XIII. THE UPPER UINTA FORMATION OF NORTHEASTERN UTAH.

By O. A. Peterson and J. LeRoy Kay.

(Plates IX-XI.)

Since the publication of the geological notes on the Uinta Basin by the senior author (Memoirs of the Carnegie Museum, Vol. XI, No. 2, 1928, pp. 94-96) much additional field work in the Uinta Basin has been done by the Carnegie Museum. The junior author has spent considerable time in verifying previous work, as well as in discovering and collecting data, geological and paleontological. Director Avinoff authorized the senior author to make short visits to the Uinta Basin in the early part of the season of 1929 and in the fall of 1930. Many localities examined in previous years, as well as others not before explored, were visited and new data were obtained. As a preliminary paper, to be followed by more detailed publications, it is thought that the new data obtained may be of immediate value to students.

While a cross-section from south to north through the Uinta sediments, from the Green River shales at Willow Creek upward to the top of the Upper Uinta at Little Mountain has been carefully made, see pp. 301–6, the chief points of inquiry in the present paper are:

1. The ascertainment by correlation of the geological position of the upper red beds of the Uinta sediments;
2. The fixation of the contact between these upper red beds and the underlying Uinta horizon (horizon C1 of Osborn) to the south;
3. A study of the contacts between the Upper Uinta and the underlying formations along the northern border of the Uinta Basin;
4. The relation between the upper Uinta and the so-called "Bishop Conglomerate" along the Uinta Mountain range.

We have been spurred to the study of the first and last subjects of inquiry by a letter of criticism from Dr. Julian D. Sears of the United States Geological Survey, referred to in the supplementary note in the article on the "Brown's Park Formation," Memoirs Carnegie Museum, Vol. XI, No. 2, 1928, p. 12. It is quite obvious that the final determination of the geological relation of the uppermost

Uinta sediments to the beds underlying them cannot be satisfactorily disposed of without the assistance of more complete fossil remains than have heretofore been available from these upper beds. The fortunate discovery of additional material, by the Carnegie Museum field-party of 1929, and especially the discovery of a quarry of Titanotheres and other remains well up in the Upper Uinta has clearly demonstrated that Peterson was in error in referring these beds to the Brown's Park Miocene in northwestern Colorado.[1]

The formation under discussion is a long and rather narrow belt along the southern base of the Uinta range. It has an extent of approximately eighty miles from east to west, reaching the foothills of the Wasatch range westward; while to the east it extends close to the Colorado-Utah state-line. In a north-south direction the formation seldom exceeds twelve to fifteen miles.

In looking at the eroded faces of the stratigraphic mass the panorama appears as of a pale brick-red. There are many other colors, but the red predominates. Along the southern borders of these upper red beds the strata have a northward and slightly westward dip of from two to four degrees. In proceeding northward through the Basin this dip constantly decreases, especially in the region where the section was made. At a point some three to four miles north of White River the strata become horizontal and very soon there is a noticeable southward dip, thus forming a syncline in this region of the Basin. The extreme southward dip observed along the northern contacts with the base of the Uinta range is seldom over twelve to fifteen degrees.

Lithologically the strata in the region, through which the geological section was taken, are made up, for the most part, of soft and hard sandstones, often enclosing lenses of clay. These sandstones alternate with soft and indurated layers of strongly arenaceous clays. Along the northern border of the Basin are numerous intercalations of masses of conglomerates of finer and coarser texture.[2] These layers of conglomerates are sometimes twenty to thirty feet thick and of considerable geographic extent.[3]

[1]Memoirs, Car. Mus., Vol. XI, 1928, pp. 94-95. This error was chiefly due to inadequate paleontological evidence, upon which the previous determination was based.

[2]The closer to the northern border of the formation, the coarser the conglomerate.

[3]For more details in lithology see pp. 305–6.

The most intensive search by Peterson (1893-95, 1912, 1929-30), Douglass (1907-29), Riggs (1910), and Kay (1928-30), revealed no clear stratigraphic break between the upper red beds of the Uinta and horizon C (=C1 of Osborn.). Furthermore the lithological gradation, color, and other conditions, along the course of the cross-section made through the Basin, are so gradual from the lower to the higher strata that it becomes extremely difficult to separate the two horizons. The exposures of the lower red beds (top of horizon C), to the west of where the section was made, or in the Duchesne Valley, are, however, capped by a decided hard banding of sandstone, which is quite persistent in the middle region and western end of the Basin. At Point Randlette about three miles above the junction of the Duchesne and the Uinta rivers, on the north bank of the Uinta, the upper part of horizon C is capped with a brown sandstone some ten to twenty feet thick. To the east of this point (Point Randlette) it is possible to trace this horizon to the north of "Pelican Lake" or the northern rim of "Leota Basin," thence crossing the region where the cross-section is taken (See map, Pl. IX) on Green River between the Baser and Leota bends of Green River, thence eastward along the south rim of "Dead Man's Bench" to the Colorado-Utah state-line.

