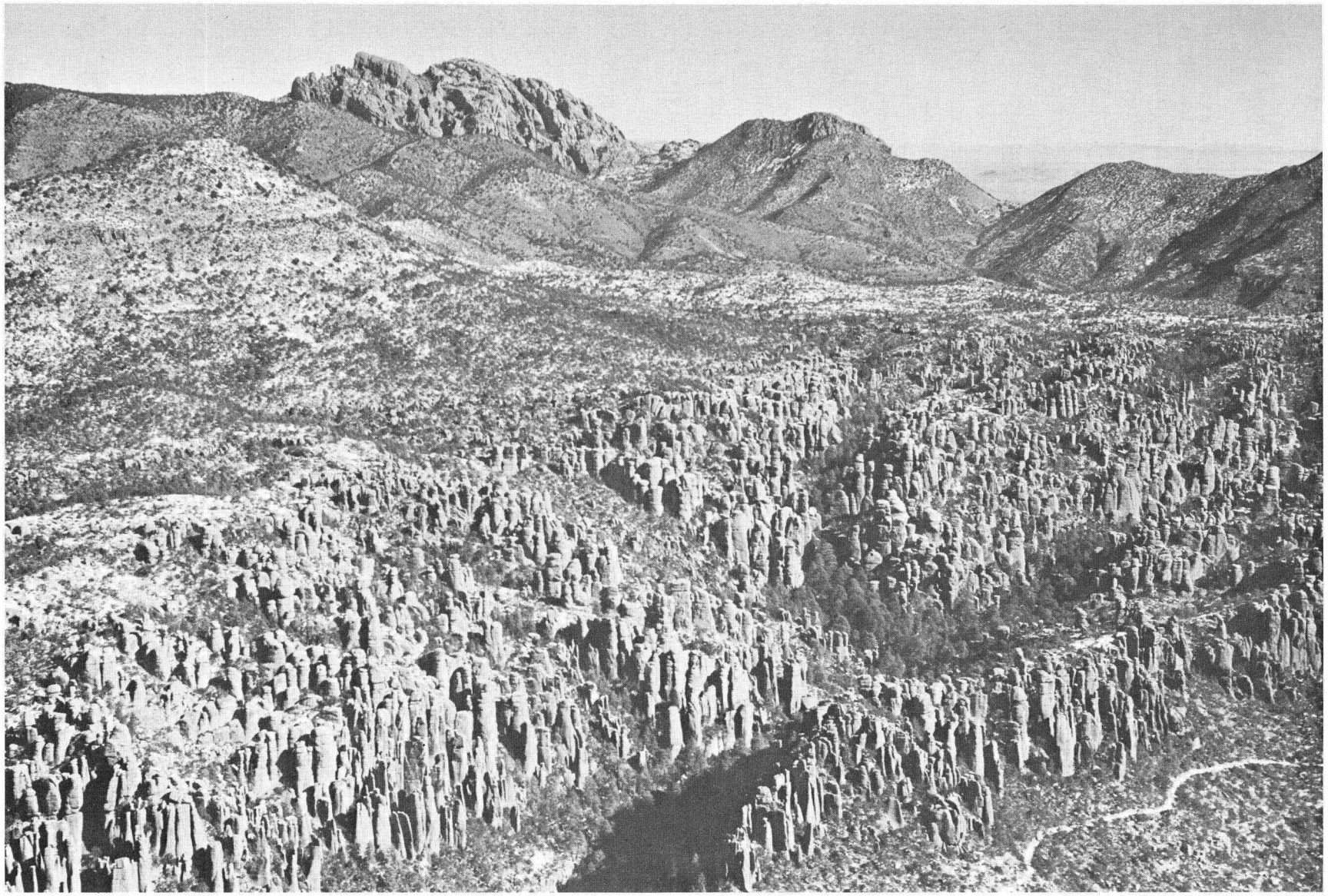

FIGURE 24. Cochise Head and Rhyolite Canyon, Chiricahua Mountains, Arizona, from southwest. Columns were eroded from welded tuffs of Rhyolite Canyon formation; Cochise Head is composed of Faraway Ranch formation; dark hills in middle distance are Precambrian, Paleozoic, Mesozoic, and probable Tertiary rocks in thrust complex. Conical peak on right is Sugarloaf Mountain, remnant of a thick rhyodacite flow. Photo by Tad Nichols.

