13.0 Cross bridge with good view to left of Red Rocks and Pyramid Mountain at 9:30, and the Jurassic section. **1.2**

14.2 Upper Triassic Owl Rock Formation roadcuts for the next 0.7 miles. **0.2**

14.4 Red Rock Park to left. **0.8**

15.2 Bridge over rail lines to Fort Wingate Army Depot. Originally a cavalry outpost established in 1862, Fort Wingate was deactivated in 1911, and was reopened as Wingate Ordnance Reserve Depot in 1918 and essentially closed again in 1992 (see Heckert et al. minipaper below). Fort Wingate is now run principally by White Sands Missile Range and serves to launch missile tests to White Sands. Note hogback exposure at 4:00. 0.5

15.7 Bridge over road to headquarters of Fort Wingate Army Depot. Note prominent tree-covered dipslope developed in the Upper Triassic Sonsela Member of the Petrified Forest Formation (Chinle Group) ahead and to the south of the highway. Strike valley is in the overlying Painted Desert Member. Dozens of above ground ammunition storage facilities called "igloos" dot the dipslope and are separated by depressions (bunkers). **1.3**

17.0 Sign for McGaffey, exit 33. **Prepare to exit to right. 1.1**

18.1 **Take exit 33**, NM Highway 400 to McGaffey. **0.2**

18.3 Stop sign. **Turn right** to go south on NM-400. **0.1**

18.4 Go straight south past turn for I-40 eastbound. **0.2**

18.6 Cross South Fork Creek. **0.7**

19.3 New entry road to Fort Wingate Army Depot on right. Drive up Sonsela dipslope. **0.3**

19.6 Crest cuesta, town of Fort Wingate ahead. Roadcuts developed in the Sonsela Member. **0.2**

19.8 Contact (Tr-4 unconformity of Lucas, 1993) between the Sonsela Member and the underlying Blue Mesa Member on right. Today's trip will focus on the Triassic section through stop 3 (Fig. 2.3). **0.2**

20.0 White sandstone to right is base of the Blue Mesa Member over redbeds of the underlying Upper Triassic Bluewater Creek Formation at the Fort Wingate Army Depot's small-arms shooting range (Fig. 2.4). **0.4**

20.4 Note Hogback near Gallup to right in distance. **0.2**

20.6 Enter town of Fort Wingate. The town (population about 950) grew up next to the military installation of the same name in the 19th century and has continued to the present, long after the fort ceased to host soldiers. The town's schools and other facilities serve the surrounding rural areas (Julyan, 1996). **0.6**

21.2 Historical marker on left for Fort Wingate. The old cavalry fort is to left behind Fort Wingate Veterans Park. Fort Wingate's history (Fig. 2.5) is detailed in the accompanying minipaper. **0.3**

FROM BEAR SPRING TO FORT WINGATE

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The area known today as Fort Wingate has had a long and complicated history of multicultural occupation and conflict. Nearby springs were frequented by traveling and war parties of Zuñi and Diné (Navajo) people, and the Zuñi referred to the place as "Anshe Kyana." Bears were often sighted at the springs as well, so this locality was known to Navajos as "Shash bitoo," and later to New Mexicans as "Ojo del Oso" (Van Valkenburgh, 1941).

The fort was first established at Bear Spring near the present-day town (mile 21.2 of the road log) and named Fort Fauntleroy by its commanding officer, Colonel Thomas T. ("little lord") Fauntleroy in 1860. When the Civil War began, however, Colonel Fauntleroy cast his lot with the Confederate Army, and the fort was quickly renamed Fort Lyon in 1862, after Brigadier General Nathaniel Lyon, an early casualty of the fighting on the Union side. Later that year the fort was abandoned, and Union troops pulled back to a site near Ojo del Gallo, about 5 mi south of present Grants, near the town of San Rafael, where they established Fort Wingate, named after Captain Benjamin Wingate, who had died earlier in the year at the Battle of Valverde, trying to repulse