From Point Randlette westward, the sandstones overlying horizon C are clearly distinct and more easily traced. They weather out to characteristic reddish brown cliffs along the streams and on the divides between Lake Fork, "Dry Gulch," Duchesne, and the course of other rivers. In places the sandstones are fine-grained; in other places coarse, with a tendency to become conglomerates. Cross-bedding is often shown, indicating stream action. In a lithological sense these Upper Uinta sandstones are distinctly different from the lower formations in the middle and western part of the Basin. There is more sandstone, less clay, and the sedimentary mass, as a whole, has less vertical thickness. There was, however, no distinct break found between horizon C and the Upper Uinta sediments along the water-courses and divides here mentioned. In the study and measurements of the strata from south to north further east in the Basin, where the section was taken, we are in fact forced to temporarily conclude that the entire tertiary sedimentation of the Uinta Basin including the uppermost beds, went on continuously.

In dealing with these uppermost beds from a faunistic standpoint we observe a sharp break. Well toward the top of the series, in the

Titanothere quarry (See section on p. 306 and Pl. XI) worked by the Carnegie Museum during 1929-30, we have secured an abundance of material pertaining to a typical Oligocene form (*Teleodus*). In the same quarry were found a portion of the lower jaw of a Cameloid (Poëbrotherium) and remains of Hyænodonts. With these was also discovered material representing a small rhinoceros provisionally referred to *Amynodon* and a fragment of a mandibular ramus, with M_2 in place, of a mesonychid comparable in size with *Mesonyx ossifragus.* Outside of the two latter genera the fauna, so far found in this new quarry, is certainly representative of a post-Eocene or basal Oligocene deposit.

Osborn (pp. 99-103, "Titanotheres of Ancient Wyoming, Dakota and Nebraska") has correlated the Uinta represented in the section at Beaver Divide, Wyoming, with horizon C ($=C_1$ of Osborn of the Uinta Basin, see p. 100). This correlation seems to rest chiefly on *Amynodon antiquus*, *Protoreodon parvus* and the evidence of a Titanothere discovered in the Wyoming section. The cameloid (*Camelodon arapahovius* Granger[4]) appears too far advanced for a form from the horizon C of the Uinta according to the artiodactyl fauna, as at present known from that horizon. The deposit in Wyoming, according to Osborn equivalent to the Uinta, may possibly represent a slightly later deposit than that of horizon C in the Uinta Basin. In other words the Uinta section of the Beaver Divide probably represents some portion of the one thousand feet of strata from the top of horizon C to the Titanothere Quarry opened by us in the Uinta Basin. According to the faunistic evidence now in our possession we must regard the uppermost red series of the Uinta sediments as pertaining to the basal Oligocene, which has been more or less anticipated, though not hitherto proven, by paleontologists who have visited and worked in the Tertiary sediments of the Uinta Basin.

The lower members of the Uinta sediments are apparently entirely absent along the northern border of the Uinta Basin. Horizons A, B, and C_1 ($= C_1$ of Osborn) so characteristic of the southern and middle part of the Uinta Basin, together with the rich fauna of horizons B and C, are entirely lacking along the northern borders. This apparent unconformity, observed by Peterson in the years 1893-1912[5], by

[4]Bull. Amer. Mus. Nat. Hist. Vol. XXVIII, 1910, p. 248.

[5]Bull. Amer. Mus. Nat. Hist., Vol. VII, 1895, pp. 72-74.

Douglass in 1908-09[6], by Kay 1928-29, led to the fruitless search by these parties for a distinct break between the Upper and Lower Uinta sediments along the southern, or rather the middle exposures, in the Uinta Basin. As has already been stated in this article, the sedimentation from the south northward in the Uinta Basin appears to have been continuous from the lower tertiary measures to the top of the Upper Uinta. So far as the Wasatch, Green River, and the lower part of the Uinta series are concerned, the deposits to the south and east are laid down in a similar order to those in the Bridger and Washakie Basins. To the north, on the other hand, the lower tertiary members of the Uinta are reduced vertically to comparatively thin fingerings or entirely absent. It is questionable whether the Wasatch is at all represented along the northern border west of Green River (see map, Pl. IX). If represented, its characteristic lithological structure, as in other places, is here entirely changed.[7]

The absence or presence of a representation of the Green River Formation in Vernal Valley was one of the studies undertaken during the early part of the season of 1929. Before ending this work Mr. Kay, the junior author, made an especial effort to trace the formation from the eastern end of the basin (near the Colorado-Utah state-line) to the vicinity of Mosby Mountain. In proceeding westward from the vicinity of "Powder Springs," Utah (see map, Pl. IX), the lithological condition and stratigraphic structure of the Green River Formation gradually changes from the typical shales to a fine-grained sandstone in many places heavily impregnated with asphaltum.[7a] The series west of the Green River Valley to Mosby Mountain we now know pertains to the same sedimentation east, south, and west in the Uinta Basin, but is here so changed that it is altogether unrecognizable as typical Green River. Furthermore, the formation in Vernal Valley thins vertically and its thickness is far less than that of the eastern, southern, and western exposures, as they appear in the Uinta Basin.

[6]"Geology of the Uinta Formation," Bull. of the Geological Soc., of Amer., Sept. 15, 1914, Vol. XXV, pp. 417-420.

[7]Numerous features in connection with the tertiary strata in the Uinta Basin, especially along the northern border, are at the present time under study.

