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ART. I. NOTES ON AMPHIBIANS FROM ROCKINGHAM COUNTY, VIRGINIA

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and
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Introduction

The junior author recently presented to the Carnegie Museum a few amphibians that he had collected while a student at Bridgewater College, Bridgewater, Rockingham County, Virginia. In view of the paucity of herpetological records for the Shenandoah Valley and because of the rarity of certain of the specimens, a brief report upon this collection seems desirable.

Thirteen species are represented by the eighteen specimens in the Carnegie Museum; three additional species are in the collection of Bridgewater College; and yet another three are mentioned in the field notes of the junior author. Thus, from Rockingham County, we list nineteen forms, and indicate the localities at which they have been found.

Dr. Harry G. M. Jopson of Bridgewater College and Dr. E. R. Dunn of Haverford College have manuscript records of three other species—*Desmognathus phoca*, *Hyla versicolor versicolor*, and *Rana catesbeiana*—from Rockingham County. The total of twenty-two forms at present known from this region could undoubtedly be increased by more extensive collecting. In Virginia, *Desmognathus ochrophaeus ochrophaeus* is known only from the east slope of the Allegheny Mountains in near-by Highland County (Netting, 1932), although it has been found in Pendleton County, West Virginia, which adjoins Rockingham County on the west. The other amphibians that may possibly occur in the county are: *Ambystoma jeffersonianum*, *Ambystoma opacum*, *Plethodon richmondi*, *Plethodon wehrlei*, *Hemidactylium scutatum*, *Aneides aeneus*, and *Pseudacris brachyphona*.

In an important study of the food habits of snakes of the George Washington National Forest, a portion of which is located in Rocking-

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ham County, Uhler, Cottam and Clarke (1939) mention twelve species of amphibians that were taken from snake stomachs. *Acris crepitans* is incorrectly listed as *Acris gryllus;* with this correction all the species referred to are represented in the Rockingham County fauna, as we now know it.

LIST OF SPECIES

Triturus viridescens viridescens Rafinesque

One adult male (CM 16971) was secured at Rawley Springs (George Washington National Forest, about eleven miles west of Harrisonburg) on October 9, 1937. The species also occurs one mile west of Bridgewater along the backwaters of the North River.

Ambystoma maculatum (Shaw)

The Spotted Salamander has been found only at Rawley Springs. One specimen was collected there in April, 1937, and three, on April 2, 1938. One of the latter, an adult female (CM 16872), measures 210 mm. in total length. Numerous egg masses were observed, and larvae were collected in both years.

Gyrinophilus porphyriticus porphyriticus (Green)

One adult (CM 16349) was taken at Rawley Springs on April 13, 1937. The species has been collected also at Bridgewater and Hone Quarry (George Washington National Forest, about fifteen miles west of Harrisonburg).

Pseudotriton ruber ruber (Sonnini)

Two adults (CM 16347-48) were collected at Rawley Springs on February 2, 1937.

Eurycea bislineata bislineata (Green)

One adult (CM 16972) was collected at Rawley Springs on October 9, 1937; others have been found at Hone Quarry.

Eurycea longicauda longicauda (Green)

One subadult (CM 16357) was secured at Bridgewater on April 10, 1938. The species occurs at Rawley Springs, also.

Plethodon cinereus (Green)

Two dark-backed adults (CM 16355-56) of this locally common salamander were collected at Bridgewater on February 2, 1938. It has also been found at Hone Quarry, Rawley Springs, Sparkling Springs, and Stokesville.

TABLE I

CM No.	Sex	Costal Grooves	Head-body Length	Tail Length	Tail as % of Head-body	Dorsum
16355	♀	20	48	49	102.0	dark; no stripe
16356	♀	19	36	30	83.3	dark; no stripe

Plethodon glutinosus (Green)

One specimen was found at Sparkling Springs (eight miles northwest of Harrisonburg) on November 14, 1937.

Desmognathus fuscus fuscus (Rafinesque)

Three adults (CM 16352-54) were taken at Bridgewater on February 13, 1937. This species is common in Rockingham County, and has been collected at Rawley Springs and Stokesville.

Scaphiopus holbrookii holbrookii (Harlan)

On April 27, 1937, a strange frog chorus, apparently consisting of dozens of voices, was heard in a wheat field at Bridgewater. The wheat was then several inches high, and heavy rains had flooded a low area to a depth of from five to six inches. Here about a dozen *Scaphiopus holbrookii holbrookii* were collected, and the mating behavior of others was observed. In several instances two males were seen clinging to one female. This observation is of interest, since in his excellent study of this species Ball fails to mention multiple clasping, and in fact specifically states: "Should another male approach, the one in amplexus croaks violently and thrusts the intruder away with a hind limb" (1936: 366). Oviposition occurred and eggs were seen attached to stubble. Calls were heard during seven or eight succeeding evenings.

The flooded area dried up in about sixteen days. Nineteen days is the shortest time reported (Ball, 1936: 355) between oviposition and protrusion of forelimbs in New England specimens, but in this more southern locality metamorphosis may have been accomplished more quickly. Unfortunately, no observations were made to prove that tadpoles were present at any time during the sixteen-day period. No Spadefoots were heard at this locality in 1938, but they were heard at the same site in May, 1939. The species has not been taken elsewhere in Rockingham County.

Two adults in the junior author's collection measure 65 and 58 mm. in head-body length. The single adult (CM 16871) in the Carnegie collection measures but 50 mm. This specimen has a broad, but not sharply demarcated, light mid-dorsal stripe, formed anteriorly by the junction, at a point between the parotoids, of two faint light stripes that extend backward from above the eyes. The stripe is widest at the mid-point of the back where it encloses a large, circular, dusky spot; it is bordered with dark brown which merges into the gray color of the sides. The light stripe is studded with numerous small black spines; there are few spines on the back, outside of the stripe, and on the sides, but in these regions numerous low warts are present. A fresh specimen (CM 17632) from Montgomery County displays similar coloration and distribution of spines and warts, although the latter are larger and more prominent. Two additional Montgomery County specimens (CM 17633-34) are almost uniform rusty brown, the usual color of specimens of *Scaphiopus* that have been stored in formalin for a few years. Prompt transfer to alcohol seems to be more necessary with *Scaphiopus* than with other eastern frogs if the specimens are to be used for the study of pattern variations.

For comparative purposes metric data upon all of the Virginia specimens of this species now in the Carnegie collection are presented in the following table:

TABLE II

CM No.	Sex	Head-body Length	Tibia Length	Interorbital Width	Tibia as % of Head-body	Interorbital as % of Head-body
17632	♂	66	23	8	34.8	12.0
17633	♂	61	21	7.5	34.4	12.3
17634	♂	61	22	8	36.0	13.1
16871	♀	50	16	6	32.0	12.0
13208	juv.	37	12.5	5	33.7	13.5
32091	juv.	36	12.5	4.5	34.7	12.5

The specimens listed above bear the following data:

13208-09 New Kent Co.: near Lanexa
May 27, 1938. Neil D. Richmond

16871 Rockingham Co.: Bridgewater 1200 ft.
April 27, 1937. L. Wayne Wilson

17632 Montgomery Co.: Radford 1800 ft.
August 6, 1939. N. B. Green and N. D. Richmond

17633-34 Montgomery Co.: Radford 1800 ft.
March 26, 1939. Paul R. Burch

In the above records only the Bridgewater station is new; it is the first Shenandoah Valley record for the Spadefoot, and the second Virginia record from west of the Blue Ridge. Dunn (1936:2) lists *S. h. holbrookii* as occurring in Essex, Accomac, and Montgomery counties; Richmond and Goin (1938: 302) have since reported it from New Kent County. Radford is only about one hundred and twenty miles southwest of Bridgewater, but it may have received its Spadefoot population from the east through the Roanoke Valley rather than from the northeast. The Blue Ridge east of Montgomery County is too poorly defined to act as an effective barrier to the westward movements of those eastern forms that are not restricted to the Coastal Plain. Valley-migrating forms may reach Roanoke by way of the Roanoke River without going above an altitude of 1000 feet; Roanoke is separated from the Shenandoah Valley by the 2000-foot Shenandoah-Roanoke divide. The Pedlar Hills intervene between Roanoke and Radford on the New River; this escarpment proved a barrier to human migration in colonial times (Fenneman, 1938:248-249) and may have affected other groups as well. The routes by which amphibians and reptiles reached the upper New River are especially worthy of study, for the New River gorge certainly seems impassable for certain kinds. Records of *Scaphiopus* within the Appalachian area are as yet too few to permit accurate appraisal of the distributional barriers that control this form, but apparently its principal migration lanes are along large and fairly mature river valleys.

Bufo americanus americanus (Holbrook)

One juvenile (CM 16358) was collected at Bridgewater on May 10, 1938.

Bufo woodhousii fowleri Hinckley

This species was taken at Bridgewater College, Bridgewater on April 10, 1938.

Acris crepitans Baird

Two adult females (CM 16350-51), measuring 20.5 mm. and 22 mm. in head-body length, were collected at Rawley Springs on March 22, 1938. The species has been seen also at Bridgewater and at Stokesville.

Dunn (1938:154) lists six criteria for use in distinguishing *crepitans* from *gryllus*. Four of these: (1) larger size, (2) more extensively webbed feet, (3) shorter legs, and (4) less definitely striped thighs, are evident in our specimens when they are compared with topotypes of *gryllus* from Riceboro, Georgia. The two other diagnostic characters used by Dunn do not hold in our specimens; they seem, therefore, to merit further discussion. First, he characterizes *gryllus* as "more rugose" than *crepitans;* the contrary is true in the Rockingham County specimens which are definitely more rugose than are *gryllus* topotypes. Wide variation in the amount of rugosity occurs in both species and we feel that this character is the least useful of those used by Dunn. Secondly, Dunn states that the anal warts of *gryllus* are less prominent than are those of *crepitans*. This statement is ambiguous because it fails to indicate whether the warts are prominent by reason of their color, size, or number. The startlingly white color of the subanal warts of some specimens of *Acris* is a result of preservation in formalin, as the senior author has determined experimentally; specimens preserved in alcohol show less color change and the subanal warts do not fade to an ivory white. It is quite evident, however, that rugosity of the central thigh area is more characteristic of *crepitans* than of *gryllus;* the Virginia specimens and many examples of *crepitans* from elsewhere exhibit a greater number of subanal warts than do topotypes of *gryllus*, but brilliant white warts are present in some specimens of each species. In addition to the characters mentioned by Dunn, *crepitans* has a shorter head and a more obtuse snout than *gryllus*.

Pseudacris nigrita feriarum (Baird)

About 7:30 P.M., on February 13, 1937, this frog was heard calling from among the long grasses in a marshy area bordering a small ditch

that parallels Long Glade Creek at Bridgewater. The calling individuals were scattered, and as the evening became cooler the calls diminished noticeably; but two specimens, a male and a female, were collected.

The female (CM 16870) has narrower and more broken dorsal stripes than do male topotypes from Pennsylvania. The dorsal surfaces of the hind legs are faintly barred. This is apparently the first record of this species in the Shenandoah Valley.

Hyla crucifer crucifer Wied

One adult male (C M 16359) was secured at Bridgewater on May 16, 1937.

Rana clamitans Latreille

The Bridgewater College collection contains specimens taken in the North River at Bridgewater on October 30, 1937.

Rana palustris Le Conte

The Bridgewater College collection contains specimens taken in the North River at Bridgewater on October 30, 1937.

Rana pipiens Schreber

The Bridgewater College collection contains specimens taken in the North River at Bridgewater on October 30, 1937.

Rana sylvatica sylvatica Le Conte

Egg masses of this species, and of *Ambystoma maculatum*, were abundant in several small pools above Rawley Springs on April 2, 1938.

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ART. II. NEW SILURIAN SCOLECODONTS FROM THE ALBION BEDS OF THE NIAGARA GORGE, NEW YORK

By E. R. Eller

Plates I-VII

Of the five thousand Scolecodonts, fossil polychæte annelid jaws, examined in this study, more than ninety per cent were found to be broken or badly crushed out of shape. Preliminary sketches were made of about five hundred good or usable forms. All specimens which were broken or which might leave a slight doubt as to their true shape were rejected.

The specimens were collected along the tracks of the Lewiston Branch of the New York Central Railroad, just north of the tunnel near the mouth of the Niagara Gorge, about one-half mile south of Lewiston, New York. They came from the thin-bedded, calcareous sandstone layers of the Manitoulin Beds, Albion formation, Medina Group, of Silurian age. The Manitoulin beds are about thirty feet thick and consist of dark greenish shale, thin-bedded argillaceous magnesian limestone, and thin, calcareous sandstone layers. Fossils are scarce in these beds. The Scolecodont horizon is from about twenty to twenty-five feet above the Whirlpool sandstone.

The layer containing the jaws was discovered by Mr. Raymond B. Hibbard, of Buffalo, New York, while searching for Bryozoa. When the Scolecodont layer is exposed, it becomes covered with a soft crust of calcareous mud which conceals the specimens from view in ordinary prospecting. To find the fossil jaws it is necessary to wash the mud from the rocks. This, of course, destroys many of the specimens. Scolecodonts were known to occur in the Niagara Gorge and the writer had spent a great deal of time searching for them and is therefore indebted to Mr. Hibbard for disclosing their exact locality. Thanks are also due to Mr. Max Kopf of Lancaster, New York, and to Mr. Hibbard for their assistance in collecting the specimens.

The sandstone layer containing the Scolecodonts is finely grained and in places calcareous. The amount of cementing material in the

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matrix seems to vary. Scolecodonts are of a chitinous-like material and a weak solution of hydrochloric acid does not affect them except in some cases where a small bubble of carbon dioxide will form directly beneath and may break the delicate jaws. A very small needle, sharpened to the finest point possible, was used to loosen the matrix around the jaws, and to clean out the muscle fossa and remove the material between the denticles. This also helped to keep the liberated gases from breaking the specimens. Whenever possible the jaws were taken from the matrix so that both surfaces could be studied, since it was found that satisfactory determinations cannot be made without seeing all surfaces. Broken specimens may be repaired by using a very thin solution of celluloid and acetone.

The jaws in this collection are relatively small in size. There is a lack of material belonging to maxillæ III and IV, and since much of the material is small, thin, and fragmentary, it is possible that the proximal maxillæ were too fragile for preservation.

The collection, including the type specimens of the new species, is in the Carnegie Museum.

DESCRIPTION OF SPECIES

Genus LUMBRICONEREITES, Ehlers, 1868

Lumbriconereites hibbardi sp. nov.

Maxilla I, plate I, figs. 1-9

Asymmetrical right and left jaws are present. The jaw is wide and elongate, being widest at the mid-region but narrowing to an acute posterior extremity. There are generally seventeen large, backward-pointing denticles which extend along the inner margin nearly to the posterior end. The inner margin, when viewed directly from the lower side, curves at the anterior end at about the third or fourth denticle and continues in a straight line to the posterior extremity. The denticles are often irregular in shape, being either round and blunt, or triangular, flat, and pointed. They usually decrease in size posteriorly. Specimens range from 1.0 mm. to 2.1 mm. in length. The hooked-shaped fang is large and is a continuation of the heavy outer margins, which are thickened, especially toward the anterior end. On the right jaw the outer margin is notched by a crescent-shaped bight which forms a shank; the left jaw is rounded and has but a slight suggestion of a bight beginning at a point just anterior to the mid-point. The inner surface, especially near the denticles, is often concave while

the outer surface is convex, except for the fossa. The fossa is wide anteriorly but narrows acutely at the posterior extremity. The margins of the fossa are well rounded thus enabling the jaw to be twisted considerably by the muscle.

This species resembles *Lumbriconereites obliquus* Eichwald (1854), in nearly all of its characteristics, but there are some differences which exist in the several scores of specimens examined. *Lumbriconereites hibbardi* is much wider. The inner margin of the jaw is not so straight as that of *Lumbriconereites obliquus*, as shown in Hinde's figures. The fossa of *Lumbriconereites hibbardi* is much wider and is well rounded anteriorly. The inner surface (upper surface of Hinde), which bears the inner margin and the denticles, is in the form of a gently sloping ridge, while in *Lumbriconereites hibbardi* this area, especially on the inside of the curved inner margin, is concave. There is a slight resemblance between *Œnonites major* Hinde (1882) and *Lumbriconereites hibbardi* (left jaws). Stauffer (1933) figured a number of specimens from the Middle Ordovician of Minnesota under two generic names, *Lumbriconereites* and *Protarabellites* and several specific names, *Lumbriconereites cameratus*, *Lumbriconereites affinis*, *Protarabellites delectus*, *Protarabellites concavus*, and *Protarabellites productus* which are similar to *Lumbriconereites hibbardi*. *Lumbriconereites austini* Foerste (1888) resembles *Lumbriconereites hibbardi*, except that the denticles are less pronounced, and the bight on the outer margin is much deeper. An undescribed jaw figured by Searight (1923), (plate I, fig. 5) is similar to *Lumbriconereites hibbardi* in some ways. *Lumbriconereites cooperi* Eller (1938) corresponds well, except for the type of denticles, surface details, and width of jaw, with *Lumbriconereites hibbardi*. Both have the difference in shape of the right and left jaws. The muscle fossa and arrangement of the denticles are similar in both species.

Genus EUNICITES, Ehlers, 1868

Eunicites vertex sp. nov.

Maxilla II, plate III, fig. 6

The jaw is elongate and is widest at the mid-region. A straight inner margin bears a series of fourteen sharp, conical or hooked denticles which decrease slightly in size posteriorly but do not reach the end of the jaw. The first few denticles point slightly forward or are

perpendicular to the inner margin; the remaining ones are directed backward. The first denticle is small and adheres to the second one. The anterior end is acute while the posterior end is quite blunt. In the posterior half of the jaw the outer margin is curved slightly to form a small shank and then gently curved to the posterior extremity. A small, rounded ridge is discernible along the posterior part of both the inner and outer margins. The lower surface is irregular and concave at the posterior end.

