Carmel Formation of The Zion Park Region Southwestern Utah—a Review

By W. B. CASHION

CONTRIBUTIONS TO STRATIGRAPHY

GEOLOGICAL SURVEY BULLETIN 1244-J

UNITED STATES DEPARTMENT OF THE INTERIOR

STEWART L. UDALL, *Secretary*

GEOLOGICAL SURVEY

William T. Pecora, *Director*

U.S. GOVERNMENT PRINTING OFFICE
WASHINGTON : 1967

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C., 20402 - Price 10 cents

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CARMEL FORMATION OF THE ZION PARK REGION, SOUTHWESTERN UTAH—A REVIEW

By W. B. CASHION

Abstract

The name Carmel Formation was first applied to rocks of Jurassic age in the San Rafael Swell of east-central Utah, although the type locality is in the Zion Park region of southwestern Utah. Subsequently, the Carmel Formation of the Zion Park region was modified as the use of other established names was extended and new names, such as the Winsor Formation, were introduced. As presently defined, the Carmel Formation of the Zion Park region includes all Jurassic strata above the Navajo Sandstone. Because this sequence contains beds previously assigned to the Winsor Formation, the Winsor is reduced in rank to a member of the Carmel Formation.

INTRODUCTION

The accepted unit composition of the Carmel Formation (Jurassic) at the type locality in southwestern Utah has undergone several changes. These changes have also involved the Winsor Formation, a Jurassic rock sequence named by Gregory (1948) and associated with the Carmel Formation in southwestern Utah. Type localities for the Carmel and Winsor Formations are near Mount Carmel, about 10 miles east of Zion Park, Utah (fig. 1). While mapping these units near Mount Carmel, the author recognized the need for a published summary of the nomenclature for these rocks, especially a chronological review of changes involving components of the Carmel Formation in the Zion Park region. The purpose of this report is to present such a summary. Boundaries of the Zion Park region of this report (fig. 1) conform to those delineated by Gregory (1950a, pl. 2) except that the part in Arizona is excluded because it contains no rocks assigned to the Carmel Formation.