[7a]In Bulletin 822, U. S. Geol. Survey, 1930, p. 77, Dr. E. M. Spieker informs us that, according to the analysis by the chemical laboratory of the United States Geological Survey and his personal investigations, this asphalt impregnation "may more properly be designated as bituminous."

Resting in apparent conformity on top of this Green River series along the northern border of the basin is the Upper Uinta Formation. This conformity is more apparent than real, because there is a break in sedimentation between the Upper Uinta and the Green River shales, consisting of horizons A, B, and C of the Upper Eocene, characteristic of the southern and middle parts of the Basin. Nowhere has this fossiliferous section (A, B, and C) been recognized as resting on the Green River series to the north, between Mosby Mountain and the Utah-Colorado state-line. As before stated, on the other hand, the Upper Uinta or basal Oligocene rests directly on horizon C to the south.

It is a well known fact that the tertiary sedimentary mass of the Uinta Basin, especially the upper series, is of a decided reddish color. The derivation of its color as well as a great part of its sediments are undoubtedly to be regarded as derived from the red quartzite and other formations along the dissected Uinta plateau. In the Upper Uinta sediments, especially along the northern borders, are intercalated many layers of conglomerates which are composed, for the most part, of quartzite from the Uinta range. An eroded surface of the Green River strata along the base of the Uinta Mountains is therefore expected to be found upon which rests the Upper Uinta Formation.[8]

The southward dip of the tertiary strata which now amounts to twelve or more degrees in places along the base of the Uinta Mountains most likely took place in a greater or less extent since the deposition of the Upper Uinta sediments. It seems that there is still a movement going on in the Uinta Range. During the field investigations of 1928, Mr. Kay found on the east side of Currant Creek (locally known as the "Red Narrows") that the mountain has faulted several hundred feet in recent years. In August of 1928 Kay visited this section and found that the mountain had sunk to the extent of admitting in the course of the fault, quaking asp (*Populus tremuloides*) in full leaf of that season. Trees fifteen to twenty feet high were almost totally buried in the fissure. In many places the fissure was still open and from two to three feet wide for a distance of a mile or more.

The "Bishop Conglomerates." The top of the Upper Uinta sediments along the southern base of the Uinta Mountain Range, has

[8]On White River above the Wagonbound Canyon is found evidence of unconformity between the Green River formation and horizon A of the Uinta.

not been found in actual contact with the so-called Bishop Conglomerates. The talus from this conglomerate along the base of Little and Mosby Mountains (see map, Pl. X and geological section p. 306) is, however, covering the Green River sediments; not underlying the Uinta as was erroneously stated by Peterson.[9] At the present time we are unable to definitely place the extensive deposits of coarse conglomerates along the flanks of the Uinta with regard to its geologic age. The final determination now reached, that the Upper Uinta tertiary beds are not of Miocene age and do not form true contacts with the conglomerates along the mountain, again raises the question as to whether or not the "Bishop Conglomerates" should be referred to the base of the Miocene section in Brown's Park, Colorado, to the north and east of the Uinta Mountain Range as was done by Peterson.[10] We feel rather doubtful that this series of the conglomerates are of Miocene age. In the Uinta Mountain Range generally these beds rest on elevations sometimes varying fifteen hundred or more feet. In the Uinta Basin there are found on eroded surfaces of different formations and in the Upper Uinta strata, layers of a conglomerate similar to that on the dissected plateaus of the elevated Uinta Mountain. "Leland Bench," to the east of Myton, Utah, is covered with a coarse conglomerate of ten to fifteen feet vertical depth and rests on the upper B and lower C of the Uinta sediments. The table of "benchland" between Lake Fork River and Ioka Post Office is well covered with this conglomerate, which rests on the eroded surface of the Upper Uinta sediments. Again this conglomerate is seen on different elevations along the Utah State Highway between Randlette and Vernal. It is possible that these sediments may pertain to those in the Brown's Park Miocene which have been regarded as of Pleistocene time.[11] Whether the "Bishop Conglomerates" found in many localities in the Uinta Range and vicinity[12] should be regarded as Pliocene, where

[9]Memoirs, Carnegie Museum, Vol. XI, p. 95.

[10] *Loc. cit.* p. 92.

[11]Near Lay Post Office in Colorado was discovered in soft sandy deposits a tooth of a proboscidean described and figured by Peterson as *Parelephas washingtoni* Osborn, Mem. Car. Mus. Vol. XI, 1928, p. 118-119.

[12]The type locality for this formation is the Bishop Mountains in Colorado. Hayden in his Preliminary Report on Wyoming and Contiguous Territory, 1871, chapters four and five, often speaks of these drifts and conglomerates, and seems to regard them as of comparatively late geologic origin.

they were referred by earlier geologists,[13] or to Pleistocene as suggested by Dr. Sinclair,[14] or, whether they should be regarded as the base of the Brown's Park as suggested by Sears[15] and Peterson,[16] does not now appear to admit of a satisfactory solution.[17] If determinable fossil remains ever should be discovered in the so-called Bishop Conglomerates (=Wyoming Conglomerate) it will help very much to settle the question.