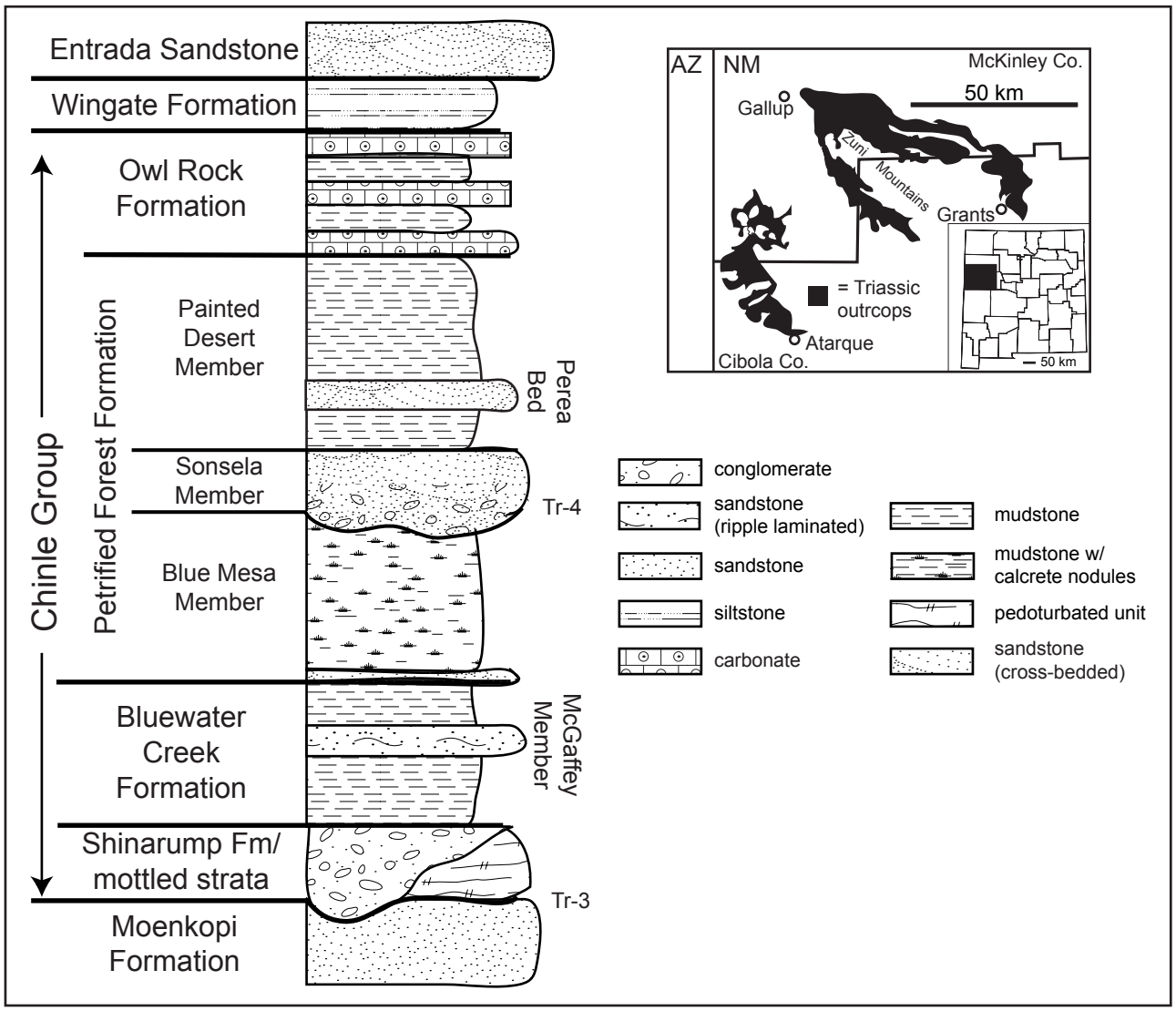

FIGURE 2.3. Generalized stratigraphy of the Upper Triassic Chinle Group in west-central New Mexico; total Chinle thickness is about 1900 ft.

the Confederate invasion of New Mexico. Ojo del Gallo had been an important watering place for centuries (it appears, for example, on the 1776 map of the Dominguez-Escalante Expedition).

FIGURE 2.4. Lower Chinle Group section at mile 20.0.

