post without fanfare and with no construction of facilities. This was a time of fierce fighting by the Pinal Apaches and other Indians. General Stoneman later became famous as Governor of California. It is said that he was removed from duty in Arizona because of his harsh and relentless pursuit and punishment of the Indians.

Even after General George Crook and later General Nelson Miles were placed in charge of the U.S. army in Arizona, Picketpost Mountain was an important station in the heliograph network that kept headquarters informed of the comings and goings of the Indians. The military telegraph from San Diego (via Ft. Yuma and Maricopa Wells) reached only as far as Ft. Whipple and Tucson. The heliograph network allowed messages to be sent in eastern Arizona and adjacent New Mexico beyond the reach of the telegraph. Using nothing but sunlight and mirrors mounted in special devices, signals were flashed from mountain to mountain by trained military heliographers. Both the name of the mountain (Picketpost) and the geologic name of the volcanic flow at the top (Heliograph Formation) recall the early military history.

When General Stoneman was in the region in 1870-1871, the Pinal Mountains (the main range of which occupy an area from 16 to 24 miles east of Picketpost Mountain) had already been explored by the King S. Woolsey expedition of 1864. Pinal is a Spanish botanical term referring to the vegetation of Pine (*Pinus*). Three species of *Pinus* are abundant in the Pinal Mountains. It seems apparent that the Woolsey expedition adopted the name Pinal from Spanish speaking people who had previously named the mountains. Further evidence of this comes from the fact that the Apache Indians living in the mountains had been given the name "Pinaleños" by Spanish speaking people before Anglo settlement, in parallel fashion to how the Pima Indians of the Gila River were referred to as "Gileños."

There were no Anglo settlements in the vicinity of the Pinals until Infantry Camp was established by Stoneman in 1870 at the location later known as Camp Pinal, now called Pinal Ranch, the Top-of-the-World area (after a bawdy house), or Sutton's Summit. A prehistoric Salado Indian ruin, Togetzoge, occupied essentially the same site 800 years ago. This important prehistoric village was excavated in the 1920's by the American Museum of Natural History, with funds supplied by Mrs. William Boyce Thompson. This area is also the "type locality" where several previously unknown species of plants were discovered by C. R. Orcutt, including the rare Green-Flowered Pincushion Cactus (*Mammillaria viridiflora*) and the

General George Stoneman's soldiers likely ate beans cooked in this pot in the 1870's. It was found by a hiker on Picketpost Mountain and turned over to the author in 1981. We can only speculate on the unforeseen event or disaster which caused this heavy metal pot to break and be discarded. Did a pack horse or mule lose footing and fall over a cliff? Was there a violent skirmish between soldiers and Indians? Did a boulder break loose (or was it pried loose?) from the top of a cliff and fall on the camp of a sleeping group of soldiers? Photograph by Carol D. Crosswhite.

endangered Deep-Red-Flowered Hedgehog Cactus *(Echinocereus arizonicus)*. Botanist Orcutt was the Arboretum's first professional field collector and taxonomist. The location of Infantry Camp or Camp Pinal was on a natural summit dividing four large watersheds, that of Queen Creek to the southwest, Pinto Creek to the north and slightly west, Pinal Creek to the northeast, and Mineral Creek to the south. We imagine that trails from Togetzoge radiated out along the various drainages and that the central location which had made it an important focal point prehistorically also made it a strategic site militarily in the Nineteenth Century. Infantry Camp was 11 miles northeast of Picketpost Mountain and also 11 miles northwest of Pinal Peak and Signal Peak on the summit of the Pinal Range.

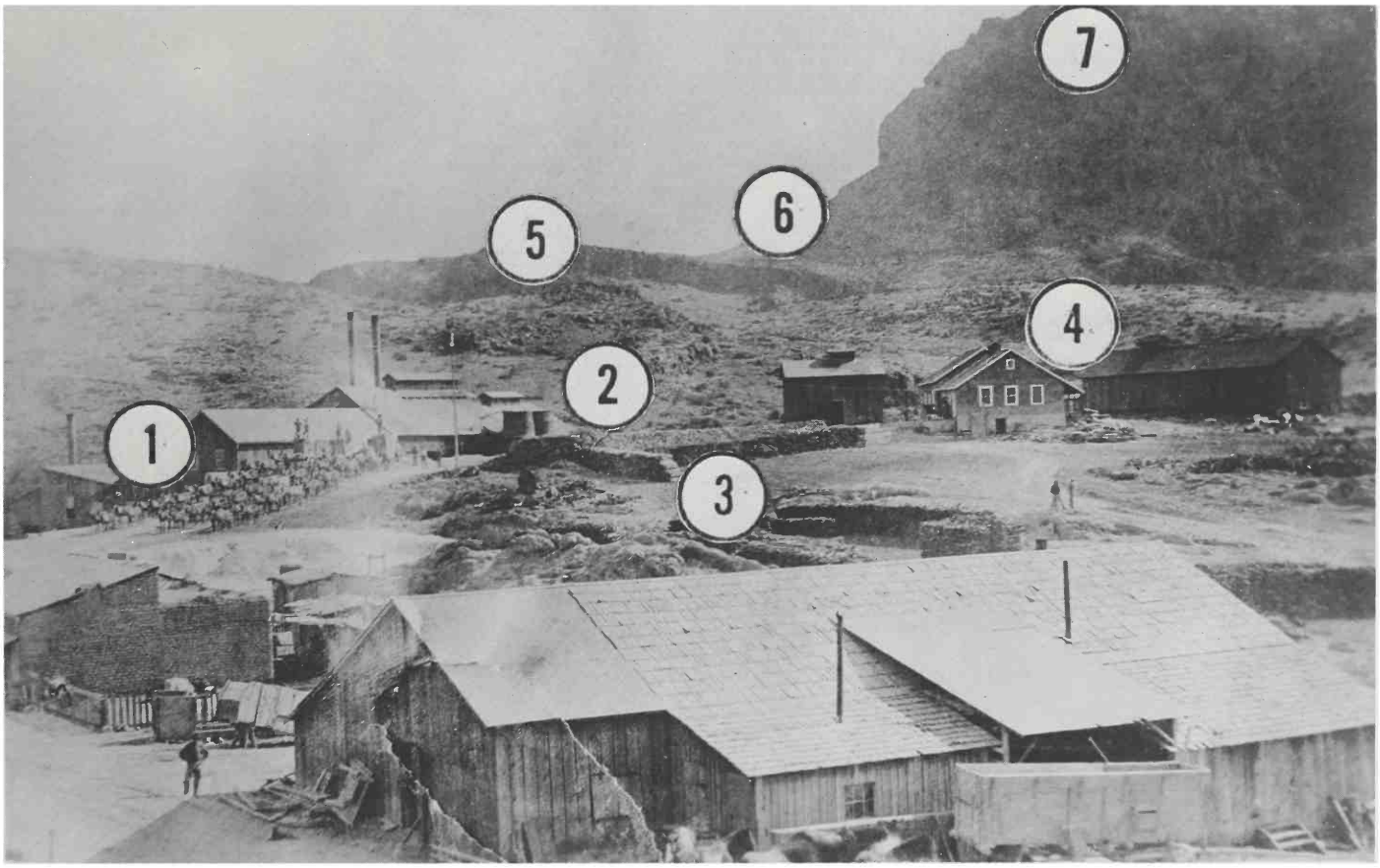
During General Stoneman's tenure in the region the most important thing to the west and south of Infantry Camp was the Picket Post; even Queen Creek was then known as Picket Post Creek because it cut through the base of the mountain. The major accomplishment of Stoneman in the Pinal region was the building of a road connecting the Picket Post drainage basin (now the Superior side of the mountains) with the Pinal Creek drainage basin (now the Globe-Miami side of the mountains). This historic road soon became known as "Stoneman's Grade," bringing prospectors, miners, cattlemen and other settlers into the Pinal Creek basin.

With discovery of the Globe Ledge (silver mine) in 1873 and subsequent establishment of the Globe Mining District, the entire "Pinal" region promised to have some economic value. Therefore, the new County of Pinal was established in 1875, with its seat of government at Florence, the nearest civilized site. Later that same year the Pioneer Mining District was established on the Picket Post side of the divide (also in Pinal County and even closer to Florence) and the Silver Queen and Silver King Mines were developed. The discoveries were so rich that they touched off a stampede of prospectors and miners to the Picket Post region. Although the silver concentrates had to be freighted by wagon through Florence (where the business office of the Silver King Mine was located), then to Maricopa Wells and Yuma, and finally by sea past the cape of Baja California all the way to San Francisco to be smelted, the mines nevertheless were quite profitable, producing millions of dollars for their owners in the 1870's and 1880's. (And in those days the U.S. dollar was worth considerably more than it is today!) As fame of the Silver King and its consort (the Queen) grew, properties changed hands and eventually the great Silver King Mining Company was incorporated under the laws of the State of California with offices in San Francisco and a capitalization of 10 million dollars to promote further development of the Arizona property! The San Francisco location was appropriate, considering that the silver ended up in bright new silver dollars issued by the U.S. mint in San Francisco. These dollars are quite rare and valuable today, being collectors items of considerable cost.

The town of Silver King grew up around the mine and the companion town of Picket Post was developed to the south, on the bank of Picket Post Creek and right on the northeastern flank of Picketpost Mountain. Picket Post was the mill town where the water (from Picket Post Creek) was used for running stamp mills to crush the ore and concentrate it for shipment. In 1879 the name of the town was changed from Picket Post to Pinal. This Pinal became a bustling city on the flank of Picketpost Mountain, having a stage coach station, innumerable saloons, bawdy houses, buildings of wood and stone, a population of 2,000 souls, and even a full-sized typeset newspaper, the *Pinal Drill*. Quite a roster of famous westerners are known to have lived in or passed through Pinal, including Bat Masterson, Wyatt Earp, and Doc Holliday. In fact, Doc Holliday's girlfriend, "Bignose Kate," died at Pinal and was buried there.

In 1881 the Globe district of Pinal County was removed to become part of the new Gila County. Thus, the part of the county with Pinal vegetation (*Pinus* spp.) passed to Gila County, while the part of the county through which the Gila River ran (right through the middle!) retained the name Pinal County. To see the Gila River, go to Florence in the middle of Pinal County, but to see the Pinal Mountains, go to Gila County!

Eventually the creeks flowing by the King and the Queen took on the names of the mines, Picket Post Creek being renamed Queen Creek, and the smaller creek passing the other mine being known as Silver King Wash. The creeks, the King and the Queen, were married by nature: they flow their waters together at a confluence precisely at the picnic area

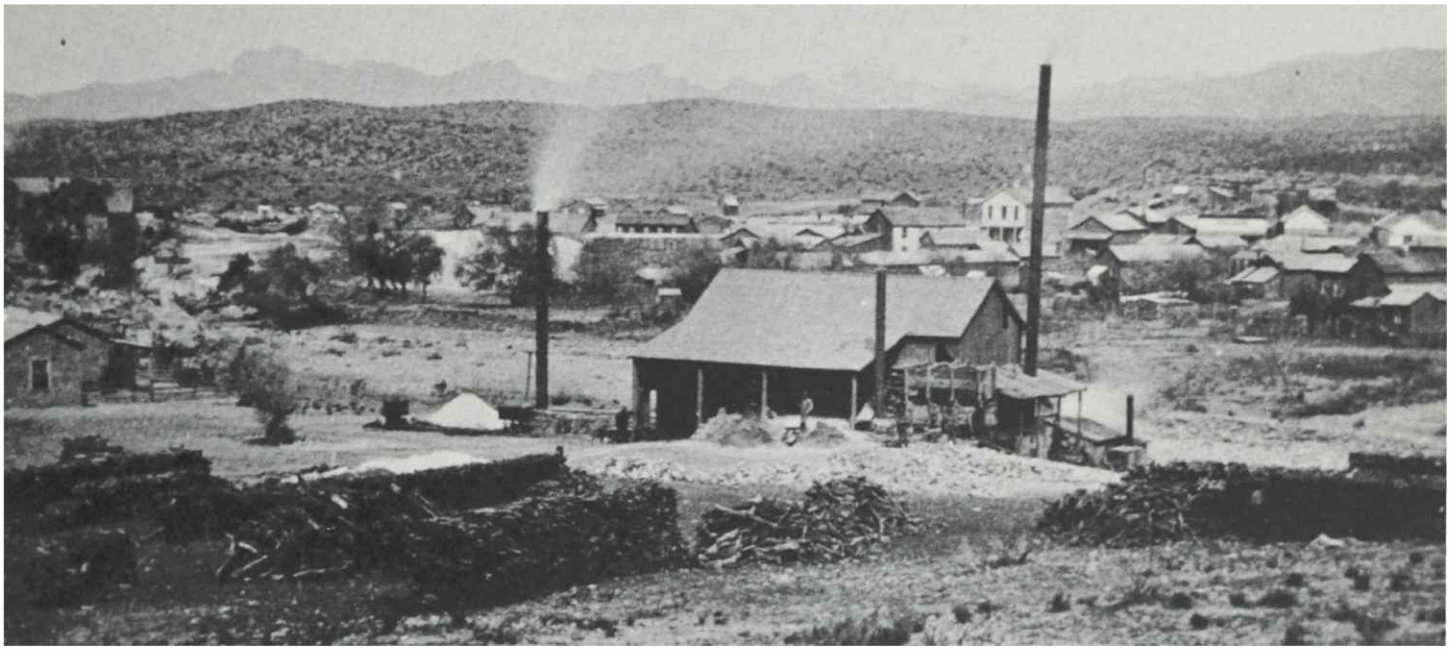


Ore from the Silver King Mine was milled here at Pinal on the northeastern side of Picketpost Mountain. The rather extensive residential and business districts are off the photo to the east and north. Photograph taken in the 1880's. Scarcely a trace of Pinal remains a hundred years later in 1984. **1:** *Note the three teams of 18 to 22 mules each drawn up in front of the mill.* **2:** *Queen Creek lies at the foot of the mill and provided water for producing steam power.* **3:** *Note the extensive piles of cordwood to left and right used for heating the boilers.* **4:** *Arnett Rhyolite of the Pancho Plateau between Queen Creek and Arnett Creek.* **5:** *Cholla Plateau.* **6:** *Eastern Tuff and Green-Spotted Sandstone.* **7:** *Upper Tuff.*

within the Boyce Thompson Southwestern Arboretum. Indeed, the founding of the Arboretum was itself only a later chapter in the drama which nature created when the great ore bodies of the King and Queen were formed. William Boyce Thompson, being trained as a mining engineer at Columbia University, knew that when silver ore played out, new drilling at greater depths often revealed rich copper deposits. In 1910 he purchased the "played out" Silver Queen and contiguous claims on 346 acres. Developing the property as the Magma Copper Mine, his company extracted more wealth from the ground than the preceding silver mine owners had ever dreamed of!

William Boyce Thompson was a developer, not an exploiter. Where the previous generation of miners had cut the trees along Picket Post Creek and on the sides of the mountain to fuel the furnaces to make steam power to run the mines and mills, Thompson spoke out in favor of studying, conserving, and making rational use of plants. His best course in college had been botany and he developed a deep appreciation, even a reverence, for plant life. As a boy growing up in Butte, Montana he had tried to grow flowers for his mother in their yard. He was deeply frustrated when fumes from the crude "stinkpot" copper smelters of the day killed them. In later years, when overseeing development of his Arboretum at Picketpost Mountain, he would make the staff bend a road to avoid damaging a tree or cactus. He was known to deliver little lectures on how the plant in question was older, more venerable, and more deserving than the person who proposed to cut it back or topple it over!

Will C. Barnes' book *Arizona Place Names* (revised by Byrd H. Granger, 1960; University of Arizona Press) states that "Today the old mining town [of Pinal], which once had two thousand residents, is the site of the Thompson Southwest Arboretum . . ." In actuality, the Arboretum extends up to, but does not include the old townsite. There is ample evidence at the old townsite, at what is now the Arboretum, and on the slopes of Picketpost Mountain, of the environmental destruction wrought by the inhabitants of Pinal. But also one has a good feeling to see how the wounds on the land and the vegetation are healing. For Arizona in the 1870's and 1880's, a population of 2,000 people was a large settlement. A considerable amount of livestock must have been grazed in the near vicinity to provide food for the inhabitants. Before the days of electricity, natural gas and petroleum products, people led burros and mules out considerable distances just to obtain firewood. But wood requirements of the local



View looking east over part of Pinal about 1880 before it had grown to its maximum population of 2,000 or 2,500 souls. Notice the large stacks of firewood in the foreground. Apart from its seamier side there were churches, both Protestant and Roman Catholic, and lodges of Odd Fellows and Masons. It had doctors, lawyers, two-story buildings and a newspaper. Persons looking for the old town today will find only a few holes where bottle hunters have dug.

residents paled in comparison with those of the mines.

At the dedication ceremonies of the Arboretum in 1929, Mr. T.T. Swift, Supervisor of the Tonto National Forest, told how he had seen the Picketpost region for the first time about 22 years previously [i.e. 1907]. "The almost complete absence of trees on the landscape made me wonder what had become of the vegetation cover. From some old photographs . . . I found that the trees which once covered this valley and adjacent hillsides had fed the adobe furnace of the once famous Silver King Mine not far from here. The pictures showed thousands upon thousands of cords of wood piled up to be used for fuel."

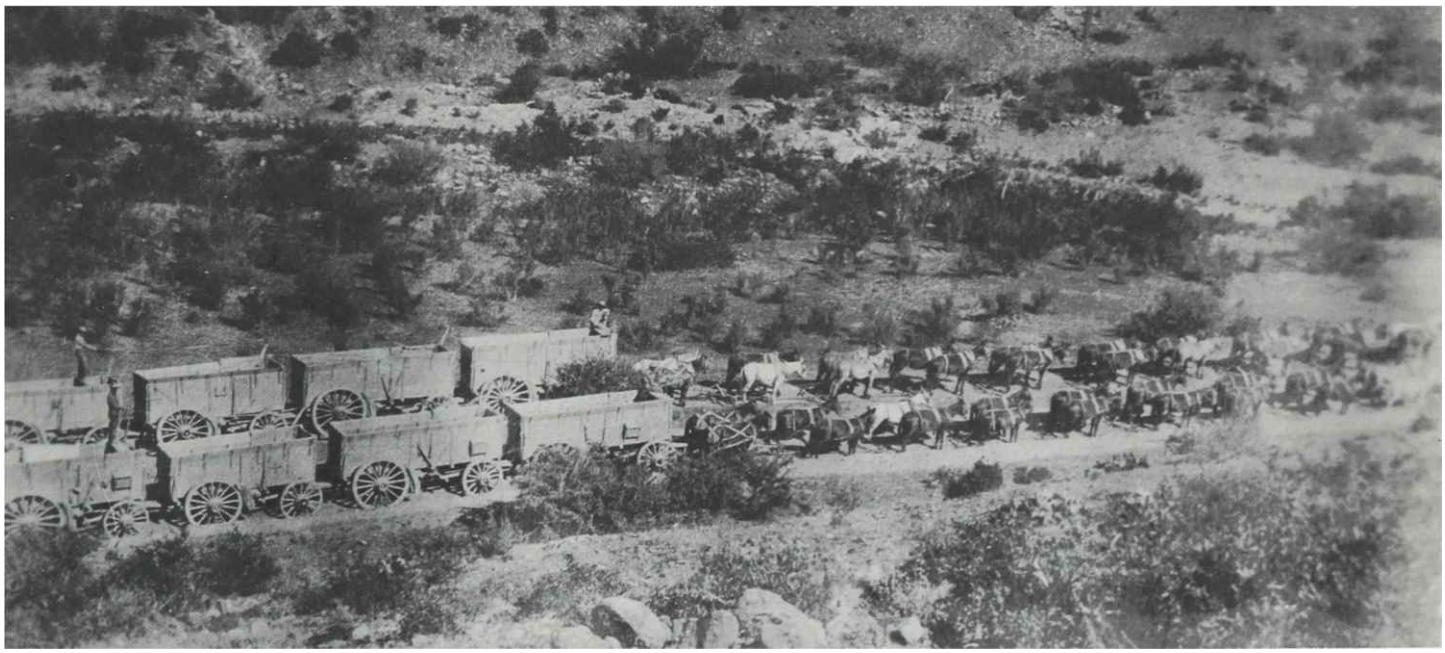
Mr. Swift continued, "Not only had this section been denuded of much of its forests, but the immediate ground cover—grasses, legumes, and other vegetation—which the pioneers tell us grew luxuriantly here, had likewise vanished, the prey of the over zealous stockman. This heavy grazing and consequent trampling out of the vegetation has continued with little interruption until now . . ." Mr. Swift went on to conclude, "As circumstances shaped themselves, it was my privilege as the local representative of the Forest Service, to assist Mr. Thompson in a small way, locating for him the ground upon which these botanical experiments are being carried out today. These investigations will be of very great value, not only in reforestation and re-establishing rapidly decreasing species, but they will go further, beautifying the homes of our people and increasing economic prosperity."