During the latter part of the season 1929, while making the cross-section (Pl. XI), Mr. Kay, assisted by Mr. R. C. Thorne, discovered in the Green River Valley, some six miles north and east of Ouray, a fossiliferous locality, of considerable promise, in what is now regarded as the upper part of horizon C. This new horizon is from two to four hundred feet higher than any, in which collecting has heretofore been done in horizon C of the Upper Eocene. This general locality is of a number of square miles in extent and offers great promise in extending our paleontological investigations. Remains of large and small mammalia are already discovered in this latter horizon together with no less than three or four quarry-prospects by the Carnegie Museum party and Mr. R. C. Thorne and his party. It is hoped that these collections may ultimately be worked up as one unit in order to more correctly ascertain the vertical range and other features of many of the genera and species already known in the upper parts of horizon B and lower C of the Uinta sediments. In the Upper Uinta (now regarded as the basal Oligocene) on the other hand, fossil remains are extremely rare. Outside of a few scattered fragments found, and not capable of proper identification and fossil plants found at the base of the formation to the west of Lake Fork River, the Titanothere Quarry operated by the Carnegie Museum (see p. 306) is the only spot where recognizable remains have been found. All this material is now being cleared from the matrix for scientific investigation and exhibition.

[13]On pages 113 and 133, F. M. Endlich speaks of the Wyoming Conglomerate as of Pliocene origin. Eleventh Annual Report, U. S. Geol. and Geographic Survey, Idaho and Wyoming.

[14]Bull. Amer. Mus. Nat. Hist., Vol. XXII, 1906, p. 278.

[15]Bull. 751-G, U. S. Geol. Survey, 1924, p. 296.

[16]Mem. Car. Mus. Vol. XI, 1928, p. 92.

[17]Hayden (Preliminary Report of the United States Geol. Survey of Wyoming and Contiguous Territories, pp. 64-65) speaks of the conglomerates resting on the Brown's Park.

Lithological section of the Uinta Formation above the Green River Shales, Uinta County, Utah, made by J. LeRoy Kay, 1929.

BASE. GREEN RIVER SHALES.

	ft.	in.
Sandstone, heavily bedded	20	
Sandstone and shale, alternating bands reddish-brown on surface	111	
Sandstone, greenish gray	4	
Clay, reddish brown	7	
Sandstone, greenish	3	6
Sandstone, gray	6	
Clay, brownish	4	6
Shale, sandy, blue-gray	6	
Sandstone, coarse, with blue clay nodules	6	
Shale, sandy, greenish yellow	4	
Sandstone, coarse, gray	11	
Shale, sandy, reddish	7	
Clay, bluish white	10	
Shale, sandy, brown	10	
Sandstone, very hard, brownish gray	6	
Shale, sandy, brownish red	13	
Clay, light blue	3	
Sandstone, coarse, streaked with greenish bands	16	6
Sandstone, brownish gray	13	
Shale, sandy, blue	22	
Sandstone, greenish yellow	17	
Sandstone, reddish brown	21	
Shale, greenish	12	
Sandstone, coarse, yellow	12	
Shale, sandy, gray	4	
Clay, sandy	6	
Sandstone, fine grained, reddish brown, weathers into blocks	4	
Sandstone, coarse, gray, weathers into greenish gray on surface	18	
Sandstone, blue-gray	6	
Sandstone, greenish gray	36	
Clay, green		6
Sandstone, partly laminated, upper part copper stained	20	
Clay, brownish red	4	
Sandstone, hard, brown	6	
Shale, sandy, green	7	6
Shale, sandy, gray	17	
Sandstone, hard, gray	1	6
Shale, gray	10	
Sandstone, coarse, light gray	10	
Shale, sandy, greenish and brown	5	
Sandstone, reddish brown	3	

	ft.	in.
Shale, sandy, brownish and green	10	6
Sandstone, light gray	2	
Shale, green	5	
Sandstone, dark gray, weathering into blocks on the surface	2	
Shale, greenish	5	
Sandstone, fine grained, gray	2	
Shale, variegated, green and brown	10	
Sandstone, light gray	6	
Shale, variegated, with sandstone nodules	14	
Sandstone, light gray	8	
Shale, red, green and purple	15	
Sandstone, fine grained	5	
Shale, green and gray	7	
Sandstone, heavy, gray	6	
Shale, greenish gray	5	
Sandstone, gray	3	
Shale, sandy, greenish	3	
Sandstone, gray	13	
Shale, sandy	2	
Sandstone, light gray	5	
Clay, greenish	4	
Sandstone, nodular, gray	3	
Shale, sandy, greenish	6	
Shale, sandy, reddish and green with sandstone nodules	14	
Sandstone, gray	22	
Shale, variegated	7	
Sandstone, fine grained nodules	1	
Sandstone, fine grained, weathering brown on surface	3	
Shale, sandy, variegated with sandstone nodules	3	
Sandstone, fine grained, gray	4	
Shale, red and green	5	
Sandstone, gray	3	
Shale, red, green, and purple	7	
Sandstone, coarse, gray	8	
Sandstone, very hard, nodular	1	3
Shale, with sandstone nodules, reddish, purple, and green	8	
Sandstone, hard, gray	5	
Shale, variegated	16	
Sandstone, nodular, light gray	4	
Shale, reddish brown	15	
Shale, reddish gray and green	12	
Sandstone, nodular, gray	6	
Shale, reddish brown and green	17	
Sandstone, soft, light gray	2	
Shale, sandy, brown and gray	12	
Shale, gray and reddish	5	