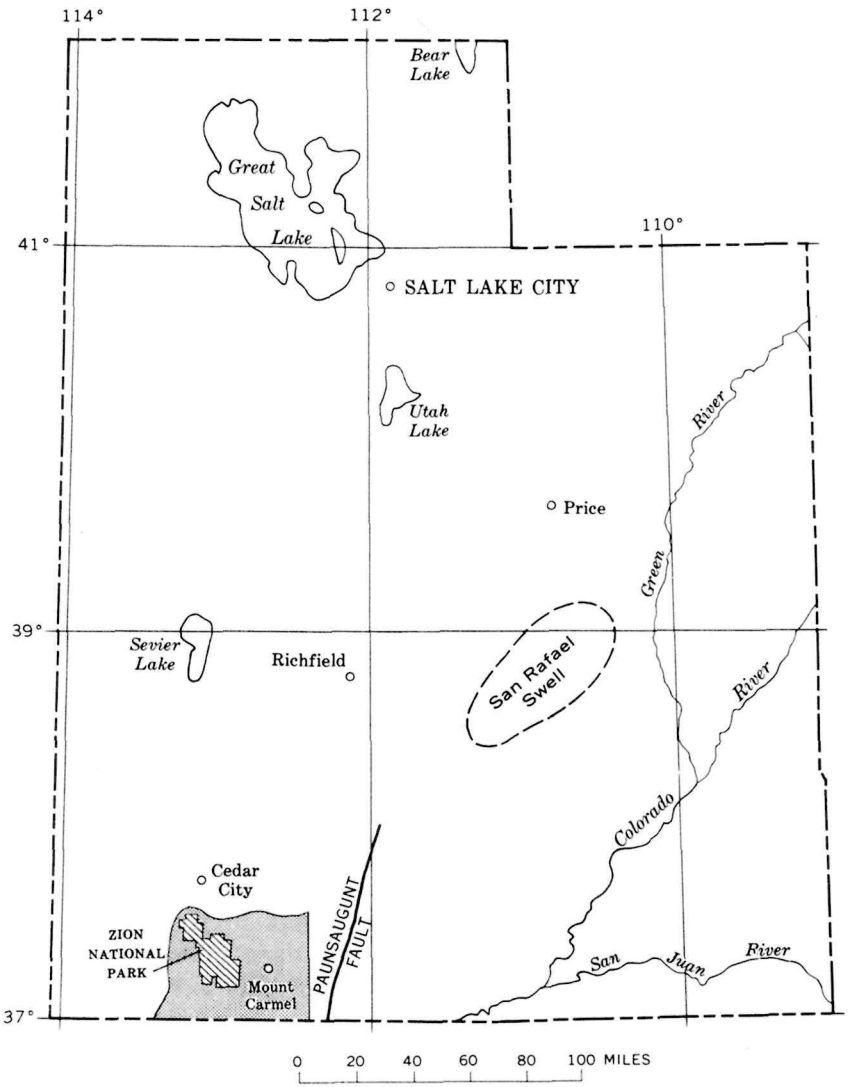


FIGURE 1.—Location of the part of the Zion Park region (stippled) in Utah (from Gregory, 1950a, pl. 2).

STRATIGRAPHY

SECTION

The stratigraphic section given below is an abbreviated version of one published in Gregory and Moore (1931, p. 73–74). It is a composite made up of five partial sections measured at the type locality of the Carmel Formation. Although this section was not designated as the type section, it has become the standard for comparison. Fossil listings have been omitted but fossiliferous beds are indicated. More recent and complete paleontologic information is given by Imlay (1964) and Sohl (1965). Unit numbers correspond to those shown on figure 2. The abbreviated descriptions, with bracketed entries by the author, are as follows:

Section of Carmel Formation between Virgin River bridge [approximately 2 miles south-southwest of Mount Carmel] and a point about 2 miles west of Mount Carmel village, Utah

[Adapted from Gregory and Moore (1931, p. 73-74. Section measured by Herbert E. Gregory)]

	Feet
Morrison(?) Formation:	
22. Sandstone, white; contains green shale	50
Summerville(?) Formation:	
21. Sandstone, banded alternately pale red and white	130
Carmel Formation:	
20. Limestone, gray, sandy, oolitic in part; fossiliferous	⅓
19. Sandstone, banded pale red and white	13
18. Gypsum, white, lumpy	3
17. Sandstone, red and green, white-banded	12
16. Gypsum, white-green	16
15. Shale, white, gypsiferous and arenaceous	2
14. Gypsum, white and green; pink lenses near top	4
13. Unconformity.	
12. Sandstone beds 4 in. to 6 ft. thick	68
[In a revised description of this section, Gregory (1950a, p. 127) showed thickness of this unit to be 168 ft. Later figure is more accurate.]	
11. Limestone, light-gray to cream; fossiliferous	28
10. Shale, gray to buff, calcareous	10
9. Limestone, cream, dense, hard, siliceous; contains thin lenses and seams of chert	1½
8. Shale like No. 6	35
7. Limestone, buff, earthy, one massive bed; top consists largely of broken shells	2
6. Shale, calcareous and arenaceous, and thin, earthy limestone, gray to cream; fossiliferous	22
5. Sandstone, gray to buff, very calcareous, fossiliferous	4
4. Limestone and calcareous shale	18
3. Limestone, cream; earthy at bottom; few feet pink; very sandy in cliff sections	20
[As described here, the total thickness of units 3–11 is 140½ ft. In a revised description of this section, Gregory (1950a, p. 127) showed total thickness of same sequence (included in units 3–15) to be approximately 218 ft. Later figure is more accurate.]	
2. Shale, brick-red	5
1. Sandstone, green-white; in places conglomerate with red quartz grains, green mud pellets, and shale fragments	6
Total Carmel Formation	269+