Geology

Often we hear it said that Picketpost Mountain is an "extinct volcano" or that it is an isolated segment of Apache Leap, the dacite cliffs that crop out above Superior. These are oversimplifications and misleading. Picketpost Mountain includes diverse kinds of lavas and tuffs erupted by a number of volcanos at different times. It also contains a number of sedimentary, metamorphic, and intrusive units. It does, however, owe its existence as a mountain to a certain volcano which erupted 18 million years ago. The vent for this particular eruption is on the top of the mountain. Vents for the other eruptions are away from the mountain or have not been traced. The 18-million year old rock which flowed from the Picketpost vent (at what is now the top of the Mountain) has been called the Heliograph Formation for nearly 20 years by Arboretum staff, students and visiting scientists, following proposal of the name by Eleanor W. Nelson in an unpublished Master of Science thesis (University of Arizona, 1966). Ms. Nelson prepared her thesis on the geology of the mountain as part of the long-standing arrangement whereby University of Arizona students use guest house facilities at the Arboretum while doing field work.

The Heliograph Formation has been classified as a quartz latite. It is somewhat similar to the Superior Dacite which forms the reddish-brown or pinkish cliffs of Apache Leap above the town of Superior. Indeed, recent authors generally treat the Superior Dacite as being mis-named, considering it quartz latite. Quartz latite occupies an intermediate position between acidic rhyolite and basic dacite.

The Heliograph Formation is a grayish-brown or reddish brown rock which tends to weather to a lighter gray. Due to the high quartz content of quartz latite, the lava flow was rather viscous and piled up in a relatively circumscribed site near the vent (but see below). The relatively hard quartz latite resisted erosion better than neighboring rocks. The area which it capped and preserved from weathering is now



Two empty trains of ore wagons pausing to accommodate the photographer on their way from Pinal to Silver King in the 1880's. It generally took 22 mules to pull each train of 4 wagons. Ruts worn into rock by the heavy wagons are still visible 100 years later. It is said that teamsters on the run between Silver King and Pinal made extra money by heaving high-grade ore from the wagons to be picked up by confederates.

Picketpost Mountain.

The top of the mountain, at 4,375 feet above sea level, is now 2,011 feet higher than the base (taken as the center of the bridge on U.S. Hwy. 60 over Queen Creek). The resistant nature of the flat top gives Picketpost the aspect of a butte. Actually the quartz latite top now only covers the central portion of the mountain, about one-eighth, and the surrounding-seven-eighths are very rapidly eroding away. In fact, the edges of the Heliograph Formation have been beveled down so that only the central half remains truly flat. It is easy to see how with time the quartz latite will continue to erode away and the rest of the mountain will quickly follow.

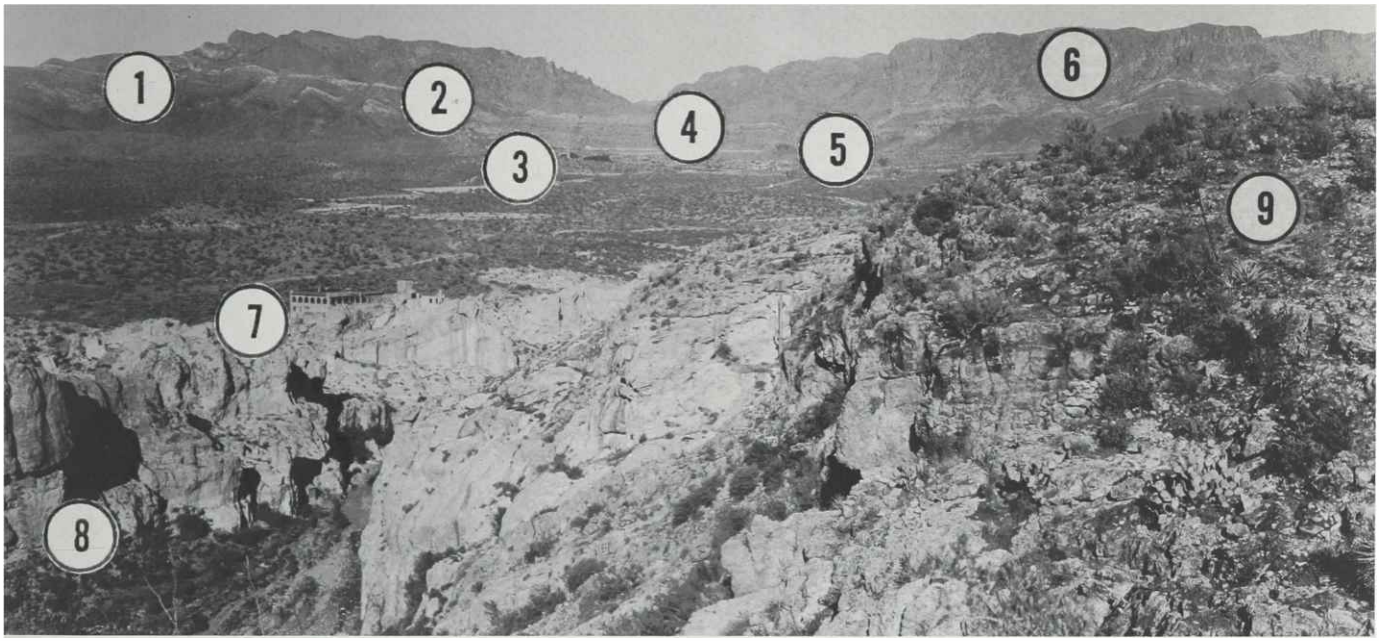
How fast is the quartz latite breaking up? Not only are erosion and weathering important, but earthquakes as well. Actually, the residents of Pinal witnessed a massive falling down the mountain of parts of the top in 1887 during the 7.5 magnitude earthquake which epicentered between Benson, Arizona and Bavispe, Sonora. Scientists at the University of Arizona used the 5-meter maximum scarp height of the 1887 earthquake to calculate the total number of such quakes which would have been required for a certain tectonic event to have occurred in southern Arizona which was known to have taken 15 million years from other evidence. They calculated that only 900 earthquakes similar to the one of 1887 would have been required. This is equal to only one every 17,000 years, a rate which we certainly can not disprove since we have already observed one during the last 98 years!

Melton (1965) calculated the rate at which mountains were becoming narrower due to weathering and erosion near Sacaton, arizona, finding it to be about one kilometer per side per million years. Interestingly, Shafiqulla et al. (1975) independently calculated that the Mogollon Rim, which more or less separates the mountains of northern Arizona from the deserts of southern Arizona, was also being worn down at a maximum rate of one kilometer per million years. Since rainfall at Picketpost Mountain of 17.0 inches per year at the base (more at the top) would be about midway between the figures for Sacaton and the Mogollon Rim, erosion at Picketpost might be expected to be comparable. If such calculations were extrapolated to the quartz latite on the top of Picketpost Mountain, then during the 18 million years since it formed it could have been weathered away from a flow 23 miles wide to its present width of seven-eighths of a mile.

Speaking against the mountain ever having been 23 miles wide is the fact that Apache Leap, with its cliffs of Superior Dacite, at a similar elevation, is only 5.25 miles from the retreating margin of the Picketpost quartz latite. If the Picketpost quartz latite had butted up against the Superior Dacite and erosion of one kilometer per million years had taken place on the face of each flow, the two rocks would now be separated by a gulf a little over 20 miles wide, a gulf four times wider than actually observed.

On the other hand, we have already stated that the extremely viscous lava on the top of Picketpost made a relatively hard caprock which protected the rocks below. Calculating another way, if we take the conservative assumption that the present width of the base of Picketpost (2.5 miles) represents the maximum extent of the quartz latite flow, the deepest erosion from the base of the mountain into the present quartz latite mass is about 1.5 miles, indicating weathering at the rate of 0.13 kilometer per million years. By such a calculation the quartz latite would be almost 8 times more resistant than average rock of the mountains studied by Melton (1965) and Shafiqulla et al. (1975).

But yet a third way of calculating adds another factor: although Picketpost is now a mountain, the theory of the



View toward the headwaters of Queen Creek from the rhyolite flow on the northeastern side of Picketpost Mountain. **1:** *Site of the old town of Silver King and the Silver King Mine.* **2:** *White bands of limestone.* **3:** *Smelter of W. B. Thompson's Magma Copper Company.* **4:** *Gap through which soldiers in the 1870's constructed "Stoneman's Grade." Infantry Camp was through the gap to the north and east.* **5:** *Town of Superior.* **6:** *Pink cliffs of "Apache Leap." According to local history some Apache men chose to leap to their death here rather than be captured by Pima Indians accompanying U.S. Army soldiers. Although this part of the legend is supported by fact, local residents go on to claim with tongue in cheek that the marekanites or "Apache Tears" found on the flank of Picketpost Mountain represent the tears of the grieving Apache wives and mothers.* **7:** *Picketpost House, W. B. Thompson's winter residence in the 1920's. Thompson died in 1930.* **8:** *An Arboretum planting area in the bottom of Queen Creek Canyon.* **9:** *Arnett Rhyolite on the Pancho Plateau. The site of the old town of Pinal lies at the foot of the plateau to the east.*

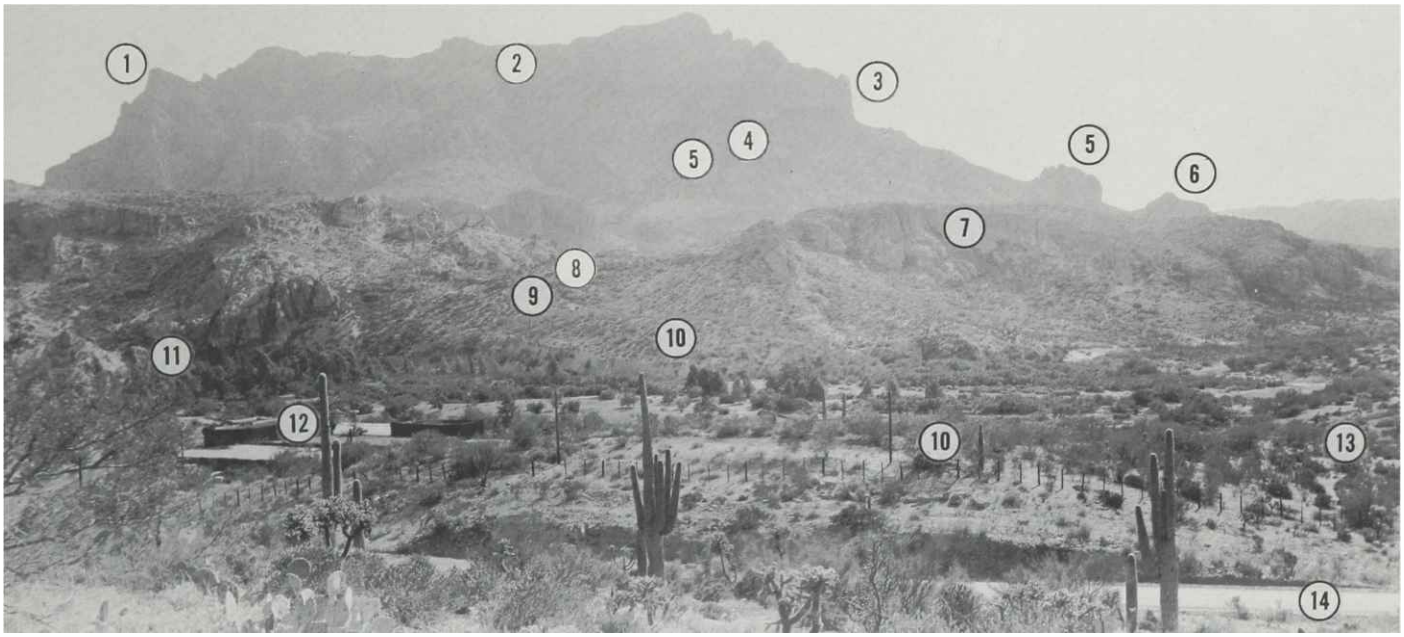
mountain's genesis (that the Heliograph Formation served as a strong caprock to protect the geologic units beneath it from erosion) requires us to assume that the mountain *per se* did not exist when the quartz latite was extruded. Therefore, the type of erosion which could whittle a mountain down by one kilometer per side per million years did not occur until Picketpost had definitely achieved mountain status!

Crosswhite and Crosswhite (1982, pg. 176) have discussed how early geologists studying the Southern Basin and Range Physiographic Province (which incidentally includes Picketpost Mountain) supposed that valleys had been sculpted between mountains by wind and water. But if the mountains and valleys had been formed by mere erosion and deposition, the process would have required huge raging rivers to move such large quantities of materials. Paradoxically the climate was one of desert and the mountains exhibited classical arid patterns of weathering! Actually we know today that valleys in this region are tectonically downdropped in relation to the mountains which are upthrust. Therefore, it is quite likely that Picketpost Mountain has slowly risen in relation to surrounding valleys during the last 18 million years, allowing erosion, weathering and earthquakes to take their toll of its mass at an ever-increasing rate.

If indeed the valley between Picketpost Mountain and Apache Leap has been subsiding for this length of time relative to the mountains, and if indeed the quartz latite is a hard caprock, then a true calculation must lie somewhere in the middle. If the mountain has taken 18 million years to achieve its present status, then perhaps erosion began at the rate of 0.0 kilometers per million years and (due to the hardness of the quartz latite) only achieved the rate of 0.5 kilometers per million years at the present. Such a calculation would suggest that the mountain was once 5 miles wide, or about twice its present base.

Incidentally, the Superior Dacite was extruded 19 million years ago, one million years before the Picketpost quartz latite. This is important to know because old-timers and mineral prospectors have claimed for years that the "dacite" on the top of Picketpost Mountain was simply an extension of the rocks at the top of Apache Leap and that erosion had removed the material that intervened. By this theory some great treasure was implied to lie under Picketpost Mountain, just as the Magma Mine lay under the Superior Dacite. Some townspeople of Superior went so far as to whisper that Thompson's Arboretum and particularly its experimental use permit for the north-facing slope of Picketpost Mountain were just ruses to obtain control of the treasure! How patently false such an assumption was is shown not only by the fact that the Picketpost and Apache Leap rocks are different, but by the fact that neither Thompson nor his company have ever filed even one mining claim on Picketpost Mountain!

The geology of Picketpost Mountain is a virtual checker-

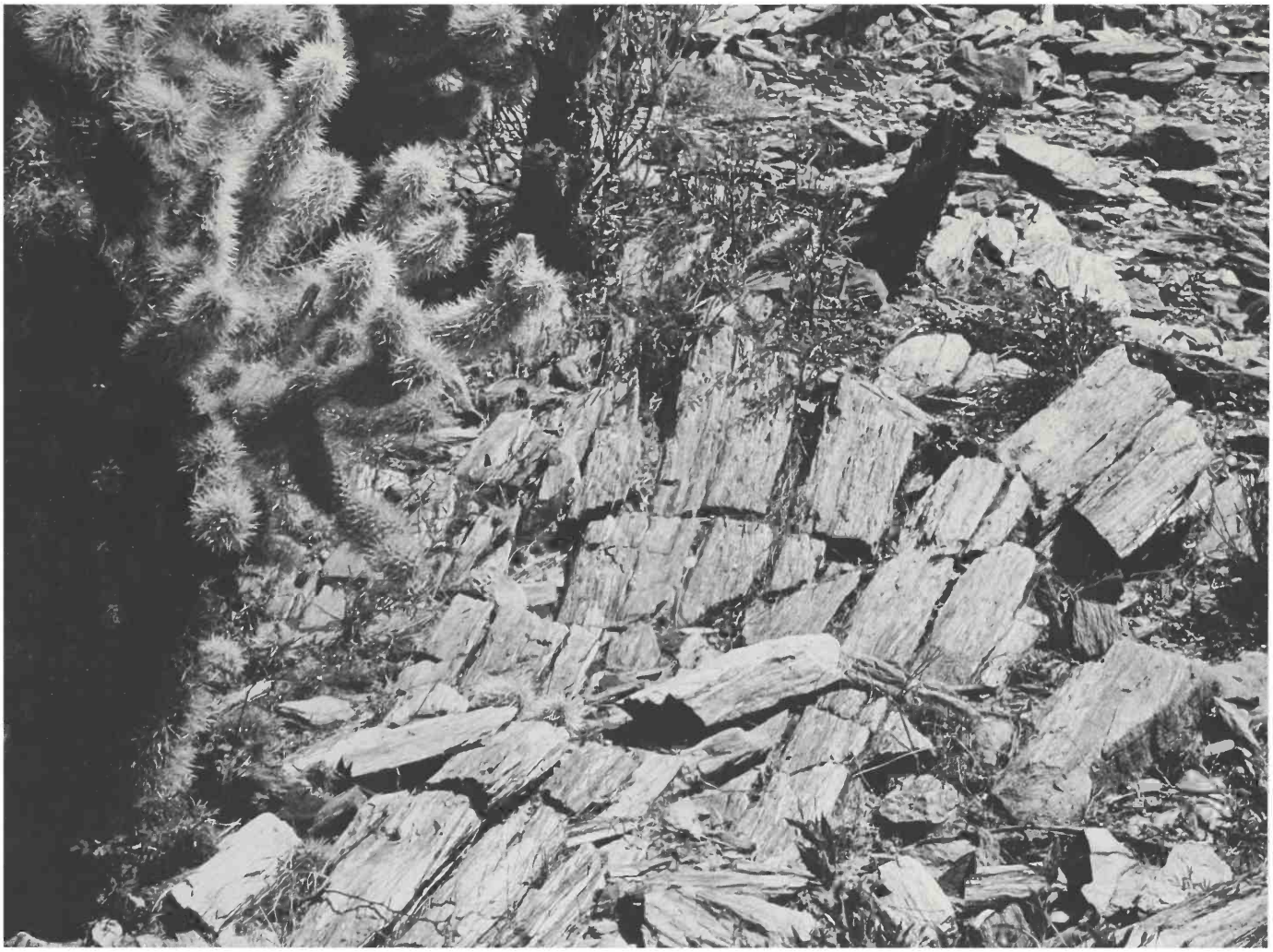


View of Picketpost Mountain and part of the Boyce Thompson Southwestern Arboretum from the north. **1:** *Main vent.* **2:** *Quartz latite.* **3:** *Upper Tuff.* **4:** *Picketpost Sandstone.* **5:** *Intrusive tuffisite.* **6:** *Small vent.* **7:** *Arnett Rhyolite.* **8:** *Rhyolitic Tuff.* **9:** *Pinal Schist.* **10:** *Alkaline Conglomerate.* **11:** *Older Basalt.* **12:** *Arboretum Visitor Center.* **13:** *Red-Speckled Andesite.* **14:** *U.S. Hwy 60.*

board. Underneath the quartz latite we find nicely preserved various remnants of past geologic events. Since the quartz latite top now caps only one-eighth of the mountain's surface area, the other rocks have been eroded very deeply on all sides of the mountain to reveal a myriad of outcroppings which are at first somewhat confusing and have required careful work and patient effort to understand. For example, stratigraphically older rocks may be topographically higher than more recent ones. It is not uncommon to find an outcropping which actually represents a window through a younger unit. Most layers were unconformably deposited originally and deformed later. Is it worth the time and effort to sort out the various rocks? Actually, a knowledge of the geologic units of the mountain proves to be of more than mere academic interest; there are often strikingly clear correlations of specific vegetation types with specific rock formations. To understand the dynamics of the vegetation it is necessary to have a thorough comprehension of the geology. Due to the complex way in which dipping, folding, faulting, fracturing, block rotation, intrusion, extrusion, subsidence, uplifting, weathering, deposition and other types of deformation have interacted at Picketpost, the various chronologic units do not make a neat stratified series such as that seen at the Grand Canyon. Some of the units were, however, nicely stratified before being deformed. The reason for the seeming jumble at Picketpost relates partly to the relative instability of the Southern Basin and Range Physiographic Province. The molten mantle is nearer the surface (which inspired Thompson to name his mine the Magma!) and the relatively thin crust is being stretched. The area was also greatly influenced by subduction of part of the Pacific plate under the continental plate prior to when Baja California and trans-SanAndrean southern California were wrenched from the coast of Mexico to travel north. The rocks of Picketpost are discussed below, beginning with the oldest and ending with the most recent.