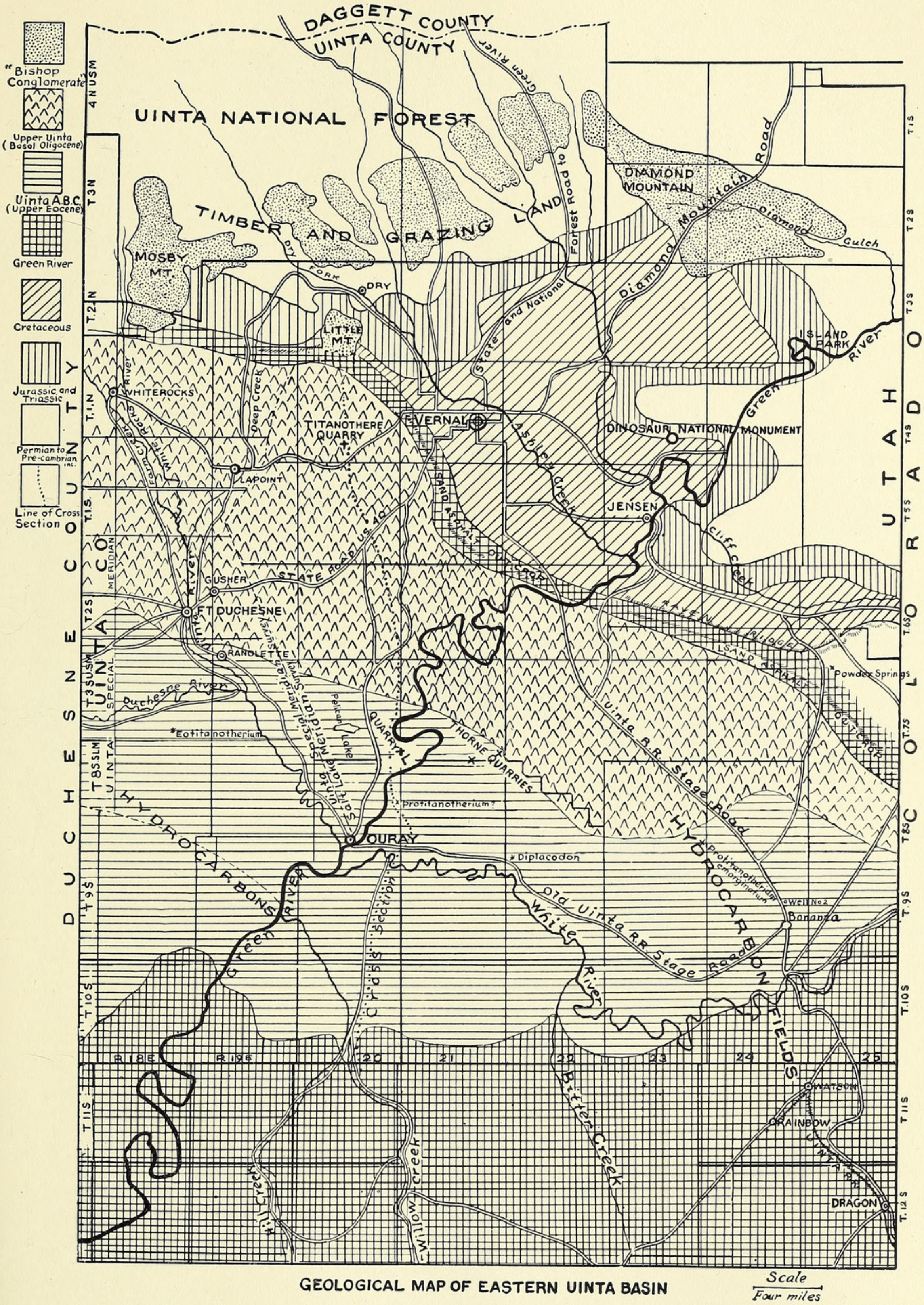
	ft.	in.
Sandstone, nodular, gray	1	
Shale, purple, gray, and green	12	
Sandstone, nodular, light gray	4	
Shale, sandy, brownish	4	
Shale, blue	1	
Shale, reddish brown	4	
Sandstone, nodular, light gray	2	
Shale, variegated	36	
Shale, and sandstone, alternating bands brown and blue-white	80	
Sandstone, nodular, gray	8	
Shale, variegated	14	
Sandstone, nodular, light colored	6	
Shale, variegated, reddish, green, and brown	65	
Sandstone, coarse, light colored	6	
Clay, reddish and white	15	
Sandstone, coarse	6	
Shale, sandy, reddish brown	23	
Clay, bluish gray, with two small bands of nodular sandstone	26	
Sandstone, nodular, gray	8	
Shale, variegated	12	
Sandstone, nodular, light colored	5	
Shale, variegated	15	
Sandstone, blue-white	6	
Shale, reddish and yellow	22	
Sandstone, light gray weathering dark on surface	4	
Shale, reddish and blue, with two small bands of nodular sandstone	15	
Sandstone, coarse, light gray	3	
Sandstone and shale, alternating bands	26	
Shale and nodular sandstone, reddish brown	30	
Sandstone, gray, weathering brown on surface	14	
Shale, sandy, variegated	6	
Sandstone	5	
Shale, dark reddish brown	6	
Sandstone, gray	4	
Sandstone, with lenses of shale	15	
Sandstone, fine grained, gray	3	
Shale, reddish brown, with lenses of sandstone	26	
Sandstone, yellow and gray	10	
Sandstone and shale, alternating bands, shales variegated	12	
Sandstone	5	
Shale, red, gray, and purple	40	
Sandstone, coarse, light gray	5	
Shale, reddish green, and purple	40	
Sandstone, coarse, loosely cemented	16	
Shale, variegated	10	
Sandstone, coarse, light gray	3	

