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JURASSIC FORMATIONS OF PARTS OF
UTAH, COLORADO, ARIZONA,
AND NEW MEXICO

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This review of the Jurassic formations, with certain interpretations and suggestions, covers an area extending from Zion Canyon, Utah, on the west to the extreme northwest corner of New Mexico on the east, and from the San Raphael Swell, Utah, on the north, to Thoreau, New Mexico, on the south. Descriptions of the formations and discussions of their correlations are, of necessity, brief.

Stratigraphic Limits of the Jurassic

The lower limit of the geologic section that is considered to be of Jurassic age is placed at the top of the Chinle formation. There is little or no discernible unconformity between Jurassic and Triassic strata, and the contact may range through several hundred feet of section. The upper limit of Jurassic beds is at the base of the Dakota sandstone of Upper Cretaceous age in the southern part of the area and at the base of a conglomeratic sandstone of probable Lower Cretaceous age in the north.

Major Divisions of the Jurassic

The Jurassic is divided into three groups, each with distinctive lithology and color: the Glen Canyon, San Raphael, and Morrison.

The Glen Canyon group includes the Wingate, Kayenta, and Navajo formations and is essentially sandstone. The underlying Chinle formation has been identified as Upper Triassic (Gregory 1917, p. 46) and the overlying Carmel as Upper Jurassic (Gregory and Moore 1931, p. 72). No fossils have been found in the beds of the Glen Canyon group, and its Jurassic age is based only on its stratigraphic position. It is possible that it is Upper Triassic, but as there are no unconformities at the base, within or above the group, it is very probable that Lower, and/or Middle Jurassic are represented by these beds.

The San Raphael group includes the Carmel, Entrada, Curtis, and Summerville formations. The Carmel contains limestone, gypsum, sandstone, and red shale in the west and north, and red shale and sandstone to the east and south. The Entrada and Curtis are sandstone, whereas the Summerville is red shale and sandstone with some gypsum.

The upper division of the Jurassic is the Morrison formation. The lower part of the Morrison is usually sandy, and the upper part is composed largely of variegated shale.

Correlations

The name Wingate, proposed by Dutton (1885) for the massive red sandstone near Wingate station, New Mexico, is the oldest Jurassic formation name now in current usage in this area. The base and top of the Wingate, as described by Dutton, were indefinite, but he doubtless referred to the sandstone designated as Entrada at the south end of the cross section in Figure 1. Gregory (1916) found a sandstone of similar lithology in northern Arizona which he correlated with the Wingate. At the same time he correlated an overlying shaly zone and a massive sandstone, which he named the Navajo, with the Todilto limestone and the massive sandstone overlying the type Wingate. Baker, Dane, and Reeside (1936, p. 5) later found that the shaly zone, which they named the Kayenta, lying between the Wingate and Navajo, is considerably older than the Todilto and identified the massive sandstone overlying the Todilto as lower Morrison. In later work (Baker, Dane, and Reeside 1947, p. 1664) these authors traced the Entrada of Utah southward to Wingate station, where it is the massive sandstone that had previously been designated as Wingate. According to all rules of priority and nomenclature, the name Entrada should now be dropped, and this bed should now be known as Wingate. The Wingate sandstone of Utah and northern Arizona is also traceable to the type Wingate locality, where it has thinned to 40 feet and lies above the Chinle and beneath the Carmel. A strict application of the rules of priority would require that the Wingate be raised from formation rank to that of a group, embracing all that section from the top of the Chinle to the top of the Entrada. Such a classification, however, would not only be unwieldy but would add to existing confusion. The writer is in accord with the views of Baker, Dane, and Reeside (1947) that the abandonment of the name Entrada, used in many publications and unpublished reports of many oil companies and familiar to many geologists, would be unfortunate and confusing. It is suggested that the section to be designated as Wingate be restricted to the lower 40-foot sandstone at the type locality and that the upper massive bed, heretofore known as Wingate, now be recognized as Entrada. The texture, cross-bedding, and color of the Wingate are very nearly identical with those of the Entrada, probably indicating a common source of material and similar conditions of deposition. This close similarity doubtless led to the errors in correlation among the geologists who did the earlier work in this region.