Pinal Schist. A billion seconds ago Richard Nixon was vice-President of the United States. A billion minutes ago Jesus Christ was delivering the Sermon on the Mount. About two billion years ago the site which is now occupied by Picketpost Mountain was on the bottom of an ocean where sands, grits and silts were accumulating. Rocks formed which would be metamorphosed to become what we now call Pinal Schist. The Early Precambrian rocks were probably laid down in the form of mudstones and sandstones composed of material weathered away from the primeval crust of the young earth. Basaltic lavas were locally interbedded with the sedimentary material. Thickness of deposition in this trough amounted to 20,000 feet or more. Metamorphosis of these older Precambrian rocks extends back 1.7 billion years to the Mazatzal Revolution, a period of major geologic activity at the Picketpost site and in Arizona generally. Interestingly major geologic revolutions in the region are clustered in two time periods, the first spanning 700 million years and the second the most recent period. This "most recent period" would represent the most recent 5% of the 2 billion years mentioned. It follows then that there was a long quiescent period intervening that amounted to the better part of a billion years.

Pinal Schist is the rock now found near the summit of the Pinal Mountains, for which it is named. It is also the basement rock of Picketpost Mountain. Pinal Schist is equivalent chronologically to the Vishnu Schist in the Grand Canyon. A notable characteristic of Pinal Schist is the tendency to have veins of white quartz, rather milky in



Teddy-Bear Cholla (Opuntia bigelovii) growing on Pinal Schist. The grain of the schist causes it to weather into fragments which might be mistaken for wood chips. The prehistoric Hohokam Indians carved ornamental palettes from Pinal Schist for use in cremation ceremonies.

appearance, which contrast markedly with the fine-grained sericitic schist. At the Arboretum the schist occurs both in the typical schistose form and as gneiss. It is exposed on most of the western flank of Picketpost up to about 2,900 feet elevation except where covered by tuffs or intruded by diabase. It is also common both west and north of the mountain. It is the rock of "Water-Tower Hill" at the Arboretum, behind the residences. Where the rhyolite is weathering away on the Pancho Plateau on the approach to Arboretum Pass (on the trail linking Queen Creek with Arnett Creek), it is surprising to see that much of the interior of the seemingly rhyolite plateau is actually schist.

Scanlan Conglomerate. Still during Precambrian times the Pinal Schist (which had been uplifted as mountains to form part of the continental plate) was beveled down to a relatively flat or rolling peneplain. At this point the land again subsided. Ocean waves advancing on the sinking schist brought a fine burgundy-red to brown sand of arkosic origin, i.e. from the decomposition of granite. If the parent granite intruded the Pinal Schist in the Picketpost region it still must lie buried under the schist. In any event, the arkosic sand going into the ocean mixed with the rocks which were on the surface of the Pinal Schist to form a stratum that Ransome (1903) named Scanlan Conglomerate. This rock formation was named for Scanlan Pass where it forms a prominent outcrop in the Globe region.

Although Scanlan Conglomerate crops out here and there on Picketpost, it is nowhere really common on the mountain. In fact the stratum usually is only a few inches to a few feet in thickness. In appearance it is either a characteristic conglomerate or little more than a breccia, depending on the rocks which were lying on the surface of the schist when it subsided, how much wave action occurred, and how much outside gravel was washed in. Sub-angular white quartz in the

continued on page 95

Picketpost Mountain

continued from page 80

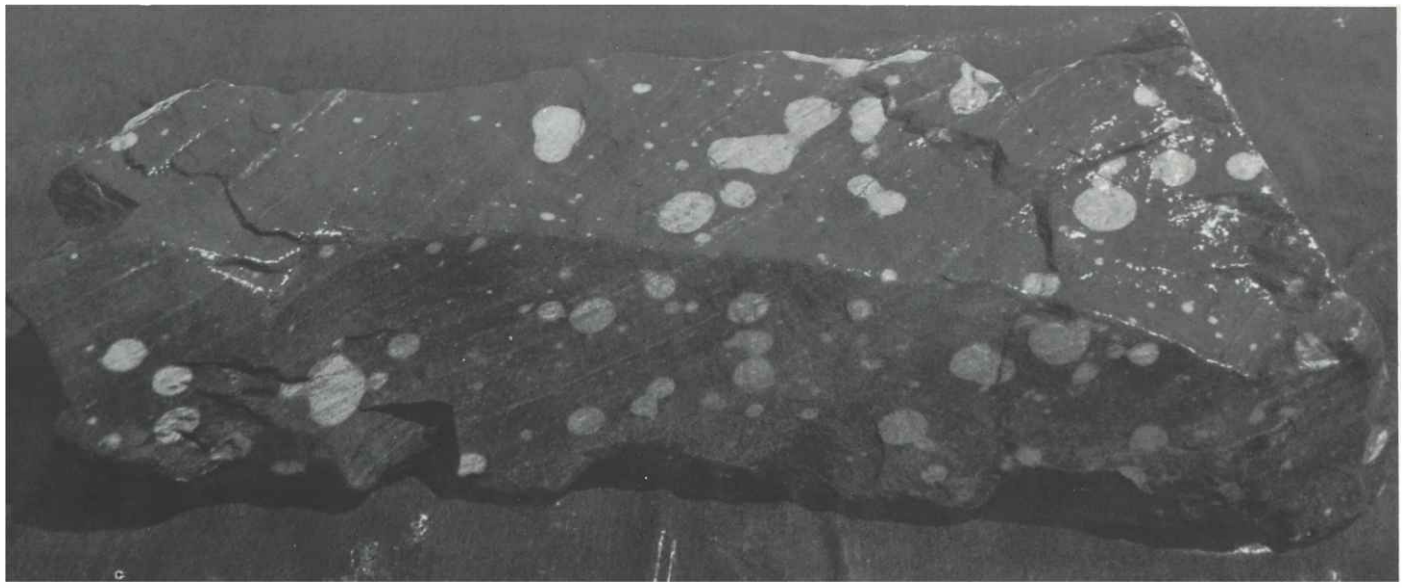
"conglomerate" facies may have arisen from quartz veins in the schist itself. Buff pebbles of quartzite may have originated as river gravels washed into an estuary. Actually the more common facies of Scanlan Conglomerate on Picketpost is a breccia formed when the arkosic sediment merely mixed with broken pieces of schist which had covered the ancient erosion surface of the Pinal formation peneplain. Scanlan Conglomerate is the basal member of the Apache Group of younger Precambrian sedimentary rocks. The Apache Group rocks are well exposed on the south face of the mountain and on the southern half of the west face. Apache Group rocks are to be looked for wherever Pinal Schist is in the process of being exposed. Although in theory Pinal Schist should underlie the Apache Group, on Picketpost Mountain diabase has so massively intruded the Apache rocks that it seems to have picked them up and spread them apart from each other and from the schist.

Pioneer Shale. One of the easiest rocks to identify is Pioneer Shale. It has polka-dot like spots where the burgundy-red to brown iron pigment of the shale has been reduced to a buff color. A theory to explain this phenomenon has not been found. It is named for the Pioneer Mining District in the Superior region. Often the shale will separate into thin shingle-like flags somewhat like the Pinal Schist but of different color and composition and having more durability. The polka-dot like appearance is not a mere surface phenomenon. It occurs in all layers of the rock.

Pioneer Shale was formed as a shallow-water ocean sediment. It is similar to the matrix of the Scanlan Conglomerate. The fine arkosic material from which it was formed probably represents a decomposition product from the same granite that went into forming the lower unit of the Apache Group. Pebbles of Pioneer Shale are common in all of the large creeks of the region, whereas Pinal Schist has usually weathered to soil before it finds its way very far from its origin. Pioneer Shale is associated with Pinal Schist on the western face of Picketpost and with diabase on the southern face of the mountain. Presumably it may be hidden by rhyolite on the northern and eastern sides.

Barnes Conglomerate. Abruptly the formation of Pioneer Shale ceased and a quite different material was flushed into the ocean to form a new stratum. Barnes Conglomerate is a beautiful puddingstone. It is named for Barnes Peak where it crops out northwest of Globe. Its pebbles are predominantly flattened ellipsoids. Similar pebbles can be seen on the beach today at Carlsbad, California. In each case the pebbles probably travelled down many miles of streams and rivers before finally arriving at the ocean. A one or two inch pebble probably began its journey as a large boulder. The pebbles of the Barnes unit are mostly quartzites, indicating that softer rocks did not survive to the pebble stage by the time they reached the ocean. The sudden appearance of the Barnes segment of the Apache Group sediments may have resulted from the metamorphosis of sandstone into quartzite somewhere in the watershed or possibly from erosion of qaurtzite previously covered by a softer rock.

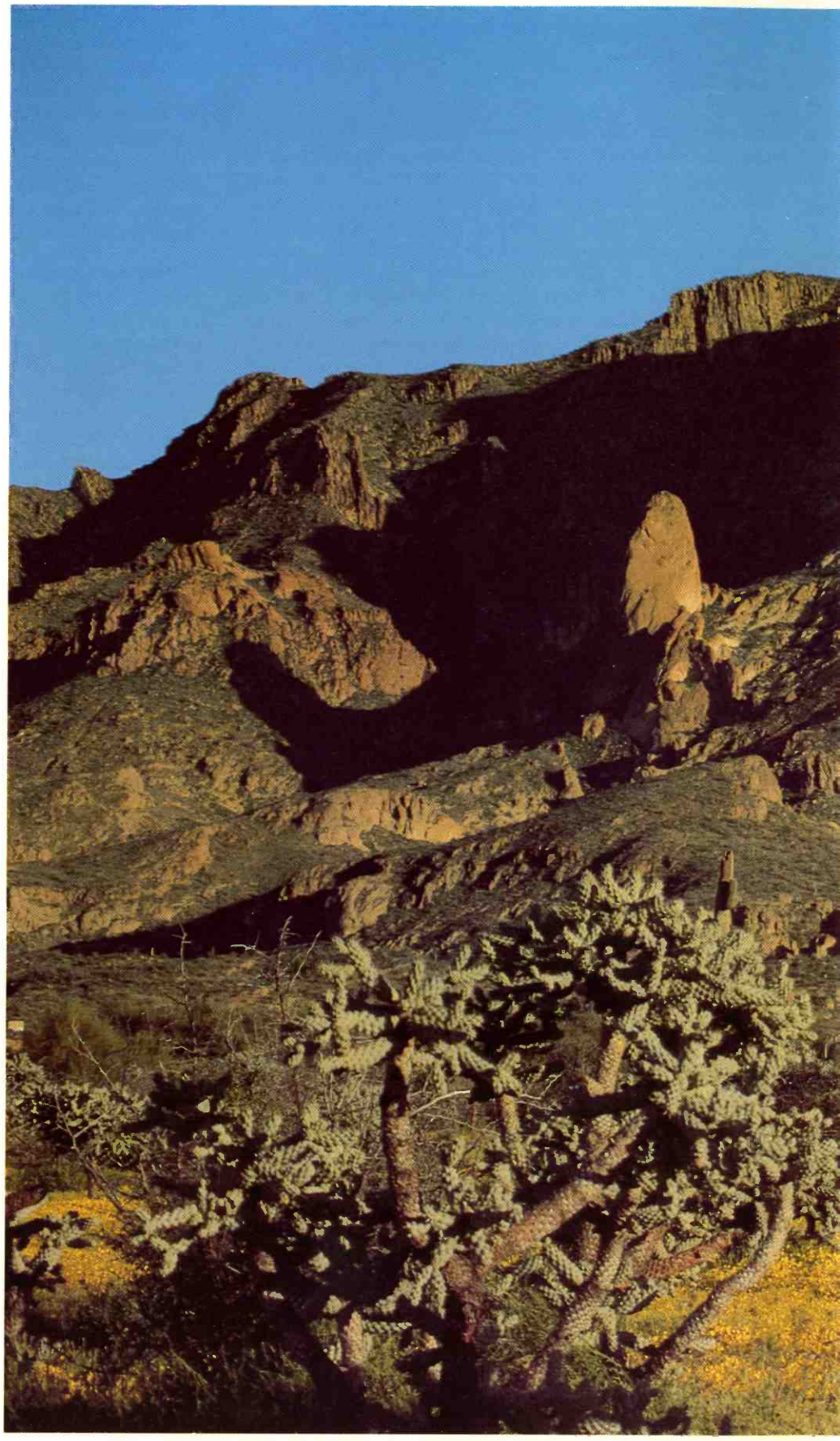
After reaching the ocean, the rounded Barnes pebbles apparently were altered to flattened ellipsoids by the buffeting action of ocean waves. Barnes Conglomerate appears to be a delta deposit. The pebbles of the conglomerate derive from rocks not presently found in the vicinity of the Arboretum. The abundant quartzite and scattered but regular jasper



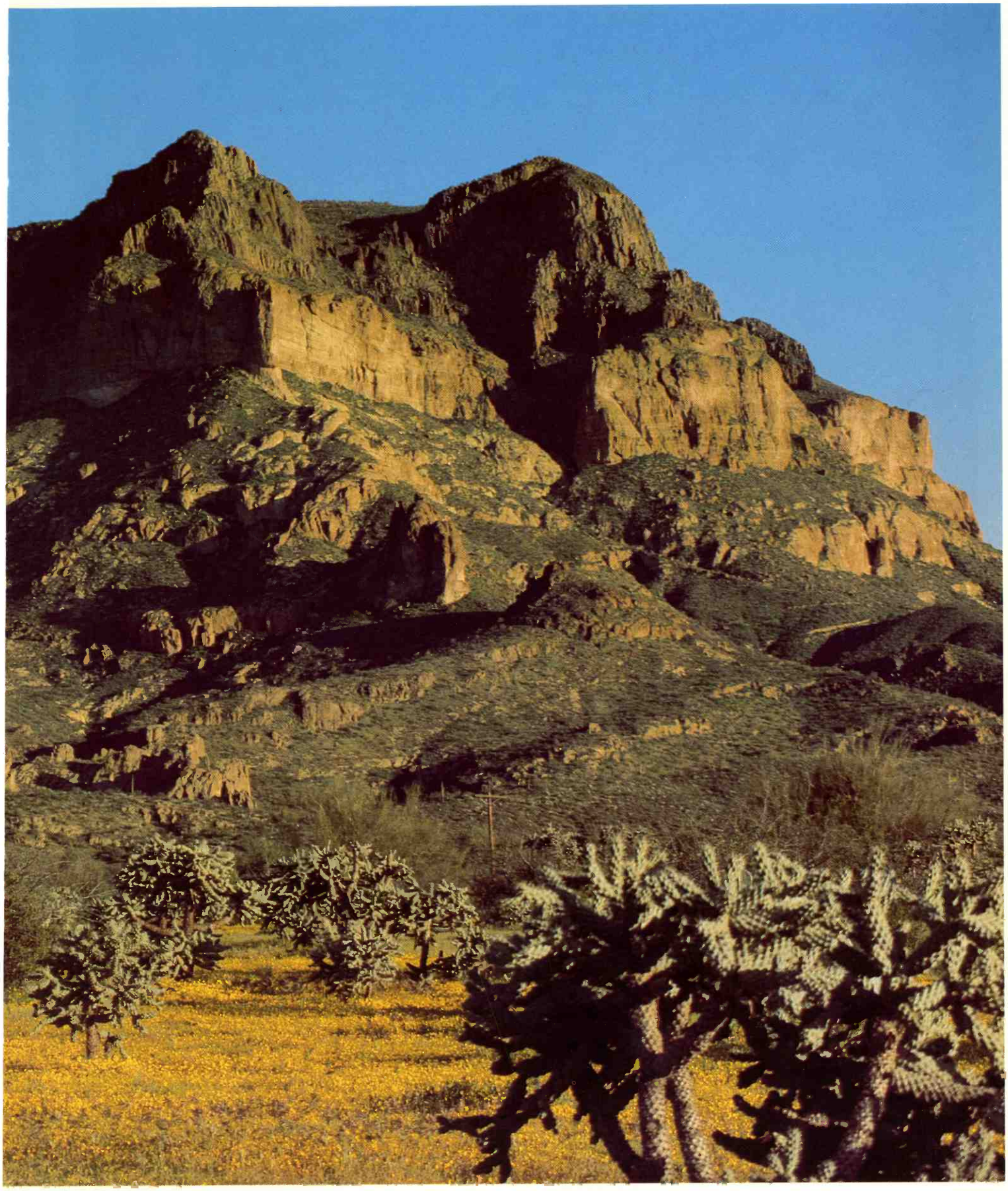
Raindrop-like spots make the Pioneer Shale easy to identify. Unlike raindrops, however, the "spots" are three-dimensional sites where the darker iron pigment has been chemically reduced. Photograph by Carol D. Crosswhite.

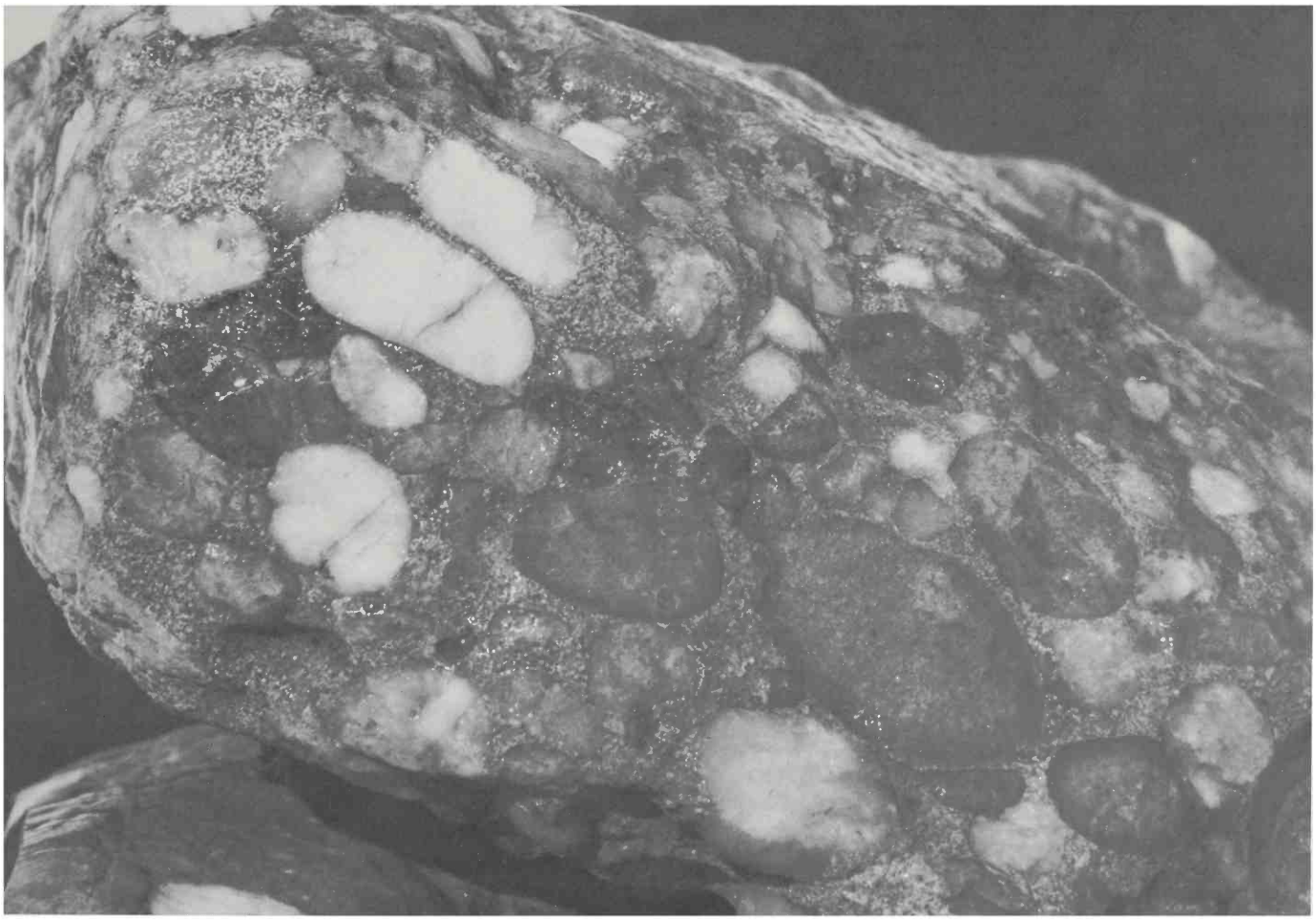
Picketpost Mountain

photograph by
Leslie Ely



Picketpost Mountain from the northwest. History of the mountain recorded on paper goes back to General George Stoneman's 1870 campaign against the Apache Indians. History recorded in stone goes back two billion years. The mountian represents a complex jumble of sedimentary, metamorphic, intrusive and volcanic formations. As we attempt to make the rocks speak they tell of repeated sinkings into the ocean followed by uplifts. At least once the Picketpost site was an ocean estuary, then deeper in the sea, then uplifted, etc. Volcanic events at the site included a great number of eruptions. One appears to have been similar to the event which buried Pompei. Another can be likened to the explosive eruption of Mt. Pelee. Volcanic rocks include basalt, andesite, rhyolite and quartz latite, with at least five major kinds of tuff and three tuffaceous sandstones. In the 1920's William Boyce Thompson chose the site with the assistance of T.T. Swift, Supervisor of the Tonto National Forest, as the location to build an Arboretum to promote arid land plant studies and conservation. Swift recorded how Thompson wanted to experiment with revegetating the north slope of the mountain which had been overgrazed by cattle and decimated by woodcutters. Revegetation work at the site by Arboretum Director Franklin J. Crider was so successful that the federal government wanted to duplicate it around the nation where erosion was a problem. In 1934 Crider left the Arboretum to become one of the founding fathers of the U.S. Soil Conservation Service. When the accomplishments of founder Thompson, Director Crider and the Arboretum are finally added up, it must be reckoned that they contributed a major impetus to formation and success of the U.S. Soil Conservation Service. Visitors to the Arboretum can examine a wide variety of natural plant communities growing on various rock types, in addition to the cultivated gardens.