	ft.	in.
Shale, reddish brown	4	
Shale, sandy, light gray	5	
Shale, sandy, blue and yellowish	20	
Sandstone, yellowish	10	
Clay, brownish red	26	
Sandstone, yellowish gray	12	
Sandstone, very loosely cemented, bluish white, appears on surface as sandy shale	16	
Clay, dark reddish brown	10	
Sandstone, light gray	4	
Shale, reddish brown and blue	5	
Sandstone, light gray	4	
Shale, sandy, brown, red, and blue-white, with lenses of sandstone	18	
Sandstone, nodular, gray	4	
Shale, sandy, purple, blue, and red	8	
Sandstone, soft	2	
Shale, variegated	9	
Sandstone	3	
Shale, reddish brown	16	
Sandstone, coarse, light gray, weathers dark on surface	4	
Shale, variegated, capped by 18 inches of sandstone	6	
Clay, variegated	3	
Sandstone, light gray	4	
Clays, variegated, small lenses of sandstone	17	
Sandstone, fine grained, bluish white	4	
Clay, sandy, brownish red	5	
Sandstone, light gray	2	
Clay, brownish red	5	
Sandstone, light gray	1	6
Clay, brownish red	2	6
Sandstone, coarse	3	
Shale, brownish red	5	
Sandstone, fine grained, gray	2	
Clay, reddish brown	3	
Sandstone, coarse, light gray	11	
Sandstone and shale, alternating bands	20	
Sandstone, coarse, yellowish	15	
Clay, red, capped by green band	20	
Sandstone, coarse, heavy bedded	8	
Clay, brownish red	8	
Sandstone, light gray, weathering into irregular blocks on surface	2	
Clay, brownish red	6	
Sandstone, nodular	7	
Sandstone and shale, brownish red	10	
Sandstone, yellowish gray	9	
Sandstone and clay, alternating	20	

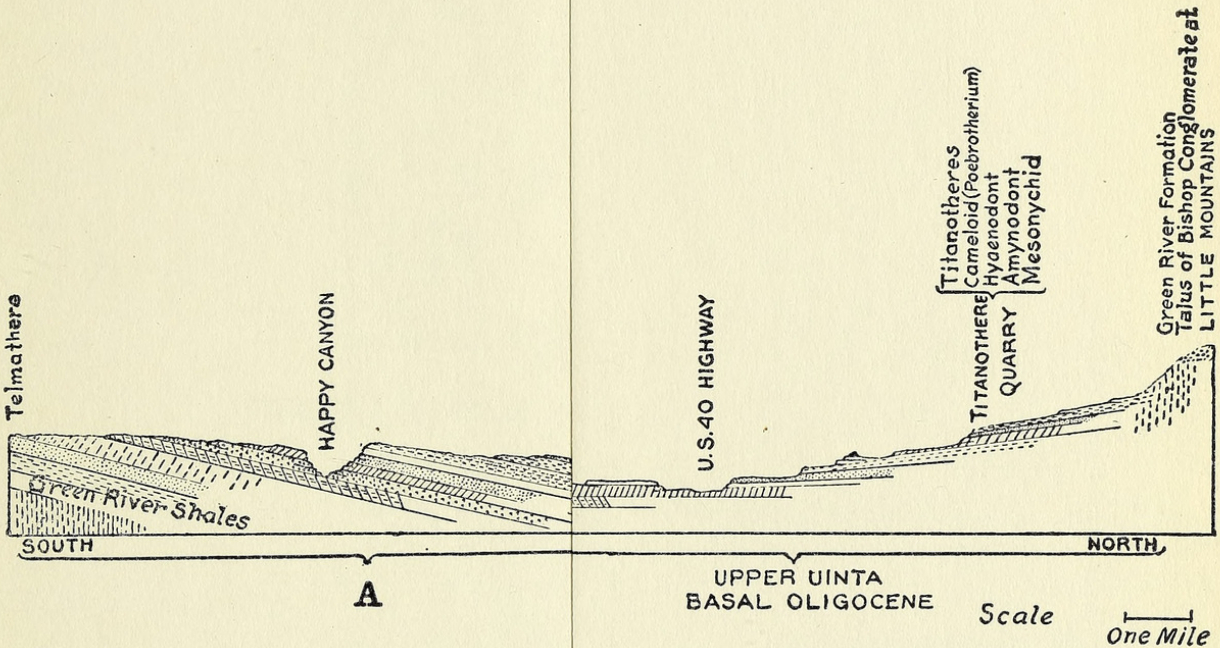
	ft.	in.
Clay, brown, red, and blue-gray	2	6
Sandstone and variegated clays alternating	62	
Sandstone, massive, light gray	28	
Clay, red	30	
Sandstone, light gray	12	
Sandstone and reddish clay, alternating	8	
Sandstone, soft, light colored	26	
Sandstone, nodular, light gray	38	
Clay, brownish red, and purple	16	
Sandstone, light colored	11	
Sandstone and shale, alternating	42	
Sandstone, with two small strata of red shale	37	
Sandstone and shale, alternating strata, shale brownish red	30	
Conglomerate	10	
Clay, brownish red and blue-gray	47	
Sandstone, laminated	10	
Sandstone and shale, variegated	9	
Sandstone, light gray	8	
Clay, brownish red and blue-white	14	
Sandstone, soft, light gray	2	
Shale, alternating brownish red and purple, with thin lenses of sandstone	41	
Conglomerate	6	
Sandstone and reddish brown sandy shale	23	
Conglomerate	4	
Sandstone, light gray	5	
Shale, sandy, brownish red with lenses of gray sandstone	26	
Shale, sandy, brownish red	12	
Sandstone, coarse, with lenses of brownish red clay	33	
Shale, brownish red, with lenses of nodular sandstone	15	
Sandstone, light gray	20	
Clay, yellow, brown, and red, with lenses of nodular sandstone	26	
Sandstone, coarse, gray	16	
Shale, reddish brown	7	
Shale, variegated with lenses of laminated sandstone	25	
Sandstone, soft, light gray	2	
Sandstone, nodular	5	
Sandstone and clay, reddish brown	19	
Sandstone, coarse, gray	16	
Clay, brownish red	8	
Sandstone and clay, light brownish red	49	
Clay, bluish white	22	
Sandstone, coarse, brownish, and gray	14	
Clay, reddish brown	22	
Sandstone, coarse, light gray	3	
Sandstone and brownish red clay	38	
Conglomerate and coarse sandstone	7	