The Formations

Glen Canyon Group

The Wingate is the basal massive sandstone of the Glen Canyon group. This sandstone is composed of rounded quartz grains coated with iron oxide. The color is usually red. The cross-bedding is of the tangential type. Gregory (1917) considered the base of the massive sandstone as the base of the Jurassic. The underlying red shale, siltstone, and thin sandstone, usually about 250 feet thick, were included by Gregory in his Division A of the Chinle. Because of intertonguing of the massive sandstone and these shaly beds, a point of contact can be followed for only a short distance. The writer has tentatively selected the top of a zone of limestone conglomerate, the top of Gregory's Division B (1917), as the top of the Chinle. The shaly beds, above the limestone conglomerate and below the massive sandstone, are included in the Wingate. The limestone conglomerate can be followed with certainty over the whole of the Navajo country and as far north as the San Raphael Swell and to the southeast as far as Thoreau, New Mexico. The Wingate reaches a maximum thickness of 1,200 feet at Bitlabito. The average thickness is 300 feet over the greater part of the area. It grades into shale and siltstone toward the west and southeast. Baker, Dane, and Reeside (1936) believed that the Wingate did not extend farther west than Lees Ferry, Arizona. Gregory and Moore (1931, p. 68) have described a section at Lees Ferry in which they found the Chinle overlain by 80 feet of orange-red, cross-bedded sandstone with the texture and structure characteristic of the Wingate. They have also described a section in Paria Canyon, Utah, which they apparently considered the equivalent of the Wingate, Kayenta, and Navajo. Moore (Gregory and Moore 1931, p. 68) concluded that the sandstone at Lees Ferry and westward has Wingate affinity and has been inappropriately included in the Chinle. The writer is in accord with this conclusion and believes that the Wingate is traceable to Zion Canyon, where the "Mauve Sandstone" (Reeside and Bassler 1922), heretofore considered as upper Chinle, is believed to be its equivalent (See Fig. 2). The Wingate thins to 40 feet at Thoreau and lies directly on the limestone conglomerate.

The Kayenta is composed of thin-bedded sandstone and red shale; its color is red, brown, or purple. Both the lower and upper contacts are gradational. The thin-bedded Kayenta section is conspicuous between the massive sandstone beds above and below.

The Navajo sandstone is composed of rounded grains of quartz with some grains of feldspar and ferromagnesian minerals. It is usually light in color. It may be pure white, gray white, cream to

buff, or red. The cross-bedding is of the torrential type, with well developed foreset and topset beds. The foresetting is predominantly to the east and southeast, indicating that the source of material was from the west, with prevailing westerly winds during deposition. The Navajo section contains thin lenticular limestone beds that disappear or grade into sandstone within short distances. Silt is rarely found in the Navajo and the section is everywhere massive. The Navajo is 2,100 feet in thickness at Zion Canyon (Reeside and Bassler 1922) and thins to the east. It is 175 feet thick at Bitlabito and 45 (?) feet thick at McElmo Canyon, Colorado, with no Kayenta present. It is not present at Durango. It wedges out south of Tuba City and in the vicinity of Lukachukai, Arizona.

San Raphael Group

The Carmel in the western and northwestern parts of the area is composed of sandstone, limestone, gypsum, red shale and gypsiferous shale. Toward the east and south the limestone and gypsum disappear and only red shale and thin-bedded sandstone are found. The lower boundary is sharp but there is no evidence of unconformity. The upper boundary is equally as sharp except in a few localities, as at Moab, where the Carmel is crinkled and the contact with the overlying Entrada is gradational. The Carmel is recognized as far south as Thoreau and as far east as San Ysidro. It is missing west of Blanding (Gregory 1938) and at Durango (Baker, Dane, and Reeside 1936). Between Blanding and Bluff the Carmel reaches an abnormal thickness of 300 feet. It is very probable that this abnormal thickness is due to the filling of a depression in the Navajo surface and may be indicative of an unconformity.