Barnes Conglomerate formed when the Picketpost site was in shallow water of an ocean estuary. Flattened ellipsoids of quartz, quartzite and occasional red jasper testify to the buffeting action of ocean waves after the pebbles had travelled many miles down streams and rivers to the sea. The matrix is chiefly a decomposed granite which provided beach sand for the area in younger Precambrian times. Photograph by Carol D. Crosswhite.

pebbles suggest rocks presently exposed in the Mazatzal Mountains to the north.

Barnes Conglomerate is exposed on the western and southern sides of Picketpost Mountain. It is fairly common in the alluvium of Queen Creek and Arnett Creek in the form of cobbles and small boulders because of its hard and durable nature. When the rock breaks it usually breaks through the pebbles, not around them. This is because the course sandy arkosic matrix has generally been well metamorphosed to quartzite. Occasional finding of cobbles which break around the pebbles suggests that heat and pressure may not have uniformly affected all Barnes deposits. One naturally wonders if the intrusion of Apache Diabase (discussed later) was responsible for the metamorphosis.

Cobbles of Barnes Conglomerate would make a fine building stone, less because of its ease in handling and more because of its beauty when worn down to cobble size. On the other hand, some people think that it looks too artificial or man-made, like concrete with exposed aggregate. A little knowledge of the journey of the pebbles to the sea, and the fact that the conglomerate itself is *over a billion years old,* makes it a delightful conversation piece.

Dripping Springs Quartzite. The source of pebbles for the Barnes Conglomerate was apparently finally used up or at least the pebbles no longer found their way to the sea. Beveling of the landscape to a peneplain would have slowed their journey to the point where they may have been worn down to sand by the time they reached the ocean. In any event, on top of the Barnes unit a sandstone formed. Conditions seem to have been rather uniform and deposition continued for a long period of time. The sandstone was later metamorphosed to quartzite. A layer up to a hundred feet in thickness is exposed on the southeastern side of the mountain on Telegraph Hill and thicker layers are found elsewhere

continued on page 110

Picketpost Mountain

continued from page 98

away from the mountain.

Dripping Springs Quartzite is rather similar to the matrix of the Barnes Conglomerate but perhaps a little finer. It is composed of weathered and eroded feldspar and quartz, indicating derivation from granite. Although exposed mostly on the southern side of Picketpost, Dripping Springs Quartzite can be seen cropping out in the bed of Queen Creek just east of the U.S. Hwy. 60 bridge. It is not discernible from a moving vehicle, however. The rock was named for the Dripping Springs Mountains which begin 10 miles east of Picketpost and extend 20 some miles further to the southeast.

As the sediments were accumulating which formed the Dripping Springs formation, the land may have been subsiding deeper under the water. In any event, stratigraphically higher and chronologically later than the Dripping Springs deposition, Mescal Limestone was formed. This latter rock has not yet been found on Picketpost Mountain. It is, however, part of the limsetone sequence above Superior where it is capped by the Superior Dacite. It was named for the Mescal Mountains a little over 20 miles southeast of Picketpost. Limestone has long been looked for on Picketpost because some of the better ore in the Superior region occurs as replacement deposits in limestone. Not only is the Mescal Limestone missing from Picketpost but also the Troy Quartzite, Escabrosa Limestone, Naco Limestone, and other Palaeozoic rocks.

Presumably there was a major period or periods of uplift at the Picketpost site which prevented sedimentary rocks from forming or eroded them away. Perhaps several generations of uplifted (or extruded) rocks were worn away by erosion. Indeed, at Picketpost there is a gap of monumental proportions between the deposition of Dripping Springs Quartzite in Precambrian times and emplacement of volcanic tuffs and lavas in the Tertiary. There were, however, two intrusive rocks formed which do now crop out on Picketpost.

Apache Diabase. This intrusive rock received the name Apache Diabase because it was found so often intruding rocks of the Apache Group. At the Picketpost site it cuts through Pinal Schist, Scanlan Conglomerate, Pioneer Shale, Barnes Conglomerate, and Dripping Springs Quartzite. In the Magma Mine the diabase also intrudes the Troy Quartzite of Middle Cambrian age but stops short of the Martin Limestone of Upper Devonian deposition. It is reasonable to assume that this intrusive resulted from igneous activity which took place between the Middle Cambrian and Upper Devonian.

On Picketpost, Apache Diabase is found only on the south side of the mountain. It is characteristically a heavy dark green rock, sometimes almost black. It weathers to an olivaceous to brown color. When broken open, the fresh rock glistens from light hitting crystals of augite. The easiest way to locate Apache Diabase on Picketpost is to hike up Alamo Wash at the western base of the mountain to "Capture Creek," a vestigial wash remaining after Alamo Creek cut into the large wash which drains the southwest side of the mountain. At Capture Creek the diabase crops out in Pinal Schist. Following the tributary to the east through more Pinal Schist, one finds the diabase again cropping out on the south side of the mountain in rocks of the Apache Group. The diabase is much thicker and more prevalent than the Apache sediments. One has the impression that the intrusion picked up and spread the sedimentary rocks in chaotic fashion.

Quartz Diorite Porphyry. Very little of this intrusive rock crops out on Picketpost and probably very few people have seen it there. Because rather similar to the quartz diorite porphyry of the Silver King Mine, it may have formed during the Laramide orogeny. Due to the physical conditions under which the magma cooled and solidified it did not completely form interlocking crystals characteristic of granitic rocks nor did it become completely aphanitic like a lava. Phenocrysts visible to the naked eye make up about three-fourths of the substance of the porphyry, the remaining one-fourth being aphanitic.

If it were not for the deep erosion of Arnett Creek into the mountain, where it cuts deeply to form Arnett Canyon with its steep cliffs, we would know nothing of the presence of this interesting rock on Picketpost. It crops out right at the foot of the trail through Arboretum Pass which links Queen Creek and Arnett Creek.

Alkaline Conglomerate. A conglomerate crops out in the form of two rounded hills on either side of Queen Creek at the north base of the mountain. The one which lies between the Visitor Center and the Arboretum entrance gate appears to overlie Arnett Ryholite and probably gave Nelson (1966) the impression that the deposit represented Gila Conglomerate, a very young rock. Close examination suggests that the rhyolite actually overlies the conglomerate. The conglomerate was definitely overlain by the Red-Speckled Andesite discussed below.

Across Queen Creek from the mouth of Silver King Wash, the same or a similar conglomerate forms the cliffs against which Silver King Wash flows. This rock has been termed Whitetail Conglomerate in the literature (Sell, 1968), but was questionably referred to Gila Conglomerate by Nelson (1966). Although the stratigraphy is confusing, the deposit seems to be overlain by Arnett Rhyolite at one point unless faulting or some other phenomenon has occurred to obscure the situation. On the trail to Arboretum Pass the Alkaline Conglomerate is definitely laid down on Pinal Schist.

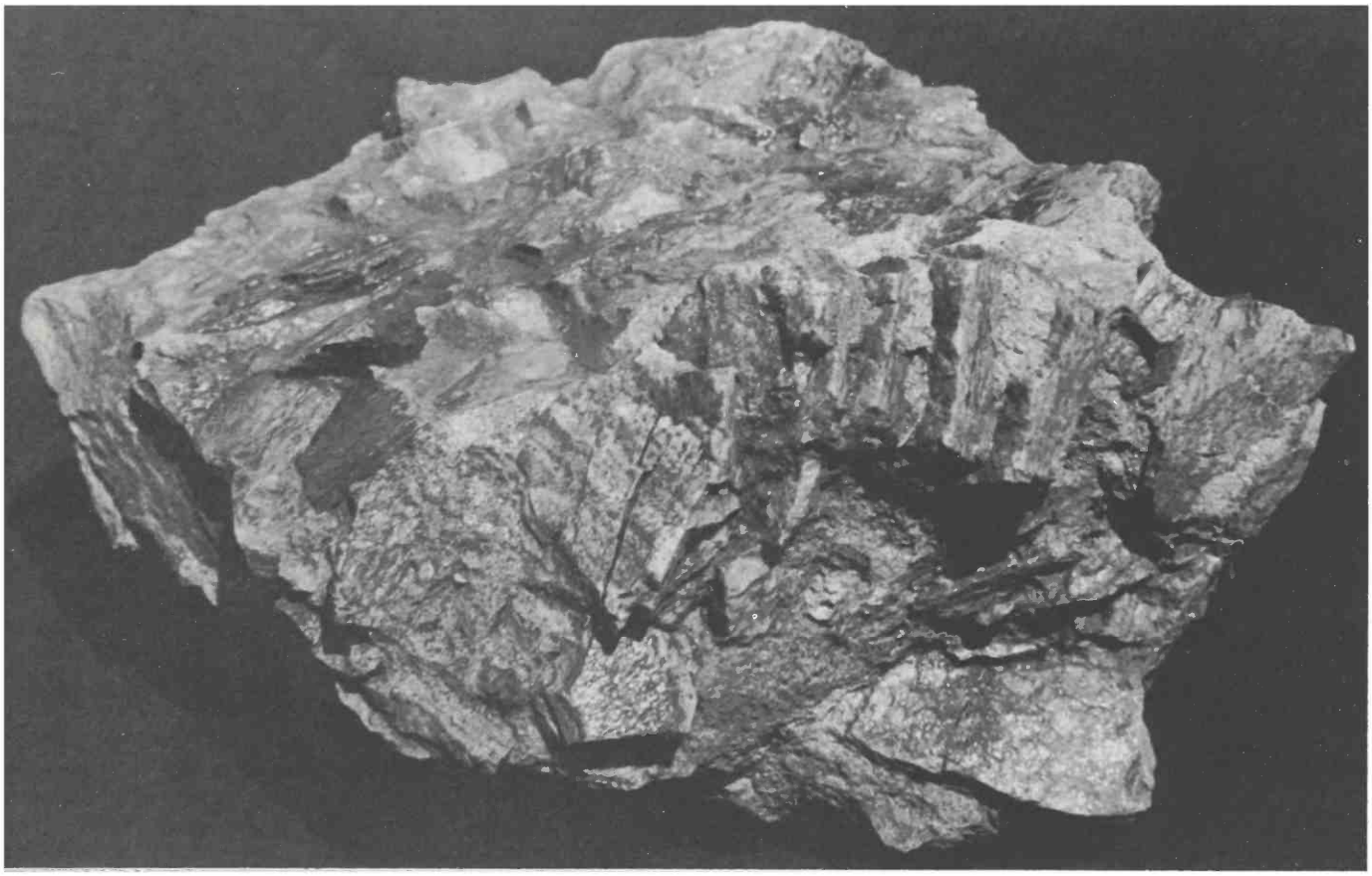
If the deposit is actually pre-rhyolite then Whitetail Conglomerate would be the logical determination. Since the present author finds no tuffs or rhyolite in the conglomerate it is treated as early post-Laramide in the present sequence. The alluvium incorporated in the conglomerate contains a very high percentage of pebbles and boulders of the Escabrosa and Naco Limestones. Epidote is present. The Alkaline Conglomerate is used educationally at the Arboretum to demonstrate marine fossils to visiting classes. Soil developed on the conglomerate is so alkaline that a carbonate layer ("caliche") has formed, the only known example on Picketpost Mountain.

Older basalt. A dark-gray, bluish-gray or occasionally reddish-purple basalt was erupted presumably before the Red-Speckled Andesite. Nelson (1966) thought that it post-dated the Lower Tuff but it seems more likely that it fits at the bottom of post-Laramide Division II proposed by Sell (1968) with the Lower Tuff at the top of that Division. The vent from which the basaltic ashes and lava issued may have

Fossils representing ocean life of the past make rocks of the Escabrosa and Naco Formations easy to identify as limestones. Cobbles and boulders of these rocks make up a large percentage of the material which formed the Alkaline Conglomerate exposed on the northern base of Picketpost at the Arboretum. Photograph by Carol D. Crosswhite.

been some distance away and is probably buried or eroded away. The flow was probably not overly viscous when molten and so may have spread at one time over an extensive area. The lower portions of the basalt are massive, while the upper portions are prominently "amygdaloidal," having numerous cavities reminiscent of the sculpturing of peach pits (from *Amygdalus*, the Peach). These cavities are mostly filled with white calcite (calcium carbonate). In one location in Arnett Canyon the base of the basalt can be seen. Here a foot or two of basaltic tuff overlain by conglomerate shows that the volcano at first belched out a gaseous pulse of ashes and fragments before the main lava flow. Incidentally, pieces of quartz diorite porphyry occurring as accidental inclusions in the basalt prove conclusively that the basalt post-dated the porphyry.

The Older Basalt of Picketpost can be placed in the Tertiary with a fair degree of accuracy. Hikers on the "High Trail" in the Arboretum (along the north-facing canyon wall of Queen Creek) meet with the Older Basalt at a fairly friendly and secluded spot where a natural depression in the basalt of the cliff has been smoothed and cemented over to provide a bench for sitting. Although not very obvious to Arboretum visitors, the same basalt crops out across Queen Creek at the base of Magma Ridge, mostly covered with talus. The basalt also must extend through the Pancho Plateau, since it is found at about the same level in Arnett Canyon. At the time the basalt flowed the topography seems to have been much less rugged. The Pancho Plateau, Magma Ridge, and Picketpost itself obviously did not exist.



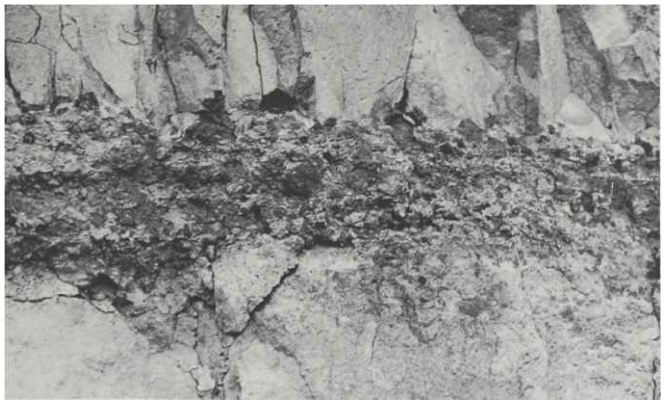
This breccia of Pinal Schist fragments in a matrix of Rhyolitic Tuff crops out a few hundred feet southwest of the author's residence. It apparently formed during the mid-Tertiary when volcanic tuff rained down on an erosion surface of schist. Erosion has once again, during the millions of years since this pyroclastic event, finally re-exposed the ancient erosion surface of schist which was present as the volcano erupted. Photograph by Carol D. Crosswhite.

Red-Speckled Andesite. An "olivine basalt" (Nelson, 1966) or andesite (Sell, 1968) with less than 5 percent phenocrysts crops out in a rather extensive area at the very lowest elevations to the west and north along U.S. Hwy. 60. It is very saprolytic and the olivine phenocrysts have mostly altered to iddingsite, giving a rusty appearance. The Red-Speckled Andesite can be seen in road cuts on Hwy. 60 and forms the low rounded hill to the west as one drives into the Arboretum through the entry gate. This andesite flow once covered the Alkaline Conglomerate east of the entry road. The contact area could be seen where the new parking lot was later built. The andesite is believed to have capped the Alkaline Conglomerate and protected it from erosion, in contrast to relationships suggested by Nelson (1966).

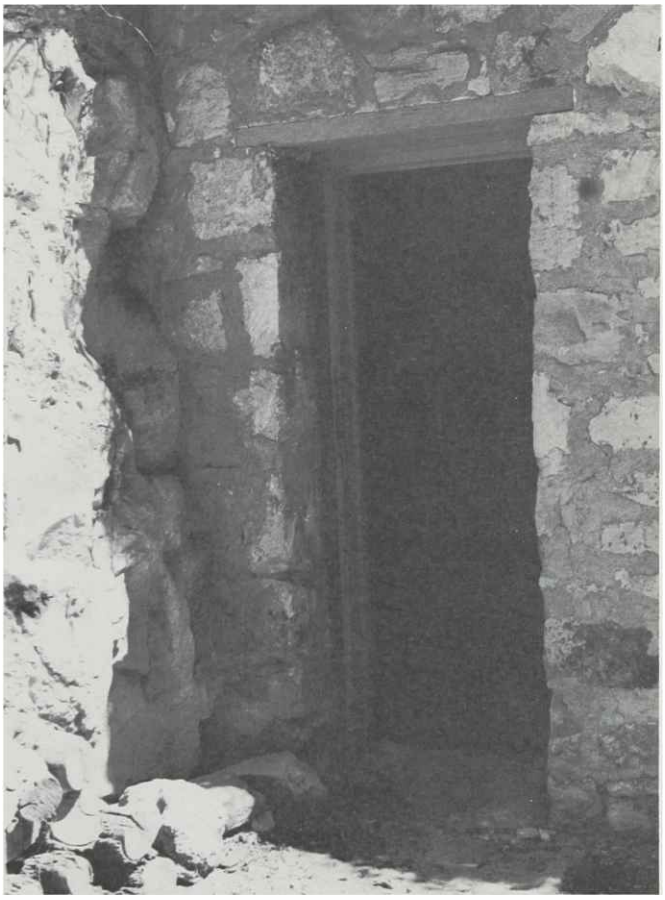
Lower Tuff. Although much of Picketpost Mountain consists of acidic tuffs and lavas of Tertiary age, particularly rhyolite, the very oldest tuff after the basalt and andesite represents a segregant of magma having a slightly basic composition. This extrusive rock is a white dacite crystal tuff. Phenocrysts make up at least one-third but less than one-half of the volume. Quartz and plagioclase are readily visible with a little brown biotite. The remaining half to three-fourths of the volume is light-colored groundmass.

This tuff obviously erupted through the Pinal Schist and Pioneer Shale because fragments of these are sometimes found incorporated in the rock. Since this crystal tuff is stratigraphically the earliest tuff on the mountain, it is referred to as the "Lower Tuff" or "lower dacite tuff." Since the quartz latite on the top of Picketpost has often been referred to as dacite, it proves confusing to refer to the Lower Tuff as "dacite tuff." Although it is not known just when the Lower Tuff was formed, it is assigned here to the post-Laramide Division II of Sell (1968). The only major outcrop of the Lower Tuff on Picketpost Mountain lies between Alamo Wash and Arnett Creek on the northwestern side of the mountain. It does, however, make a small outcrop in the bottom of Arnett Canyon east of Arboretum Pass where Nelson (1966) thought it represented a window through the basalt, pre-dating the latter. The opposite viewpoint is taken here.