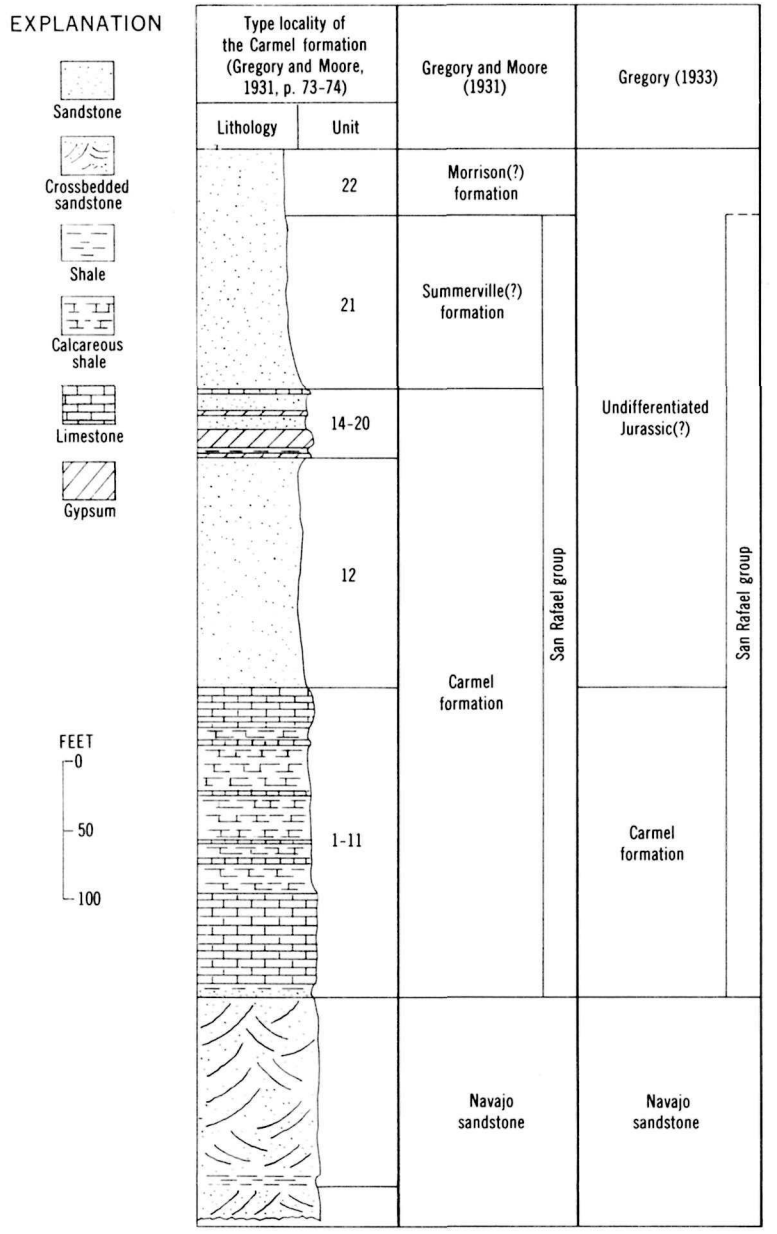
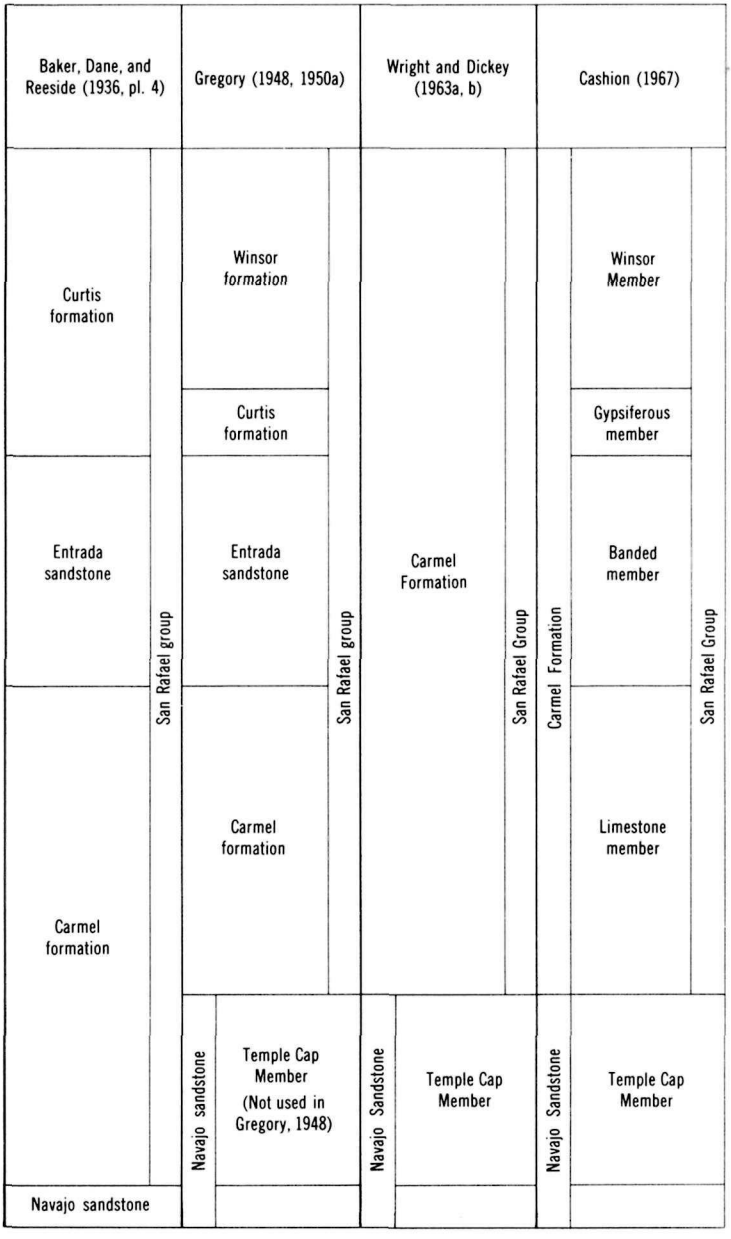