The fort at Ojo del Gallo was built a few months after the Confederate forces had been defeated and expelled from New Mexico, for the expressed purpose of dealing with the Navajo. The Navajo had used the preoccupation of the territory's military forces with the Confederates to strike at the villages, mines, and ranches of settlers they viewed as intruders. Once the Confederate threat had ended, Colonel R. S. Canby, military commander of New Mexico, began a plan to build a series of forts near Navajo territory, and to move the Navajo to a reservation far distant from the territory's population centers, both to protect New Mexicans against further raiding, and, perhaps, to prevent the Navajo from being exterminated. Before Canby could act, however, he was replaced by Brig. General James H. Carleton.

Carleton immediately implemented Canby's plan, and the construction of Ft. Wingate at Ojo del Gallo commenced. The location afforded excellent pasturage and was near the intersection of two major trails – the Spanish highway to Zuni Pueblo and the old military roads to Ft. Defiance, to the west. The site suffered, however, from its swampy surroundings and water table

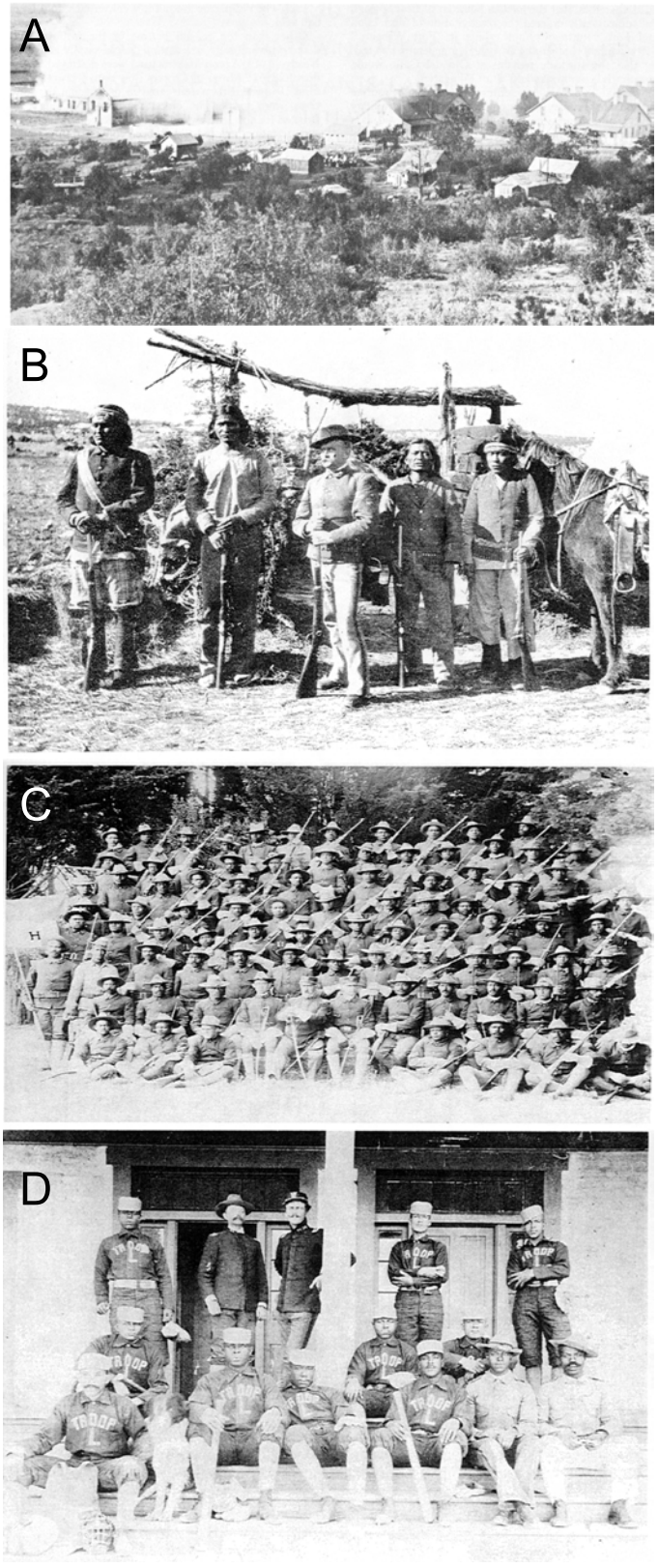

FIGURE 2.5. Historical photographs of Fort Wingate in the 19th century. A. Fort Wingate burning on July 2, 1896; B. Navajo (Diné) Scouts, Troop K, 4th Cavalry, ca. 1881-1884; C. "Buffalo Soldiers" of Troop H, 9th Cavalry, ca. 1899-1900; D. Baseball team of "Buffalo Soldiers," Troop L, 9th Cavalry, ca. 1899. Photos from Smith (1967) and Daniel (1997), Museum of New Mexico negatives 15773, 86944, 98372 and 98374.

