A REVIEW OF THE BROWNS PARK FORMATION

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INTRODUCTION

Brown's Park, located in the extreme northwest corner of Colorado and the adjacent northeast corner of Utah, is the type area for a mid-Tertiary formation which crops out extensively throughout the region. It was from this mountain park that Powell (1876, p. 44) described the Browns Park group, now known as the Browns Park formation.

The Browns Park is of considerable interest to the practicing geologist in that much of the middle and late Tertiary history of the region must be deciphered from evidence obtained from beds of this formation. Two events in the Tertiary geologic history of northwest Colorado which are intimately connected with several aspects of the Browns Park formation are (1) the beginning of the extensive volcanism, the effects of which modify much of the present topography of the region, and (2) the post-Browns Park collapse of the east end of the Uinta Mountain arch and the west end of the Axial Basin anticline, which formed the Uinta Mountain graben.

CHRONOLOGY OF INVESTIGATIONS

Sedimentary rocks which are now included in the Browns Park formation were examined by members of all three of the early regional surveys (Hayden, 1871; King, 1877; Powell, 1876; and White, 1878, 1889). Following the early surveys a number of geologists became concerned with the Browns Park formation while engaged in the detailed mapping of portions of northwest Colorado (Gale, 1910; Sears, 1924; Hancock, 1925; and Bradley, 1936, 1945).

The reports of the early surveys generated considerable controversy as to the relationship that the course of the Green River exhibited with the Uinta Mountain Uplift. After more details of the geology of the region became known, it was found that the partial burial of the Uinta Mountains by the Browns Park formation was influential in determining the present course of the Green River (Hancock, 1915, and Sears, 1924a).

For many years the Browns Park formation as described from the eastern end of the Uinta Mountains was thought to be the same as the Uinta formation of the Uinta Basin and the two names were used interchangeably. Irving (1896) was the first geologist to present fossil evidence that the Browns Park formation was not Eocene, but probably was either Miocene or Pliocene in age. It was not until over thirty years later that sufficient faunal collections were found to substantiate this early age determination (Peterson, 1924, 1928). Although most vertebrate paleontologists agree that the age of the formation is Miocene and/or Pliocene, refinements to this age assignment are still being made (McGrew, 1951, 1953, and 1955).

AREAL DISTRIBUTION OF THE FORMATION

The principal exposures of the Browns Park formation extend from Brown's Park east along the Uinta Mountain graben and the Axial Basin anticline to a locality in T. 5 N., R. 94 W., east of Juniper Mountain. These outcrops continue eastward along the south flank of the Sand Wash Basin to Cedar Mountain, northwest of Craig, Colorado. Outcrops of considerable areal extent have been described and, in some cases, mapped throughout the Sand Wash Basin between Cold Springs Mountain and Cherokee Ridge, along the Cherokee Ridge between Baggs, Wyoming, and Powder Wash, Colorado, along the north flank of the White River Uplift in the vicinity of Pagoda, and throughout the Elkhead Mountains. Among the detailed geologic maps which depict part of these outcrops are those by Gale (1910, plates XVI, XVIII), Hancock (1925, plate XIX), Sears (1924, plate XXXV), and Bradley (1936, plate 34; 1945).

The recently published geologic map of Wyoming indicates outcrops of Browns Park formation over a sizeable area along the west and north flanks of the Sierra Madre Mountains and along the north end of the Saratoga Valley (Love, et al., 1955).

The thickest deposits of the Browns Park formation are generally found either in down-dropped areas associated with extensive normal faulting as in the Uinta Mountain graben (Bradley, 1936, p. 184), or preserved beneath high-level lava flows as at Mount Welba in the Elkhead Mountains.

LITHOLOGY

The Browns Park formation has been separated in the literature into two units. The lower unit is a conglomerate of variable thickness which consists primarily of pre-Cambrian cobbles and is termed the basal Browns Park conglomerate. The upper unit is composed of beds of chalky-white and grayish-white sandstone, tuffaceous sandstone, thin beds of chert, and occasional beds of vitric tuff and fresh water limestone.

Most of the sandstones in the upper unit are soft, friable, and calcareous.

Along the south flank of the Sand Wash Basin and east of the Little Snake River, the upper part of the formation is highly cross-bedded and suggests a windblown deposit (Bradley, 1936, pp. 182-183; Sears, 1924, p. 295). At these localities, the cross laminations are characterized by extreme variability in both direction and amount of dip. Dips up to 32° are quite common. North of Powder Wash, the sand grains found in the upper part of the formation contain frosted and pitted surfaces and are generally well rounded and sorted. Bradley (1936, p. 183) believes that the sand grains from this area were well rounded in the formation from which the Browns Park was derived, and that the grains had been secondarily enlarged before they were reworked in the Browns Park formation.