FIGURE 2.—Stratigraphic nomenclature of the Carmel Formation and associated



units as applied by various workers in the Zion Park region, Utah.

LITHOLOGIC SUBDIVISIONS

As a result of recent work (Wright and Dickey, 1963a,b) the upper boundary of the Carmel Formation has been moved stratigraphically higher and the formation now includes all beds in the measured section just presented. This sequence in the Zion Park region can be divided into four members which are recognizable throughout the region. The dominant lithologies are, in ascending order, (1) limestone and calcareous shale with argillaceous siltstone or sandstone at base, units 1–11 on figure 2; (2) red and gray banded sandstone, unit 12 on figure 2; (3) massive gypsum and gypsiferous shale and sandstone, with limestone at top in most of the region, units 14–20 on figure 2; and (4) light-gray and pale-red sandstone, units 21–22 on figure 2.

AGE

Significant fossil collections have been taken from the limestone member and a few collections of poorly preserved nondiagnostic fossils from the limestone at the top of the gypsiferous member. The fossils indicate that the age of the limestone member is Middle Jurassic to possibly early Late Jurassic, and the stratigraphic position of the members above it indicates that they are probably early Late Jurassic (Imlay, 1964, p. C3–C5).

SUMMARY OF NOMENCLATURE

ESTABLISHMENT OF THE SAN RAFAEL GROUP

Stratigraphic studies in eastern Utah, particularly in the area of the San Rafael Swell (Gilluly and Reeside, 1928), give the basis for subdividing that part of the Jurassic sequence assigned to the San Rafael Group. In the San Rafael Swell this group, composed of limestone, sandstone, shale, and gypsum, lies between the Navajo Sandstone and the Morrison Formation. Gilluly and Reeside named, in ascending order, the Carmel Formation, Entrada Sandstone, Curtis Formation, and Summerville Formation, and constituted them as the San Rafael Group. The name Carmel, from a locality near Mount Carmel, Utah, studied by H. E. Gregory and L. F. Noble, was adopted in 1926 at a conference of H. E. Gregory, R. C. Moore, James Gilluly, and J. B. Reeside, Jr. (U.S. Geol. Survey, Press Bull. 6064, March 30, 1926). Type sections for the other formations of the group were established in the northern part of the San Rafael Swell (Gilluly and Reeside, 1928). Although the name Carmel was adopted in 1926, a section at the type locality was not described until 1931. At that time Gregory and Moore (p. 73, 74) placed the lower boundary at the top of the Navajo Sandstone and the upper boundary at the top of a thin fossiliferous limestone (unit 20, fig. 2) and tentatively identified two units above it as Summerville(?) Formation and Morrison(?) Formation.