	ft.	in.
Clay, sandy, variegated	16	
Fossiliferous conglomerate and sandstone, fine grained, alternately soft and hard, (*Carnegie Titanothere Quarry*)	3	
Conglomerate	4	
Sandstone, reddish gray and light brown	23	
Clay, brownish red and variegated with lenses of sandstone	93	
Sandstone, conglomerate and brownish red clay; the clays are mostly sandy	91	

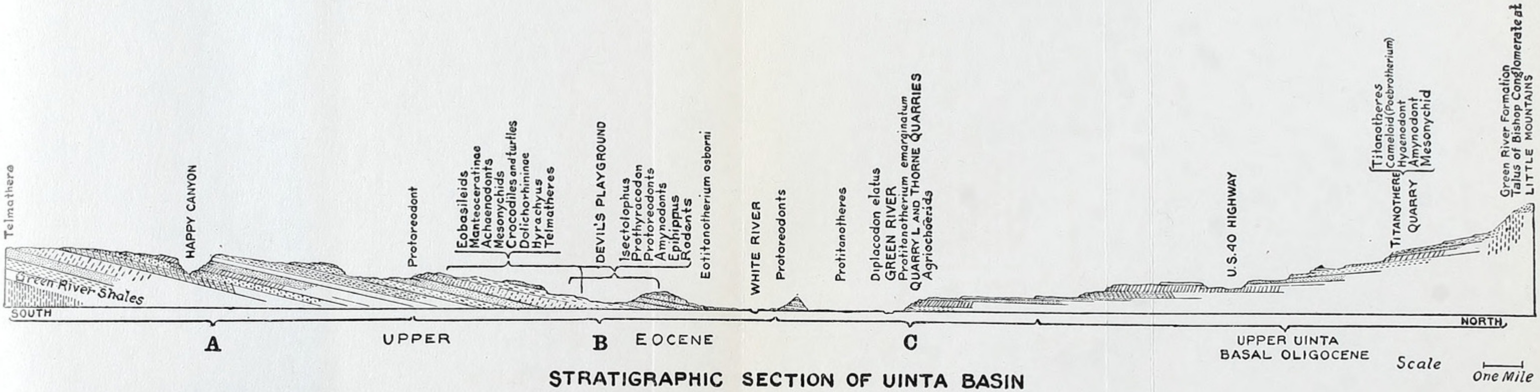
Top of Section ... 3020 ft. 3 in.