The Entrada and its members may be considered as representing the whole of the San Raphael group where the Carmel is absent. The Entrada, at the type locality, is overlain by Curtis and Summerville. The Curtis apparently grades into Summerville, and the Summerville, in part, grades into the Moab tongue of the Entrada. Farther south the Entrada divides again into a lower bed, the Entrada proper, and the Bluff sandstone member. A new name, the Red Mesa is here introduced for the crinkly shale and sandstone beds, 100 feet in thickness, between the Entrada and the Bluff member. This section is well exposed at the west end of Red Mesa, on the Utah-Arizona line, about 17 miles west of the "four corners." The Red Mesa member is about the same age as the Summerville, but its lithologic characteristics and color are wholly unlike those of the Summerville, and it is definitely separated from the Summerville. The crinkly beds of the Red Mesa are similar in appearance to the Carmel at Moab which led Stokes (1944) to conclude that the Bluff and Entrada were one and the same bed. The Bluff loses

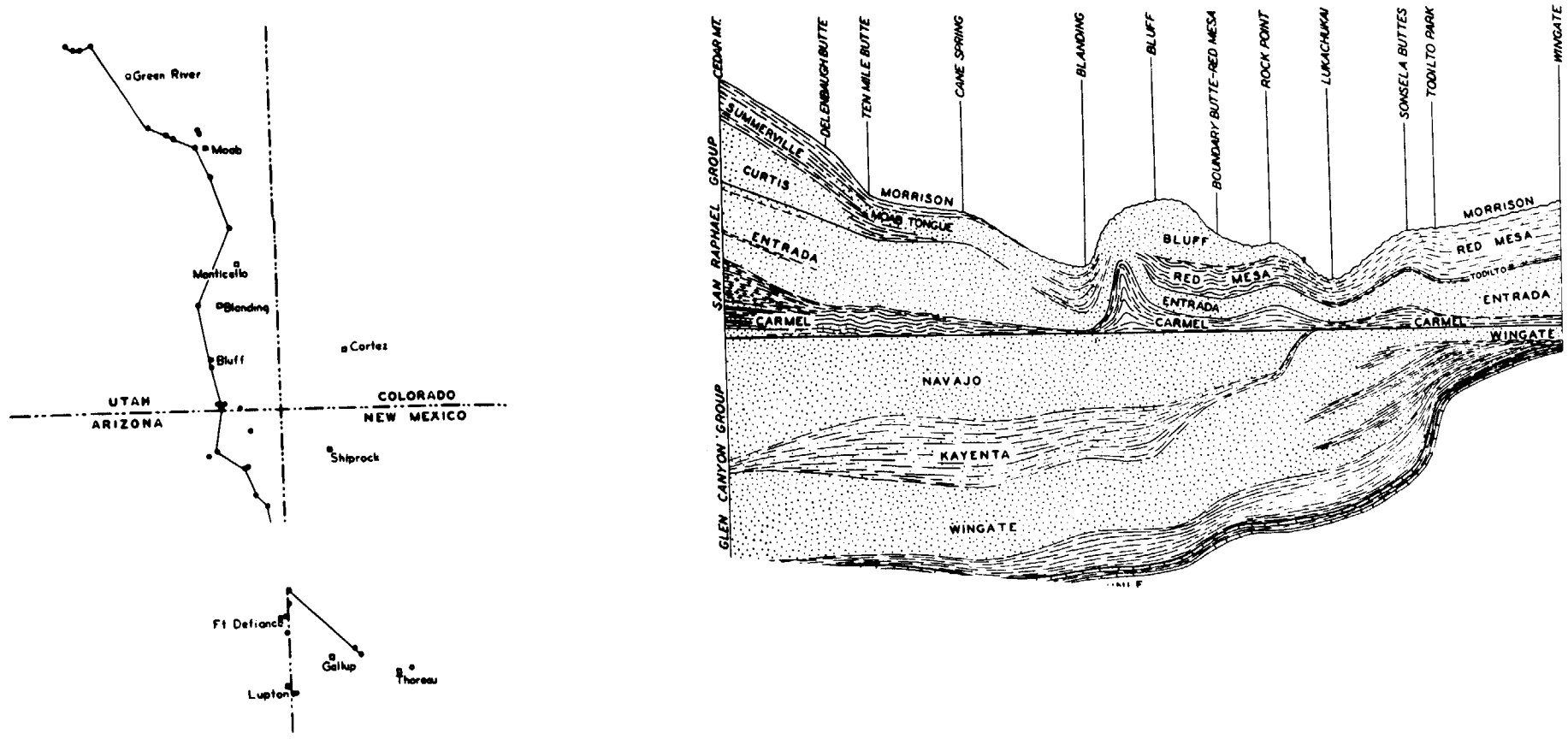


FIGURE 1. Section northern San Raphael Swell to Wingate station

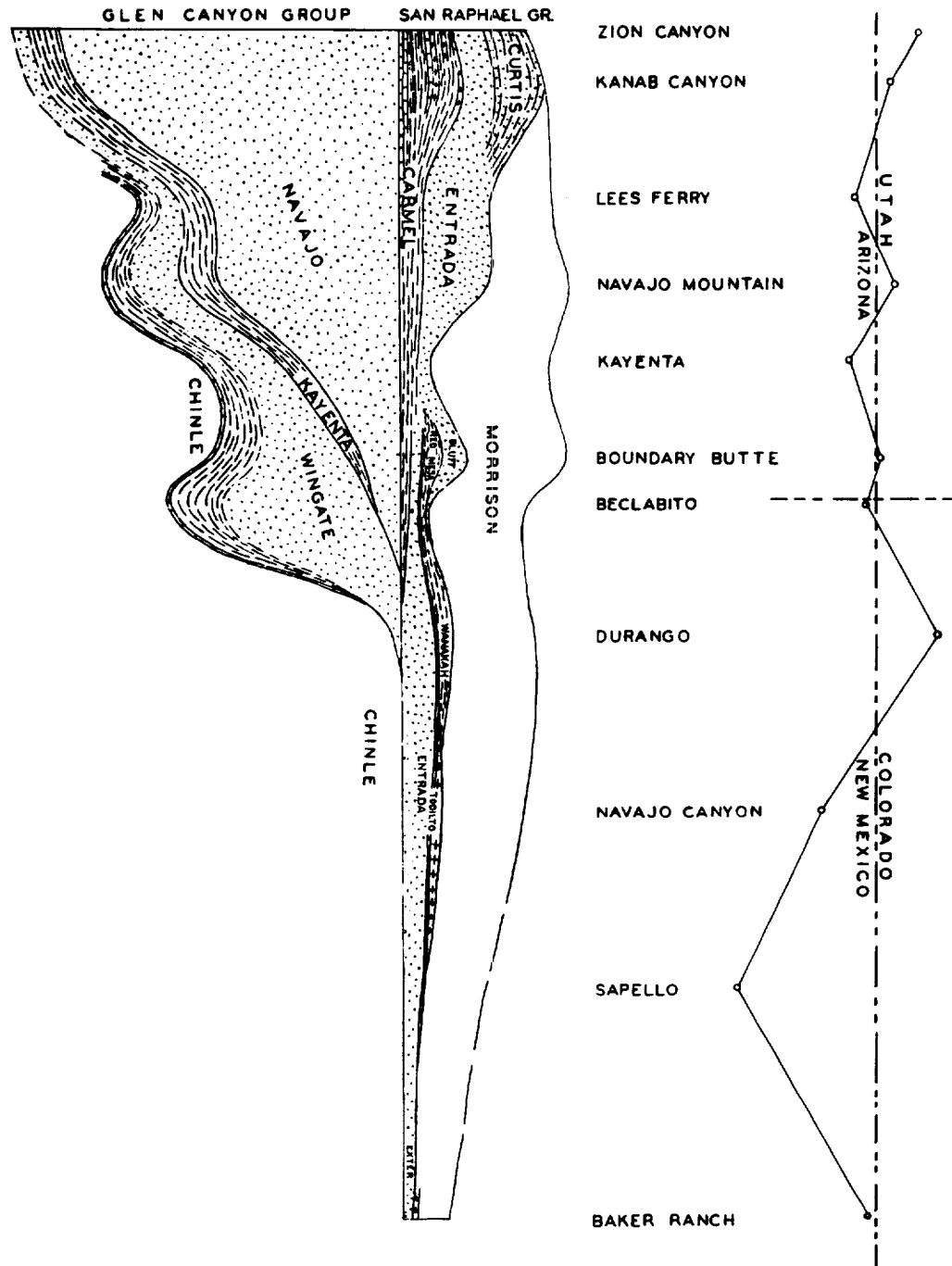


FIGURE 2. Section Zion Canyon to northeastern New Mexico