Rhyolitic Tuff. Above the post-Laramide Division II rocks there occurs an extensive bed of rhyolitic tuff on Picketpost. Toward the east the tuff contains massive inclusions of



The layer of basaltic agglomerate which is found at the Clevenger cave house can be traced also on the north side of the Pancho Plateau (pictured here) as well as the south side in Arnett Canyon. It is laid down on clean white Rhyolitic Tuff and in turn is covered with more of the exact same tuff. It is suggestive of a quite violent type of pyroclastic activity. Photograph by Frank S. Crosswhite.



Robert Clevenger's homestead was a cave house in Queen Creek Canyon. Clevenger enlarged a cave which had been occupied by prehistoric Indians. For building the walls he used pieces of the same Rhyolitic Tuff from which the cave itself was cut. Note the layer of basaltic agglomerate on the tuff cliff just above the doorway. Photograph by Frank S. Crosswhite.

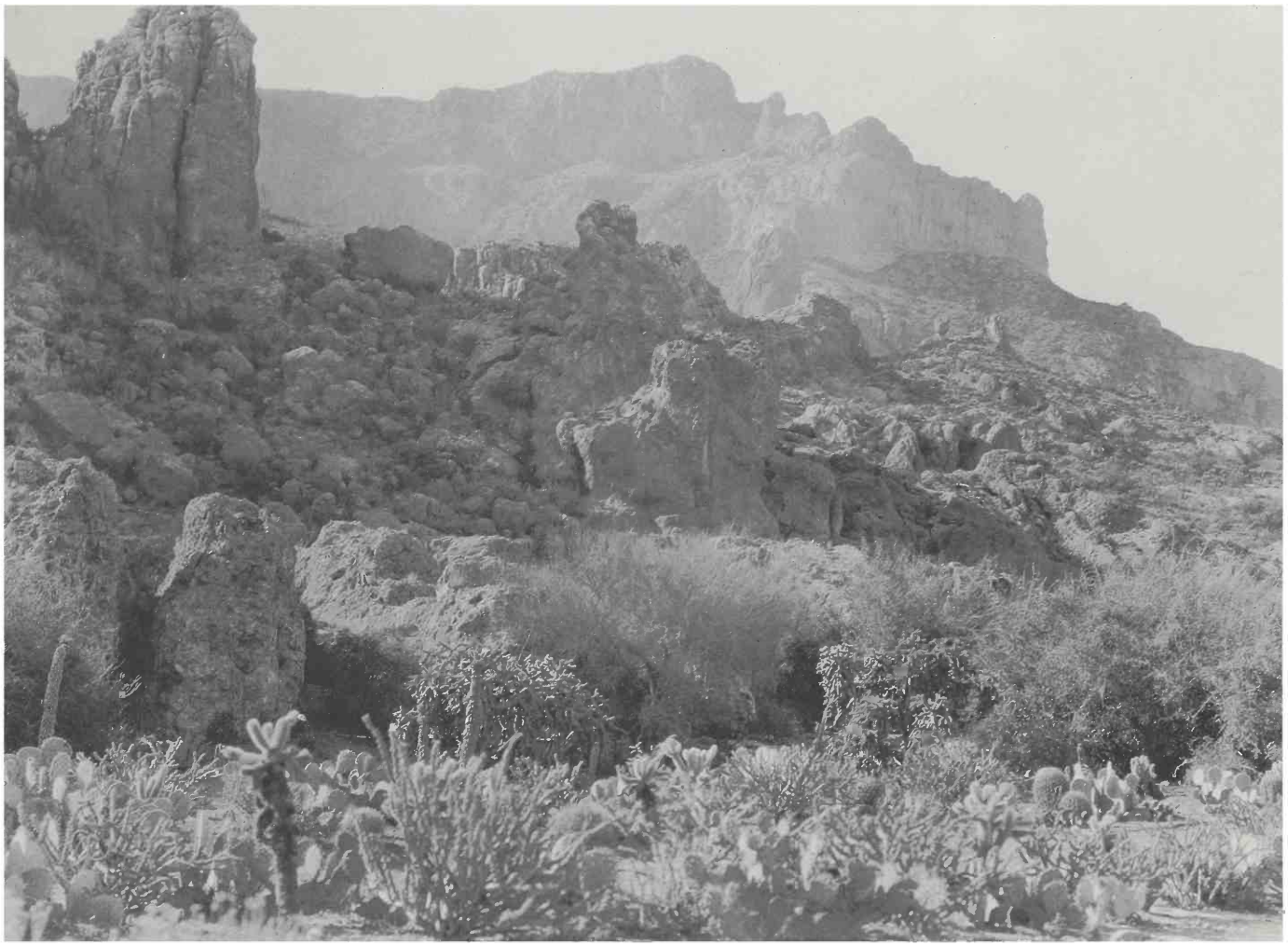
most of the rocks it cut through or passed by, including Pinal Schist, Apache Diabase, Apache Group sediments and Older Basalt. It becomes cleaner to the west. There may have been a violent pyroclastic blowout, a raining down of ashes, followed by a mudflow similar to that which buried Pompeii. In any event, a rock was formed which is a massive white vitric tuff. After belching forth at least a six foot thick layer, the Arnett Volcano, as we shall call it, put out about a foot-thick layer of agglomerate—rounded pieces of dark basalt and light vitric tuff. This foot-thick layer can be followed through much of Arnett Canyon and can also be seen on the cliffs on either side of Queen Creek. It is a good "marker bed" because after its deposition the volcano again issued forth a clean white vitric tuff. This marker bed is at about roof-level of the Clevenger Homestead stone house, but disappears due to faulting a short distance to the west.

The rhyolitic tuff occurs through much of the Arboretum and along much of Arnett Creek. It crops out prominently on the lower end of the Pancho Plateau near the confluence of Arnett Creek and Queen Creek. It straddles Alamo Wash about 300 yards southeast of U.S. Hwy. 60. It also crops out in the highway cut north of the Arboretum Visitor Center building. It can be seen in Telegraph Canyon under the rhyolite. This tuff often weathers into little cube-like fragments which are easy to slip on when climbing. This particular tuff is not very tough.

Arboretum Sandstone. For lack of a better name, and to differentiate it from the Picketpost Sandstone discussed later, the tuffaceous sandstone which crops out at lower elevations can be called Arboretum Sandstone. This occurs on the top of the ridge across U.S. Hwy. 60 from the Visitor Center, on the Pancho Plateau west of First Day Pass, and west of Water-Tower Hill. The deposit west of Water-Tower Hill has been quarried for building rock walls at the Arboretum (such as the seat-wall in front of the Visitor Center) and garden terraces (such as in the Cactus Garden).

Although Arboretum Sandstone is often fissile enough to use as a utility stone, it is rough and irregular enough that it would have little economic value. Nevertheless, it is rather picturesque as used in the seat-wall and particularly in the stone wall and pillar which hold the large metal gates at the Arboretum entrance. (The recently constructed west rockwork at the entrance is made of Arboretum Sandstone.)

Arboretum Sandstone typically has a brownish-orange color, probably from oxidized iron particles originating in eroded Older Basalt. The sandstone is composed of sand-sized particles derived not only from tuff and basalt, as might be expected, but also from quartzite, shale, schist and quartz. Occasionally pebbles and small cobbles are found weathering out of the sandstone, but a true conglomerate phase has not yet been located. Since a pebble of a fossil-bearing limestone has been found in the stratum west of Water-Tower Hill, it



The rock outcroppings in the Cactus Garden at the Arboretum represent the brecciated zone of the Arnett Rhyolite. This zone of the volcanic flow is an autobreccia formed when chunks of lava at the edge of the flow cooled, solidified, then broke loose and became re-incorporated in the molten matrix. Cacti in the garden never have a potassium deficiency; the rock consists chiefly of potash feldspars and quartz. Notably absent are Creosotebush and other plants of alkaline situations. Photograph taken in 1932 prior to extensive planting of exotic cacti.

seems probable that erosion was working on either the Escabrosa or Naco Limestones somewhere in the vicinity of Picketpost Mountain when the Arboretum Sandstone was forming. Presently outcrops of these limestones are about 6 miles to the east in the cliffs above Superior.

Arboretum sandstone apparently was formed in a local basin. Probably the rhyolitic tuff, and perhaps the rhyolite which followed, dammed up whatever creek or drainage system was present at the time. A lake formed. Sand-sized particles were dumped into the lake. Either there were few pebbles and cobbles or they were deposited at a site still buried or eroded away. Unfortunately the bed of ancient Lake Arboretum is difficult to trace because of the faulting and other deformation which has taken place.

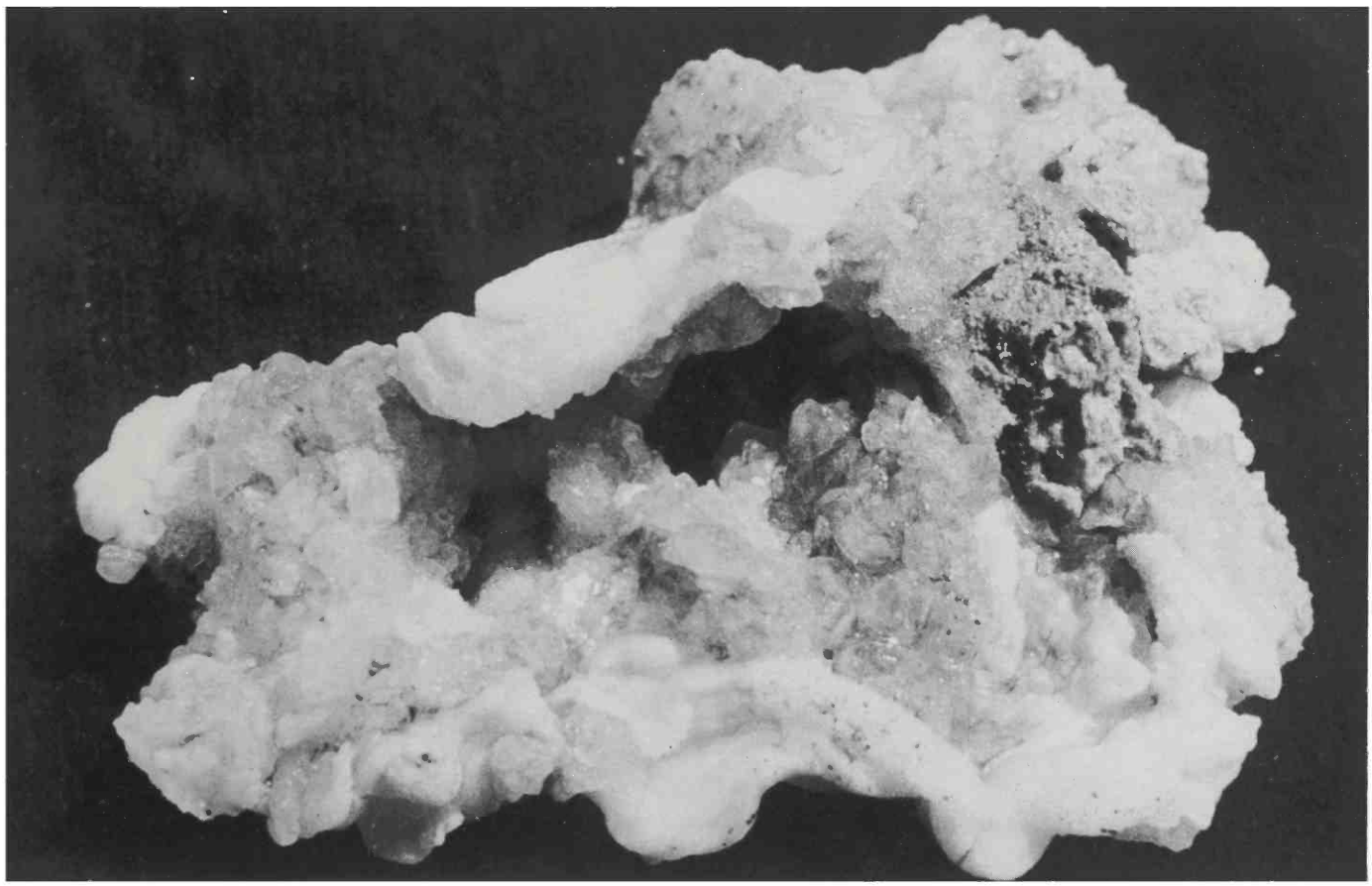
Arnett Rhyolite. This is perhaps the most characteristic rock of Picketpost Mountain. It covers much of the north face and the east face. It is the rock which both Queen Creek and Arnett Creek have cut into to form impressive steep canyons. It probably came from the same volcano which produced the rhyolitic tuff. After the tuff came the molten magma which was extruded and hardened to form rhyolite. The vent is thought to be located east of the mountain.

The thickness of the rhyolite varies with the location from 100 feet up to 500 or more feet. Considering that much has already eroded away and some still lies buried, the maximum thickness could have been 800 feet or more. Rhyolite occurs on Picketpost up to about 3,200 feet elevation. The rhyolite has three basic facies.

The first facies, brecciated rhyolite, crops out in the Cactus Garden, in First Day Pass, and at numerous other locations. This was the outer zone of the flow, the zone which cooled first. It may have been exposed to rain, snow, groundwater, or perhaps even the postulated Lake Arboretum. In any event the would-be glassy structure was extremely devitrified. This zone is an autobreccia: as pieces of rhyolite cooled and solidified, they were re-incorporated into the flow. The result is a rock having a matrix of rhyolite surrounding massive inclusions of rhyolite. The highly fractured nature of the breccia provided many little channels for fluids. This promoted the devitrifi-

Arboretum Sandstone has long been used as a utility rock at the Arboretum. It is a tuffaceous sedimentary rock associated with the Arnett Rhyolite and Rhyolitic Tuff. Rockwork by Thomas Ives. Photograph by Carol D. Crosswhite.

View south across Ayer Lake to Magma Ridge, with the Upper Tuff and Heliograph Formation of Picketpost in the distance. The extremely weathered appearance of the Arnett Rhyolite across the lake makes the rock appear very ancient, which indeed it is. Actually it has probably been exposed to weathering only during the last few million years because it was probably once covered by the upper volcanic units of Picketpost which themselves took millions of years to wear down at this location. At the present, weathering and erosion of the rhyolite are perceptibly destroying the ridge at a very rapid rate.



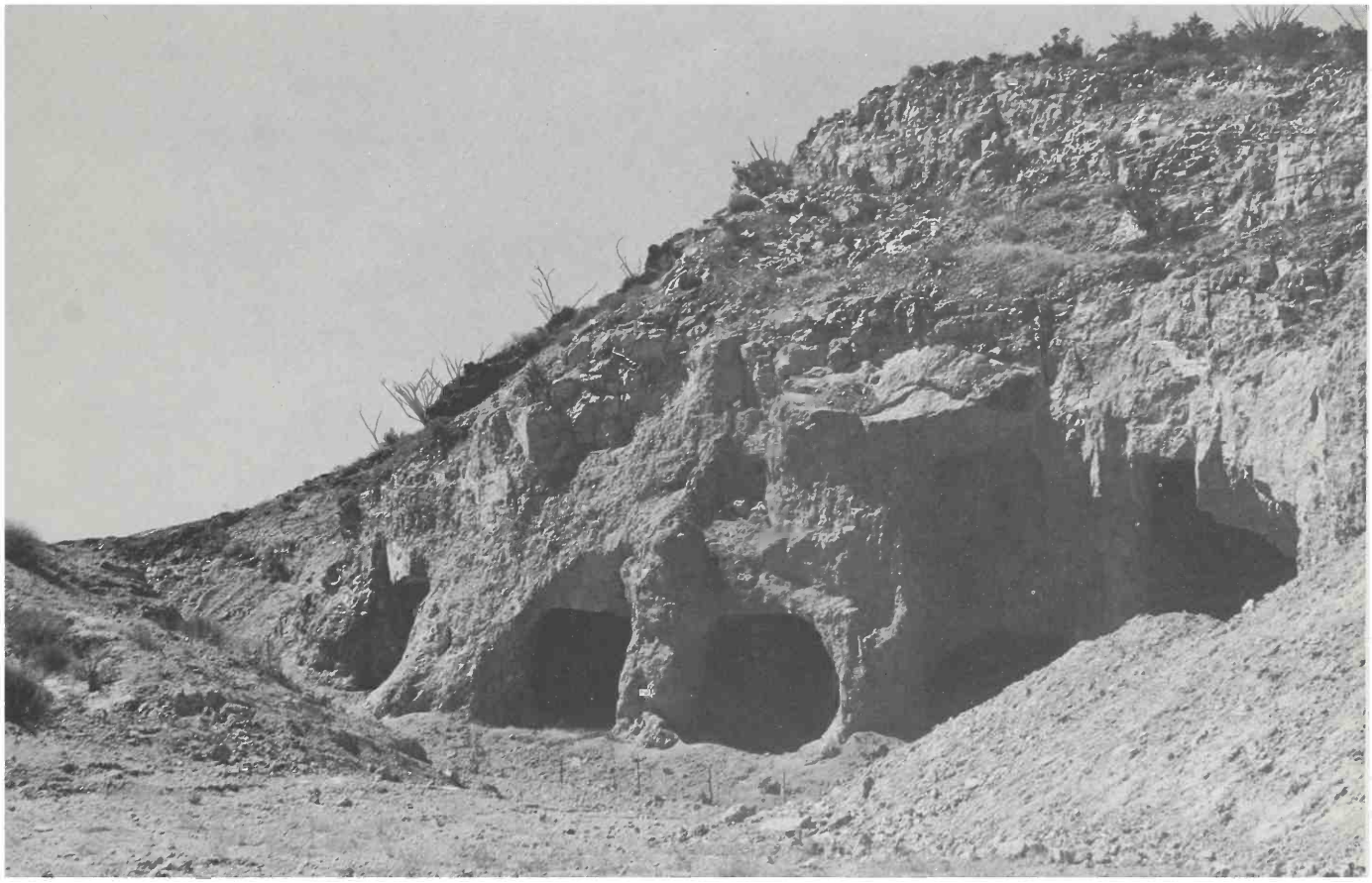
Chalcedony formed in many different strata of Picketpost Mountain due to the high silica content of various acidic volcanic units. Migration of silica-bearing fluids produced innumerable patterns, each of which is unique. In the specimen pictured chalcedony is intermixed with megascopically crystaline quartz. In other instances the silica produced opal and agate in certain Picketpost strata. Photograph by Carol D. Crosswhite.

cation process which took away the glassy aspect of a rock which otherwise might have been an obsidian. Desilicification, migration of silica-bearing fluids from the hardening rock, resulted in beautiful chalcedony (a cryptocrystalline quartz) filling the channelways. As the rhyolite becomes saprolitic, "desert roses" and other forms of chalcedony can be found littering the ground where the rock decomposed, the chalcedony being harder than the saprolite itself.

The second facies is a commercial perlite, presently being mined on the east side of the mountain. It probably occurs throughout the main rhyolite flow interior to the brecciated zone. The perlite cooled slower and did not become completely devitrified. "Apache Tears" are marekanites of hydrated obsidian found in the perlite like plums in a pudding. They are sold at the Arboretum Visitor Center for making jewelry.

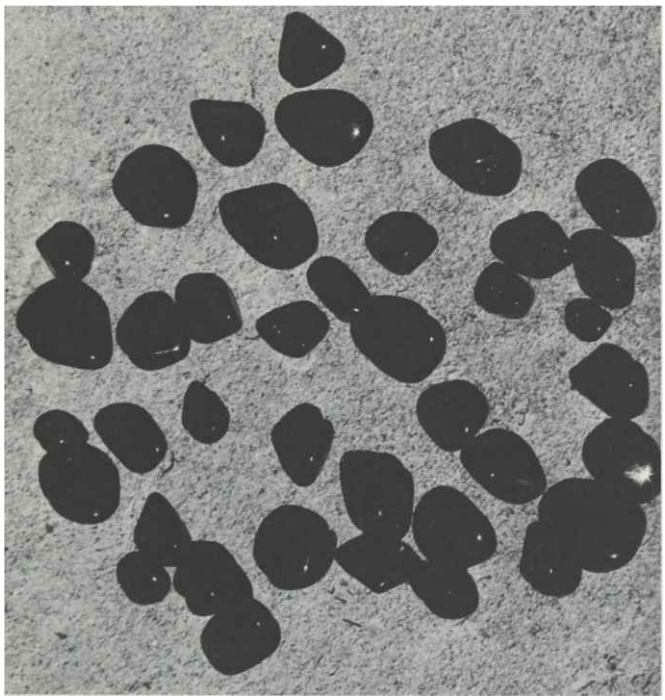
Being interior to the outer layer, the perlite zone probably was not exposed to as much water as the brecciated zone. It does, however, still have water tied molecularly to the structure! Theoretically the water would have been driven off as the perlite cooled. It would only have been retained when solidification took place under pressure, which apparently did take place, the pressure deriving from the weight of the outer brecciated rhyolite. As a result, when the perlite is mined, crushed and heated to 700°F, it pops like popcorn to become an excellent insulating material. It also makes an excellent additive to potting soil for growing cacti and succulents and has long been used for such at the Arboretum. The numerous air spaces in the exploded perlite provide aeration for plant roots and minimize the possibility of waterlogging the soil. Use of expanded perlite horticulturally is thought to have been an Arboretum discovery in the decade of the 1920's although popularization in the nursery industry did not take place for some years.