No other species resembles this form closely. Hinde described a species, *Staurocephalites serrula* Hinde (1880) but later placed it in the genus *Eunicites* (1882). This species, according to both of Hinde's papers, is of the same general type as *Eunicites vertex*. *Staurocephalites niagarensis* Hinde (1879), which might possibly belong to the genus *Eunicites*, is similar to *Eunicites vertex*. Stauffer (1933) described several forms, *Staurocephalites acutidentatus* Stauffer, *Staurocephalites dentatus* Stauffer (fig. 32), and *Staurocephalites antiquus* Stauffer which are of the same general character as *Eunicites vertex*. *Eunicites acuminatus* Eller (1934) resembles *Eunicites vertex* except that the former has a wider anterior end and a more acute posterior extremity.

Eunicites petasus sp. nov.

Maxilla I, plate III, figs. 7-8

The jaw is in the form of a simple forceps without denticles on the inner margin. In cross-section the jaw is nearly round. The posterior end is very wide and tapers anteriorly to a pointed fang which is slightly hooked. The fossa is very large and round. The margins around the fossa are usually broken but there is evidence that they were thick and the edges well rounded.

Jaws or forceps of this kind are common in many genera of recent and fossil polychæta. Hinde (1879) (1882) described a form *Eunicites simplex* Hinde which is similar except that the posterior end is wider and the fang not so hooked. *Hyalinœcites subulatus* Stauffer and *Hyalinœcites plenus* Stauffer (1933) resemble *Eunicites petasus* in a general way. If the description of Stauffer's genus *Hyalinœcites* was not so specific, *Eunicites petasus* might be included under that category. Except for its very short body, *Arabellites ? conus* Eller (1938) resembles *Eunicites petasus* in its other characteristics. The writer feels that those species having a simple forceps of this kind should probably be grouped under a new genus but hesitates to do so at the present time.

Leodicites gen. nov.

Maxilla II, plate VII, figs. 1-4

This genus includes those forms in which the jaws of maxilla II are without a fang or primary denticle. The jaw is medium in size, more or less triangular in shape, and may be either highly convex or flattened. A straight or curved inner margin bears a series of denticles which are variously shaped and which are not always uniform in arrangement. The anterior margin is round or slightly incurved to form a blunt or an acute shank. A large bight or indentation is present on the outer margin just posterior to the shank. The fossa is large and may occupy from one-half to three-quarters of the jaw length.

Genotype, *Leodicites variedentatus*, n. sp.

It is with some hesitation that the writer has concluded to erect a new genus for jaws of this type. Jaws of this kind were originally included by Hinde (1879) under the genus *Arabellites* but were later placed by him (1882) in the genus *Eunicites*. He (1879) described several species, *Arabellites lunatus* Hinde, *Arabellites cristatus* Hinde, *Arabellites cervicornis* Hinde, *Arabellites similis* Hinde, and *Arabellites politus* Hinde, which possess this type of jaw and might perhaps be referred to this genus. In looking over the literature on recent forms, I have found that jaws of this kind, *Leodicites*, maxilla II, exist in many recent genera. Some recent genera which have a maxilla II of this type are *Onuphis*, *Leodice*, *Œnone*, *Nematonereis*, *Eunice*, *Diopatra*, *Paramorphysa*, *Aracoda*, *Marphysa*, and *Lysidice*. *Leodicites* is similar to *Ildraites* except that it does not have a fang and is a maxilla II. *Ildraites* has a prominent fang and is a maxilla I. The posterior areas of both genera are similar.

Leodicites variedentatus sp. nov.

Maxilla II, plate VII, figs. 1-4

The jaw is rudely triangular in shape and measures from .61 mm. to 1.1 mm. in length. Along the curved inner margin a series of eleven to fifteen, sharply pointed, conical denticles extends practically to the narrow but blunt posterior extremity. The denticles are not uniform in size but usually point in a backward direction. A small or medium sized first denticle is often supplemented by a larger, second or third denticle. The second, fourth, and fifth denticles may be small or minute. The remainder of the denticles are larger and decrease

regularly in size toward the posterior end. The anterior margin is rounded from the fang and then slightly incurved to a pointed shank. A deep, crescent-shaped bight on the outer margin emphasizes the acuteness of the shank. The fossa is deep, fairly wide, and extends for about two-thirds the length of the jaw. A thickened margin with well rounded edges is present around the fossa. The upper surface is highly convex and the lower surface is flattened or slightly concave.

Leodicites variedentatus resembles *Arabellites similis* Hinde (1879) and *Eunicites cristatus* (Hinde) (1882). There is a slight resemblance between *Leodicites variedentatus* and *Eunicites hebes* Hinde (1882). Stauffer (1933) described a species, *Arabellites contritus*, which seems to agree rather well with *Leodicites variedentatus* in some of its details. *Arabellites magnificus* Stauffer, *Arabellites falciformis* Stauffer and several other similar species of Stauffer (1939) conform in many ways with *Leodicites variedentatus.*

Genus ARABELLITES, Hinde, 1879

Arabellites oviformis sp. nov.

Maxilla I, plate I, figs. 10, 11

The jaw is oblong and has parallel margins. With the fang, there are from eight to twelve, conical, blunt or sharply pointed, backward directed denticles which extend to the posterior end of the inner margin. The denticles usually decrease slightly in size posteriorly. The strongly hooked fang is of medium length. The posterior extremity of the jaw is obliquely truncate. The inner margins are straight with well rounded edges. In most specimens the inner margin, which bears the denticles, is quite close to one of the outer margins. The lower surface is only gently convex and may be slightly concave in the central part parallel to the length of the jaw. Except for the fossa, the upper surface is convex. A large, shallow fossa, just posterior to the fang, is present and has a broad and well rounded anterior part. It narrows slightly to the posterior extremity. An average specimen is 1.3 mm. in length.

The fossa of *Arabellites rectidens* is similar to that of this species but the other characters, such as general outline, size, position of the denticles and hook, do not correspond. In most species of *Arabellites* the fossa is not known or has not been included in the descriptions or figures. Where known, it is usually found only in the posterior third. *Arabellites oviformis* is thus very interesting because of the large fossa which extends to the anterior part. The general outline, denticles, fang, and lower surface, are similar to other species of *Arabellites.*

Arabellites plenidens sp. nov.

Maxilla I, plate II, figs. 12, 13

The jaw is narrow and elongate, measuring from 1.7 mm. to 2.5 mm. in length. There are from eighteen to twenty-one, small, sharp or blunt denticles extending along the inner margin almost to the rounded posterior extremity. The denticles are directed backward with no appreciable decrease in size at the posterior end. The fang is short and in the smaller specimens thin and sharply pointed but thick and blunt in the larger jaws. The outer margin of the jaw is nearly straight or gently curved. The upper surface is convex and quite smooth; the lower surface is irregular. A rather large fossa is located in the posterior third of the jaw. The anterior end of the fossa is deep and wide but becomes narrow and quite shallow posteriorly. The margins around the fossa are thickened and the edges rounded.

No other forms correspond closely to this species. This is due to the narrowness of the jaw, the large number of denticles extending from the anterior to the posterior extremities, and the short, abruptly hooked fang. The jaws are rather large for this fauna, being nearly twice the size of any other species in this collection.

Arabellites rectidens sp. nov.

Maxilla I, plate III, figs. 1-5

The jaw is oblong in its general shape but rather irregular in outline. The inner margin is formed by a low ridge on the lower surface. It bears a series of six, sharp, backward directed denticles which do not reach the posterior end. The elongate fang does not form a hook but points in a more forward direction. The posterior end is widely truncate but is thin and broken in most specimens. The inner margins are thick with the edges well rounded. The under surface is convex, as is the upper one except for the concave fossa. Typical specimens measure about 1.0 mm. in length.

There is a surprising similarity between this form and *Arabellites spicatus* var. *contractus* Hinde (1880) from the Wenlock group of England, later changed by Hinde (1882) to *Arabellites contractus* in the description of the forms from the Silurian of Gotland. *Arabellites rectidens* differs only in the smaller size of the fossa, the thicker outer margins of the jaw, and the lesser number of denticles. *Arabellites spicatus* Hinde (1880) has "an elevated spike-like projection at the corner of the base," which makes it, together with the differences men-

tioned for *Arabellites contractus* (1882), dissimilar to *Arabellites rectidens*. *Arabellites spicatus* Hinde (1882) from the Silurian of Gotland may be differentiated from *Arabellites rectidens* by the short, thick fang and the deep indentation or bight at the posterior end of the jaw. Except in side view, *Protarabellites hamiltonensis* Stauffer (1939) is similar to *Arabellites rectidens*.

Genus NEREIDAVUS, Grinnell, 1877

Nereidavus invisibilis sp. nov.

Maxilla I, plate II, figs. 1-11

The jaw measures from .57 mm. to 1.70 mm. and is elongated. A series of often more than fifty, extremely small, needle-shaped denticles is on the inner margin. Starting close to the first denticle or fang, the denticles either point backward or are perpendicular to the inner margin. They are very compact and extend only two-thirds the length of the jaw. On some jaws the denticles appear to be missing, while on others there are only stubs, often on the under side of the margin. The denticles measure about .016 mm. in diameter. It is probable that in many cases they were broken off during burial, although in some specimens the denticles seem to be just small, rounded, tubercle-like teeth. The denticles are not uniform in length, longer ones may appear almost any place along the margin but usually they are found in the anterior end. The fang is short, either heavy and quite straight or thin and strongly hooked. The fang is more or less oblique to the plane of the lower surface of the jaw, often approaching a right angle. The inner margin, which is straight or gently curved, usually incurves abruptly to the fang. The outer margin is straight or slightly curved. The posterior of the left and right jaws differs fundamentally. In the right jaw the posterior is truncate while in the left jaw there is a large bight in the outer and posterior margins. This bight in the posterior part radically changes the shape of the fossa. In the left jaw the deep fossa which is rounded anteriorly, narrows abruptly, and follows the area near the inner margin to the posterior end. The fossa in the right jaw is deep and rounded but becomes shallow or convex posteriorly. This shallowness is reflected by a convex area on the lower surface. A wide and heavy margin, often flattened but with rounded edges, surrounds the fossa in both left and right jaws. The upper and lower surfaces are irregularly convex but near the fang on the lower surface the jaw is often quite flattened and concave.

The majority of the specimens in the present collection are of this species. As is often the case in scolecodonts, the right and left jaws differ from each other. If only a few specimens were available, and if

it were not possible to take some of them from the matrix, it is conceivable that four species might be described from the present material. Dr. Hinde placed forms of this kind in the genus *Œnonites*, but the writer feels, at least for the present, that they belong in the genus *Nereidavus*. However, they have many characteristics of the genus *Arabellites*. Hinde (1882) described a form, *Œnonites aspersus* Hinde, from the Silurian of Gotland which is similar to this species in most of its characteristics. Both forms have the same outline, the same type of fang which is in a position oblique to the plane of the jaw, and both have very minute denticles. They differ chiefly in the anterior part. In *Œnonites aspersus* Hinde, the denticles continue along the inner margin to the end of the jaw, while in *Nereidavus invisibilis* they stop about one-third the distance from the end of the jaw. The fossa of the left jaw of *Nereidavus invisibilis* is much wider and more rounded in the anterior part than in *Œnonites aspersus* Hinde. *Nereidavus antiquus* Hinde (1880), and *Nereidavus perlongus* Eller (1934), resemble *Nereidavus invisibilis* in a general way. Zebera (1935) described the species, *Arabellites perneri* Zebera and *Arabellites kettneri* Zebera, which have a similarity to *Nereidavus invisibilis*. From the figures, it is apparent that the posterior extremities in Zebera's specimens are missing, which makes it difficult to form definite conclusions. The anterior end of *Pronereites naviculiformis* Zebera (1935) is similar to that of *Nereidavus invisibilis*. In its general characteristics, *Nereidavus invisibilis* is similar to *Nereidavus ontarioensis* Stauffer (1939).

Genus ŒNONITES, Hinde, 1879

Œnonites parvidentatus sp. nov.

Maxilla I, plate III, fig. 9

The outline of the jaw is irregularly triangular. Anterior to the mid-region the jaw widens. The inner margin is straight and bears a series of twelve, blunt, backward-directed denticles which posteriorly decrease irregularly in size. The fang is small and points forward. The outer margin is well rounded anteriorly and curves to an irregularly-shaped shank. Posterior to it is a small bight. The inner and outer margins form an acute posterior extremity. The lower surface is slightly concave and the upper surface, containing the fossa, is convex.

This form is similar to *Œnonites curvidens* Hinde (1882, fig. 32), especially the outer margins. Except for the outer margin, *Œnonites*

kopfi m. resembles *Œnonites parvidentatus*. The fang and denticles are very much alike. *Œnonites parvidentatus* is similar to *Œnonites dignus* Stauffer, *Œnonites tacitus* Stauffer, and *Œnonites inornatus* Stauffer (1933), but the outer margin is quite different.

Œnonites levis sp. nov.

Maxilla II, plate III, fig. 10

The jaw is small and sub-triangular in shape. Along the inner margin a series of eleven, sharply pointed, conical, slightly backward directed denticles extends to the posterior extremity. On the whole, the denticles are rather large for the size of the jaw. The first denticle or fang is rather small but the second denticle is larger than any of the others. The next two denticles are blunt but wide and were probably broken off at some time, then worn round. The remaining denticles become slightly smaller toward the posterior end. The outer margin is angular in outline and bears a small shank or angular process just anterior to the mid-region. The lower surface is convex except in the area of the shank where it is flattened. A narrow fossa is present just anterior to the shank.

In a general way this species resembles a form described by Hinde (1880) as *Arabellites pectinatus* Hinde from the Cincinnati Group at Toronto, Ontario. *Œnonites tacitus* Stauffer and *Œnonites inornatus* Stauffer (1933) have the same general outline but differ in the shape of the denticles.

Œnonites albionensis sp. nov.

Maxilla II, plate III, fig. 11

The jaw is oblong and tapers posteriorly to form an acute end. Along the inner margin is a series of twelve to fourteen, blunt, angular denticles which extends almost to the posterior extremity. The fang, which begins some distance from the anterior end, is not large and is usually perpendicular to the inner margin. The next one or two denticles are minute. Following these, the denticles are large, point back, and gradually decrease in size to the posterior end. The outer margin is irregular. At the anterior end a large shank is present, followed by the usual bight. The margin continues in a straight line to the posterior end where it curves slightly. The surface of the upper and lower sides is gently convex. The fossa extends from the shank to the posterior extremity.

These jaws do not seem to agree closely with any other known forms.

The presence of a shank on the outer margin is similar to that of *Œnonites kopfi* m. and *Œnonites fornicatus* m., but the anterior end is unlike these.

Œnonites coalescens sp. nov.

Maxilla I, plate III, fig. 12

The jaw is elongate and is widest at about one-third the distance from the anterior end. Both anterior and posterior ends taper gradually to acute points. The inner margin is gently curved and a series of nineteen, pointed, conical, and triangular-shaped denticles extends almost to the posterior extremity. The fang is long and thin. The second denticle is smaller but heavier than the first. It is braced in such a manner that it probably acted as a support and together with the first, functioned as the fang. Both of these denticles are either perpendicular to the inner margin or are directed slightly forward. A space exists between the second and third denticles. The next three or four denticles are small but increase in size gradually to about one-third the distance from the posterior end. From this point there is a rapid decrease to the last denticle, which is minute. The outer margin is curved from the anterior end to the widest part of the jaw and then gently incurved to the posterior end. The lower surface is convex except for the mid-region where it is slightly flattened. The upper surface is convex or nearly flat. The fossa extends from about the mid-point to the posterior end.

It is rather difficult to determine whether this form belongs to the genus *Eunicites* or *Œnonites*. Species, similar to the form described above, have been placed in both of these genera. However, in reviewing the literature, it is apparent that for forms of this kind more species have been described under the genus *Œnonites* than under *Eunicites*. The species conforms satisfactorily to the following analysis of the genus by Hinde: "Jaw with a more or less curved anterior hook, followed by a series of smaller teeth, similar in character to those of the existing genus *Œnone*." Hinde (1879) described several specimens from the Cincinnati Group of Toronto, Canada, as *Eunicites varians* (Grinnell). These jaws in outline are similar to *Œnonites coalescens*, but differ in the width of the jaw and the type of denticles. If these specimens of *Eunicites varians* (Grinnell) could be seen from the other side, they might prove to be altogether different types. Species of a similar nature, *Eunicites contortus* Hinde and *Eunicites clintonensis* Hinde (1879), were subsequently found by Hinde (1882) to be side views of *Lumbriconereites obliquus* Eichwald. *Œnonites*

curvidens Hinde (1872) resembles *Œnonites coalescens* rather well except for the outer margin which has, according to Hinde, "in the central portion an inflated, obliquely directed, process. The denticles are similar, especially the closeness of the second denticle to the fang." Specimens of the same species, Hinde (1879), from the Cincinnati Group from Toronto, Canada, do not correspond so well. Caley (1936) described a species, *Eunicites trentonensis* Caley which is similar to *Œnonites coalescens* except that the anterior area is not so wide and the first few denticles are of a different character.

Œnonites staufferi sp. nov.