# VOLCANIC GEOLOGY OF THE NORTHERN CHIRICAHUA MOUNTAINS

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Volcanic rocks, of probable Tertiary age, in the Chiricahua National Monument and the northern Chiricahua Mountains (figs. 24, 48), were described in recent publications by Enlows (1955) and by Sabins (1957b). The volcanic rocks are exposed in two structural blocks. The lower one, occupying the crest and eastern slope of the mountains, contains only the two older units, the Nipper and Faraway Ranch formations, overlying older rocks. This block has been overridden from the west by a complex of thrust slices in which Nipper overrides Faraway Ranch; a slice of formations, ranging in age from older Precambrian to Cretaceous, overrides Nipper; this slice, in turn, is overlain again by Nipper and Faraway Ranch; and finally, overlying all, the Rhyolite Canyon formation, which seems to post-date the youngest thrusts, rests unconformably on Faraway Ranch (fig. 25).

According to Sabins (1957b), the older volcanic Nipper and Faraway Ranch formations may have been extruded after the oldest thrust faults of the post-Comanche orogeny had been formed, but these rocks are obviously displaced by the younger thrusts. If Sabins is correct, completion of the first thrust movements may have set the stage for the onset of volcanism. The relief caused by these orogenic adjustments had at least partially eroded away, prior to the first eruptions, because the volcanic rocks accumulated on an erosion surface that bevelled Paleozoic and Comanche (Bisbee) sediments. The very earliest volcanic rocks, basic to intermediate in composition, were themselves debris from the erosion of some fairly distant volcanic source. Interlayered with this detritus is some material derived from Paleozoic or other sediments. As time went on lava flows were added to the accumulating Nipper formation.

The sombre-hued Nipper formation is the basal unit of the sequence. Its lower half is a thick conglomerate of poorly sorted, well rounded andesitic and possibly basaltic cobbles and boulders in a matrix of graywacke sandstone. Similar conglomerates, higher in the section, are interstratified with dark green augite basalt flows and graywacke sandstones. At one locality, a 20-foot bed of Paleozoic limestone conglomerate appears in the sequence. Light-weathering, aphanitic andesite flows comprise much of the upper part of the formation.

The Nipper volcanic rocks, more restricted in outcrop than any of the others, crop out in three areas. One of these areas is in the lower, eastern structural block, below the western thrust slices. In this area is the peculiar, prominent hill known as the Nippers from which Sabins named the unit. The basic to intermediate volcanic rocks of this area are overlain by the Faraway Ranch formation. The second exposure, just west of Cochise Head, is near the base of the thrust slices, where the formation overrides Faraway Ranch rocks and has been overridden, in turn, by rocks ranging in age from Precambrian to Comanche. In the third area, west of Maverick Peak, Nipper lies unconformably on older rocks and is in turn overlain in normal sequence by the Faraway Ranch and Rhyolite Canyon formations.

The Faraway Ranch formation was named by Enlows, (1951) after Faraway Ranch, just west of Chiricahua National Monument. This formation overlies the Nipper rocks, is much more widespread, and is easily distinguished from the dark, underlying volcanic rocks by its much lighter color. Most of the formation consists of pale, reddish-brown-weathering rhyolite and rhyodacite flows and agglomerate.