The third facies of rhyolite is the center of the flow, a massive, very hard rock which cooled more slowly and under more pressure. This central zone has few inclusions. Massive rhyolite was quarried for building the Arboretum Visitor Center building, as was Arboretum Sandstone and other rocks. Between the perlite zone and the central zone are found many spherulites and lithophysae shaped somewhat like eggs. The centers may be hollow or filled variously with ice-blue crystalline quartz, agate, chalcedony or opal. Above the central zone of rhyolite lies another zone of perlite and then another zone of devitrified material. These upper two zones have weathered badly in comparison with the lower zones which were capped by the more resistant central zone. Although there are five zones from bottom to top, there are only three basic facies.



A local tourist attraction, the Apache Tears Mine, with caverns extending into the perlite zone of the Arnett Rhyolite. Visitors pay a fee to collect Apache Tears from piles of perlite ore such as the one in the right foreground. Most perlite operations in the Arnett Rhyolite are now of the strip-mining type using bulldozers. Photograph by Carol D. Crosswhite.

One of the perlite crushing and shipping operations which depend on the Arnett Rhyolite. Perlite from the east side of Picketpost Mountain is widely used in the United States as an insulator, as a component of filtration systems, and as a horticultural soil amendment. Photograph by Carol D. Crosswhite.



Jewelry quality Apache Tears from the Arnett Rhyolite which have been carefully polished using gemstone procedures are sold at the Arboretum Visitor Center for 50¢ to $1 each. Rough unpolished stones go for only 10¢. Photograph by Carol D. Crosswhite.

Eastern Post-Rhyolite Tuff. On the east side of Picketpost a vitric dacite tuff crops out on the Cholla Plateau. It is a fine grained buff to brown rock above the weathered and rounded rhyolite. A little over half of the rock's volume is matrix, less than a fourth pumice lapilli, with the remainder equally divided between phenocrysts (mostly quartz, plagioclase and biotite) and inclusions of previous rocks such as schist, diabase and basalt.

Eastern Green-Spotted Sandstone. Associated with the above mentioned Post-Rhyolite Tuff is a related tuffaceous sandstone. This sandstone presumably incorporates some of the tuff together with sand, grit and pea-gravel sized particles of the surrounding rocks. Indeed, it is a dark tan rock spotted with small gray grains of quartzite and schist (about the size of pea gravel or chicken grit), red hematite (probably oxidized from diabase), and most notably, characteristic green inclusions which probably represent clay altered pumice. Grit-sized pieces of rhyolite and chalcedony are also present. Matrix of the sandstone appears to be formed of fine-grained quartz, glass dust and tuff. Both the Eastern Post-Rhyolite Tuff and Eastern Green-Spotted Sandstone seem to have formed more or less contemporaneously, only the manner of deposition being different. Of course, the manner in which the sandstone was deposited allowed a greater amount and variety of particles of surrounding rock to be incorporated.

Picketpost Sandstone. This is a very prominent feature of Picketpost Mountain. The formation makes prominent steep cliffs on the western and northwestern sides which rise from about 2,800 feet elevation to 3,500 feet. Picketpost Sandstone also occurs on the other sides of the mountain in smaller outcrops. Sometimes it is covered by talus. Looking up to this high sandstone today, it is difficult to envision the conditions that prevailed when it formed.

There can be no question about the sandstone forming as finely sorted sediment deposited in a lake. We are not used to looking up to see the bottom of a lake! Looking up to Picketpost from the U.S. Hwy. 60 bridge over Queen Creek, the top of the sandstone is 1,200 feet higher! What fantastic erosion has occurred! How much mountain uplift or valley subsidence has taken place? Gone from our view are the banks of the lake. What held the waters in? What we now see is a cross-section through the bed of ancient Lake Picketpost. The erosion surface upon which the sandstone was deposited varied from rhyolite to the north to Pinal Schist and Apache Group sediments to the east, and Apache Diabase to the south.

Picketpost Sandstone is rather unifrom. A little over half of the rock's volume consists of sand-sized grains of white quartz and gray quartzite. Color of the sandstone varies depending on the relative proportions of white to gray sand. On the south side of the mountain the gray quartzite inclusions range up to grit size. The matrix cementing Picketpost Sandstone consists of devitrified shards of a buff or brownish-tan tuff.

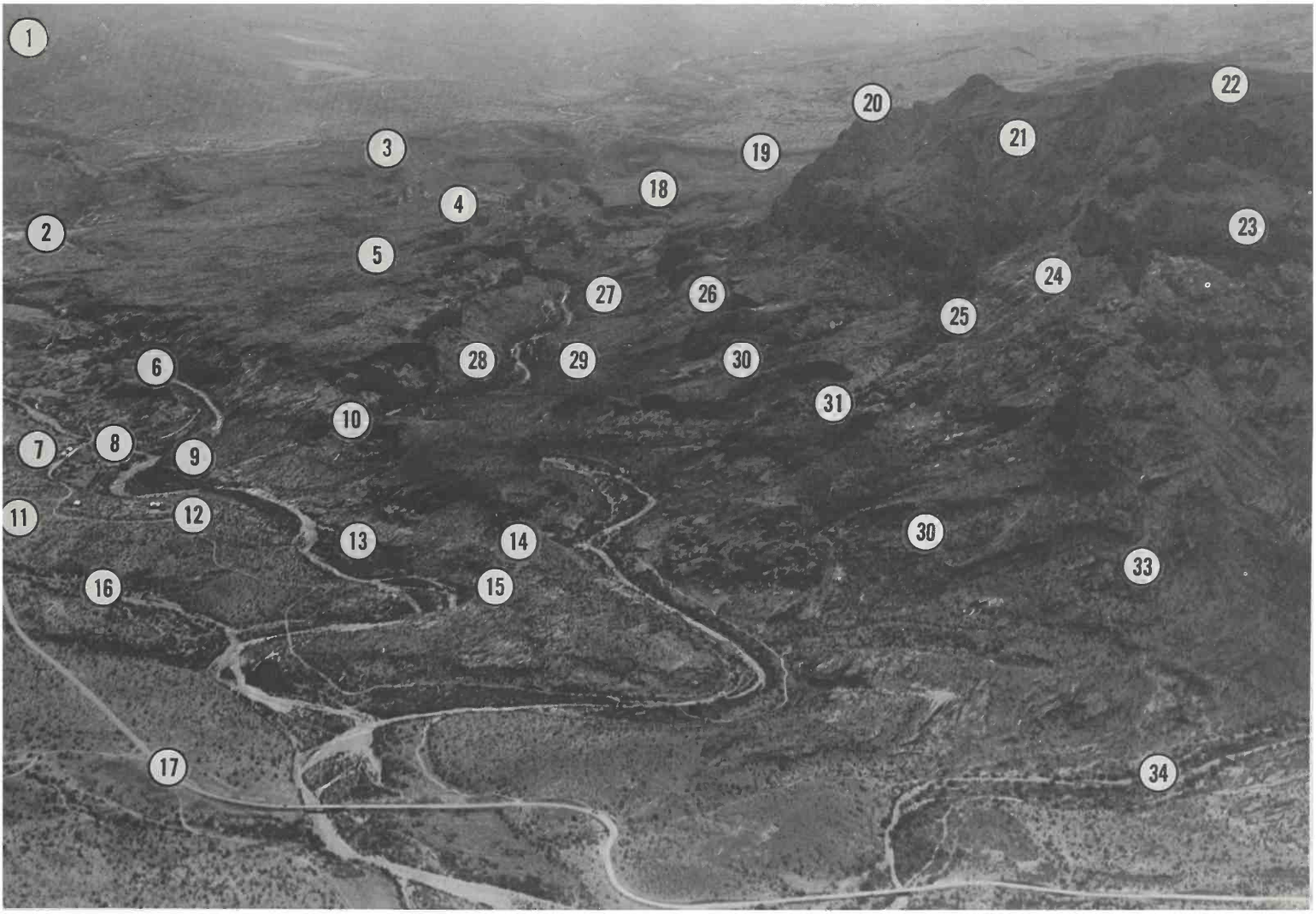
Southern Post-Sandstone Tuff. A new vitric rhyolitic tuff was laid down on Picketpost Sandstone on the south side of the mountain. A thickness of about 500 feet is exposed from about 3,000 feet elevation up to 3,500 feet. Presumably, significant deformation, faulting and weathering had occurred between the times when the Picketpost Sandstone formed and the Post-Sandstone Tuff was erupted, since the tuff is found directly on Apache Group sediments, Apache Diabase, and Arnett Rhyolite as well as sandstone.

This pinkish or tan tuff consists of about three-fourths matrix with the remaining one-fourth about equally divided among accidental inclusions, pumice and phenocrysts. The phenocrysts are mostly quartz with some biotite. The inclusions are mainly schist, diabase, quartzite, basalt and rhyolite.

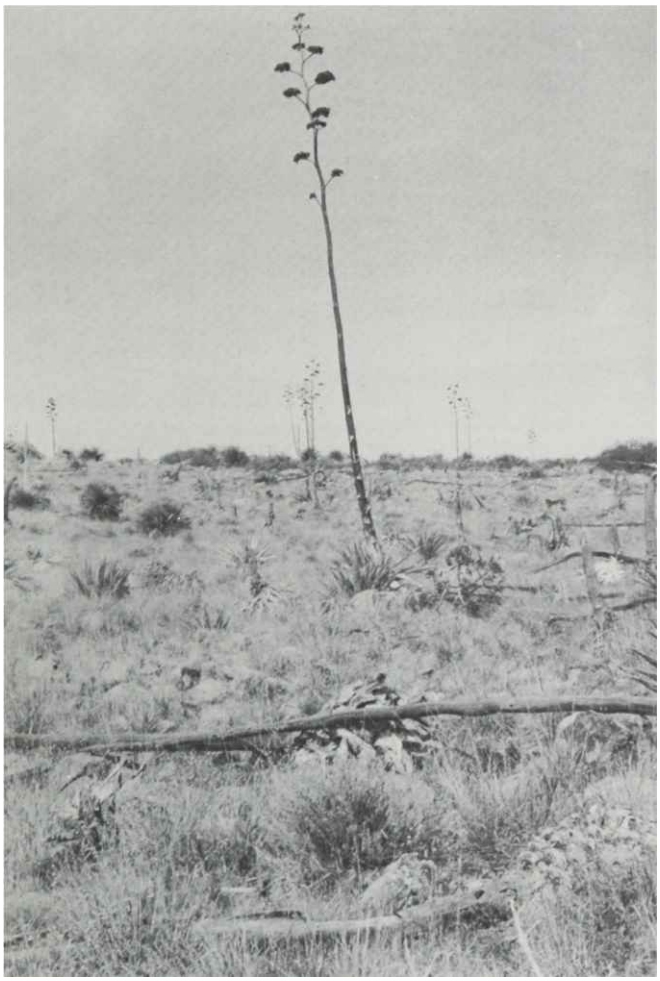
Upper Tuff. The most recent pyroclastic can be referred to as the Upper Tuff. It lies directly under the quartz latite flow which caps the mountain. It probably originated from the same vent as this lava on the northeastern side of the mountain. The Upper Tuff is a dacite-like crystal tuff. On a volume basis, only one-third of the rock is groundmass of devitrified glass dust, the remainder being phenocrysts and accidental inclusions.

The phenocrysts are about equally quartz and clay-altered plagioclase with a little orthoclase and biotite. Associated inclusions, ranging from few to many (sometimes up to one-third or more of the rock), are present which represent fragments of most of the previous Picketpost rocks.

Although the Upper Tuff is a dark tan, it weathers to an olivaceous rock which often appears greener because of the presence of lichens. It forms a vuggy layer with abundant quartz and chalcedony which almost rings the top of the mountain from about 3,400 feet elevation to 3,800 feet. It makes very prominent cliffs.



Aerial view of Picketpost Mountain from the northwest. **1:** *Superior and the "dacite" cliffs of Apache Leap are off the photo to the northeast.* **2:** *Townsite of old Pinal of the 1870's and 1880's. No buildings remain.* **3:** *Apache Tears Mine. A small entrance fee for collecting Apache Tears.* **4:** *Rockhound Wash.* **5:** *Pancho Plateau. Arnett Rhyolite with Hopbush (Dodonaea viscosa).* **6:** *Queen Creek Canyon with a riparian ribbon of Fremont Cottonwood (Populus fremontii), Arizona Ash (Fraxinus velutina) and Walnut (Juglans major). The north slope has pockets of Inland Chaparral with abundant Scrub Oak (Quercus turbinella) and rarer Holly-Leaf Buckthorn (Rhamnus crocea var. ilicifolia) and Mountain Mahogany (Cercocarpus betuloides). The south slope is a community of Saguaro (Carnegiea gigantea) and Paloverde (Cercidium microphyllum).* **7:** *Arboretum Visitor Center. Constructed in 1925 principally of Arboretum Sandstone and Arnett Rhyolite.* **8:** *Silver King Wash.* **9:** *Alkaline Conglomerate with Creosotebush (Larrea tridentata).* **10:** *Arboretum Pass. At this saddle the Arnett Rhyolite has eroded away leaving a low spot of crumbling Rhyolitic Tuff.* **11:** *Red-Speckled Andesite crops out west of the Arboretum entry gate.* **12:** *Author's residence at the foot of Water-Tower Hill, a knoll of Pinal Schist with abundant Buckwheat Bush (Eriogonum fasciculatum).* **13:** *Bosque of Mesquite in floodplain of Queen Creek.* **14:** *First Day Pass. A cleft (not visible in photo) provides restricted access by Arboretum personnel to the fenced experimental reserve. The brecciated zone of the Arnett Rhyolite flow is exposed in the pass.* **15:** *One-Seeded Juniper (Juniperus monosperma) on north slope.* **16:** *Happy Camp Wash. Desert Hackberry (Celtis pallida) on west slope.* **17:** *U.S. Hwy 60. The photo was taken before the new alignment.* **18:** *Cholla Plateau, with its namesake (Opuntia bigelovii, O. fulgida) and Hopbush (Dodonaea viscosa). The Eastern Tuff and Green-Spotted Sandstone crop out to the southwest.* **19:** *Telegraph Canyon.* **20:** *Vent from which the uppermost volcanics were extruded.* **21:** *Inland Chaparral with Mountain Mahogany (Cercocarpus betuloides).* **22:** *Heliograph Formation, a quartz latite extruded about 18 million years ago. The flat top is Semidesert Grassland with scattered copses of Scrub Oak (Quercus turbinella).* **23:** *Upper Tuff. Lichens often give a green tint.* **24:** *Picketpost Sandstone. Covered mostly with Jojoba (Simmondsia chinensis) but white ashy layer at the base on the west side of the mountain has a band of Creosotebush (Larrea tridentata).* **25:** *Diatreme-like tower of tuffisite (= intrusive "tuff") cutting bed of Picketpost Sandstone, probably by explosive drilling.* **26:** *Inland Chaparral of Scrub Oak (Quercus turbinella).* **27:** *Arnett Canyon.* **28:** *Older Basalt with Hummingbird Bush (Beloperone californica) and other plants not found elsewhere on the mountain.* **29:** *Ribbon of broad-leaved trees along Arnett Creek. Outer floodplain is covered with Mesquite (Prosopis velutina).* **30:** *Canyon Hackberry (Celtis reticulata) grows on moist sites on the mountain's north slope.* **31:** *Arizona Rosewood (Vauquelinia californica) is common in ravines.* **32:** *Selaginella and ferns occur on naturally terraced steep slopes.* **33:** *Lower Tuff.* **34:** *Alamo Creek.*



Semidesert Grassland grows on the Heliograph Formation at the top of Picketpost Mountain. Sotol (Dasylirion wheeleri) and Golden-Flowered Century Plant (Agave palmeri) are both abundant, as are scattered copses of Scrub Oak (Quercus turbinella). Photograph by David E. Brown.

Heliograph Formation. As mentioned previously, this name has been widely used at the Arboretum by students, staff and visiting scientists for the lava capping the mountain, the name having been proposed by Eleanor Nelson (1966) in an unpublished MS thesis. The lava of this formation intergrades with the Upper Tuff, so that it is obvious that the two represent different pulses of the same eruptive sequence. A Mt. Pelee type of explosive eruption of tuff followed by flowing of lava appears to have taken place.

The lava is a gray to brown or reddish rock. Where badly weathered it tends to resemble the Upper Tuff and sometimes this tuff is even found interbedded with it. Nevertheless, the two can usually be easily differentiated. The lava has prominent flow banding. It is prominently porphyritic, the phenocrysts of quartz, biotite, plagioclase and sanidine representing up to half of the volume of the rock. The remaining groundmass or matrix is usually glassy but occasionally aphanitic.

Associated with the normal rock of the Heliograph Formation is a glassy black to brown vitrophyre which cooled more quickly. Persons wishing more details on the geology of the Heliograph Formation and two interesting diatreme-like towers of tuff or tuffisite which seem to have intruded the other rocks on the north face of the mountain by explosive drilling, are referred to the excellent thesis by Nelson (1966).

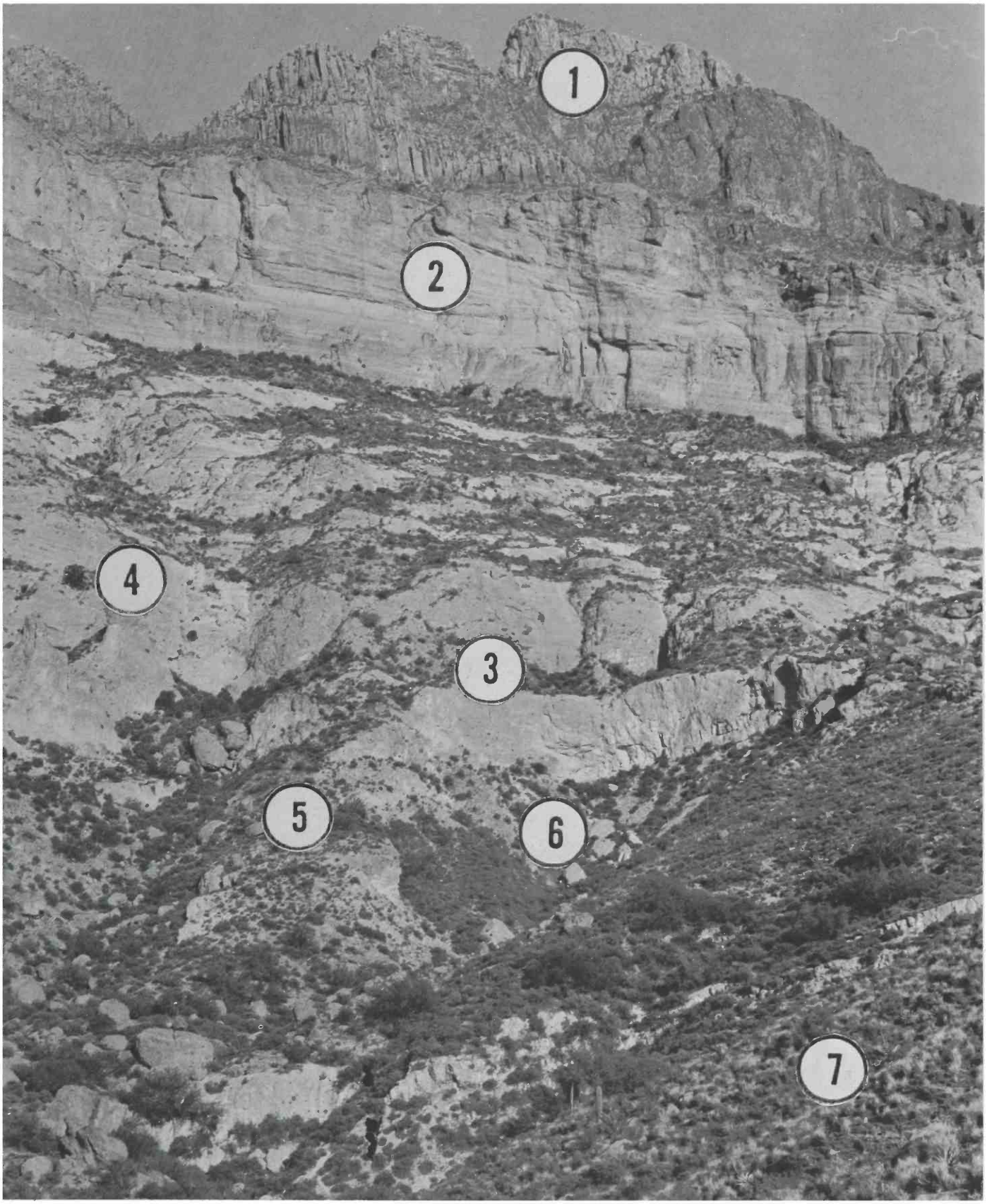
Vegetation.