Maxilla II, plate III, fig. 13

The jaw is narrow at the anterior end, increasing in width toward the mid-region, and then tapering to an obtuse posterior extremity. On the inner margin, a series of sharp triangular shaped, backward pointing denticles extends almost to the posterior end. The denticles are large anteriorly but rapidly decrease in size toward the posterior region. The fang is small and abruptly hooked. The outer margin is irregular and curves gently to the fang. The upper and lower surfaces are irregular. The fossa extends from about the mid-region to the posterior end.

This species does not resemble very closely any other known form. *Œnonites regularis* Hinde (1880) is similar but it has a more angular outline. *Œnonites excelsus* Stauffer and *Œnonites paratus* Stauffer (1933) are slightly similar to *Œnonites staufferi.* The maxilla II of *Arabellites alfredensis* Eller (1934) resembles, especially in the anterior region, that of *Œnonites staufferi.*

Œnonites fossulus sp. nov.

Maxilla I ?, plate III, fig. 14

The jaw is long with the anterior end tapering to a long, acute extremity. Along the inner margin is a series of nine, rather large, blunt, backward pointing denticles which extends nearly to the posterior end. The fang is large and is situated at about one-third the distance from the anterior end. It is directed backward in an acute angle with the inner margin. The second denticle is minute. The outer margin is nearly straight; the inner margin is gently curved. An elongate fossa is present on the upper surface. It begins anterior to the fang but does not continue to the end of the jaw, stopping at about a third of the distance from the last denticle. The lower surface is gently convex.

Only one specimen of this species is present in the collection and it is broken into four parts. All but the anterior tip was recovered. The jaw is quite different from that of other forms, especially in the anterior region with its long and sharply pointed extremity and the acutely, backward directed fang. Even though it is badly broken, the writer feels this specimen should be figured and described. *Staurocephalites serrula* Hinde (1880, fig. 20) later recorded as *Eunicites serrula* (Hinde), 1882, is similar to *Œnonites fossulus*, except that it does not have the anterior end extended so much. Stauffer (1933) describes a form, *Staurocephalites dentatus* Stauffer, fig. 32, which also is slightly similar to *Œnonites fossulus*.

Œnonites kopfi sp. nov.

Maxilla II, plate IV, figs. 1-3

The jaw is triangular in outline, measuring in average .8 mm. in length. In most specimens the inner surface is rather flat while the outer is quite convex. The inner margin, bearing the denticles, is straight from the anterior end for about two-thirds of its length, at which point it arches slightly and, with the outer margin, forms a slightly concave area. There are from 16 to 19 denticles on the inner margin. The fang, or first denticle, is small, conical, and slightly curved and points in a forward direction. Following it, there is a series of small, blunt, compact denticles which extends to the end of the jaw. In most specimens the denticles are uniform in size, perhaps slightly decreasing toward the posterior end. The outer margin is round and thick, except at the anterior end. At the posterior end, on the right side of a left jaw and on the left side of a right jaw, the outer margin is much wider and forms a flange which is one side of the rim of the concave area. The outer margins enclose a large fossa which extends two-thirds of the length of the jaw. The fossa is wide and rounded anteriorly but becomes narrow at the posterior end.

This species is common in the fauna. The large fossa makes the jaw a very formidable, grasping apparatus. Hinde, 1882, described a form, *Œnonites radula* Hinde from the Silurian of Gotland, which resembles this species in so many ways that the writer was tempted to place it under that category. It differs, however, in the structure of the outer margin. In Hinde's species the margins unite anteriorly and acutely to form the fang, whereas in *Œnonites kopfi* the margin follows the rounded fossa and is not so prominent anteriorly. The fang of *kopfi* does not seem to be in the same plane or a part of the

outer margin, as in Hinde's species. The inner surface of *Œnonites radula* Hinde is more concave than *Œnonites kopfi*. From the figures of *Œnonites radula* Hinde it appears that the denticles in this species do not extend the full length of the inner margin; in *Œnonites kopfi* more denticles are present and they extend the full length of the margin. There is a general resemblance between *Œnonites alpenœnsis* Eller (1938) and *Œnonites kopfi*, although the outer margins and the denticles do not correspond. The flange on the outer margin of *Œnonites kopfi* is similar to a structure found on the variety described by Hinde (1882) as *Œnonites radula cristula* Hinde.

Œnonites fornicatus sp. nov.

Maxilla II, plate IV, figs. 4-6

In outline, the jaw is a curvilinear triangle and its margins taper posteriorly to form either an acute or an obtuse angle. Both the inner and outer surfaces are convex. The inner margin bears a series of small, blunt, fairly compact denticles along the first three-quarters of its length. The number of denticles varies between thirteen and fifteen; the majority of jaws, however, bear fifteen. The denticles are rather uniform, with only slight reduction in size posteriorly. The fang is small, conical, straight or slightly hooked, and usually points in a forward direction. The anterior margins are irregularly curved; the anterior part is extended into a pointed shank. The fossa is large and extends nearly the full length of the outer margin.

These jaws probably represent maxilla II and were used for crushing as well as grasping. The large fossa with its muscle made the jaw very powerful. The form is similar to *Œnonites kopfi* m. in general shape, but its outlines or margins are not so straight and the presence of a shank make it a distinct species. There are also fewer denticles and they do not extend to the posterior end as in *Œnonites kopfi*. The inner surface of *Œnonites kopfi* is quite flat, while the same surface of *Œnonites fornicatus* is convex. *Œnonites radula* Hinde (1882), is similar to *Œnonites fornicatus* in size and especially in the arrangement of the denticles. *Œnonites fornicatus* differs from *Œnonites radula* Hinde in the irregularity of the margins, the convexity of the inner surface, and the presence of a distinct flange on the anterior part of the outer margin. In *Œnonites securis* Hinde (1882), the front portion is curved and continues into an upward projecting shank somewhat similar to that of *Œnonites fornicatus*. The outer margins of *Œnonites fornicatus* remind one of *Œnonites alpenœnsis* Eller (1938).

Œnonites peracutus sp. nov.

Maxilla I, plate IV, figs. 7, 8

The jaw is narrow, triangular in outline, and has straight margins that curve posteriorly to form a slightly obtuse but not truncate posterior extremity. Including the fang, there are usually a series of eighteen denticles which begin well to the anterior end and extend along the inner margin almost to the posterior end. The denticles are of various shapes. Those at the anterior end are long, conical and sharp, while those at the posterior end are often small, blunt, and compact, but in some specimens they may be slightly hooked. Many of the denticles have the appearance of being worn or broken and this may be the reason for the various shapes and sizes. A long, thin, rather straight, sharply pointed fang is directed from the jaw at about right angles with the inner margin. The fossa is broadly oval, deep, medium sized, and located in a plane more perpendicular to the denticles than parallel to them. The margins of the fossa are thickened into a round or slightly flattened rim. An average specimen measures 1.3 mm. in length.

This rather delicate species is represented by only a few complete specimens and a number of fragments. It does not resemble any other species very closely due to the position and character of the fossa and the number and arrangement of the denticles. The jaws have certain characteristics which are common to the genus *Arabellites* and the writer was hesitant to place it in the genus *Œnonites*. There is a slight similarity between *Œnonites ? infrequens* Hinde (1879) and the lower surface of *Œnonites peracutus*. If the upper surface of *Eunicites trentonensis* Caley (1936) were known, it might resemble *Œnonites peracutus* except for its larger denticles.

Œnonites flexus sp. nov.

Maxilla I, plate IV, figs. 9, 10

The jaw is elongate with a straight inner margin and a gently curved outer margin. There are from twelve to sixteen, sharp, or blunt, conical shaped denticles distributed along the inner margin almost to the posterior extremity. The large conical, sharply pointed fang, and often the adjacent denticle, points in a forward direction. The remainder of the denticles point backward and usually diminish in size posteriorly. The last few denticles are often minute. The fossa is long and oval in shape and extends almost the complete length of the jaw.

Hinde (1879) described a species, *Œnonites amplus* Hinde from the

Clinton of Dundas, Ontario, which is very similar in its general shape to *Œnonites flexus* but which differs in the arrangement of the denticles, the width of the jaw, and the straightness of the outer margin. *Œnonites naviformis* Hinde (1880, 1882) from England and Gotland, corresponds in a general way but is not closely related due to the presence of a notch or a bight on the outer margin. Searight (1923) figures (plate I, figure 1), but did not name or describe, a form which is similar to *Œnonitus flexus* except that the outer margin is not as gently curved, the fossa is not in the same position, and the fang is curved backward instead of pointing forward. Stauffer (1933) described three similar forms, *Œnonites tacitus* Stauffer, *Œnonites dignus* Stauffer, and *Œnonites inornatus* Stauffer which generally may be correlated with *Œnonites flexus*. *Œnonites orthodontus* Eller (1938) is similar to *Œnonites flexus*, particularly in the arrangement and form of the denticles, but it differs in the acuteness of the anterior end and in the prominence of the fang.

Œnonites exactus sp. nov.

Maxilla I, plate IV, figs. 11, 12

The jaw is elongate and widest at the anterior end but narrows gently to form a slightly hooked posterior extremity. The inner margin is straight except for the most posterior part which curves gently. Along the inner margin a series of from fourteen to sixteen, sharp, conical, backward pointing denticles extends almost to the posterior end. The fang, or first denticle, is only medium sized and it is followed by a very small denticle. The next denticle in the series is very much larger than any of the others and was probably used more as a fang than as the first tooth. Next in order are two small denticles followed by three larger ones. The remaining denticles are of various sizes except at the posterior end where they gradually decrease in size and become minute. The third denticle appears to begin well toward the outer margin and because of its large size a concave area is present just posterior to it. The outer margins are curved and their edges well rounded. The upper surface, except for the fossa, is convex, and the lower surface is flat or slightly concave. The fossa is oval in shape at the anterior end and tapers to an acute posterior extremity. The fossa begins about one-third of the distance from the anterior end and well behind the large, third denticle.

The interesting feature of this species is the consistency in number and the diversity in sizes of the denticles in all the specimens examined. No particularly close relationships to this species have been noted.

However, several species have a general similarity to *Œnonites exactus*. *Œnonites amplus* Hinde (1879) from the Clinton of Ontario is an example. Several specimens described as *Œnonites naviformis* Hinde (1880, 1882) may be brought into this category. The figured, but undescribed form from the Cedar Valley Limestone of Iowa, Searight (1923, plate I, fig. 1), is similar to *Œnonites exactus*. Three specimens described by Stauffer (1933) from the Middle Ordovician of Minnesota, *Œnonites dignus* Stauffer, *Œnonites inornatus* Stauffer, and *Œnonites tacitus* Stauffer, may be considered as having slight similarity. If *Lumbriconereites cooperi* Eller (1938) is viewed from the upper side, (Plate XXVIII, fig. 3), it would show a close resemblance to *Œnonites exactus*. In outline, shape of fossa, and arrangement of the denticles *Lumbriconereites cooperi* is quite similar and might easily be mistaken for *Œnonites exactus*. However, if *Lumbriconereites cooperi* Eller or any other related forms are viewed from the under surface, it is evident at once that there is no relationship between them and *Œnonites exactus*.

Œnonites permistus sp. nov.

Maxilla I, plate IV, fig. 13

The jaw is sub-triangular in outline and measures 1.1 mm. in length. In a typical specimen a series of twenty-three denticles is present along the inner margin. The inner margin is straight for most of its length, but curves posteriorly. The first thirteen denticles are conical, very sharply pointed, and perpendicular to the inner margin of the jaw. The second denticle is the largest and, together with the slightly smaller first denticle, it acted in the capacity of the fang. Following the large second denticle is a series of nine small, rather uniform teeth. They are followed by two larger denticles. The remaining denticles are of a different character, being rather blunt in comparison, triangular in outline, and directed backward. They extend to the posterior end. The outer margin is straight from the curved anterior end to a point about mid-way, where it forms a sharp angle and incurves to the acute posterior extremity. The wide fossa begins just anterior to the mid-region and narrows abruptly to the posterior end. The upper and lower surfaces are gently convex with some irregularities in the extreme posterior region.

The arrangement and character of the denticles of this species are of particular interest. This is especially true of the second denticle which is larger than the first and probably served as the fang. This position gives it a better foundation on the jaw. If, in a mechanical

sense, the muscle and the fossa acted as a fulcrum, it is probable that a fang-like denticle located a little closer to the center (or closer to the muscle) would have more strength and holding power. On the other hand, this position of the fang would lessen the reaching ability. The tendency of a larger, fang-like denticle to appear second or even fourth in position is not uncommon. Among the forms described in this paper, *Œnonites exactus* and *Œnonites levis* have an anterior denticle, other than the first one, developed in the form of a fang. By and large, this species does not resemble closely any of the others. There is a similarity, in general outline and in position of the fossa, of *Œnonites naviformis* Hinde (1882) and *Œnonites permistus*. *Œnonites exactus* m. and *Œnonites levis* m. have characters which are somewhat similar to those of *Œnonites permistus*.

Œnonites lewistonensis sp. nov.

Maxilla I, plate V, figs. 1, 2

The jaw is small, measuring only 0.6 mm. in length. A series of nine, blunt or sharply pointed denticles extends along the inner margin to about one-fourth the distance from the posterior end. The fang is large, pointed, and strongly hooked. Adjacent to and more or less coalesced with the fang are two, compact, forward pointing denticles. There is a small space between them and the next denticle. The remaining denticles are fairly large for the size of the jaw and are directed backward. The irregularly curved outer margins continue around the posterior extremity to the inner margin where they meet in a slightly acute ending. The fossa is long, narrow, and deep. It begins well in the anterior part of the jaw and continues around the posterior end. The upper and lower surfaces of the jaw are generally convex, although there are areas which are irregular and slightly concave.

This form cannot be closely correlated with any other described species. However, the anterior end, including the fang and first denticles, is like that of certain species of *Lumbriconereites*. There is a slight similarity to *Œnonites naviformis* Hinde (1882) but in *Œnonites lewistonensis* the posterior end is wider and the denticles are of a different character and arrangement.

Œnonites bidens sp. nov.

Maxilla I, plate V, figs. 3-5

The jaw is small and elongate. From nine to thirteen, sharp, conical, mostly backward directed denticles are present on the curved

inner margin. The fang and second denticles are practically mirror images of each other and are more or less coalesced. Both denticles are directed slightly forward. Following these teeth is a vacant space on the margin about one-third the distance from the anterior end. From this point the denticles are small but increase in size to about the middle and then decrease in size to the posterior end. The outer margin is broadly curved from the front end to just anterior to the mid-region where it is gently incurved to an acute posterior extremity. The fossa is small, oval, and is in the posterior half of the jaw. Both the upper and lower surfaces are convex except for the area adjacent to the second denticle and the inner margin. An average specimen measures .65 mm. in length.

Specimens of this kind are not very common in the collection. This species demonstrates the tendency of a second denticle to support the fang. *Œnonites coalescens* m. is very similar in outline and general character to this species. It differs by being much larger and by lacking the space on the inner margin between the second and third denticles. The adhesion of the second denticle to the fang is a similarity in both species.

Œnonites triangulus sp. nov.

Maxilla II, plate V, figs. 6, 7

The jaw is triangular in cross-section and measures about .60 mm. in length. Along the strongly incurved or arched inner margin is a series of twelve, blunt, compact denticles which extends to the posterior end. In the anterior part the denticles are fairly large but they diminish rapidly in size in the posterior region. The first denticle or fang is slightly larger than the others and points in a forward direction. The outer margins are curved with well rounded edges. The upper surface is highly convex. The lower surface is gently concave. The fossa extends nearly the full length of the form; it is not very wide at the center and narrows to an acute angle at both the anterior and posterior ends.

This form is similar to *Œnonites radula* Hinde (1882) from the Silurian of Gotland except that it is more strongly arched, less triangular in outline, and the fossa is not so wide. *Œnonites triangulus* resembles *Œnonites kopfi* m. in a general way. It differs by having a more curved or arched inner margin, a fossa which is not as wide at the anterior end, and a less triangular outline. *Œnonites triangulus* also differs from *Œnonites kopfi* m. by having the outer margin rounded

from the anterior end instead of being straight or incurved to a sharply pointed shank.

Œnonites (?) **franci** sp. nov.

Maxilla I, plate V, figs. 8, 9

The jaw is narrow and elongate, measuring 1.1 mm. in length. A straight inner margin bears a series of ten to twelve, large, backward directed denticles which does not extend to the posterior extremity. They diminish in size posteriorly. The fang is large, oval in cross-section, and is strongly hooked. The outer margins are parallel and slightly curved to the blunt posterior extremity. The lower surface is mostly convex but in some specimens it is slightly concave or flattened just adjacent to the denticles and the posterior end. The upper surface is strongly convex, except for the fossa and a small area at the posterior extremity. The fossa, which is fairly deep, long, and oval, extends about two-thirds the length of the jaw, almost to the posterior end.

There is some doubt as to the genus in which this form should be placed. It might be placed in the genus *Arabellites*. Hinde (1879) described Arabellites (Maxilla I), as a "Jaw with an extremely prominent anterior hook, and a row of smaller teeth on a wide base." This species conforms with the first qualification but it does not, however, possess a wide base. In *Œnonites* (?) *franci*, in the writer's opinion, the large fossa, which extends almost to the anterior end, and the small posterior extremity, are not quite characteristic for the fossil genus *Arabellites*. Likewise, such characteristics are not found, so far as the writer is aware, in the Maxilla I of the recent genus *Arabella*. The posterior extremity of the jaws of Maxilla I of the genus *Arabella* is usually truncate and there are surfaces present for articulation with the carriers. In species of *Arabellites* with truncate posterior ends, the fossa or areas for muscle attachment are small and are located in the posterior third of the jaw. Hinde (1879) erected the genus *Œnonites* to include forms having "Jaws with a more or less curved anterior hook followed by a series of smaller teeth, similar in character to those of the existing genus *Œnone*." The form described above does not conflict with any of the characters of *Œnonites* and for the present the species will be included in that genus. There is a slight resemblance between *Œnonites serratus* Hinde (1879) and *Œnonites franci*. *Eunicites trentonensis* Caley (1936) has the same general shape as *Œnonites franci*, but in the former the anterior denticles begin close to the fang.