At least 2,000 feet of the flows are exposed at Cochise Head. The agglomerate contains angular fragments of dark, basaltic rock in a tuffaceous matrix. Two basalt flows, separated by a clay-veneered, irregular surface, are known in the formation as well as local lenses of stream-deposited tuff and lacustrine deposits. Some of the lacustrine deposits are red, clastic sediments overlain by medium- to thin-bedded white sandstone. Others are light-colored and include fresh-water limestone. Sabins (1957b) suggested that the lakes, in which these sediments accumulated, were formed where volcanic flows blocked stream channels.

The Faraway Ranch formation thickens southward toward the present high part of the Chiricahua Mountains, thus suggesting a southern source. As already mentioned, these rocks rest on the Nipper formation in the lower, eastern structural block as well as on the western complex of thrust slices. Obviously, both Nipper and Faraway Ranch rocks were displaced by the younger post-Comanche thrusts, and both formations were penetrated by siliceous intrusions of probable Tertiary age. It is evident that the resulting relief was then reduced before any further volcanic outpourings. Enlows (1955) called attention to the angular unconformity between the Faraway Ranch and Rhyolite Canyon formations.

Most of the eruptions that spread their products over this new erosion surface must have given rise to glowing clouds or nuées ardentes. These are emulsion-like mixtures of incandescent dust, larger particles, and gas. These mixtures form dense clouds that flow very rapidly down even a very gentle slope, leaving deposits in which the hot, plastic fragments flatten, weld together, and become arranged in ill-defined planes (eutaxitic structure) parallel to the surfaces over which the glowing clouds advance. The resulting deposits are called welded tuff, or ignimbrite.

Photographs of nuées ardentes show that, whereas the cloud as a whole advances over the ground, much dust and ash rise high into the air, forming great cauliflower clouds. This cooled ash falls back on the main, welded deposit, so that many welded tuffs are somewhat friable in their upper portions where they also lack the eutaxitic structure.

Eruptions of glowing clouds were first observed, in modern times, at Mont Pelée, Martinique (Lacroix, 1904; Perret, 1937), and at Komagatake, Japan (Kozu, 1934). Welded tuff has been described from many localities, (Moore, 1934; Marshall, 1935; Mansfield and Ross, 1935; Gilbert, 1938; Williams, 1942; Westerveld, 1943, 1947; Cotton, 1944; Fenner, 1948). For the welded tuffs of Chiricahua National Monument, Enlows (1955) proposed the name Rhyolite Canyon formation after Rhyolite Canyon in which these rocks are well exposed (fig. 24).

Enlows has recognized nine members in the Rhyolite Canyon formation. Seven of these are welded rhyolite tuff, one is rhyolite tuff, possibly resulting from an ash shower, and the uppermost is a rhyodacite flow, 220 feet thick, which caps Sugarloaf Mountain. Combined maximum thicknesses of the nine members, as measured by Enlows, total 1927-1/2 feet. One of the welded tuff members attains a maximum thickness of 880 feet. Some of the dense, firmly welded tuffs grade upward into less coherent tuffs. The several members thicken and thin in various directions, and Enlows has suggested several sources.

The Rhyolite Canyon formation is found only in the western structural block, above the thrust slices and above the Faraway Ranch formation. The welded tuffs appear not to have been affected by the post-Comanche thrusting or penetrated by the Tertiary siliceous intrusions, but they were displaced by normal faults of the Pliocene