The Picketpost site is commonly referred to as desert. Nevertheless, even toward the foot of Water-Tower Hill, only a few yards from U.S. Hwy. 69 (where desert conditions should be strongest at the bottom of the mountain), a tree of One-Seeded Juniper *(Juniperus monosperma)* grows naturally at 2,400 feet elevation. Perhaps only the astute observor sees it hidden behind other vegetation. If one climbs the north face of Picketpost the *Juniperus* becomes more abundant. The One-Seeded Junipers are harder to pick out with the naked eye than the Saguaro Cacti *(Carnegiea gigantea)* which are much more dramatic. Actually the community of Saguaro and Palo Verde *(Cerdidium microphyllum)* at Picketpost Mountain, practically the standard for the Arizona Upland portion of the Sonoran Desert, is characteristic of southern exposures indicating that the community is already a little marginal for the climate even at lower elevations of the mountain! The most common plant on Picketpost is probably Jojoba *(Simmondisia chinesis)*, although in specific locations Buckwheat Bush *(Eriogonum fasciculatum)*, Hopbush *(Dodonaea (viscosa)*, Scrub Oak *(Quercus turbinella)*, Arizona Rosewood *(Vauquelinia californica)*, Mountain Mahogany *(Cerocarpus betuloides)* and others are characteristic. For convenience, the vegetation of Picketpost will be discussed below starting at the top of the mountain and working down.

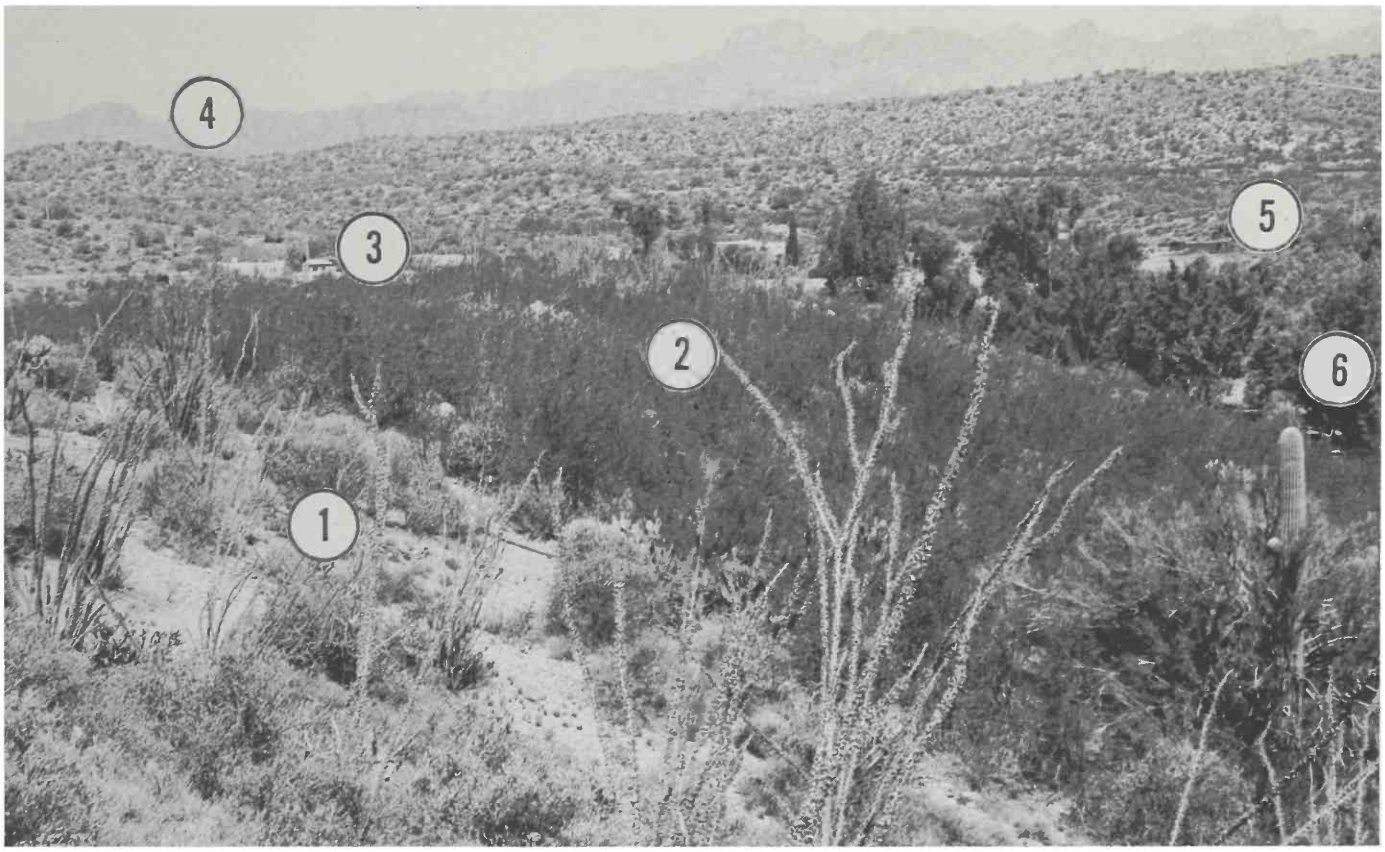
Semidesert Grassland. The top of Picketpost Mountain is covered with grass and has been classified by Brown (1982) as Semidesert Grassland. Aside from the numerous types of Grama Grass *(Bouteloua* spp.), Three-Awn *(Aristida* spp.), Lovegrass *(Eragrostis* spp.), Sacaton *(Sporobolus wrightii)* and Tobosa *(Hilaria mutica)*, there are thickets of Scrub Oak *(Quercus turbinella)* and abundant rosettes of *Agave*. Desert Spoon or Sotol *(Dasylirion wheeleri)* is not uncommon. The grassland formation on Picketpost is associated with but is not co-extensive with the Heliograph Formation. Although it is mappable as a discrete entity only on this rock, it occupies mostly the topographically flat portion of the formation.

Brown (1982, pg. 126) published a photograph of the grassland on Picketpost and expressed surprise that "one of the most prevalent grasses at this remote locale in 1977 was an introduced species, Lehman Lovegrass *(Eragrostis lehmanniana)*." Although Lehmann Lovegrass is famous as *the* grass that the U.S.D.A. Soil Conservation Service (SCS) has found so effective for soil stabilization and revegetation in the Southwestern United States, it was one of the first and most successful grasses which Arboretum Director Franklin J. Crider experimented with and planted in the Picketpost experimental reserve before the SCS was founded.

Indeed, the early work at the Arboretum in soil-retention by plant roots was instrumental in development of the Soil Conservation Service. Since the importance of conservation work at the Arboretum has not been well publicized, the opportunity to digress to this subject will be taken here. In starting the Arboretum, Founder Thompson and Director Crider believed that they might reverse the vicious cycle of de-vegetation on Picketpost referred to previously in this



View of the west face of Picketpost Mountain from a point due east of the old Picketpost Mine. **1:** *Quartz Latite or "dacite" of the Heliograph Formation.* **2:** *Upper Tuff.* **3:** *Picketpost Sandstone with Jojoba (Simmondsia chinensis).* **4:** *One-Seeded Juniper (Juniperus monosperma) at left.* **5:** *Creosotebush (Larrea tridentata) at right. Creosotebush can be traced along a white ashy very saprolytic layer at the base of the Picketpost Sandstone.* **6:** *Pioneer Shale.* **7:** *Pinal Schist. On this particular hill grasses predominate over the Buckwheat Bush (Eriogonum fasciculatum). Photograph by Carol D. Crosswhite.*



Abrupt transition between Pinal Schist with vegetation of Buckwheat Bush **(1)** *and Alkaline Conglomerate with Creosotebush* **(2)**. *View to the northwest across the bunkhouse used by visiting university classes and plant scientists* **(3)** *toward the Superstition Volcanic Field* **(4)**. *The Arboretum entry gate* **(5)** *and trees of the picnic area* **(6)** *are visible at the right. Photograph by Frank S. Crosswhite.*

article in the quotation by T. T. Swift, Supervisor of the Tonto National Forest. They reasoned that they should locate species of groundcovers which could live long enough on the damaged hillsides to hold back enough soil to allow other species to become established. Prior to development of SCS few scientists other than Crider had an interest in erosion control plants, or had facilities or funding to pursue such conservation work.

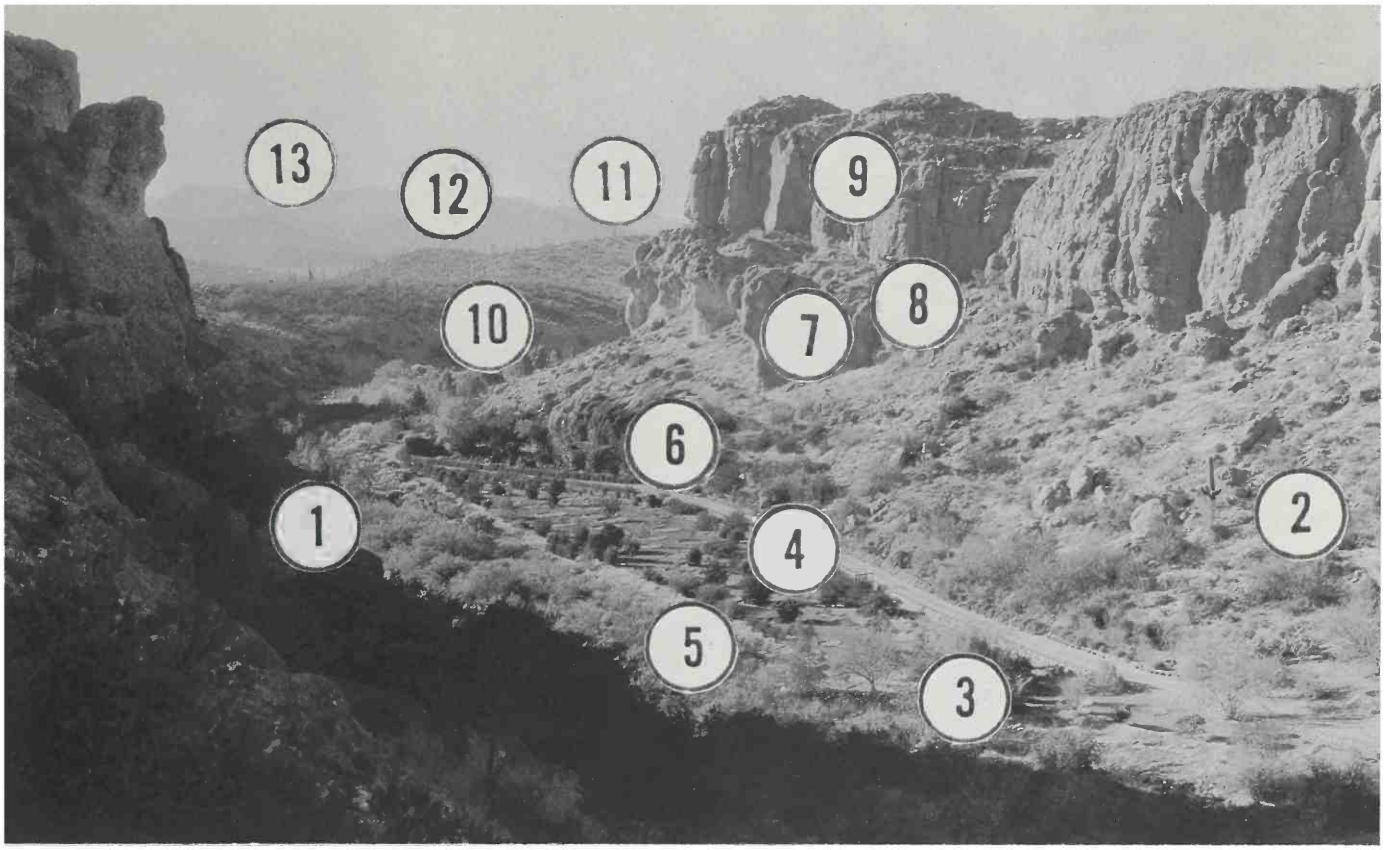
At the Arboretum Crider masterminded a conservation project of enormous proportions and later ramifications. After conducting extensive experiments in root growth using lysimeters, dry-land planting methods, and revegetation at the Arboretum for a number of years, he agitated widely for conserving soil by planting groundcovers on the land. He developed a cooperative program at the Arboretum whereby a large nursery of erosion control plants was established by the U.S. Forest Service for planting on government land where erosion had become a problem (largely due to overgrazing or destructive land use). Labor was provided by the Civilian Conservation Corps. The Arboretum through Thompsons' endowment paid for many of the physical improvements and most importantly provided technical know-how, seeds and cuttings. The Forest Service called this the "Arboretum Nursery."

This soil conservation nursery became so successful at the Arboretum that the federal government saw need of replicating it many times over across the United States. Success for Crider meant consolidation of the program under a new agency which became the U.S. Soil Conservation Service. In 1934 Crider left the Arboretum to become one of the founding fathers of this new government agency. He worked for many years at SCS in charge of the Plant Materials section headquartered at Beltsville, Maryland. When the achievements of Founder Thompson, Director Crider, and the Arboretum are finally added up, it must be reckoned that they contributed a major impetus to formation and success of the U.S. Soil Conservation Service.

Mountain Mahogany and Hackberry Scrubland. A Chaparral formation with characteristic Mountain Mahogany *(Cercocarpus betuloides)*, Hackberry *(Celtis reticulata)*, One-Seeded Juniper *(Juniperus monosperma)* and Scrub Oak *(Quercus turbinella)* is seen on the north slope of Picketpost. It extends from about 3,000 feet elevation to 4,200 feet.

Although perhaps most common on the eroded slopes of the Heliograph Formation, it also occurs on the Upper Tuff and on some of the Picketpost Sandstone. It seems to have a dis-affinity for the Arnett Rhyolite, where it is largely replaced in similar habitats by Oak Scrubland or in more xeric sites by Hopbush and Cholla Scrubland.

Oak Scrubland. This vegetation type is beautifully developed on the north side of the montain. It extends from about 2,500 feet elevation up to 3,200 feet. The characteristic species is the Scrub Oak *(Quercus turbinella)*, also found at higher elevation in the Mountain Mahogany and Hackberry Scrubland. *Quercus turbinella* is the species par excellence for Interior Chaparral in Arizona. In both Sonora and Arizona *Quercus turbinella* goes by the Spanish designation "Chaparro." Vegetation types are designated by Spanish-speaking plant scientists by adding the suffix -al to the end of a plant name.



Queen Creek Canyon looking west. **1:** *North-facing community of Scrub Oak (Quercus turbinella) and Arizona Rosewood (Vauquelinia californica) on Arnett Rhyolite and Rhyolitic Tuff. Mountain Mahogany (Cercocarpus betuloides) and Holly-Leaf Buckthorn (Rhamnus crocea var. ilicifolia) are also present on the slope but not common.* **2:** *South-facing community on the same geologic material. Paloverde (Cercidium microphyllum), Saguaro (Carnegiea gigantea) and Opuntia (both Prickly Pear and Cholla) are common.* **3:** *Note the rock wall to the left built as a flood control device so the upper floodplain could be used for Arboretum purposes.* **4:** *Young Arboretum plantings in 1929.* **5:** *Mesquite (Propsopis velutina) and other riparian plants along Queen Creek.* **6:** *Cave House. The old Clevenger Homestead.* **7:** *Rhyolitic Tuff (the undercut portion of the lower cliffs).* **8:** *Lower brecciated zone of the Arnett Rhyolite (the more resistant material capping the lower cliffs).* **9:** *Perlite zone of the Arnett Rhyolite.* **10:** *Alkaline Conglomerate with Creosotebush (Larrea tridentata) predominant.* **11:** *Directly below is Water-Tower Hill, composed of Pinal Schist with Buckwheat Bush (Eriogonum fasciculatum) predominant.* **12:** *The hill directly below has been quarried for Arboretum Sandstone. Blackfoot Daisy (Melampodium leucanthum) is more abundant on the sandstone and associated Rhyolitic Tuff than elsewhere. Between the quarry and the Pinal Schist (on the right) is a hill (just below the horizon) of Red-Speckled Andesite.* **13:** *Hills in the distance are mostly of Pinal Schist.*

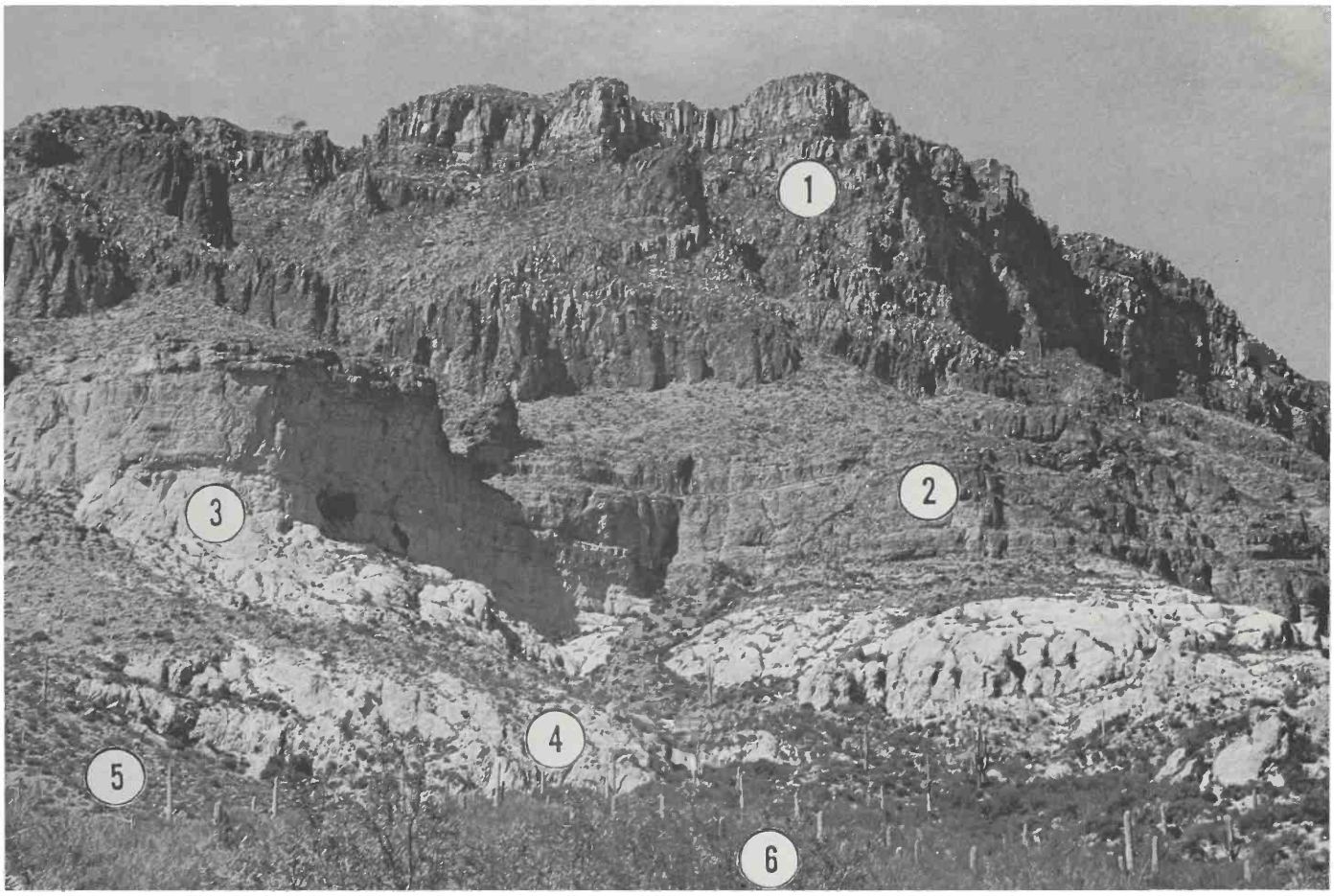
Thus Pinal indicates vegetation of *Pinus* and Chaparral indicates vegetation of Scrub Oak.