Œnonites acinaces sp. nov.

Maxilla I, plate V, figs. 10-14

The jaw is short and narrow, measuring from 0.57 mm. to 1.18 mm. in length. Along the straight inner margin is a series of nine or ten, large, conical, sharply pointed denticles extending to the posterior extremity. The first denticle, or fang, is very long, straight or slightly hooked, oval in cross-section, and usually pointed in a forward direction. The next two or three teeth are smaller and are followed by a large flattened denticle. Of the remaining five denticles, the first three are small and the remaining two are somewhat larger. The denticles are usually perpendicular to the inner margin but may be directed slightly backward. The outer margins are parallel and are curved to the posterior extremity and last denticle. The anterior margin is quite straight and terminated with the outer margins in a sharp point. The fossa is long, very narrow, and opposite the inner margin. At the anterior end, the fossa opposite the fang is slightly enlarged. The margins of the fossa are narrow and the edges rounded except at the anterior end where they are wider and quite flat. The upper surface is arched or convex while the lower surface is concave. In some specimens both surfaces are gently convex or flattened.

The very large, formidable denticles situated on such a small base, together with a narrow fossa, make this form very interesting. Perhaps the long sharp denticles counteract the ineffectiveness of the weak muscles which are indicated by the small fossa. In specimens where surfaces are slightly convex or flattened, it is difficult to tell whether the jaws are right or left ones. *Œnonites acinaces* does not correspond readily with other species of *Œnonites* although it possesses the characters of that genus.

Genus ILDRAITES, Eller, 1936

Ildraites geminus sp. nov.

Maxilla I, plate VI, figs. 1-5

The jaw is elongate, quite wide anteriorly, and tapers to an acute posterior extremity. Length of the specimens ranges from .60 mm. to 1.42 mm. On the gently curved inner margin a series of from sixteen to twenty-three conically shaped denticles extends almost to the posterior end. The first two denticles, which constitute the fang, are small and thin, and may be coalesced or separated by a small space. They are slightly hooked and usually point in a backward direction, oblique to the lower surface. The next six to eleven denticles are very small and are perpendicular to the inner margin or may, especially the

anterior teeth, point in a forward direction. The remainder of the denticles are large and gradually diminish to a minute size at the posterior extremity. The inner margin is notched in the posterior part by a deep, wide crescent-shaped bight. From the acute shank formed by the bight, the outer margin incurves to the anterior end. The fossa is of medium size and is limited to the posterior half of the jaw. Thick margins with well rounded edges surround the fossa. The upper surface of the jaw is highly convex while the lower surface is usually concave and irregular.

This form is similar to *Ildraites duplex* m. but differs by having denticles, smaller in size and different in shape, along the whole inner margin. *Ildraites geminus* is more arched, the lower surface more concave, and the shank more acute than in *Ildraites duplex* m. Stauffer (1939) described three species, *Lumbriconereites expansus* Stauffer, *Eunicites grandis* Stauffer, and *Arabellites priscus* Stauffer, which, judging from the figures, seem to resemble each other quite closely and correspond, except for the second denticle, to *Ildraites geminus* m.

Ildraites horridus sp. nov.

Maxilla I, plate VI, figs. 6-9

The left and right jaws are asymmetrical, rudely triangular in shape, and measure from 1.01 mm. to 1.59 mm. in length. A broadly curved inner margin bears a series of conical, sharply-pointed denticles, eight on the right jaw and from eleven to thirteen on the left jaw. The fang of the right jaw is very large, conical, and points in a backward direction. On the left jaw the fang is smaller and extends in a forward direction. In most specimens the second denticle is usually small but may be quite large. Two specimens do not have a second denticle in the usual place. The third denticle is very large in both right and left jaws. The remaining denticles are of various sizes and are not arranged in any particular order. The denticles point in a backward direction and extend along the narrow posterior to the blunt extremity. The anterior margin incurves to a long, acutely pointed shank. A deep, crescent-shaped bight on the outer margin emphasizes the narrow shank. Two-thirds of the length of the jaw are taken by a wide, deep fossa. The outer margins of the fossa are not thickened but the edges are well rounded. The upper and lower surfaces are convex except for a slight concave area at the third denticle on the lower surface.

Most of the jaws were found in a broken condition, but a few complete specimens made a description possible. The jaws are rather unique, being unlike any other species except possibly *Arabellites cervicornis* Hinde (1879) and *Arabellites anglicus* Hinde (1880).

Ildraites duplex sp. nov.

Maxilla I, plate VII, figs. 5-6

The jaw is elongate with a rather wide anterior region. Measurements in length range from .71 mm. to 1.48 mm. Along the gently curved inner margin a series of nine to fourteen triangular shaped denticles extends nearly to the acute posterior extremity. The first and second denticles are very large, the second usually slightly larger than the first. These two denticles are very close together and act as the fang. A vacant space is present between these two denticles and the next tooth. On some specimens the third, fourth, and fifth denticles are minute. Following them, are several large teeth which gradually diminish in size posteriorly. The first two denticles are directed forward or are perpendicular to the inner margin, the remainder are pointed in a backward direction. The outer margin is slightly curved to about the mid-region where it is notched by a shallow, crescent-shaped bight. The fossa is deep and of medium size. Its margins are thick and the edges well rounded. The upper surface is strongly convex. The lower surface is usually slightly convex but may be concave in the mid-regions and near the fang.

This form is related to several other species and is similar to them except for a difference in the first two denticles. The interesting arrangement in which the first and second denticles are almost of the same size and act as a fang was noticed also in other species of this fauna. *Arabellites angustus* Hinde, *Arabellites arcuatus* Hinde, and *Arabellites anglicus* Hinde (1882), agree with *Ildraites duplex*, but only in a general way. A slight similarity exists between *Ildraites* (*Arabellites*) *marcellusensis* (Eller) (1934), *Ildraites bipennis* (Eller) (1936), *Ildraites peramplus* m., and *Ildraites duplex*.

Ildraites peramplus sp. nov.

Maxilla I, plate VII, figs. 7-9

The jaw is long and wide, measuring from 1.1 mm. to 1.6 mm. in length. On the straight inner margin is a series of nine or ten, conical, pointed denticles which are directed sharply backwards. The first five or six denticles are rather large and uniform in size. The remaining denticles are smaller and continue nearly to the acute posterior extremity. A large fang is curved backward, oblique to the plane of the lower surface. The outer margin is straight from the fang to about two-thirds of the length of the jaw where it is notched by a deep, crescent-shaped bight. A long wide fossa, beginning at about the base of the fang and extending to the posterior extremity, is present on the

upper surface. The fossa is deep or concave near the margins but flattened or slightly convex in the central area. The margins of the fossa are narrow; the edges rounded. The lower surface is convex but in some specimens it may be slightly flattened in the middle region.

Hinde (1880, 1882) placed species of this kind under the genus *Arabellites*. The writer (1936) erected a genus, *Ildraites*, for forms with the anterior end similar to *Arabellites* but having a posterior end and outer margin notched by a deep, crescent-shaped indentation or bight. Hinde (1879), in erecting the genus *Arabellites*, included forms with "(2). Sickle-shaped jaws and allied forms" and further explained "the second resemble the second pair (Maxilla II)" of *Arabella* (*Œnone*) *maculata* Edwards, as figured in Cuvier's "Regne Animal." The forms described under the genus *Ildraites* are of Maxilla I; have a different type of muscular attachment, and do not possess any apparent surfaces for the articulation of carriers. Hinde (1882) described a species, *Arabellites spicatus* Hinde, and under "remarks" said, "This jaw appears to represent the pincers (Maxilla I), although there is not indication of any attachment as there is in the normal types of the existing genus *Arabella*." There is a close resemblance between *Ildraites* (*Arabellites*) *marcellusensis* (Eller, 1934) and *Ildraites peramplus*. *Ildraites bipennis* (Eller, 1936) is similar to *Ildraites peramplus*, except for the denticles, which, in the former, do not extend as far along the inner margin.

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EXPLANATION OF PLATE I

Figures magnified about 35 times.

Numerals in parentheses at the right indicate the Carnegie Museum catalogue numbers of the respective specimens.

FIG. 1. *Lumbriconereites hibbardi* sp. nov. Maxilla I, left jaw, side view (17751).

FIGS. 2, 3. *Lumbriconereites hibbardi* sp. nov. Maxilla I, right jaw (17754).
FIG. 2. Under side.
FIG. 3. Upper side.

FIG. 4. *Lumbriconereites hibbardi* sp. nov. Maxilla I, right jaw, side view (17749).

FIG. 5. *Lumbriconereites hibbardi* sp. nov. Maxilla I, left jaw, side view (17755).

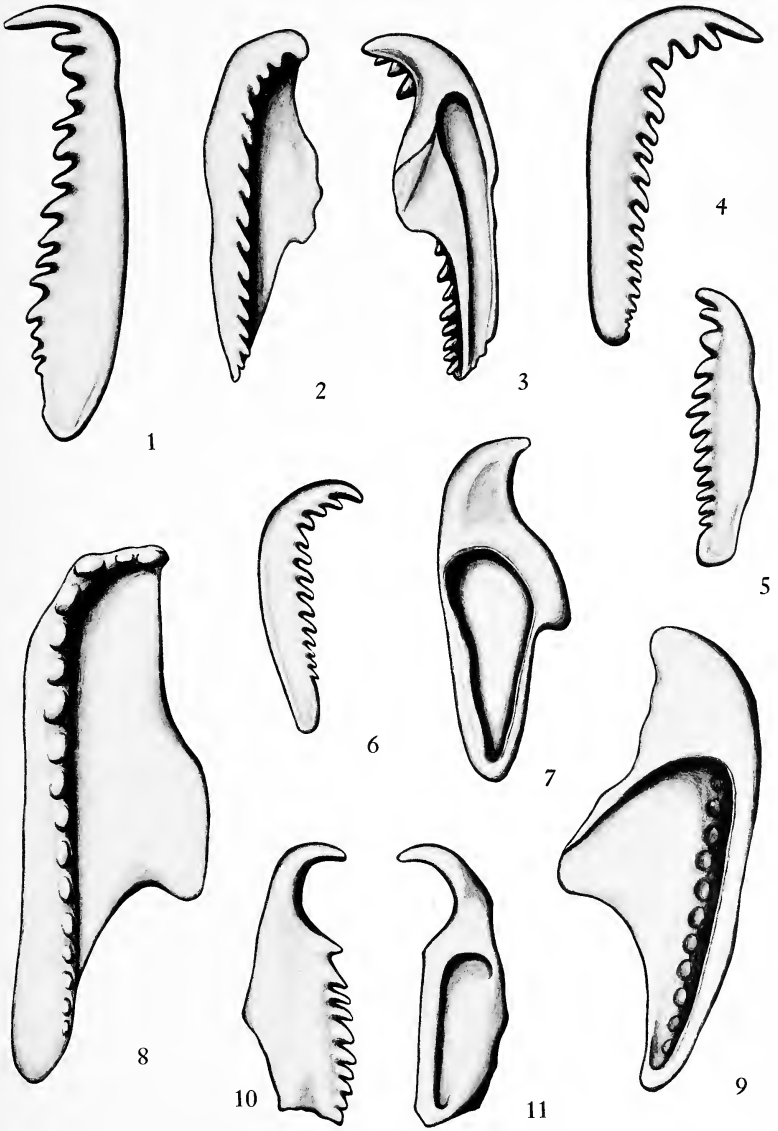
FIG. 6. *Lumbriconereites hibbardi* sp. nov. Maxilla I, right jaw, side view (17750).

FIG. 7. *Lumbriconereites hibbardi* sp. nov. Maxilla I, left jaw, upper side (17756).

FIG. 8. *Lumbriconereites hibbardi* sp. nov. Maxilla I, right jaw, under side (17753).

FIG. 9. *Lumbriconereites hibbardi* sp. nov. Maxilla I, right jaw, upper side (17752).

FIGS. 10, 11. *Arabellites oviformis* sp. nov. Maxilla I, righ jaw. (17769).
FIG. 10, under side;
FIG. 11, upper side.



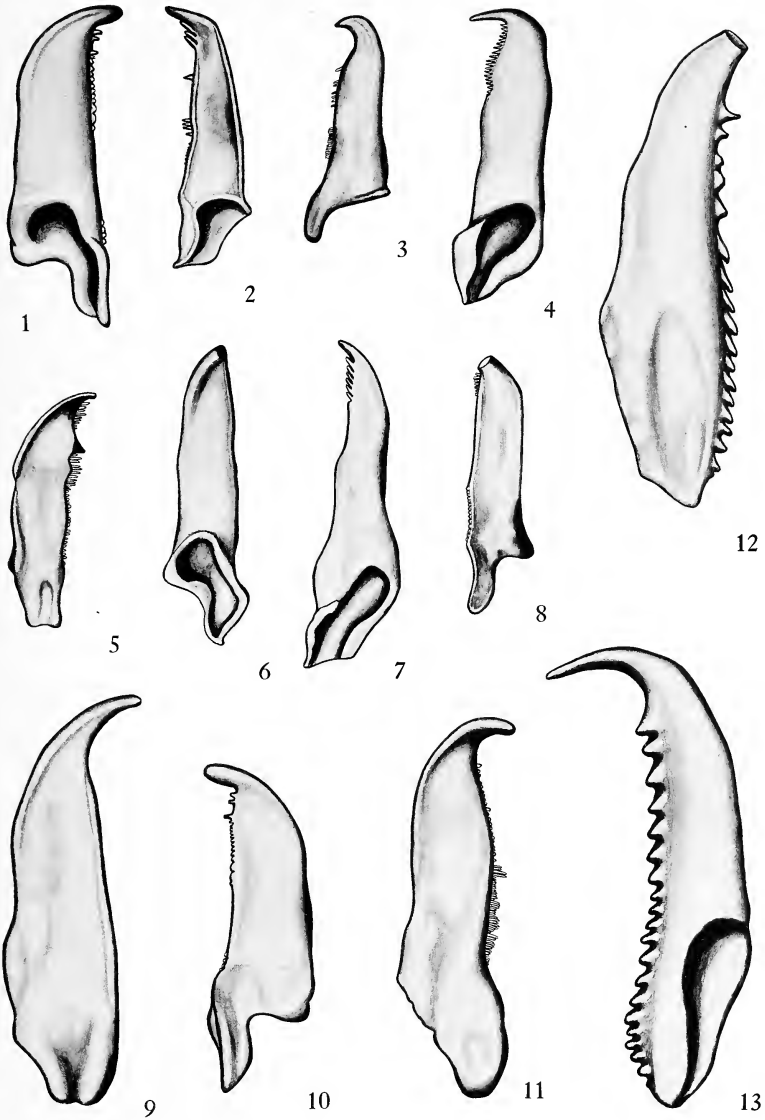
Scolecodonts from Silurian of New York.

EXPLANATION OF PLATE II

Figures magnified about 35 times.

Numerals in parentheses at the right indicate the Carnegie Museum catalogue numbers of the respective specimens.

FIG. 1. *Nereidavus invisibilis* sp. nov. Maxilla I, left jaw, upper side (17765).
FIG. 2. *Nereidavus invisibilis* sp. nov. Maxilla I, right jaw, upper side (17763).
FIG. 3. *Nereidavus invisibilis* sp. nov. Maxilla I, left jaw, under side (17760).
FIG. 4. *Nereidavus invisibilis* sp. nov. Maxilla I, right jaw, upper side (17759).
FIG. 5. *Nereidavus invisibilis* sp. nov. Maxilla I, right jaw, under side (17758).
FIG. 6. *Nereidavus invisibilis* sp. nov. Maxilla I, left jaw, upper side (17766).
FIG. 7. *Nereidavus invisibilis* sp. nov. Maxilla I, right jaw, upper side (17762).
FIG. 8. *Nereidavus invisibilis* sp. nov. Maxilla I, left jaw, under side (17757).
FIG. 9. *Nereidavus invisibilis* sp. nov. Maxilla I, right jaw, under side (17764).
FIG. 10. *Nereidavus invisibilis* sp. nov. Maxilla I, left jaw, under side (17765).
FIG. 11. *Nereidavus invisibilis* sp. nov. Maxilla I, right jaw, under side (17767).
FIG. 12. *Arabellites plenidens* sp. nov. Maxilla I, right jaw, under side (17775).
FIG. 13. *Arabellites plenidens* sp. nov. Maxilla I, right jaw, upper side (17774).



Scolecodonts from Silurian of New York.

EXPLANATION OF PLATE III

Figures magnified about 35 times.

Numerals in parentheses at the right indicate the Carnegie Museum catalogue numbers of the respective specimens.

FIGS. 1, 2. *Arabellites rectidens* sp. nov. Maxilla I, right jaw (17770).
FIG. 1. Under side.
FIG. 2. Upper side.

FIG. 3. *Arabellites rectidens* sp. nov. Maxilla I, left jaw, side view (17772).

FIGS. 4, 5. *Arabellites rectidens* sp. nov. Maxilla I, right jaw (17771).
FIG. 4. Under side.
FIG. 5. Upper side.

FIG. 6. *Eunicites vertex* sp. nov. Maxilla II, right jaw, under side (17749).

FIG. 7. *Eunicites petasus* sp. nov. Maxilla I, left jaw, under side (17768).

FIG. 8. *Eunicites petasus* sp. nov. Maxilla I, right jaw, upper side (17749).