The basal conglomerate of the Browns Park formation generally consists of cobbles and pebbles of rock-types comprising the pre-Cambrian core of the nearest mountain range. Near the east end of the Uinta Mountains, Bradley (1936, p. 182) describes the conglomerate as consisting essentially of cobbles of Uinta Mountain quartzite. In the Axial quadrangle, Hancock (1925, p. 24) describes the conglomerate as consisting of pebbles of schist, gneiss, coarse and fine-grained granite, white and reddish quartzite, and white and reddish vein quartz.

The thickness of the basal conglomerate has been reported as varying from 0 to 300 feet. The upper unit was reported by Sears (1924, p. 286) as having an aggregate thickness of 1200 feet, however, a thickness in excess of this estimate has been penetrated in drilling within the Uinta Mountain graben. The estimate by Powell (1876, p. 40) of 1800 feet for the total thickness of the formation appears to be fairly representative for northwestern Colorado.

VOLCANICS CONTAINED IN THE BROWNS PARK FORMATION

According to Bradley (1936, p. 183) the lower part of the Browns Park formation along the south side of the Washakie Basin contains considerable amounts of glass tuffs. The glass shards in these tuffs have a refractive index ranging from a little below to a little above 1.50. With the shards are found a moderate quantity of mineral fragments, among which the heavy minerals consist chiefly of biotite and magnetite with lesser amounts of apatite and zircon. Feldspars are rare, but grains of sanidine are found together with plagioclase crystals that range in composition from calcic oligoclase to calcic andesine. The mineral suite represented by the fragments points to a source area in which the volcanic rocks ranged in composition primarily from andesites to rhyolites.

The volcanics observed in the upper part of the Browns Park formation have a different composition. Hancock (1925, p. 24) describes a Browns Park type sandstone capped by a volcanic conglomerate, which is exposed about 6 miles southeast of Pagoda and about 100 feet below the top of the basalt flows that form the Flat Tops. The conglomerate is composed entirely of well-rounded pebbles and boulders of basalt, some of which are as much as 18 inches in diameter.

In the Elkhead Mountains a transition zone several hundred feet in thickness is present in which typical Browns Park sandstones grade upward into volcanic breccias consisting of basalt boulders imbedded essentially within a Browns Park sandstone matrix.

Several pure, bluish-gray beds of volcanic ash are exposed near the top of the Browns Park section in the canyon where Moffat County 318 crosses Vermilion Creek. These beds are considerably thicker and appear to be of a different chemical composition than those found in the lower part of the section. (Field conference will pass these beds.)

Hancock (1915, p. 187) reported finding a portion of the Browns Park sandstone resting upon the basalt flow which caps Cedar Mountain northwest of Craig. The sandstone contains numerous rounded masses of the basalt and suggests that the basalt on the mountain is upper Browns Park in age.

AGE OF THE BROWNS PARK FORMATION

The Browns Park sediments have been found to overlie unconformably all formations from the pre-Cambrian through the Middle Eocene Bridger formation. Considerable differences existed among the early geologists, however, as to a more exact age determination, and the latitude of opinion ranged from Upper Eocene (King, 1877, p. 222) to Pleistocene (Sinclair, 1906, p. 278). The scarcity of fossils required that most age arguments be based upon physical criteria.

The first collection of diagnostic vertebrate fossils was found near Sunbeam, Colorado. A study of the fauna resulted in dating the formation between uppermost Oligocene and middle Miocene (Peterson, 1924, p. 300). Additional fossils found near the Greystone post office prompted Peterson (1928, p. 88) to change the age to upper Miocene or lower Pliocene. The younger age was based essentially upon the discovery of a primitive new species of probescidean from a stratigraphic horizon fairly high in the section. The U. S. Geological Survey has tentatively classified the formation according to Peterson's age determination (Wilmarth, 1938, p. 275).

Additional faunal collections from the Browns Park formation in south-central Wyoming (McGrew, 1953, pp. 62-64; 1955) have caused some vertebrate paleontologists to favor a lower and middle Miocene age for at least part of the formation.

The relationship of the volcanics to the Browns Park formation, particularly at Cedar Mountain, along with the available fossil evidence, suggest that the upper part of the Browns Park formation near the type area is equivalent, at least in part, to the North Park formation exposed at North Park in north-central Colorado and Saratoga Valley in south-central Wyoming.

A suggestion is now before the Committee on the Continental Genozoic selected by the Society of Vertebrate Paleontologists to consider the Browns Park formation as Middle Miocene (Hemingfordian) and, perhaps, partly Lower Miocene (Arikareean) in age. The North Park formation is now known definitely to be at least partly Upper Miocene (Barstovian) in age (McGrew, 1955).

At one time, it was believed (Sears, 1924, p. 296) that the Bishop conglomerate was the basal conglomerate of the Browns Park formation. Bradley (1936, pp. 181-182) has demonstrated, however, that the Gilbert Peak erosion surface, upon which the Bishop conglomerate was deposited, is distinctly older than the Bear Mountain erosion surface upon which the basal Browns Park conglomerate was deposited.