REVISIONS

Later, Gregory (1933, p. 15) restricted the Carmel Formation in the Zion Park region by placing the upper boundary at the top of the limestone and calcareous shale sequence (units 1–11, fig. 2). He assigned the beds above this sequence to "undifferentiated Jurassic(?)" and stated that they probably represent the rest of the San Rafael Group and the overlying Morrison Formation. Gregory (1950a, p. 91) explained that redefining the upper boundary of the Carmel was the result of reexamining numerous outcrops in southern Utah and concluding that the abrupt change in sedimentation at the top of the limestone and calcareous shale sequence marked a more appropriate position for the formation boundary.

Inasmuch as continuous tracing of the formations in question is impossible and satisfactory evidence had not been found for precise correlation between the Zion Park region and the San Rafael Swell, there was still doubt about the relation of the type Carmel to the Carmel of the San Rafael Swell. Additional information from studies in south-central Utah led Gregory (1950a) to another revision in which part of the sequence that had previously been included in the Carmel was assigned to the Entrada Sandstone (unit 12, fig. 2) and the Curtis Formation (units 14–20, fig. 2). The beds of Jurassic age above unit 20 were named Winsor Formation. First reference to the Winsor was made in a report describing the geology of central Kane County, Utah (Gregory, 1948, p. 235), but the source of the name was not explained until later (Gregory, 1950a, p. 98) and the type locality was designated in a separate paper (Gregory, 1950b, p. 42). The type locality is in Winsor Cove, an open area in the valley of Muddy Creek, just west of Mount Carmel.

During the 1950's, some authors who described the San Rafael Group in areas adjacent to the Zion Park region suggested revisions of correlation that involved the Carmel Formation. These authors are not cited here, however, because a review of the overall stratigraphy of the Carmel Formation is not within the scope of this report. Stokes and Holmes (1954) used the nomenclature of Gregory (1950a) in a fence diagram that includes the Zion Park region, but they pointed out that the Curtis Formation of southwestern Utah might be a facies of the Carmel of the San Rafael Swell.

Detailed mapping and regional stratigraphic studies by members of the U.S. Geological Survey have yielded new information and given a firmer basis for correlation of Jurassic rocks of the Colorado Plateau. Wright and Dickey (1963a, b), after studying the regional stratigraphy of the San Rafael Group, concluded that the Entrada Sandstone, Curtis Formation, and Winsor Formation of the Zion Park region should be

included in the Carmel Formation because all Jurassic strata above the Navajo Sandstone near Mount Carmel are correlatives of beds within the Carmel Formation as it was first recognized in the San Rafael Swell.

Despite the Carmel problems in the Zion Park region, the name has been used logically and consistently in most other parts of the Colorado Plateau. Carmel is a well-established and useful name and its continued use in the Zion Park region seems appropriate. The author, in mapping near Mount Carmel, used those limits for the Carmel prescribed by Wright and Dickey (this report, fig. 2) and also divided the formation into four members. The boundaries of these members are the same as those for the four widespread lithologic subdivisions described earlier in this report. Informal descriptive member names are assigned to all except the one that has previously been called Winsor Formation (see fig. 2).

The Carmel Formation of the Zion Park region, as described by Wright and Dickey (1963a, b), includes Gregory's Winsor Formation. Consequently, several recent publications concerning these rocks do not use Winsor Formation, and a clarification of its status should be made. The author feels that it would be advantageous to retain the name Winsor in the Zion Park region and herein changes the rank of the Winsor to a member of the Carmel Formation. The name Winsor should not be used east of the Paunsaugunt fault (see fig. 1) where it has been applied to beds that are considerably younger than the beds included in the Winsor near Mount Carmel (J. C. Wright, written commun., 1966).

Although no type section was designated by Gregory, the description of the Winsor Formation in his section 13 (Gregory, 1950a, p. 126) might be considered as typical Winsor and it was measured in, or very near, Winsor Cove. Therefore Gregory's section is here designated as the typical section of the Winsor. The two units which comprise the Winsor described in section 13 are the same as units 21 and 22 in the section describing the type Carmel (Gregory and Moore, 1931, p. 73; this report, fig. 2).

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Contributions to Stratigraphy

GEOLOGICAL SURVEY BULLETIN 1244

This volume was published as separate chapters A–J

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[Letters designate the separately published chapters]

☆U. S. GOVERNMENT PRINTING OFFICE : 1967 O - 257-578