FIG. 9. *Œnonites parvidentatus* sp. nov. Maxilla I, left jaw, under side (17787).

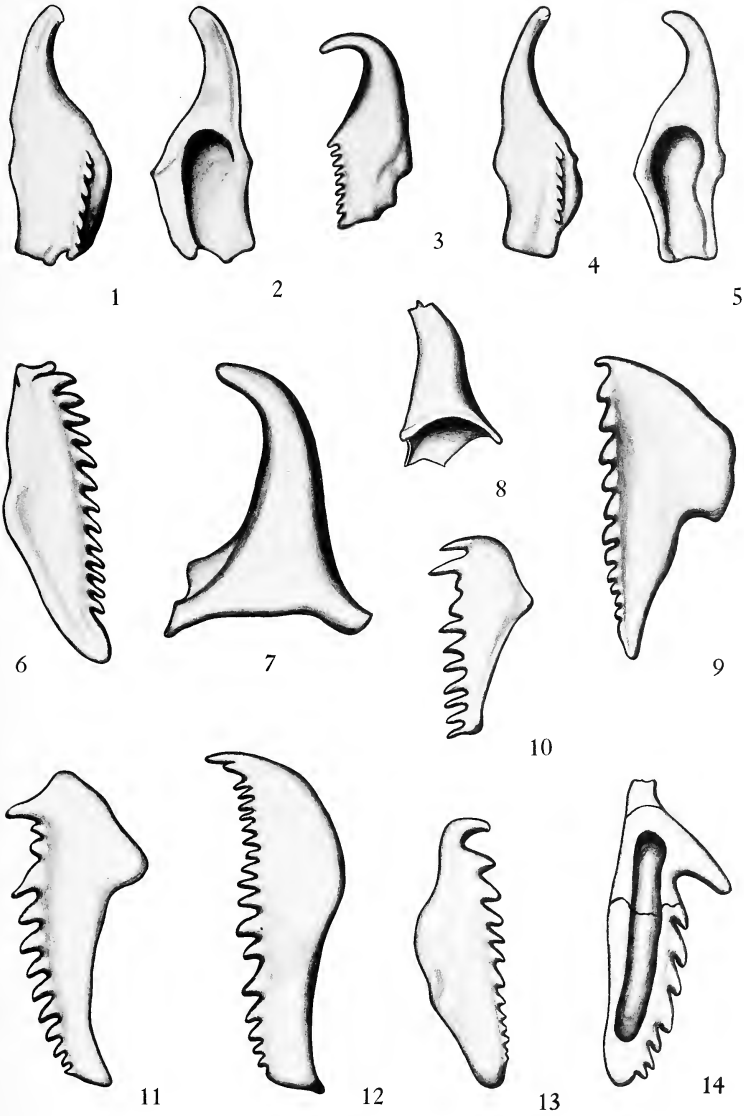
FIG. 10. *Œnonites levis* sp. nov. Maxilla II, left jaw, under side (17791).

FIG. 11. *Œnonites albionensis* sp. nov. Maxilla II, left jaw, under side (17749).

FIG. 12. *Œnonites coalescens* sp. nov. Maxilla I, left jaw, under side (17786).

FIG. 13. *Œnonites staufferi* sp. nov. Maxilla II, right jaw, under side (17792).

FIG. 14. *Œnonites fossulus* sp. nov. Maxilla I ?, left jaw, upper side (17782).



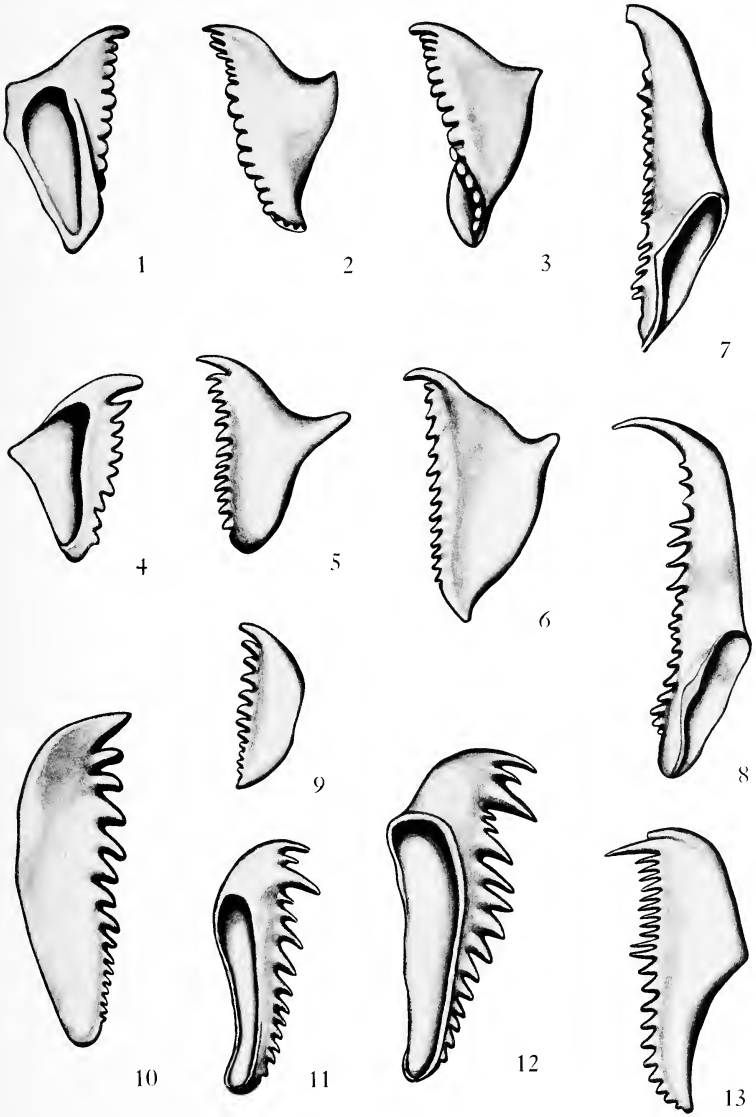
Scolecodonts from Silurian of New York.

EXPLANATION OF PLATE IV

Figures magnified about 35 times.

Numerals in parentheses at the right indicate the Carnegie Museum catalogue numbers of the respective specimens.

FIG. 1. *Œnonites kopfi* sp. nov. Maxilla II, left jaw, upper side (17790).
FIG. 2. *Œnonites kopfi* sp. nov. Maxilla II, left jaw, under side (17749).
FIG. 3. *Œnonites kopfi* sp. nov. Maxilla II, left jaw, under side (17790).
FIG. 4. *Œnonites fornicatus* sp. nov. Maxilla II, left jaw, upper side (17789).
FIG. 5. *Œnonites fornicatus* sp. nov. Maxilla II, left jaw, under side (17749).
FIG. 6. *Œnonites fornicatus* sp. nov. Maxilla II, left jaw, under side (17774).
FIG. 7. *Œnonites peracutus* sp. nov. Maxilla I, left jaw, upper side (17763).
FIG. 8. *Œnonites peracutus* sp. nov. Maxilla I, left jaw, upper side (17783).
FIG. 9. *Œnonites flexus* sp. nov. Maxilla I, left jaw, under side (17778).
FIG. 10. *Œnonites flexus* sp. nov. Maxilla I, right jaw, under side (17772).
FIG. 11. *Œnonites exactus* sp. nov. Maxilla I, left jaw, upper side (17788).
FIG. 12. *Œnonites exactus* sp. nov. Maxilla I, left jaw, upper side (17773).
FIG. 13. *Œnonites permistus* sp. nov. Maxilla I, left jaw, under side (17779).



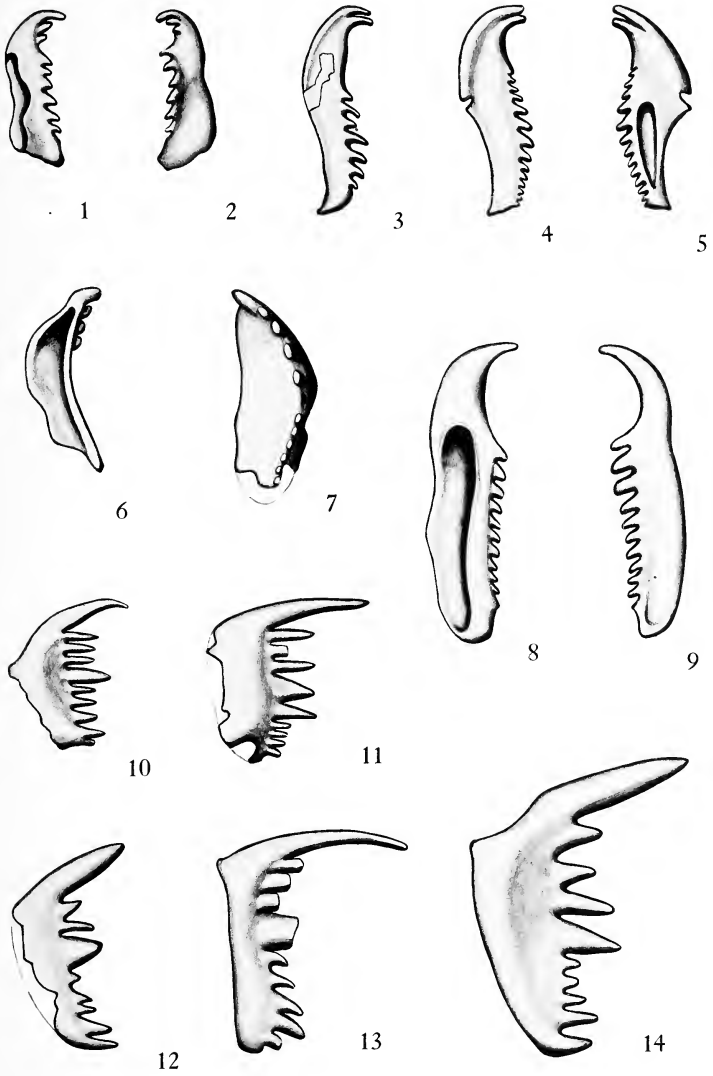
Scolecodonts from Silurian of New York.

EXPLANTION OF PLATE V

Figures magnified about 35 times.

Numerals in parentheses at the right indicate the Carnegie Museum catalogue numbers of the respective specimens.

FIGS. 1, 2. *Œnonites lewistonensis* sp. nov. Maxilla I, left jaw (17784).
FIG. 1. Upper side.
FIG. 2. Under side.
FIG. 3. *Œnonites bidens* sp. nov. Maxilla I, right jaw, under side (17781).
FIGS. 4, 5. *Œnonites bidens* sp. nov. Maxilla I, right jaw (17793).
FIG. 4. Under side.
FIG. 5. Upper side.
FIGS. 6, 7. *Œnonites triangulus* sp. nov. Maxilla II, left jaw (17780).
FIG. 6. Upper side.
FIG. 7. Under side.
FIGS. 8, 9. *Œnonites franci* sp. nov. Maxilla I, left jaw (17785).
FIG. 8. Upper side.
FIG. 9. Under side.
FIG. 10. *Œnonites acinaces* sp. nov. Maxilla I, right jaw, under side (17776).
FIG. 11. *Œnonites acinaces* sp. nov. Maxilla I, right jaw, under side (17785).
FIG. 12. *Œnonites acinaces* sp. nov. Maxilla I, right jaw, under side (17777).
FIG. 13. *Œnonites acinaces* sp. nov. Maxilla I, right jaw, under side (17808).
FIG. 14. *Œnonites acinaces* sp. nov. Maxilla I, right jaw, under side (17785).



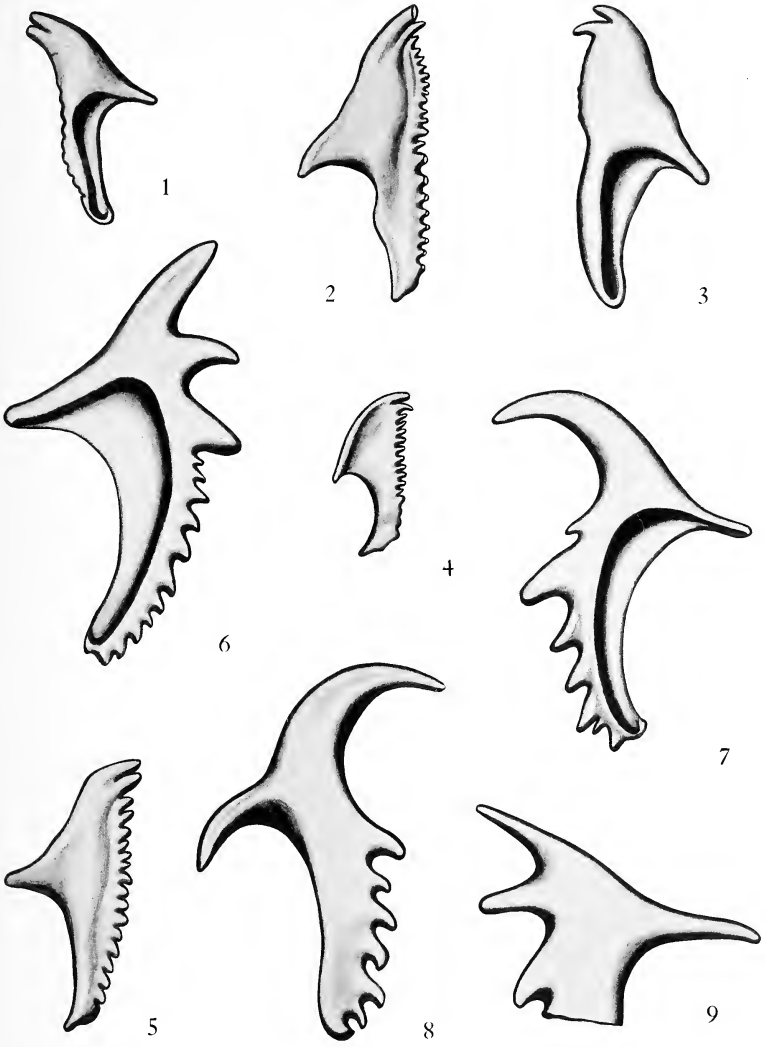
Scolecodonts from Silurian of New York.

EXPLANATION OF PLATE VI

Figures magnified about 35 times.

Numerals in parentheses at the right indicate the Carnegie Museum catalogue numbers of the respective specimens.

FIG. 1. *Ildraites geminus* sp. nov. Maxilla I, right jaw, upper side (17803).
FIG. 2. *Ildraites geminus* sp. nov. Maxilla I, right jaw, under side (17794).
FIG. 3. *Ildraites geminus* sp. nov. Maxilla I, right jaw, upper side (17795).
FIG. 4. *Ildraites geminus* sp. nov. Maxilla I, right jaw, under side (17796).
FIG. 5. *Ildraites geminus* sp. nov. Maxilla I, right jaw, under side (17804).
FIG. 6. *Ildraites horridus* sp. nov. Maxilla I, left jaw, upper side (17797).
FIG. 7. *Ildraites horridus* sp. nov. Maxilla I, right jaw, upper side (17798).
FIG. 8. *Ildraites horridus* sp. nov. Maxilla I, right jaw, under side (17799).
FIG. 9. *Ildraites horridus* sp. nov. Maxilla I, left jaw, under side (17800).



Scolecodonts from Silurian of New York.

EXPLANATION OF PLATE VII

Figures magnified about 35 times.

Numerals in parentheses at the right indicate the Carnegie Museum catalogue numbers of the respective specimens.

FIG. 1. *Leodicites variedentatus* sp. nov. Maxilla II, left jaw, upper side (17761).

FIG. 2. *Leodicites variedentatus* sp. nov. Maxilla II, left jaw, under side (17807).

FIGS. 3, 4. *Leodicites variedentatus* sp. nov. Maxilla II, left jaw (17806).
FIG. 3. Upper side.
FIG. 4. Under side.

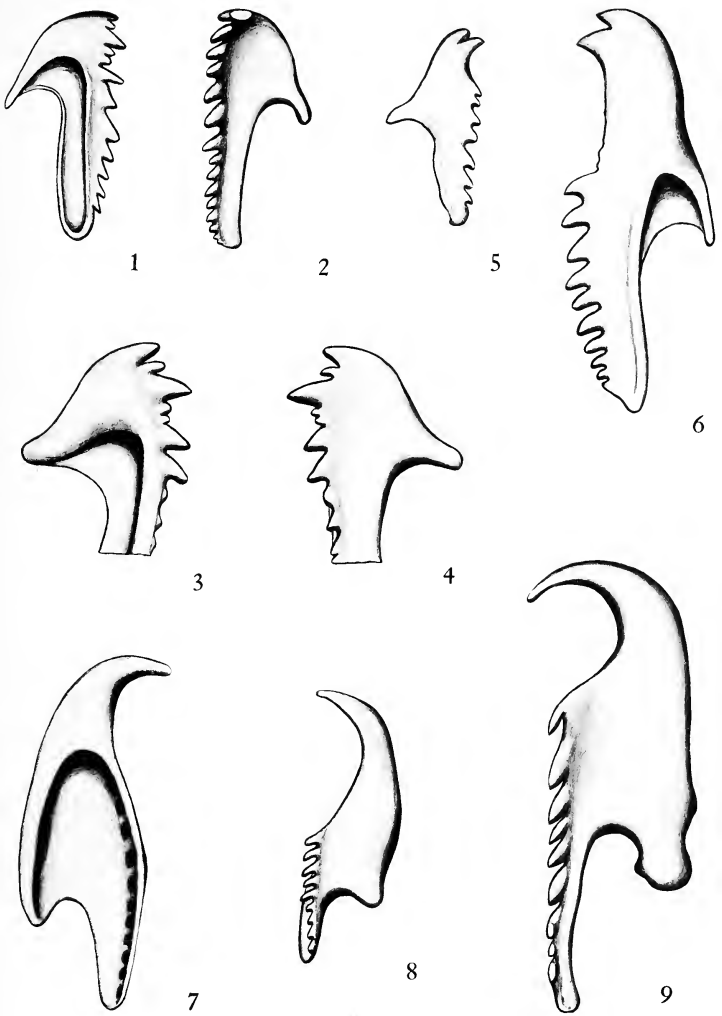
FIG. 5. *Ildraites duplex* sp. nov. Maxilla I, right jaw, under side (17778).