ENVIRONMENT OF DEPOSITION

Bradley (1936, p. 184) believes that the basal conglomerate of the Browns Park formation is part of a shifting gravel mantle which was deposited as a result of a change in the climate to greater aridity. As evidence supporting the arid conditions under which much of the sandstones were deposited, he cites the occurrence of halite molds in beds exposed near the west end of Browns Park and the presence of wind-faceted cobbles, wind-blown sand, and possible dune deposits, in part of the formation exposed along the south side of the Washakie Basin.

The thick sections of Browns Park found in the down-faulted areas may be partially attributed to subsidence of the fault troughs contemporaneous with deposition. Bradley reports (1936, p. 185) that during deposition of the Browns Park formation, the east end of the Uinta Mountain arch began to fail. A local angular unconformity within the Browns Park formation is exposed a few miles west of Ladore post office. The major collapse of the Uinta Mountain Arch, however, occurred in post-Browns Park time. Sears (1924, pp. 287-298) has discussed in detail the evidence for this collapse and described the extent of the resulting graben.

REFERENCES

Bradley, W. H. (1936), "Geomorphology of the North Flank of the Uinta Mountains," U. S. Geol. Survey Prof. Paper 185-I, pp. 182-185, plate 34.

.... (1945), "Geology of the Washakie Basin, Sweetwater and Carbon Counties, Wyoming and Moffat County, Colorado," U. S. Geol. Survey Oil and Gas Inv., Prel. map no. 32.

Gale, H. S. (1910), "Coal Fields of Northwestern Colorado and Northwestern Utah," U. S. Geol. Survey Bull. no. 415, pp. 86-89, plates xvi, xviii.

Hancock, E. T. (1915), "The History of a Portion of Yampa River, Colo., and Its Possible Bearing on That of Green River," U. S. Geol. Survey Prof. Paper 90-K, pp. 183-189.

.... (1925), "Geology and Coal Resources of the Axial and Monument Butte Quadrangles, Moffat County, Colorado," U. S. Geol. Survey Bull. no. 757, pp. 23-25, plate xix.

Hayden, F. V. (1871), "Preliminary Report of the United States Geological Survey of Wyoming and Portions of Contiguous Territories," Second Ann. Rept. U. S. Geol. Survey, p. 64.

Irving, J. D. (1896), "The Stratigraphic Relations of the Brown's Park Beds of Utah," N. Y. Ac. Sci., Trans. 15, pp. 252-259.

King, Clarence (1877), "Systematic Geology," Rept. U. S. Geol. Expl. 40th Par., vol. 2, p. 222.

Love, J. D., Weitz, J. L., and Hose, R. K. (1955), Geologic Map of Wyoming, U. S. Geol. Survey.

McGrew, P. O. (1951), "Tertiary Stratigraphy and Paleontology of South-central Wyoming," Wyo. Geol. Assoc. Guidebook, 6th ann. field conf., pp. 54-57.

.... (1953), "Tertiary Deposits of Southeastern Wyoming," Wyo. Geol. Assoc. Guidebook, 8th ann. field conf., pp. 61-64.

.... (1955), Personal communication, Univ. of Wyoming, Laramie, Wyo.

Peterson, O. A. (1924), "Discovery of Fossil Mammals in the Brown's Park Formation of Moffat County, Colo.," Carnie Mus. Annals, vol. 15, p. 300.

.... (1928), "The Brown's Park Formation," Carnegie Mus. Mem., vol. 11, no. 2, pp. 87-130.

Powell, J. W. (1876), "Report on the Geology of the Eastern Portion of the Uinta Mountains and a Region of Country Adjacent thereto," U. S. Geol. and Geog. Survey Terr., pp. 40, 44, 168-169.

Sears, J. D. (1925), "Geology and Oil and Gas Prospects of Part of Moffat County, Colorado, and Southern Sweetwater County, Wyoming," U. S. Geol. Survey Bull. no. 751-G, pp. 295-296, plate xxxv.

.... (1924a), "Relations of the Browns Park Formation and Bishop Conglomerate, and Their Role in the Origin of Green and Yampa Rivers," Geol. Soc. America Bull., vol. 35, pp. 279-304.

Sinclair, W. J. (1906), "Volcanic Ash in the Bridger Beds of Wyoming," Bull. Amer. Mus. Nat. Hist., vol. XXII, p. 278.

White, C. A. (1878), "Report on the Geology of a Portion of Northwestern Colorado," U. S. Geol. and Geog. Survey Terr., Tenth Ann. Rept., p. 38.

.... (1889), "On the Geology and Physiography of a Portion of Northwestern Colorado and Adjacent Parts of Utah and Wyoming," Ninth Ann. Rept. U. S. Geol. Survey, p. 691, plate LXXXVIII.

Wilmarth, M. G. (1938), "Lexicon of Geologic Names of the United States," U. S. Geol. Survey Bull. no. 896, pp. 194, 275.