its massiveness southward and grades into the upper part of the Red Mesa. The Carmel, Entrada, and Red Mesa can be traced without difficulty southeast to Thoreau and the south end of Mesa Gigante (Kelley and Wood 1946). In the southern and eastern parts of the area the Todilto limestone member overlies the Entrada and underlies the Red Mesa. The Todilto is present at Lukachukai, Bitlabito, San Ysidro, Navajo Canyon, Sapello, and Durango, where it is known as the Pony Express beds (Burbank 1930). The Todilto is overlain by gypsum reaching 80 feet in thickness in the southern and eastern parts of the area. The gypsum is present at Mesa Gigante, San Ysidro, Gallina, Navajo Canyon, and in the Sandia Mountains. It is not present at Sapello. Parker (1934) suggests that the basal gypsum of the Morrison at Baker ranch and overlying the Exter, may be equivalent of the Todilto gypsum. The Red Mesa is, in part, equivalent to the Wanakah of Colorado. Burbank (1930, p. 172) included the Salt Wash member of the Morrison (upper La Plata) and the Pony Express in the type Wanakah. Goldman and Spencer (1941, p. 1748) excluded the Pony Express, Bilk Creek sandstone, and Salt Wash from the Wanakah. It appears that the Red Mesa is the equivalent of both the Bilk Creek and Wanakah as defined by Goldman and Spencer. The Entrada is identifiable at Sapello (Heaton 1939), Baker Ranch (Heaton 1939; Kan. Geol. Soc. 1934), and in the

vicinity of Tucumcari (Darton 1928). Going west from Boundary Butte, the characteristic lithology of the Entrada rises into the Red Mesa section and the Entrada of the Kayenta area is about Bluff in age. The so-called Todilto of the Kayenta area is therefore somewhat younger than at the type locality.

Morrison

The uppermost part of the Jurassic is included in the Morrison. The bedding and composition of the Morrison are extremely variable. The lower part is predominantly sandy and is generally included in the Salt Wash member (Lupton 1924, p. 127). The upper part of the Morrison, consisting of green, white, purple, and red shale was named the Brushy Basin shale member by Gregory (1938, p. 59). In the southern part of the area, the entire Morrison grades into sandstone. The Morrison is everywhere unconformable on older beds. In the Lupton area the Morrison overlaps the Red Mesa Todilto, either due to non-deposition or erosional unconformity, and rests on the Entrada, where the contact is tentatively recognized by a slight change of color. The upper surface is unconformably overlain by Dakota sandstone of Upper Cretaceous and Burro Canyon (Stokes 1948, pp. 9 and 10) of Lower Cretaceous ages.

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