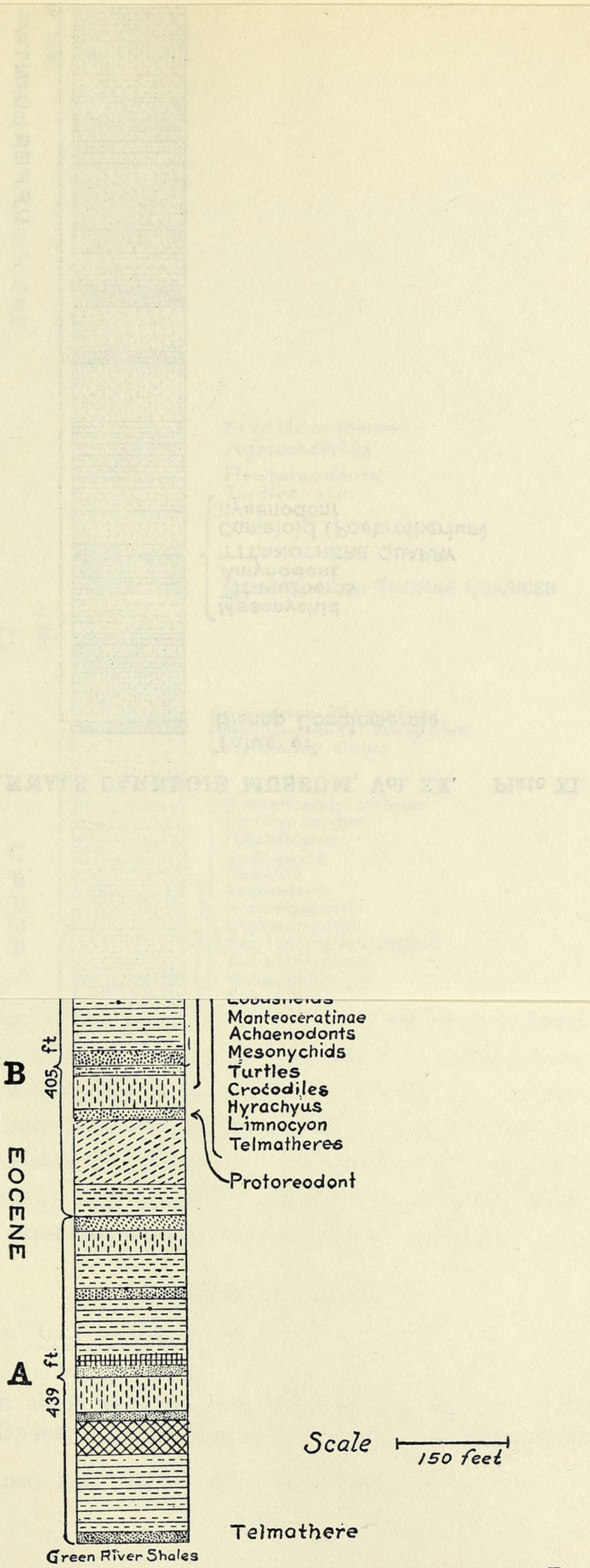
GEOLOGICAL MAP OF EASTERN UINTA BASIN


Telmathere
HAPPY CANYON
U.S.40 HIGHWAY
TITANOTHERE QUARRY
Titanotheres
Cameloid (Poebrotherium)
Hyaenodont
Amynodont
Mesonychid
Green River Formation
Talus of Bishop Conglomerate at
LITTLE MOUNTAINS
Green River Shales
SOUTH
NORTH
UPPER UINTA
BASAL OLIGOCENE
Scale
One Mile

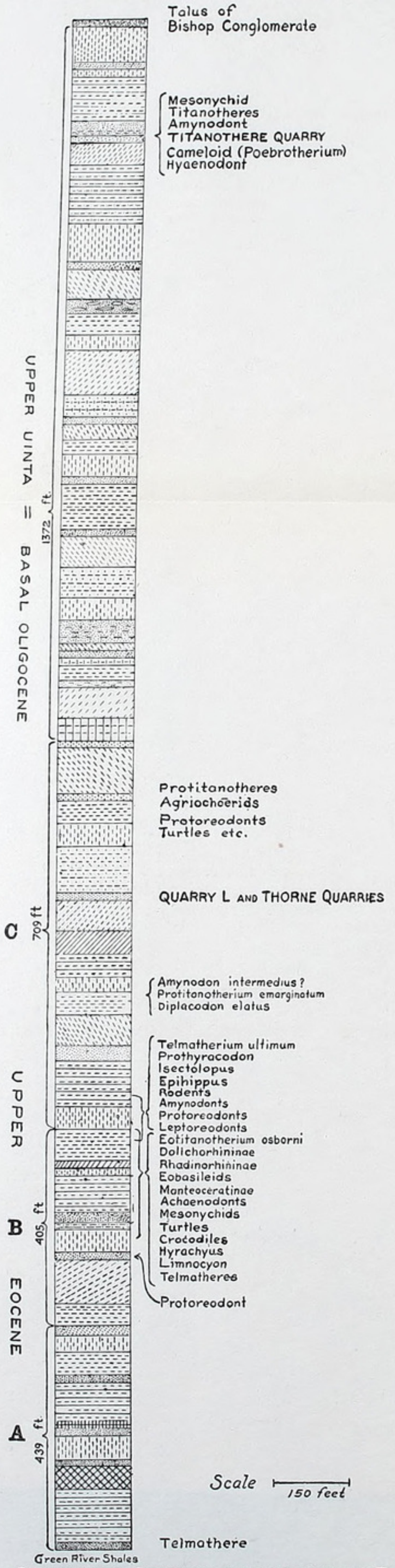
A



STRATIGRAPHIC SECTION OF UINTA BASIN



COLUMNAR SECTION OF HORIZONS A,B,C, AND UPPER UINTA



COLUMNAR SECTION OF HORIZONS A,B,C, AND UPPER UINTA