near the surface. The fort was built of adobe, with a wooden stockade. Shortly after it was constructed, the fort served as a staging area and supply depot for Kit Carson's war against the Navajo, begun in 1863, which was designed to end the Navajo threat once and for all. His scorched-earth campaign effectively ended the Navajo resistance, and the Navajo people were forcibly resettled in the Bosque Redondo reservation near Fort Sumner, in central New Mexico, in 1864. Ft. Wingate served as a temporary detention center, from which the Navajo made "the Long Walk" to Hwéeldi, their name for Bosque Redondo. The resettlement plan was an egregious failure, and in 1868 the surviving Navajo were allowed to return to their homeland.

As the Navajo returned to northwestern New Mexico, Ft. Wingate at Ojo del Gallo was abandoned; it had fallen into decay during the Civil War and was too far removed from the new Navajo Reservation. The soldiers of Ft. Wingate moved west, to take up quarters at the site of the previous Ft. Lyon, which was then renamed Fort Wingate. There, in 1868, the fort was re-established in the present-day town of Fort Wingate, and again served as a temporary detention center for 7000 Navajos, now traveling from Fort Sumner on to Fort Defiance and the newly established Navajo Reservation.

Fort Wingate remained an important facility throughout the remainder of the 19th century. In 1877, Victorio's Chiracahua Apaches surrendered there, and in 1881-1882 Douglas MacArthur's father, Major General (at the time Captain) Arthur MacArthur commanded Company K of the 15th Infantry at the fort, and a very young Douglas (b. 1880) lived there briefly. "Buffalo Soldiers," (African-American cavalry units, with white officers, including a young John J. Pershing), principally of the 9th Cavalry, were stationed at Fort Wingate in 1876-1881 and again in 1899-1900 (Fig. 2.5C-D). With the arrival of the railroad in 1880, logging operations begun earlier by officers at the fort enjoyed great success. On July 2, 1896, much of the facility was destroyed by fire, but was rebuilt at the same site (Fig. 2.5A). Consequently, the oldest buildings at the original site only date to 1906.

One of the regular duties of the Ft. Wingate troops was to provide entertainment at the New Mexico Territorial Fair in Albuquerque. According to Fugate and Fugate (1989), in 1903 the manager of the Fair arranged a mock battle between cavalry troops and Navajo men. Both sides were issued blank cartridges, and the "battle" was scheduled for Old Town. However, some of the Navajo substituted real ammunition for the blanks, planning to shoot cavalry and escape in the confusion. The plot was discovered, however, and the Ft. Wingate contingent rode soberly back to its post. A short time later, the War Department issued orders banning any future mock battles between cavalry and Indians.

Troops were stationed at Ft. Wingate until 1911, when it was deactivated, but it was reopened in 1912 for several years in order to house about 4000 Mexican troops and their families who had fled from Pancho Villa's army into Texas during the Mexican civil war. General John J. Pershing returned to the fort during his campaign against Pancho Villa, although he was not formally stationed at Fort Wingate at that time.

In 1918, the U. S. Army Ordnance Department assumed control of the Fort for munitions storage, and by 1920 it was the largest storage facility of munitions in the world. Around 1925, Congress

appropriated $500,000 for a Navajo School; the barracks were converted to dormitories, and the parade grounds became a ball field. By the 1930s, more than 100 ordnance storage buildings were familiar sights to travelers on old Route 66, and many of the hogans and houses in the area are constructed from ammunition crates left over from that era. The present-day administrative compound for Fort Wingate (entrance under the bridge at mile 15.2 of the road log) was built in 1941, and it was during World War II that the Fort took on its present-day appearance with multiple railway spurs and hundreds of concrete "igloos" covering dipslopes developed on Chinle Group sandstones.