FIG. 6. *Ildraites duplex* sp. nov. Maxilla I, right jaw, upper side (17805).

FIG. 7. *Ildraites peramplus* sp. nov. Maxilla I, left jaw, upper side (17802).

FIG. 8. *Ildraites peramplus* sp. nov. Maxilla I, left jaw, under side (17785).

FIG. 9. *Ildraites peramplus* sp. nov. Maxilla I, left jaw, under side (17801).



Scolecodonts from Silurian of New York.

ART. III. PLEISTOCENE FOSSILS FROM THE BELCHER ISLANDS IN HUDSON BAY

By Horace G. Richards
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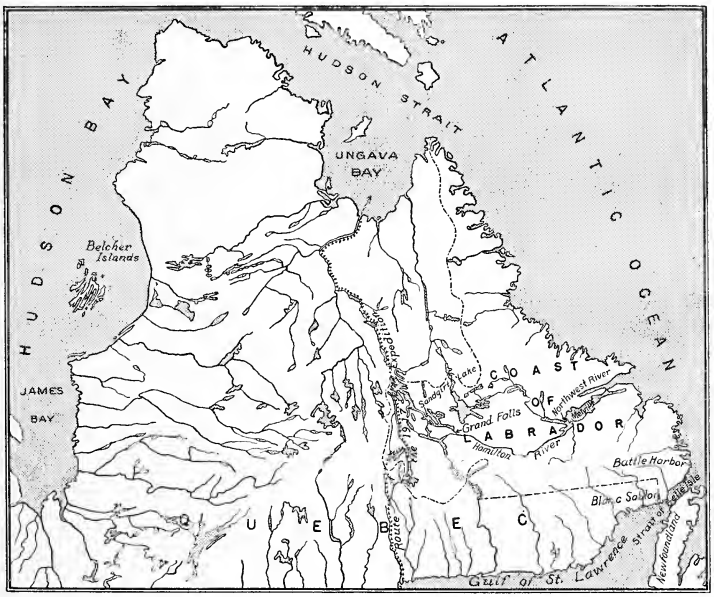
Trenton, New Jersey*

Through the kindness of E. R. Eller of the Carnegie Museum, I have had the opportunity of examining some Pleistocene fossils obtained by an expedition to the Belcher Islands, Hudson Bay, Canada, led by J. Kenneth Doutt and Arthur C. Twomey of that museum. The narrative of the expedition and the summary of results have already been published (Doutt, 1939; Twomey, 1939).



Map of Labrador Peninsula showing Belcher Islands

The following information on the localities is taken from the field notes of Mr. Doutt:

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ssued March 25, 1940.

A. Tukarak Island, Belcher Islands, about 56° 10′ N. lat., 78° 55′ W. long., about 100 feet above sea level near the south end of Long Lake. The shells had been dug out of the bank by lemmings (Station 5320).

B. Tukarak Island, about 300 feet above sea level in a clay bank that had been pushed to the surface by ice pressure.

C. Mukpollo Peninsula, Flaherty Island, about 56° 00′ N. lat., 79° 15′ W. long. A shell bed about 10 inches thick near the top of the hills. Beneath this layer was a layer of black sand with shells that extended down at least 12 or 14 inches (Station 5311).

D. About 1 mile north of *C*. and about 50 feet above sea level (Station 5312).

List of Species

No attempt is made here to give an exhaustive account of the distribution of the various species. The notes on the Pleistocene distribution are taken from lists in the following papers: Hudson and James Bays (Richards, 1936); Newfoundland (Richards, 1937); St. Lawrence Valley and New Brunswick (Dawson, 1872); Lake Champlain (Goldring, 1922; Howell and Richards, 1937); Maine (Clapp, 1907; Little, 1917); and Greenland (Richards, unpublished).

The notes on the recent distribution of the species are obtained from Dawson (1872), Whiteaves (1901), Johnson (1934) and data from various museums.

The original set of fossils is in the Carnegie Museum, while duplicates have been deposited in the Academy of Natural Sciences of Philadelphia.

Pelecypoda

Saxicava arctica Linné

(*S. rugosa* Linné)

Common at all four localities.

Pleistocene: Hudson and James Bays; Greenland; Newfoundland; St. Lawrence Valley; New Brunswick; Maine; Champlain Valley of New York and Vermont. Probably the most abundant of all northern Pleistocene species.

Recent: Greenland to the West Indies. However, the heavy, coarse variety typical of the Pleistocene is limited to Arctic and Sub-Arctic seas.

Mya truncata Linné

Localities *A*, *B* and *D*.

Pleistocene: Hudson and James Bays; Newfoundland and Labrador; Riviere du Loup, Montreal and St. Lawrence Valley; New Brunswick; Maine; Greenland.

Recent: Greenland to Massachusetts; Hudson Bay.

Astarte striata Leach

Localities *A* and *B*.

Pleistocene: Charlton and Cary Islands in James Bay; Stag Island in Rupert River; Newfoundland; Maine; Greenland.

Recent: Davis Strait to Massachusetts Bay; rare.

This species has been confused with *A. banksii* Leach and *A. compressa* Linne and consequently it is difficult to ascertain its complete range.

Astarte borealis Schumacker

Locality *D* (rare).

Pleistocene: Charlton and Cary Islands, James Bay; Labrador; Maine; Greenland.

Recent: Of northern distribution, the exact range is uncertain because it has been confused with *A. arctica* Gray (Greenland).

Mytilus edulis Linné

Localities *A*, *B* and *D*, frequently broken.

Pleistocene: Various localities in James Bay; Newfoundland; Greenland; Riviere du Loup and St. Lawrence Valley; Lake Champlain Valley; New Brunswick and Maine.

Recent: Greenland to North Carolina; James Bay.

Pecten islandicus Müller

Locality *D*, numerous perfect specimens.

Pleistocene: Hudson and James Bays; Newfoundland and Labrador; St. John, N. B.; Maine.

Recent: Greenland to Cape Cod.

Leda pernula Müller

Fragments at locality *A*.

Pleistocene: James Bay (abundant); Riviere du Loup; Lawlors Lake, N. B.; Maine.

Recent: Greenland to Massachusetts Bay; Hudson Strait.

GASTROPODA

Acmaea testudinalis Müller

Localities *A*, *B* and *C*.

Pleistocene: Charlton and Cary Islands, James Bay; Labrador.

Recent: Labrador to Connecticut; Hudson and James Bays, Gulf of St. Lawrence.

Puncturella princeps Mighels and Adams

(*P. noachina* Linné)

Locality *B* (rare).

Pleistocene: Riviere du Loup and Quebec.

Recent: Labrador, Gulf of St. Lawrence and in deep water to North Carolina.

BRACHIOPODA

Rhynchonella psittacea Gmelin

Locality *D*.

Pleistocene: Charlton and Cary Islands, James Bay; Riviere du Loup, Montreal and St. Lawrence Valley.

Recent: Abundant on stony or rocky ground throughout northern seas including Hudson Bay.

CRUSTACEA

Balanus sp.

Localities *C* and *D*.

SIGNIFICANCE OF THE FOSSILS

The marine Pleistocene deposits of the Hudson Bay region are usually regarded as of early post Wisconsin age. The ice was then retreating which caused Hudson and James Bays to rise because of the increased

water released by the melting ice. The land was lower than at present due to the weight of the ice. It is believed that there was a differential uplift of the land in post Wisconsin time, when the earth had recovered from the weight of the ice, greater to the north where the weight of the ice had been greater. Abandoned shorelines up to 500 feet above the shore of Hudson Bay are evidences of this post Wisconsin uplift.

That James Bay was deeper and more saline than at present is shown by the finding of numerous shells on the beaches of Charlton and Cary Islands (85 miles north of Moose Factory) that are not at present living in James Bay. It was suggested (Richards, 1936) that these shells were Pleistocene fossils, having lived in post Wisconsin time when the Bay was of greater size than at present. Since a marked similarity is shown between the fossils from Charlton and Cary Islands and those from the Belcher Islands, it is suggested that the two faunas are contemporaneous and that rather uniform conditions prevailed over the region. The finding of brackish water fossils on the James Bay Coastal Plain south of Moose Factory (Kindle, 1924) suggests that this region was covered by a shallow brackish sea not unlike James Bay today.

Marine shells are reported in this paper up to about 300 feet above sea level or to almost the highest point on the Belcher Islands. It is therefore most probable that the entire group of islands was covered by the sea in post Wisconsin time. Therefore the flora and fauna of the islands must be of recent introduction. However, since the Belchers lie only about 60 miles west of the mainland and since the Bay is frozen solid for several months of the year, the re-population of the islands would have been relatively easy.

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ART. IV. GEOGRAPHICAL DISTRIBUTION OF THE RECENT MOLLUSCA OF NEWFOUNDLAND

By Stanley Truman Brooks
and
Betty Watt Brooks

The following summary constitutes the final report covering the collections made by us between 1934 and 1938 upon the island of Newfoundland. We feel that in Newfoundland we have found a territory of critical value in the study of animal distribution. The several species found within the confines of the Great Island, which are not known from the United States and Canada, will lead many to believe that they have been introduced through commerce. This may well be, but if attention is paid to the localities in which many of these species live, the uninhabited islands off the rocky shores, the deep fastnesses of the Rocky Downs, and other localities along this ancient shore, then the conviction will grow that we have found a natural fauna distributed by nature through the centuries that have passed. The majority of these forms witnessed the Ice Age and through that troublous time retained the stations they inhabit today. Introduction through commerce may have occurred not only once but many times within certain areas such as the city of St. John's. However, this locality is the least important and probably the most barren of all. Before one may form a conclusion it should be remembered that all of the shipping to this country has been done by fishermen and by merchant-fishermen. None of these has imported much garden material and the small islands along the Southern Shore, which has been found to be the critical area, have scarcely been touched by the foot of man. Some of them are uninhabitable even for a frugal goat. True, the fisherman may have drawn up his nets from the sea and spread them out to dry or at the most, he may have pastured a few sheep upon their rocky summits. In the main, however, these islands and these headlands may be thought of as uninhabited areas.

Resume of Travels

The first trip[1] to Newfoundland was made in 1934. This was accomplished by the senior author alone and was a survey from the east to the

[1] Brooks, S. T., *The Land and Freshwater Mollusca of Newfoundland.* Annals of the Carnegie Museum, vol. 25, p. 83-108, pls. 12, 13, 1936.

Issued, July 3, 1940.

west, along the track of the overland railway, and thence north to the deep fiord of Bonne Bay on the west coast. This trip, which we consider now as a journey of reconnaissance, was fruitful in bringing to light many forms heretofore unknown from this region. Not only did new species come to light, but also the major divisions of the fauna were then determined. This will be discussed later in this paper.

The second trip, which also included only the senior author, was accomplished partly through the kindness of Captain "Bob" Bartlett of the Schooner "Morrissey." Eight days with Captain "Bob," whose cargo included a cow, a calf, two dozen hens and innumerable gold fish and "guppies," landed him at Brigus where field work started. Leaving Brigus, trips were made to some sixty-three ports along the northeastern coast of Newfoundland and southern Labrador. In most instances the time was too short, or the paucity of specimens made collecting a discouraging business. Three weeks were spent at the Grenfell Hospital at St. Anthony, partly in field work for molluscs and partly in researches in human parasitism.[2] The shores near this port were traversed for miles in each direction and only in rare cases were good collecting localities found. The encroachment of vegetation in the many lakes and ponds in this vicinity has made a situation inhospitable to molluscs and whatever fauna once lived there has now been lost in oblivion. Wherever one finds patches of blue grass or hardwood trees one finds a few specimens.

The third trip to Newfoundland allowed a greater coverage of territory. Mrs. Brooks and the three children, all ardent collectors, located on the Southern Shore at the village of Ferryland, Lord Baltimore's former home. There intensive and exhaustive collecting brought to light the largest number of forms yet to be collected in Newfoundland. While Mrs. Brooks filled her five months sojourn with travels in and along the southern coast, the writer engaged in many short trips over the Avalon Peninsula and went north for an extended trip to Labrador.

The collections made in the summer of 1937 brought to light the fact that several interesting European species occur in Labrador and on the islands off the shore of Ferryland. It was therefore planned to concentrate during the summer of 1938 on making a collection from these islands. This was accomplished by Mrs. Brooks at Mobile, on the numerous rocky islands in that district, and in the deep indentations at Placentia, Northeast Arm, and Southeast Arm of Placentia Bay. On nearly every island

[2] Brooks, S. T., *A Short Study of Human Parasitism in the Middle North.* The Journal of Parasitology, vol. 23, No. 1, p. 104, Feb. 1937.

the fauna that we had discovered the year before at Ferryland was duplicated. But only two months of the summer could be allowed for this work as our ultimate goal was England and the extensive collections of the British Museum.

DEFINITION OF THE NEWFOUNDLAND FAUNA

With the exception of a few species and subspecies that are unique to this island, the molluscan fauna of Newfoundland today is the same as that which existed in this area during and very likely even before the Pleistocene, and before the separation of Newfoundland from the mainland. In our study we have made a division of this fauna into two groups:

(1) The circumboreal species that have migrated from their Holarctic centers of origin down into the contiguous land areas and;

(2) Those species characteristic of the continental areas which have been derived from an earlier migration of progressive forms.

Under the circumboreal species we include those with a truly circumpolar distribution as well as those which now show greater affinities to the east than to the west. It is the belief of the authors that all of the forms herein united under the heading circumboreal will, in the future, be found in either fossil or recent state in the unknown portions of northern Canada and Siberia. It may be possible, however, that, due to geographical conditions so far unknown to us, there was an influx of so-called European species into eastern America from Holarctica and that these were prevented from spreading and joining with their fellows of eastern Europe. Our only criterion for this statement is that the majority of these are not known from Siberia, Alaska, and the great spaces of Canada, but are common to eastern Canada, Newfoundland, Labrador, and in many cases to Greenland and Iceland. Again we must realize that there exists a paucity of collections from these extensive areas and that we will be able to determine the exact range of our "European Species" in North America only when more careful studies are made of these regions. This, it may be said, has long been one of our most enticing dreams and perhaps one of the most important. It also may be stated that *in the main*, these so-called "European Forms," are not importations through commerce, but are a part of the distribution of the basic species *via* Holarctica. The evidence possessed by us will be discussed under the various headings. Of the entire Newfoundland fauna 41.7 per cent is included in the circumboreal group.

Around 58.3 per cent then must fall within the other group which had its development upon the North American continent. This brings us to

another interesting observation. In Newfoundland we find a very definite eastern and western distribution. The forty-six species occurring on the western side of the island are predominantly of American origin, whereas the eastern fauna, consisting of thirty-nine species, is predominantly Holarctic in origin and contains the so-called "European forms."

It is very doubtful whether there is anything significant in the fact that these dual faunas occupy the areas of the geosynclines,[3] the Acadian and the St. Lawrence, while there is an obvious paucity in the central region or that of the New Brunswick Geosyncline. The activity of the former two geosynclines, is probably responsible for the present ecological conditions that enable these eastern and western faunas to live, but it is interesting to note that the map of this billion-year old scene of orographical activity is also the one of the present molluscan distribution.

Much knowledge is still hidden in the rocks and folds of this rugged island, for Newfoundland is an ancient land, the major portion of it having been above the surface of the sea for the last one-hundred million years. Twenhofel[4] tells the story of the subsequent folding, faulting, and erosion.

During the Tertiary, Newfoundland was a low plain with the drainages following the structure of the ancient formations, much the same as they are today. In the middle or late Tertiary there came an uplift and tilting which raised the region of the Long Range (western) some 2000 feet and the northeastern coast to some 700 feet, with a subsequent sinking to the south. A greater submergence of the shore line occurred following the glaciation, which accounts for the great bays of the eastern portion of the island as well as the drowned valleys along the western periphery (formation of Bonne Bay and the Bay of Islands). It is with this latter submergence that the many interesting islands fringing the shores of the Avalon were formed. In the late Pleistocene,[5] the submergence also caused the formation of the Bay of St. Lawrence and the Strait of Belle Isle, which separated Newfoundland from the American continent.

Now one thing is obvious and that is that the fauna of present-day Newfoundland attained its place in that island subsequent to any total

[3] Twenhofel, W. H., *Newfoundland: Geology and Peoples.* Sigma Xi Quarterly, vol. 27, p. 103-112, 121, 1939.

[4] Twenhofel, W. H., *Physiography of Newfoundland.* American Journal of Science, vol. 33, p. 1-24, 1912.

[5] Schuchert, C. and Dunbar, C. O., *Stratigraphy of Western Newfoundland.* Memoirs Geol. Soc. Am., no. 1, 1934.

glaciation that may have occurred. We are assuming that a total glaciation would cause the extermination of the flora and fauna of the region it occupied. If the glaciation was *total*, then all populated areas would have been covered and no plant or animal could have existed or lived through that time. Just when such an absolute glaciation may have occurred in Newfoundland is not yet known. There are various conflicting evidences and theories but one thing is certain. The snails seem to indicate that no disastrous glaciation has occurred since *their last* migration into this island.