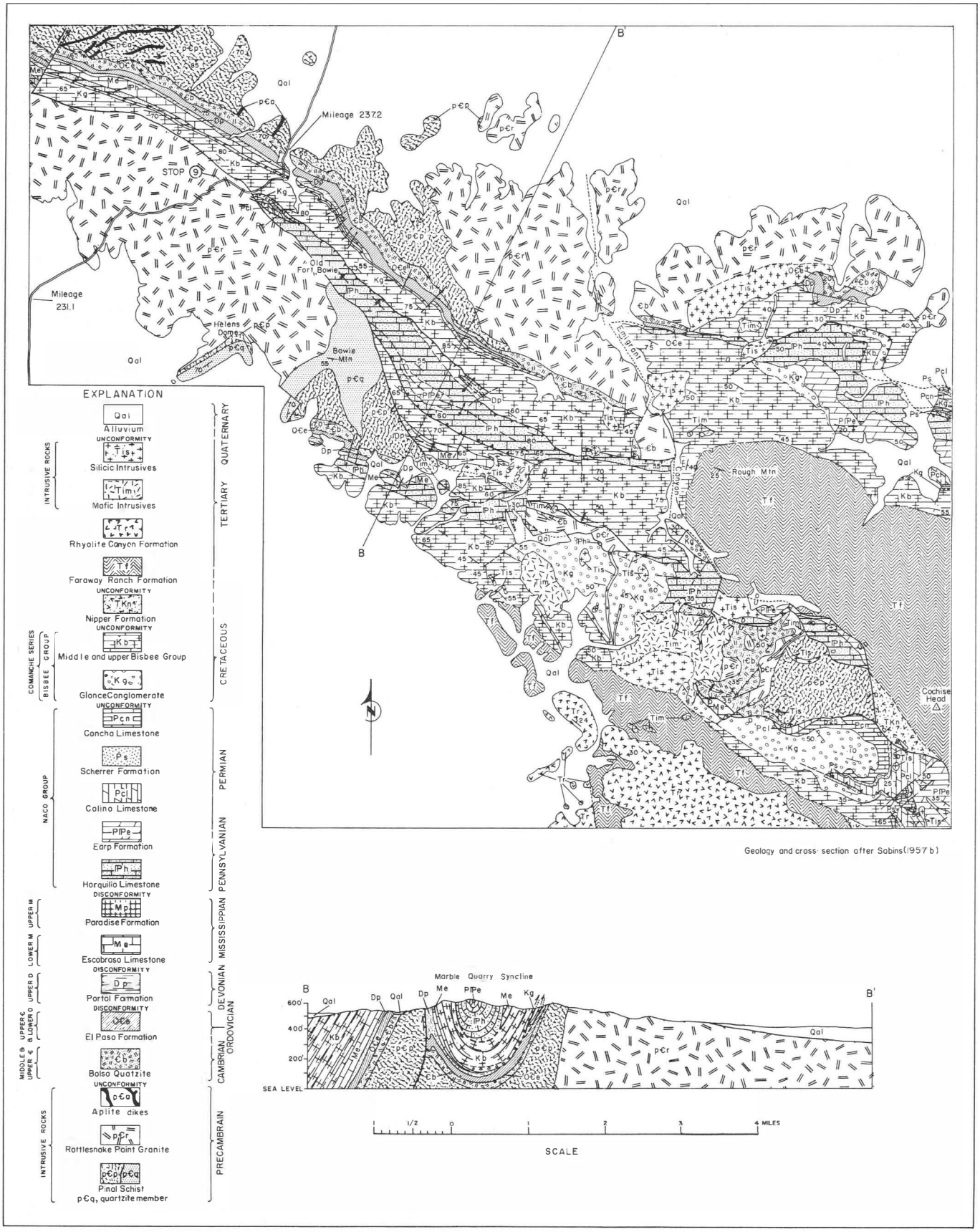


FIGURE 25. Geologic map and cross section of area between Apache Pass and Cochise Head, Chiricahua Mountains, Cochise County, Arizona (after Sabins, 1957b).

(?) Basin and Range orogeny. A probable correlative of this formation has been described by Guillerman (1958) in the central Peloncillo Mountains east of the Chiricahuas.

Once more the relief caused by orogeny is slowly eroding away. Deep canyons have been cut into the volcanic rocks. The welded tuffs, especially the 880 foot member, have yielded to erosion in an unusual manner, with the development of a pinnacled surface displaying an exquisite, almost lacy detail. This is the so-called "Wonderland of Rocks," the principal scenic feature of Chiricahua National Monument.