Fort Wingate continued to serve as a conventional ordnance storage and disposal facility throughout the Cold War. In the 1960s, the base was also used as a testing facility for rockets for the Pershing-1 missile. In the late 1980s, Fort Wingate was listed as one of the military facilities to close under BRAC (Base Realignment and Closure) 1988. As part of BRAC 1988, many munitions stored at Fort Wingate were removed and eventually disposed of in Iraqi and Kuwaiti deserts in early 1991. Others were disposed of on-site in somewhat less spectacular fashion.

Fort Wingate has long had a substantial economic impact on the region. In the 1870s and 1880s many of the officers stationed there augmented their paychecks by running logging and cattle companies. The former supplied railroad ties, and the latter often sold beef back to the government to supply the fort. Fort Wingate has long had a substantial civilian work force as well. In the 1880s, the fort employed male Navajos as scouts (Fig. 2.5B) and as laborers for facility construction, and female Navajos often worked as laundresses. Indeed, from 1868 through World War II, Navajos comprised the largest civilian workforce at Fort Wingate. During World War II the Fort employed over 1500 civilians (90% of them Navajo) loading and unloading munitions, especially TNT. By the late 1980s the fort had only a single military employee, the commanding captain, and the rest of the workforce was civilian. Since the drawing down of the facility, over $23 million has been spent to clean up a variety of "contaminants," including unexploded ordnance (UXO), explosive compounds, PCBs, heavy metals, pesticides, asbestos and (gasp!) lead-based paint. Much of this cleanup was contracted to TPL, Inc., which has a substantial facility employing as many as 85 people on-site. (Sources: WPA, 1940; James, 1967; Chilton et al., 1984; Fugate and Fugate, 1989; Julyan, 1996; Daniel, 1997; Mangum, 1997; Defense Technical Information Center, 2002; Global Security, 2002).

21.5 **Road to right** to Cibola National Forest Wingate Office; begin ascent of Chinle dipslope developed primarily on the Zuni Mountains Formation (formerly the "mottled strata") (see Heckert and Lucas, this volume). **0.3**

21.8 Outcrops of the Zuni Mountains Formation on left. **0.1**

21.9 Cattleguard. Enter Cibola National Forest. **0.2**

22.1 **STOP 1.** Pull off on dirt roads to left to look at the base of the Chinle Group.

At this stop, we focus on the early depositional history of the Chinle Group. Here, thick deposits of pedogenically modified strata overlie the unconformable surface between the Upper Triassic Chinle Group and the underlying Middle Triassic Moenkopi Formation (Fig. 2.6). These basal Chinle strata encompass a wide range of lithotypes, including conglomerates, sandstones, and mudrocks, some of which have been altered to the point where they have become "porcellanites." These strata are intensively color-mottled and turbated. Historically, these strata have been called the "mottled strata," both here and throughout their outcrop distribution from eastern Arizona to the Lucero uplift in central New Mexico (e.g., Stewart et al., 1972a; Ash, 1978; Lucas and Hayden, 1989; Heckert and Lucas, 2002a). Similar strata in east-central Utah were termed the Temple Mountain Member of the Chinle Formation by Robeck (1957). The turbation has been attributed to lungfish (Dubiel et al., 1987), crayfish (Hasiotis et al., 1993), or pedogenesis (Lucas and Hayden, 1989; Lucas and Anderson, 1993; Heckert and Lucas, 2002a). In this volume, Heckert and Lucas introduce the term "Zuni Mountains Formation" for these strata.

Here, at Stop 1, these strata are as thick or thicker than on any other locality on the southern Colorado Plateau (~65 ft). Indeed, these strata are so thick (and the underlying Moenkopi Formation so thin) that they are mapped with the Moenkopi Formation on Anderson et al.'s (2003) geologic map of the Fort Wingate quadrangle that accompanies this volume.

Our emphases here are threefold: (1) a thin remnant of the Moenkopi Formation is present; (2) above the Moenkopi Formation an unconformable surface (Tr-3 unconformity of Pipiringos and O'Sullivan, 1978) is overlain by a complex array of deposits; (3) these deposits