Chamberlin (1895)[6] states that the evidences in Newfoundland give the impression "that the glaciation of the isle was more probably attributable to the development of local ice sheets than to an extension of the ice fields of the mainland." As to the Avalon Peninsula he says that "no granitic erratics from the interior nucleus, or at most extremely few, mingle with the local red sandstone and gray crystalline rocks in the drift. These facts indicate an extremely local derivation."

Coleman (1926)[7] indicates that the glaciation of the critical (for land snail evidence) Southern Shore was quite ancient; either Kansan or Jerseyan and was of several hundred feet in thickness. No true moraines occur along the present shore, but a few large, transported blocks do occur at Fermeuse. He says that, although the evidences are sparse, he would conclude that:

(1) there was an ice cap spreading out from the center of the peninsula, and;

(2) there were probably two invasions of the ice; one in the early Pleistocene and another in the late, the latter corresponding to the Wisconsin Sheet of the mainland. There was no indication of powerful ice action and it was not heavy enough to depress the shore.

Twenhofel (1912)[8] described the western portion of the Island, the Long Range, as a remnant of an extensive peneplain, cretaceous in origin, which was elevated and then dissected. This region shows extensive glacial activity and erratics of glacial origin are found on the tops of the highest "peaks" (table lands) of the Long Range. Physiographically, Twenhofel divides the island into three parts: the Long Range and coastal region;

[6] Chamberlin, T. C., *Notes on the Geology of Newfoundland.* Bull. Geol. Soc. Amer., p. 467, 1895.

[7] Coleman, A. P., *The Pleistocene of Newfoundland.* The Journ. of Geology, vol. 34, no. 3, pp. 200-204, 1926.

[8] *loc. cit.*

the central region between the Long Range and Placentia and Trinity Bays; and the Avalon Peninsula. All evidences point to a greater glacial activity in the western and central portion, with the least activity in the Avalon. However, there is an indication that the southern region of the Long Range was not glaciated. Valley glaciers have deposited boulder clay and erratics only to an altitude of 500 feet and the table lands show little glacial activity and no erratics.

In his later paper, Twenhofel (1939) states that during the Ice Age most, if not all, of Newfoundland was covered by the ice. His reaction to the finding of what presumably are plant relicts, as indicating unglaciated areas, is that this evidence may well exist but that more work must be done in this field. He also correlates the last glaciation with the Wisconsin advance and believes that the ice had disappeared from 25,000 to 50,000 years ago. Following this there were some submergences of the coast during which time the larger bays and long salients were formed. In the more northerly part of the island there has been a reversal of the subsidence, but to the south there is a continued sinking.

The Species and Their Significance

Euconulus fulvus is a species of the eastern, central, and western portions of the island. In the aggregate, the *Euconulids* are circumboreal in distribution and as fossils are first found in the Pliocene beds.

Vertigo modesta and its races form one of the most important of the circumboreal complexes. The genus is widespread in the Pliocene having then attained a distribution which, at present, is restricted to some extent by subsequent glaciations, especially in western America and in Siberia. In Newfoundland it is limited to the western area and the northern peninsula. The races of this group include *V. krausseana* of Siberia and Alaska; *V. arctica* of Lapland and Alaska (?); *V. hoppi* of Greenland; and *V. modesta* and varieties of North America. In our study of *V. arctica* and *V. hoppi* in the British Museum, and of the former in the Bryant Walker Collection of the University of Michigan, we have come to the conclusion that they are both *V. modesta*. In a collection made this past year in the islands of the Belcher Group, Hudson's Bay, by Dr. Arthur C. Twomey, of the museum staff, we have specimens of true *modesta* that are absolutely identical with *arctica* and which prove to our satisfaction the unity of these species. The Newfoundland specimens are all more typical of the southern American forms.

Pupilla muscorum is another circumboreal species which has occurred

since the Pliocene and is now found in Newfoundland at various localities in the Long Range (west coast) and *on an island off the Southern Shore*, at Ferryland. This species is noted for its "spotty" distribution in America and to the present time has been found only in the two regions in Newfoundland, the Long Range and the Avalon Peninsula.

Vallonia pulchella, another Pliocene, circumboreal, immigrant is found only on the Avalon Peninsula, and *Columella edentula* only in the western area. *Zoogenetes harpa* and *Punctum pygmaeum* both occupy the region between Trinity Bay and the west coast of Newfoundland, while *Cochlicopa lubrica* is found generally over the entire island.

Limax arborum is a species, which in a natural state, is new to North America. It had previously been found in greenhouses in Colorado by T. D. A. Cockerell. In the same manner as Cockerell we approached this astounding find through dissection and, upon finding the penis sheath bearing its unmistakable flagellum, we decided that it could be no other. We collected it at seven localities along the shore from Aquaforte and Ferryland, along the Southern Shore, to Brigus on Conception Bay, and more strikingly found it on a small island, Fox Island, off the shore at Torr's Cove. It is difficult to see how it could have been introduced into all of these localities.

Only two specimens of *Limax maximus* have been identified from Newfoundland; one from St. John's, and one from Bay Bulls. In the latter locality the specimen was darker, and the respiratory orifice was typical of *flavus* and not of *maximus*. A dissection, however, did not show the rectal appendix or caecum of *flavus*.

Deroceras laeve and *D. agrestis*, probably, are both circumboreal in distribution and both have been introduced over much of the world. The former is found sparsely in the central, western, and eastern parts of Newfoundland, and the latter generally over the entire island.

Zonitoides nitidus is found only on the Avalon Peninsula while *Vitrina limpida* is found on *the islands of the east coast*, and on the western coast and northern peninsula. The *Vitrinas* in the aggregate, including *V. alaskana*, *V. limpida*, *V. pellucida*, *V. angelicae*, and *V. exilis*, form another circumboreal complex, such as *Vertigo modesta*, and also have an equally long geological history, appearing in the late Eocene.

Retinella electrina (the American form of the European *R. hammonis*), is another widely spread form and in Newfoundland is found over the entire island. Another widely spread species is *Stagnicola palustris*, for, with its varieties, it may be collected over the entire island.

Helix hortensis is undoubtedly a circumboreal form, but at present it is known only from Europe and North America; the Asiatic localities being in some doubt. It is spread over the entire island of Newfoundland with its greatest population being along the face of the moist Long Range. This species was first discovered in America in the Pleistocene of Maine, and is now found in Massachusetts, Maine, New Hampshire, Vermont, Connecticut, and New York. It has been reported from the Amur Valley in Siberia; from "debris" of Indian camps in Nebraska, and it lives in goodly numbers in the Province of Quebec, and on the islands of Michelon and St. Pierre.

Trochulus striolatus (*Hygromia rufescens*), is known to occur in Siberia, Europe, Labrador, and Quebec. It has been found in large numbers by us in the vicinity of St. John's and Placentia.

Helicigona arbustorum, an inhabitant of northern Europe, Iceland, and Quebec, was reported from St. John's, Newfoundland, by Whiteaves, in 1863. We had questioned its presence in Newfoundland since no amount of labor on our part had succeeded in turning it up. We were assured, however, by the workers in the British Museum, that Whiteaves had not made a mistake, and that it either had become extinct through destruction of its habitat or that we had not yet discovered its lair.

Vallonia excentrica was found in great numbers on the headlands around St. John's and along Conception Bay at Harbour Grace.

Arion ater, a presumably introduced form, is commonly found from St. John's south along the Southern Shore. Finding it in the tangled fastnesses of the uninhabited Rocky Downs, miles from any semblance of gardens and farms, might point to an earlier migration than that of man might afford. Since it occurs in Maine, it should, if an ancient migrant, ultimately be found along the intervening shores. In this regard we believe that more extensive collections from the islands of our eastern coast and from those farther north must be made to more fully know the distribution and past history of many of these so-called introductions. *Arion hortensis* occupies the Avalon and the west coast of Newfoundland although not in great numbers. *Arion subfuscus* (=*fasciatus*), has been reported from Trepassey and Whitbourne and has been collected by us from the islands of the Avalon Peninsula and along the shore from the southern reaches of the eastern shore north to St. Anthony on the northern Peninsula. It is undoubtedly generally distributed. *Arion circumscriptus* is here reported for the first time from Newfoundland. It is much more common along the eastern shores than is *hortensis*. The dissection of this form showed genitalia typical of the species.

Vertigo alpestris is one of our most important finds. Its distribution is given as "Europe," and Mozley, in a personal communication with us, listed it from Vladivostock, Lake Baikal, and Irkutsk, Siberia. In Newfoundland it was first found by Mrs. Brooks on a small rocky island (Nancy's Portion, at Ferryland, the Southern Shore), in 1937. Here it occurred in great numbers which stimulated us to seek it on more islands along the shores of the Avalon. During the summer of 1938, Mrs. Brooks again found it on small islands in the deep arms of Placentia Bay. No one of these islands could be or ever has been occupied by man. Some of them are mere heaps of stone rising only a few feet above the highest tides. The snails were found deep among the stones and rubble under a moisture-holding moss (*Dicranum* sp. and *Hypnum* sp.), feeding upon a whitish mould covering the lower dead layers of moss. In some instances they were over a foot below the visible surface. On Nancy's Portion they were found in blue grass and were feeding upon the bleached tests of sea urchins and other limy shells dropped by the gulls. So far, this species has not been found on the mainland. Associated with it were *Vitrina limpida*, *Helix hortensis* (ranging smaller than the mainland forms) and other species. We feel that this is an ancient migrant to Newfoundland and by no means an introduction. Its isolation *on the small islands* has enabled it to persist to this day although it has disappeared (as far as we can ascertain) from the mainland. The subsidence and formation of these islands occurred during the late Pleistocene.

Oxychilus lucida is found all along the Southern Shore of the Avalon.

Discus rotundatus is another mystery shell found in the summer of 1937 for the first time in North America. Mrs. Brooks collected large numbers of this species in the ruins of buildings at Ferryland, on the South Shore. It was not found on the islands but only in this one district. Where it occurred, *Discus cronkhitei* and *Discus cronkhitei anthonyi* were not found. Its isolated occurrence is not one to offer much evidence for a natural migration. It may later be found in other parts of the island and will, if found, become more important to our problem.

The distribution of *Discus cronkhitei* and *Discus cronkhitei anthonyi* in Newfoundland is interesting. The former is a species of the western mountainous area of America, extending north throughout the coastal region of Canada and Alaska. The latter is confined to the more southern limits of North America, but even then attaining a distribution north to Great Slave Lake.

The presence of *Discus cronkhitei* in Newfoundland, and not in the

intervening spaces, can be explained by assuming that the species formerly had a continuous distribution from west to east. The absence of this species in the marls and loess of the intervening spaces may be explained by assuming that the distribution was a northern one and that the species did not penetrate into the southern limits (of the subspecies) before the advance of the ice destroyed its continuity. But again there is no reason to believe that the two species gained their dispersal into Newfoundland simultaneously. *Discus cronkhitei* is logically the oldest form and therefore could have made its way into Newfoundland at an early time. Then the strong American subspecies found it possible to encroach upon the entire southern territory of the parent (?) species and in so doing it spread over all the areas now occupied. However, the subspecies had an early start and gained a very wide dispersal before the period of island formation in the late Pleistocene.

Radix pereger is a versatile species found in Europe, Iceland, and in Newfoundland. Formerly it had been confused with the variety *geisericola* of Iceland, but according to F. C. Baker the Newfoundland variety is *lacustris* Leech. We collected it in great numbers in the small lakes at Whitbourne and in goodly numbers in Clam Cove River far to the south of the Avalon Peninsula. It occurs only on the Avalon. There is little evidence that this species was *introduced* into Newfoundland from Europe. Whitbourne is in the more populous part of the island and this species could have found its way into the lakes there from some kind of railway shipments, but Clam Cove River is a small stream far out of the beaten track (crossed by a spur of the railway that once served the Southern Shore), and it would stretch one's credulity to imagine any of the local fishermen accidentally seeding the area with this species from any kind of imports. We have confidence that this will prove to be one of the natural migrants of the Pleistocene or earlier periods.

Succinea groenlandica is to be viewed with some suspicion. We have been unable to compare our specimens with any from Greenland, but they have been authoritatively determined to be of this species. However, its scanty distribution in the Bonne Bay (Lomond) district does not stimulate much faith in its importance in a study of distribution.

Margaritana margaritifera is found over the entire island of Newfoundland. The late great student of the molluscs, Bryant Walker, put forward the theory that America has been the recipient of two distinct immigrations of this species; one by the western route (Siberia), and the other by an easterly route from Europe. The reasons he gave for this theory are

the absence of this species in the extensive central region of North America, and its presence in both the eastern and western areas. However, as Pilsbry and others have stated, the past history of the molluscs extends so far back into geological time that various geographical changes may have altered the apparent pattern of their distribution. This species is one of the most ancient of any of the forms with which we shall have to deal. Therefore, we do not feel that any especial pattern of distribution must be delineated in order to explain the present range. It is obviously a species from the Holarctic realm which followed the same path later trod by the more recent migrants. This Holarctic realm was not necessarily limited only to the one portal, the Siberian doorway, but was the emerged circumpolar mass which held in common embrace the northern reaches of Asia, Europe, and North America. In no other way are we able to explain our distributional phenomena and in so doing we are following the geological findings of Schuchert and Chamberlin, and the paleontologic-taxonomic expressions of Matthew and Pilsbry. There is, however, sufficient evidence among the molluscs to cause one to think of a migration *limited within the Holarctic realm to those species of western Europe*, and it is these species that we have been discussing. But the possibility remains that the fauna of the contiguous areas may have been exterminated by some force of nature which would thus render Walker's picture untenable. However, the possibilities of a migration from western Europe are sufficient to pique the curiosity.

It is hardly necessary to enumerate the species forming the large group of American origin (58.3% of the fauna), as they are all included in a "chart of the species," which follows. They are typically American in their affinities although some are known from Asia (*Zonitoides arboreus*), and nearly all are from circumboreal genera. We feel that the presence of *Discus cronkhitei* in Newfoundland, and in its present range in America, points to its early dispersal throughout North America, inclusive of Newfoundland. The dual character of its distribution within Newfoundland again indicates that nature extirpated many of these forms from the greater part of Newfoundland and then allowed a later influx of more recent forms. That there have been successive waves of migration into the Newfoundland area by the American species seems to be above doubt. It then follows that the Holarctic-European aspect of the eastern coast of Newfoundland would indicate a more ancient dispersal, the members of this fauna having been able to withstand the subsequent vicissitudes of the vacillating ice sheet. Not only are these remnants found in Newfoundland

but also to a limited degree in Laborador, eastern Canada, and New England. It would seem that this dispersal took place before the formation of the Strait of Belle Isle and the St. Lawrence Gulf, during the late Pleistocene.

CONCLUSIONS

1. In Newfoundland there exist the relicts of two major dispersals of molluscan life:

   (a) those species of Holarctic origin;

   (b) those of American origin.

2. The majority of those more closely related to the present European fauna are found in eastern Newfoundland (the Avalon Peninsula).

3. In Newfoundland, the majority of the species of American origin are found in the western portion of the island.

4. This populating of Newfoundland took place (once or many times) before the submergence, forming the Strait of Belle Isle and the Bay of St. Lawrence, occurred.

5. The species of Holarctic origin are of two groups:

   (a) those truly circumboreal in distribution;

   (b) those not known to be truly circumboreal, but which are of the the western European fauna (including Greenland and Iceland).

6. In view of the lack of evidence for any absolute extermination of life, no total (therefore fatal) glaciation of Newfoundland has occurred since the depression of the Strait of Belle Isle and the Bay of St. Lawrence.

7. The species found on the islands of the Southern Shore indicate that there has been no total glaciation of eastern Newfoundland since the formation of the fringing islands of the Avalon Peninsula and since the advent of the species found there.

8. Newfoundland had freshwater connections with Holarctica through which the mussels and aquatic snails, both circumpolar and American *in origin*, made their way into the various drainage systems.

LIST OF LOCALITIES AND SPECIES IN NEWFOUNDLAND*

St. John's

1. *Helix hortensis* (Müller)
2. *Helicigona arbustorum* (Linnaeus)
   Reported by Whiteaves in 1863.
3. *Trochulus striolatus* (C. Pfr.)
   Collected by us in St. John's proper at Forest Road, Circular Road, Signal Hill and at Quidi Vidi village.
4. *Oxychilus lucida* (Draparnaud)
   Circular Road.
5. *Vallonia excentrica* (Sterki)
   Collected in great numbers at Forest Road and on Signal Hill.
6. *Limax maximus* Linnaeus
   Rare in Newfoundland.
7. *Deroceras agrestis* (Linnaeus)
8. *Arion circumscriptus* Johnston
9. *Helisoma campanulata* (Say)
   In Murray's Pond and Quidi Vidi outlet.
10. *Amnicola limosa* (Say)
11. *Stagnicola palustris perpalustris* Baker and Brooks
12. *Cochlicopa lubrica* (Müller)

THE SOUTHERN SHORE

Petty Harbour

1. *Arion ater* (Linnaeus)

Bay Bulls

1. *Limax maximus* Linnaeus
2. *Limax arborum* Bouch.-Chant.
3. *Arion ater* (Linnaeus)

Mobile

1. *Zonitoides arboreus* (Say)
2. *Limax arborum* Bouch.-Chant.
3. *Deroceras agrestis* (Linnaeus)
4. *Arion circumscriptus* Johnston
5. *Arion subfuscus* (Draparnaud) equals *fasciatus* Nils.

The Ferryland District
(Mainland fauna)

1. *Helix hortensis* (Müller)
   A colony of this species exists at Aquaforte but has not been found in the village of Ferryland.

*Unless otherwise designated all the species listed are in the collections of the Carnegie Museum.