On Picketpost the Oak Scrubland shows an affinity for Arnett Rhyolite and Rhyolitic Tuff. A good place to observe this plant community is along the "High Trail" in the Arboretum on the north-facing cliff of Queen Creek Canyon. Sometimes the Oak Scrubland of Picketpost consists of little more than dense clumps of Scrub Oak. Often the Oak is intermixed somewhat with Jojoba *(Simmondsia chinensis)*, the Oak occupying what seem to be the colder and wetter microhabitats. One-Seeded Juniper *(Juniperus monosperma)* is sometimes present even as low as the Queen Creek cliffs, as are an occasional Mountain Mahagony *(Cercocarpus betuloides)* and Holly-Leaf Buckhorn *(Rhamnus crocea* var. *illicifolia)*, even on rhyolite exposures.

Rosewood Scrubland. The previous two scrubland vegetation types are considered to be facies of the Interior Chaparral described by Brown (1982). The Rosewood Scrubland and the succeeding five vegetational units are here considered to be facies of Sonoran Desertscrub because of their seemingly more subtropical nature. To students of vegetation in other countries they might be too luxuriant and have parameters of "groundcover" too high to qualify as true desert plant communities.

The Rosewood Scrubland of Picketpost consists of stands of Arizona Rosewood *(Vauquelinia californica)* intermixed with Jojoba *(Simmondsia chinensis)*. These occur on slopes and in ravines. On the south side the facies follows ravines from about 3,000 feet elevation up to 4,200 feet. On the north side it extends from 2,500 feet to about 3,800 feet. It occurs on Arnett Rhyolite, several tuffs, some of the Picketpost Sandstone, and some of the Heliograph Formation.

Jojoba Scrubland. Jojoba *(Simmondsia chinensis)* is probably the most common plant on Picketpost Mountain. It



View looking north at the south side of the mountain. **1:** *Quartz Latite lava of the Heliograph Formation. On this southern exposure Saguaro (Carnegiea gigantea) extends practically to the top of the formation.* **2:** *Upper Tuff. Arizona Rosewood (Vauquelinia californica), Desert Lavender (Hyptis emoryi), and Jojoba (Simmondsia chinensis) are found on steep slopes, grasses on the flatter, more eroded areas.* **3:** *Southern Tuff. Rhyolite Bush (Crossosoma bigelovii) is common.* **4:** *Picketpost Sandstone. Mormon Tea (Ephedra sp.) is present.* **5:** *The Saguaro forest on the southern base of the mountain is mostly on Apache Diabase.* **6:** *Mesquite (Prosopis velutina) marks ground at about 3,000 feet elevation near the beginning of a wash extending west to Alamo Creek. Seepwillow (Baccharis glutinosa) and true Willow (Salix sp.) are common in the wash on Apache Diabase, Pioneer Shale and Pinal Schist. Photograph by Frank S. Crosswhite.*

grows as a part of many of the other vegetation types. It does, however, tend to make rather pure stands which ring the mountain at about 3,200 feet to 4,200 feet on the south and east side and 2,800 feet to 3,600 feet on the north side, with rather pure lenses extending down to almost 2,600 feet on the west slope on Pinal Schist.

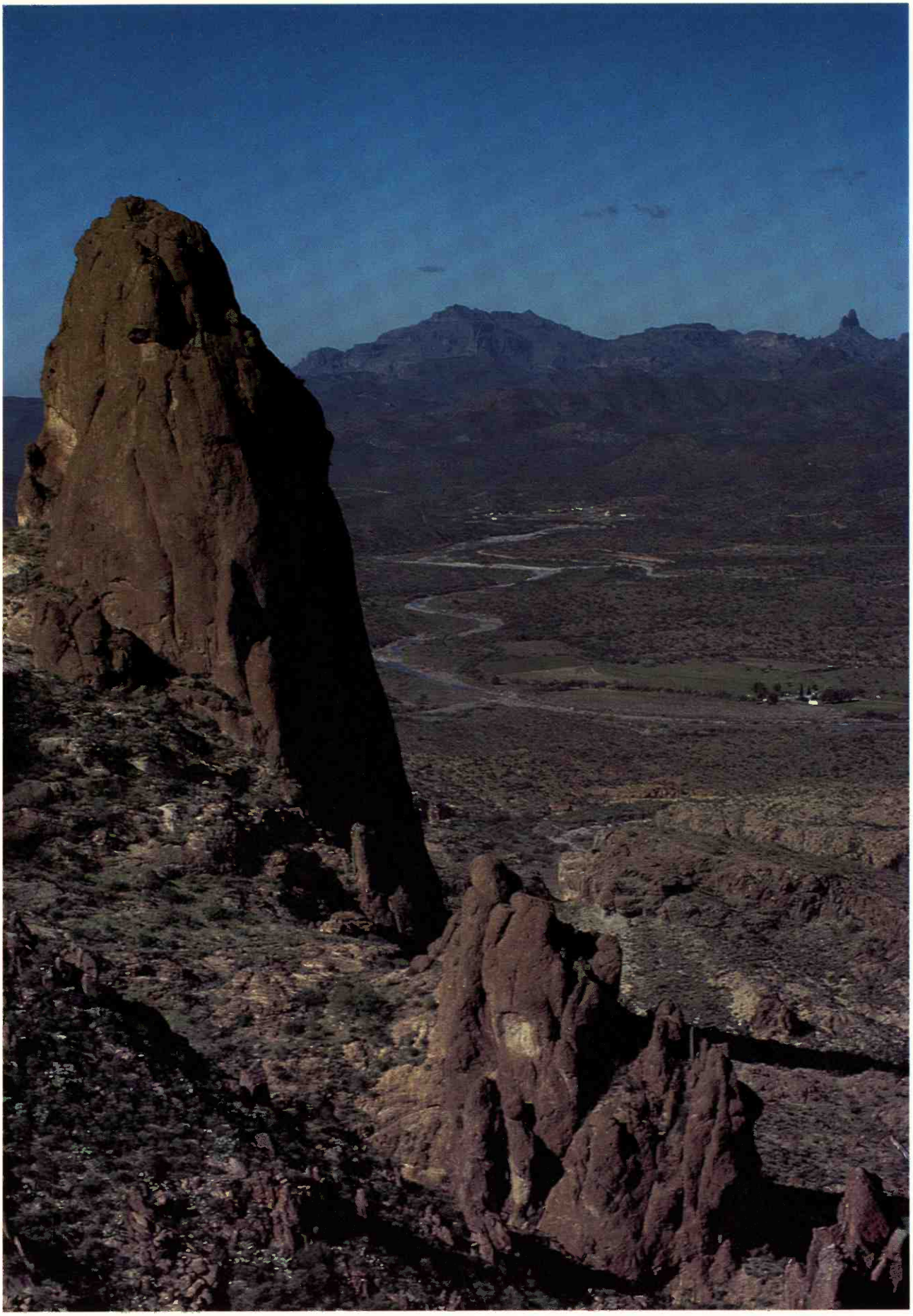
The purest stands seem to be on Arnett Rhyolite, the higher elevation tuffs, and parts of the Heliograph Formation. On the north side of the Mountain Jojoba does less well on the upper reaches of the Heliograph formation, Upper Tuff and Picketpost Sandstone. This is probably because of the cold winter temperatures since it thrives on similar rocks on the south side of the mountain.

Hopbush and Cholla Scrubland. One of the clearest correlations on Picketpost Mountain is the fit of this plant community with the Arnett Rhyolite. Characteristic are Hopbush *(Dodonaea viscosa)* and Chain-Fruit Cholla *(Opuntia fulgida)*. As in the case of Jojoba, these plants grow in some of the communities other than the one in which they are most common. An extremely strong relationship (as might be suggested by the name) is that of Rhyolite-Bush *(Crossosoma bigelovii)* for the rhyolite and rhyolitic tuffs. It is not found on any of the other rocks of the mountain.

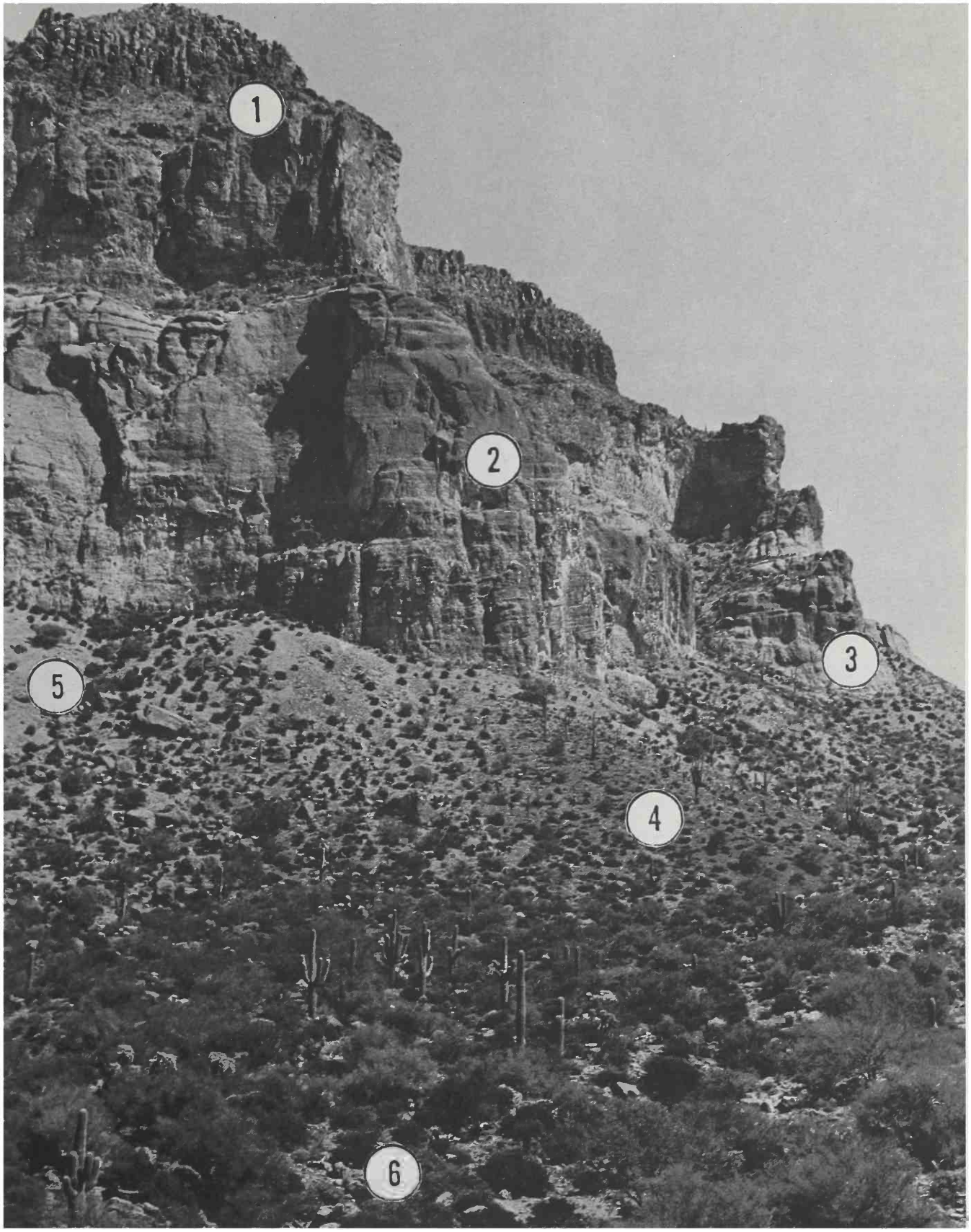
Characteristics of the Arnett Rhyolite to which certain plants seem well adapted are the shallow (or almost non-existent) soil and slightly acid rock. Ocotillo *(Fouquieria splendens)*, Compass Barrel Cactus *(Ferocactus acanthodes* var. *eastwoodiae)*, and Green-Flowered Pincushion Cactus *(Mammillaria viridiflora)* are other common plants, as are *Graptopetalum rusbyi*, Resurrection Plant *(Selaginella)*, and various ferns. The Hopbush and Cholla Scrubland is present through much of the Arboretum and can be nicely viewed at Ayer Lake.

Buckwheat Bush and Jojoba Scrubland. This is the community characteristic of the Pinal Schist. The most common plants are Buckwheat Bush *(Eriogonum fasciculatum)* and Jojoba *(Simmondsia chinensis)*, with occasional Fish-Hook Barrel Cactus *(Ferocactus wislizenii)*, Fish-Hook Pincushion Cactus *(Mammillaria microcarpa)*, Blackfoot Daisy *(Melampodium leucanthum)* and the fern *Notholaena sinuata.*

Buckwheat Bush and Jojoba Scrubland is common on the western side of Picketpost from about 2,400 feet to 3,400 feet elevation. It is also very common away from the mountain to the west. At the Arboretum it occurs on Water-Tower Hill. It



View from the north side of Picketpost Mountain, looking down across Queen Creek to the Superstition Mountains. The rock represents the remains of an intrusive tuffisite which formed from explosive drilling through older rock formations which later eroded away. Photo by Les Ely.



View looking east at the southwest corner of the mountain. **1:** *Quartz Latite.* **2:** *Upper Tuff.* **3:** *Picketpost Sandstone.* **4:** *Apache Diabase with Saguaro (Carnegiea gigantea) and Teddy-Bear Cholla (Opuntia bigelovii).* **5:** *Here and to the north (left) lies a nice stand of Semidesert Grassland on talus mostly of Upper Tuff.* **6:** *Paloverde (Cercidium microphyllum) and Jojoba (Simmondsia chinensis) on Precambrian rocks. The photographer is standing near an outcropping of Barnes Conglomerate, with Pinal Schist to the west and Apache Diabase to the east. Boulders fallen down from the mountain are also present and consist mostly of Upper Tuff and Quartz Latite. Photograph by Frank S. Crosswhite.*

also crops out along the trail to Arboretum Pass opposite the hill of Alkaline Conglomerate.

Saguaro and Palo Verde Scrubland. This is primarily a south-slope community at Picketpost, the characteristic plants being found where the sun hits fairly directly in the winter. The correlation is quite striking from an airplane or when looking down from the top of the mountain. Although the community is quite common on the south side of the mountain on Apache Diabase, it occurs on schist, rhyolite and various tuffs if hit directly by the winter sun from the south. Many south-facing exposures are present even on the north side of the mountain, particularly on the south-facing cliffs of Arnett Canyon and Queen Creek Canyon, where beautiful formations of the community occur.

The characteristic plants are the Saguaro Cactus *(Carnegia gigantea)* and Palo Verde *(Cercidium* spp.*)*, with Brittlebush *(Encelia farinosa)*, Mormon Tea *(Ephedra)*, *Trixis californica* and numerous spring wildflowers. Where this community occurs on the Older Basalt in Arnett Canyon, there are plants not seen on other rocks of Picketpost, Hummingbird Bush *(Beloperone californica)* being a good example. Experimentally we find that Saguaro will survive when put in a freezer at 25°F for intervals up to about 30 hours duration. To achieve freezing temperatures for this length of time in nature the air temperature would have to remain freezing through an entire day. Therefore, wherever the Saguaro and Palo Verde Scrubland occurs on Picketpost, we believe that there has not been a continuous day of freezing weather.

Creosotebush and Bursage Scrubland. Visitors to the Arboretum are often startled to discover that Creosotebush *(Larrea tridentata)* and Bursage *(Ambrosia deltoidea)*, so common in the valleys of the Phoenix and Tucson regions, are rare plants on Picketpost Mountain. An excellent example of Creosotebush and Bursage Scrubland does exist, however, on the Alkaline Conglomerate at the Arboretum. This community, complete with the sounds of its characteristic insects, can be observed on either the hill directly east of the new Arboretum parking lot or at the beginning of the High Trail opposite the picnic area. In each instance the plant community abruptly ends where the rock type changes, making classic text-book examples of geologic influence on vegetation types. The Creosotebush is never found on other rocks of Picketpost such as Arnett Rhyolite, Pinal Schist, etc.

Broadleaf Forest. This is a subdivision of what Brown (1982) referred to as Sonoran Riparian Deciduous Forest. It is associated with the Quaternary Alluvium of the bottoms of the canyons having steep walls. On the east side of the mountain it is found in the bottom of Telegraph Canyon and on the north side in Arnett Canyon and Queen Creek Canyon. Characteristic trees are Fremont Cottonwood *(Populus fremontii)* and Arizona Ash *(Fraxinum velutina)* with occasional Arizona Walnut *(Juglans major)* and Arizona Sycamore *(Platanus wrightii)*.

Mesquite Bosque. This is a forest of Velvet Mesquite *(Prosopis velutina)* and Catclaw *(Acacia greggii)* with an admixture of Desert Hackberry *(Celtis pallida)*, Tomatillo *(Lycium)*, and other shrubs. It replaces the Broadleaf Forest where canyons have less steep walls and often grows on the floodplain between the Broadleaf Forest and the canyon wall when the canyons have steeper walls. The amount of sunlight and water relations are the determining factors.

This community follows Alamo Creek on the west side of the mountain and is common on the lower parts of both Arnett Creek and Queen Creek. Interestingly, it is present in the upper part of Telegraph Canyon rather than the lower because the upper canyon lies on the south and southwestern side of the mountain where the sun hits more directly.

Sonoran Interior Marshland. To make this treatment of the vegetation complete, some mention should be made of the beautiful example of Sonoran Interior Marshland at Ayer Lake in the Arboretum. Characteristic plants are Cattails *(Typha domingensis)* and Bulrushes *(Scirpus)*.

Concluding Remarks

History of the Picketpost region recorded on paper goes back 115 years to the time of General George Stoneman who later became Governor of California. History of the region recorded in stone goes back a fascinating two billion years. Even the most durable of stones in the geologic history of the mountain has fallen victim to the forces of erosion and weathering. Many different cycles of rock formation and destruction have taken place. Interestingly, there is now no trace of the bustling metropolis of Pinal with its two-story buildings, stores, hotels, mills, bawdy houses and "permanent" dwellings which rode the rugged hip of Picketpost less than a hundred years ago.

Exactly midway between the time of General Stoneman and the present, William Boyce Thompson established an Arboretum on the northern shoulder of the mountain to promote arid land plant studies and conservation. Visitors to the Arboretum can examine a wide variety of natural plant communities growing on various rock types.

References

Barnes, Will C. 1960. *Arizona Place Names.* Revised edition by Byrd H. Granger. University of Arizona Press. Tucson.

Brown, David E. (editor). 1982. Biotic communities of the American Southwest—United States and Mexico. *Desert Plants* 4: 1-341.

Crosswhite, Frank S. and Carol D. Crosswhite. 1982. The Sonoran Desert. pp. 163-319. In Gordon L. Bender (editor), *Reference Handbook on the Deserts of North America.* Greenwood Press. Westport, Connecticut.

Melton, M.A. 1965. The geomorphic and paleoclimatic significance of alluvial deposits in southern Arizona. *J. Geol.* 73: 1-38.

Nelson, Eleanor W. 1966. *Geology of Picketpost Mountain.* MS thesis. University of Arizona. Tucson.

Peterson, Donald W. 1968. Zoned ash-flow sheet in the region around Superior, Arizona. *Arizona Geological Society Southern Arizona Guidebook* III: 215-222.

Ransome, F.L. 1903. *Geology of the Globe Copper District, Arizona.* U.S. Geol. Surv. Prof. Paper 12. 168 pp.

Sell, James D. 1968. Correlation of some post-Laramide Tertiary units. Globe (Gila County) to Gila Bend (Maricopa County) Arizona. *Arizona Geological Society Southern Arizona Guidebook* III: 69-74.

Shafiqullah, M., H. W. Peirce, and P. E. Damon. 1975. Rate of structural and geomorphic evolution of the southern margin of the Colorado Plateau in Arizona. *Geol. Soc. Amer. Cordilleran Sect. Abstracts with Programs* 7(3): 373-374.