2. *Zonitoides arboreus* (Say)
   Collected at Chance Cove and Spout Pond.
3. *Striatura exigua* (Stimpson)
   Collected only at Chance Cove.
4. *Retinella electrina* (Gould)
   Collected at Ferryland Village, Chance Cove and Spout Pond.
5. *Oxychilus lucida* (Draparnaud)
   Living in Ferryland Village and south in the wilds of Spout Pond.
6. *Discus rotundatus* (Müller)
   Collected for the first time in North America in ruins of Church of England (1937), in Ferryland Village. This has not been found in any other locality.
7. *Discus cronkhitei* (Newcomb)
   Neither this nor the following species were found within the *rotundatus* area but were collected at Chance Cove.
8. *Discus cronkhitei anthonyi* (Pilsbry)
9. *Cochlicopa lubrica* (Müller)
10. *Limax arborum* Bouch.-Chant.
11. *Deroceras agrestis* (Linnaeus)
12. *Arion subfuscus* Ferussac
    Collected at Aquaforte, Chance Cove, Trepassey, and Brigus Cross-Roads.
13. *Arion ater* (Linnaeus)
    Chance Cove, Aquaforte.
14. *Arion hortensis* Ferussac
15. *Arion circumscriptus* Johnston
16. *Fossaria umbilicata* (C. B. Adams)
    Two small streams, Priest's River and Freshwater R.
17. *Radix pereger lacustris* (Leach)
    Clam Cove River and an interesting find.
18. *Helisoma campanulata* (Say)
    Spout Pond.
19. *Anodonta brooksiana* van der Schalie
    A species described by Dr. van der Schalie from material collected in Spout Pond. It is also found at Whitbourne.
20. *Margaritana margaritifera* (Linnaeus)
    Spout Pond.

The Ferryland District
(Island Fauna)

Nancy's Portion Island

1. *Helix hortensis* (Müller)
2. *Euconulus fulvus* (Müller)
3. *Zonitoides arboreus* (Say)
4. *Retinella electrina* (Gould)

5. *Vitrina limpida* (Gould)
6. *Discus cronkhitei* (Newcomb)
7. *Discus cronkhitei anthonyi* (Pilsbry)
8. *Vertigo alpestris* Alder
9. *Pupilla muscorum* (Linnaeus)
10. *Cochlicopa lubrica* (Müller)
11. *Deroceras laevis* (Müller)
12. *Arion subfuscus* (Draparnaud)

The Isle of Boise

1. *Discus cronkhitei* (Newcomb)
2. *Cochlicopa lubrica* (Müller)

Harry's Island

1. *Helix hortensis* (Müller)
2. *Cochlicopa lubrica* (Müller)
3. *Discus cronkhitei anthonyi* (Pilsbry)

Ship Island

1. *Discus cronkhitei* (Newcomb)
2. *Discus cronkhitei anthonyi* (Pilsbry)

Gull Island

1. *Cochlicopa lubrica* (Müller)
2. *Zonitoides arboreus* (Say)
3. *Discus cronkhitei anthonyi* (Pilsbry)
4. *Deroceras agrestis* (Linnaeus)
5. *Arion subfuscus* (Drap.)

Fox Island

1. *Cochlicopa lubrica* (Müller)
2. *Zonitoides arboreus* (Say)
3. *Discus cronkhitei* (Newcomb)
4. *Discus cronkhitei anthonyi* (Pilsbry)
5. *Deroceras agrestis* (L.)
6. *Limax arborum* Bouch.-Chant.
7. *Arion subfuscus* (Drap.)

Pee Pee Island

1. *Vitrina limpida* (Gould)
2. *Retinella electrina* (Gould)
3. *Vertigo alpestris* Alder
4. *Discus cronkhitei* (Newcomb)
5. *Discus cronkhitei anthonyi* (Pilsbry)

PLACENTIA BAY

Village of Placentia
(Mainland Fauna)

1. *Trochulus striolatus* (C. Pfr.)
2. *Cochlicopa lubrica* (Müller)
3. *Vallonia excentrica* (Sterki)
4. *Zonitoides arboreus* (Say)
5. *Deroceras agrestis* (L.)
6. *Arion circumscriptus* Johnston

Cape Shore Road

1. *Helix hortensis* (Müller)
2. *Retinella electrina* (Gould)
3. *Discus cronkhitei* (Newcomb)
4. *Discus cronkhitei anthonyi* (Pilsbry)

Glendon's Cove, Pointe Verde

1. *Cochlicopa lubrica* (Müller)
2. *Zonitoides arboreus* (Say)
3. *Discus cronkhitei anthonyi* (Pilsbry)

Island Fauna of Placentia Bay
(Southeast Arm)

Verran's Island

1. *Zonitoides arboreus* (Say)
2. *Vertigo alpestris* Alder
3. *Discus cronkhitei* (Newcomb)
4. *Discus cronkhitei anthonyi* (Pilsbry)
5. *Deroceras agrestis* (L.)

The Little Island

1. *Zonitoides arboreus* (Say)
2. *Euconulus fulvus* (Müller)
3. *Vertigo alpestris* Alder
4. *Discus cronkhitei* (Newcomb)
5. *Discus cronkhitei anthonyi* (Pilsbry)

Round Island

1. *Zonitoides arboreus* (Say)

Nameless Island No. 1

1. *Zonitoides arboreus* (Say)

Nameless Island No. 2.

1. *Zonitoides arboreus* (Say)
2. *Cochlicopa lubrica* (Müller)

Phillips Island

1. *Zonitoides arboreus* (Say)
2. *Discus cronkhitei anthonyi* (Pilsbry)
3. *Cochlicopa lubrica* (Müller)
4. *Deroceras agrestis* (L)

Island Fauna of Placentia Bay
(Northeast Arm)

Seven Islands No. 1.

1. *Zonitoides arboreus* (Say)
2. *Euconulus fulvus* (Müller)
3. *Vertigo alpestris* Alder
4. *Discus cronkhitei anthonyi* (Pilsbry)

Seven Islands No. 2.

1. *Cochlicopa lubrica* (Müller)
2. *Vertigo alpestris* Alder

Seven Islands No. 3.

1. *Zonitoides arboreus* (Say)
2. *Vertigo alpestris* Alder
3. *Discus cronkhitei anthonyi* (Pilsbry)

Seven Islands No. 4.

1. *Zonitoides arboreus* (Say)
2. *Discus cronkhitei anthonyi* (Pilsbry)

St. John's north to Conception Bay

Torbay

1. *Trochulus striolatus* (C. Pfr.)
2. *Oxychilus lucida* (Draparnaud)
3. *Deroceras agrestis* (Linnaeus)
4. *Limax arborum* Bouch.-Chant.
5. *Arion circumscriptus* Johnston

Conception Bay
(Mainland Fauna)

Manuels River

1. *Arion hortensis* Ferrusac

Brigus

1. *Vertigo perryi* Sterki
2. *Amnicola limosa* Say
3. *Ferrissia caurina* Cooper
4. *Deroceras agrestis* (L.)
5. *Limax arborum* Bouch.-Chant.
6. *Arion circumscriptus* Johnston

Harbour Grace

1. *Vallonia excentrica* (Sterki)
2. *Cochlicopa lubrica* (Müller)

Carbonear and Carbonear Island

1. *Cochlicopa lubrica* (Müller)
2. *Deroceras agrestis* (L.)

Trinity Bay
(Mainland Fauna)

Shoal Harbour and Clarenville

1. *Helix hortensis* (Müller)
2. *Zonitoides arboreus* (Say)
3. *Striatura milium* (Morse)
4. *Euconulus fulvus* (Müller)
5. *Retinella electrina* (Gould)
6. *Punctum pygmaeum minutissimum* (Lea)
7. *Discus cronkhitei* (Newcomb)
8. *Discus cronkhitei anthonyi* (Pilsbry)
9. *Succinea ovalis* Say
10. *Zoogenetes harpa* Morse

Trinity

1. *Cochlicopa lubrica* (Müller)
2. *Zonitoides arboreus* (Say)

Whitbourne (on Newfoundland Railway)

1. *Helix hortensis* (Müller)
2. *Arion fasciatus* Nils. (records of the A.N.S.P.)
3. *Arion subfuscus* (Drap.)
4. *Stagnicola palustris papyracea* Baker and Brooks (Type locality)
5. *Radix pereger lacustris* (Leach)
6. *Valvata sincera nylanderi* Dall
7. *Amnicola limosa porata* Say
8. *Helisoma campanulata* (Say)
9. *Margaritana margaritifera* (Linnaeus)
10. *Anodonta marginata* Say
11. *Anodonta brooksiana* van der Schalie

Terra Nova (on Newfoundland Railway)

1. *Helix hortensis* (Müller)
2. *Succinea ovalis* Say

Grand Falls (on Newfoundland Railway)

1. *Zonitoides arboreus* (Say)
2. *Euconulus fulvus* (Müller)
3. *Retinella electrina* (Gould)
4. *Deroceras laeve* (Müller)
5. *Helicodiscus parallelus* (Say)
6. *Discus cronkhitei* (Newcomb)
7. *Discus cronkhitei anthonyi* (Pilsbry)
8. *Succinea ovalis* Say
9. *Cochlicopa lubrica* (Müller)
10. *Stagnicola palustris perpalustris* Baker and Brooks (Type locality)
11. *Helisoma campanulata minor* (Dunker)
12. *Physa heterostropha* Say
13. *Amnicola limosa porata* Say
14. *Margaritana margaritifera* (Linnaeus)

The Southwest Coast to Cape Ray

1. *Helix hortensis* (Müller) (from Port au Port)
2. *Margaritana margaritifera* (Linnaeus)
3. *Succinea ovalis* Say (in B. Walker Collection, University of Michigan)

Bay of Islands (West Coast)

1. *Helix hortensis* (Müller)
2. *Zonitoides arboreus* (Say) (A.N.S.P.)
3. *Euconulus fulvus* (Müller) (A.N.S.P.)
4. *Retinella electrina* (Gould) (A.N.S.P.)
5. *Helicodiscus parallelus* (Say) (A.N.S.P.)
6. *Punctum pygmaeum minutissimum* (Lea) (A.N.S.P.)
7. *Discus cronkhitei* (Newcomb) (A.N.S.P.)
8. *Arion hortensis* Ferrusac (A.N.S.P.)
9. *Succinea ovalis* Say
10. *Vertigo gouldii paradoxa* Sterki (A.N.S.P.)
11. *Cochlicopa lubrica* (Müller)
12. *Physa heterostropha* Say (M.C.Z.)

Bonne Bay (West Coast)

1. *Helix hortensis* (Müller)
2. *Zonitoides arboreus* (Say)
3. *Zonitoides nitidus* (Müller)
4. *Striatura exigua* (Stimpson)
5. *Hawaii miniscula* (Binney)

6. *Euconulus fulvus* (Müller)
7. *Helicodiscus parallelus* (Say)
8. *Retinella electrina* (Gould)
9. *Punctum pygmaeum minutissimum* (Lea) (A.N.S.P.)
10. *Discus cronkhitei* (Newcomb)
11. *Discus cronkhitei anthonyi* (Pilsbry)
12. *Arion hortensis* Ferrusac
13. *Succinea ovalis* Say
14. *Succinea avara* Say
15. *Succinea groenlandica* (Beck) Müller
16. *Succinea peoriensis* "Wolf" Walker
17. *Pupilla muscorum* (Linnaeus) (A.N.S.P.)
18. *Vertigo modesta* (Say) (A.N.S.P.)
19. *Vertigo gouldii paradoxa* Sterki (A.N.S.P.)
20. *Vertigo elatior* Sterki
21. *Columella edentula* (Draparnaud) (A.N.S.P.)
22. *Cochlicopa lubrica* (Müller)
23. *Vallonia albula* Sterki (A.N.S.P.)
24. *Planogyra asteriscus* Morse
25. *Carychium exiguum* (Say)
26. *Stagnicola newfoundlandensis* Baker and Brooks (Type locality)
27. *Fossaria obrussa* (Say)
28. *Fossaria obrussa brooksi* Baker (Type locality)
29. *Fossaria umbilicata* (C. B. Adams)
30. *Gyraulus hornensis* Baker
31. *Helisoma campanulata davisii* (Winslow)
32. *Physa heterostropha* Say
33. *Valvata lewisii* Currier
34. *Margaritana margaritifera* (Linnaeus)

Northwest Coast including White Bay

1. *Helix hortensis* (Müller) (Parson's Pond) (Pointe Riche)
2. *Zonitoides arboreus* (Say)
3. *Euconulus fulvus* (Müller)
4. *Retinella electrina* (Gould)
5. *Vitrina limpida* (Gould)
6. *Deroceras agrestis* (Linnaeus) (Plumb Point, Brig Bay; La Scie; Starke's Bight, Goose Cove; St. Anthony; Port Au Choix; Englee.)
7. *Deroceras laeve* (Müller) (A.N.S.P.)
8. *Punctum pygmaeum minutissimum* (Lea) (A.N.S.P.)
9. *Discus cronkhitei* (Newcomb)
10. *Discus cronkhitei anthonyi* (Pilsbry)
11. *Succinea ovalis* Say (A.N.S.P.)
12. *Succinea avara* Say (A.N.S.P.)
13. *Succinea verrilli* Bland (A.N.S.P.)
14. *Pupilla muscorum* (Linnaeus) (A.N.S.P.)

15. *Vertigo modesta* (Say)
16. *Vertigo modesta parietalis* Ancey (A.N.S.P.)
17. *Vertigo modesta castanea* Sterki (A.N.S.P.)
18. *Vertigo gouldii* Binney (var.)
19. *Vertigo gouldii paradoxa* Sterki (A.N.S.P.)
20. *Columella edentula* (Draparnaud)
21. *Cochlicopa lubrica* (Müller)
22. *Vallonia albula* Sterki (A.N.S.P.)
23. *Zoogenetes harpa* Morse
24. *Stagnicola palustris* (Müller) (A.N.S.P.)
25. *Gyraulus parvus* (Say)
26. *Physa gyrina* Say (A.N.S.P.)
27. *Valvata lewisii* Currier (A.N.S.P.)
28. *Margaritana margaritifera* (Linnaeus) (A.N.S.P.)
29. *Anodonta marginata* Say (A.N.S.P.)
30. *Arion circumscriptus* Johnston (La Scie)
31. *Arion subfuscus* (Draparnaud) (La Scie; St. Anthony; Starke's Bight, Goose Cove; Englee.)

CHART OF SPECIES SHOWING DISTRIBUTION

Species	Newfoundland Distribution			Origin		
	West	Central	East	Holarctic	European	American
1. *Helicigona arbustorum*	..	..	×	..	×	..
2. *Helix hortensis*	×	×	×	..	×	..
3. *Zonitoides nitidus*	..	..	×	×	..	..
4. *Zonitoides arboreus*	×	×	×	..	..	×
5. *Hawaii minuscula**	×	..	..	..	..	×
6. *Striatura exigua**	×	..	..	..	..	×
7. *Striatura milium**	..	..	×	..	..	×
8. *Euconulus fulvus*	×	×	×	×	..	..
9. *Retinella electrina*	×	×	×	..	..	×
10. *Vitrina limpida*	×	..	×	..	..	×
11. *Limax maximus**	..	..	×	..	×	..
12. *Limax arborum****	..	..	×	..	×	..
13. *Deroceras agrestis*	×	..	×	×	..	..
14. *Deroceras laeve*	×	×	×	×	..	..
15. *Discus cronkhitei*	×	×	×	..	..	×
16. *Discus cronkhitei anthonyi*	×	..	×	..	..	×
17. *Helicodiscus parallelus*	×	×	..	..	..	×
18. *Punctum pygmaeum minutissimum**	×	..	×	×	..	..
19. *Arion ater*	..	..	×	..	×	..
20. *Arion hortensis*	×	..	×	..	×	..
21. *Arion subfuscus*	×	×	×	..	×	..
22. *Arion circumscriptus*	..	..	×	..	×	..
23. *Trochulus striolatus**	..	..	×	..	×	..
24. *Oxychilus lucida**	..	..	×	..	×	..
25. *Discus rotundatus****	..	..	×	..	×	..
26. *Succinea ovalis*	×	×	×	..	..	×
27. *Succinea avara*	×	..	..	..	..	×
28. *Succinea peoriensis**	×	..	..	..	..	×
29. *Succinea groenlandica**	×	..	..	..	×	..
30. *Succinea verilli*	×	..	..	..	..	×
31. *Pupilla muscorum*	×	..	×	×	..	..
32. *Vertigo perryi**	..	..	×	..	..	×
33. *Vertigo alpestris****	..	..	×	..	×	..
34. *Vertigo modesta*	×	..	..	×	..	..
35. *Vertigo modesta parietalis*	×	..	..	..	..	×
36. *Vertigo modesta castanea*	×	..	..	..	..	×
37. *Vertigo gouldi*	×	..	..	..	..	×
38. *Vertigo gouldi paradoxa*	×	..	..	..	..	×

CHART OF SPECIES SHOWING DISTRIBUTION

Species	Newfoundland Distribution			Origin		
	West	Central	East	Holarctic	European	American
39. *Vertigo elatior*	×	..	..	..	..	×
40. *Columella edentula*	×	..	..	×	..	..
41. *Cochlicopa lubrica*	×	×	×	×	..	..
42. *Vallonia albula*	×	..	..	..	..	×
43. *Vallonia excentrica**	..	..	×	..	×	..
44. *Vallonia pulchella**	..	..	×	×	..	..
45. *Zoogenites harpa*	×	..	×	×	..	..
46. *Planogyra asteriscus**	×	..	..	..	..	×
47. *Carychium exiguum**	×	..	..	..	..	×
48. *Radix pereger lacustris*	..	..	×	..	×	..
49. *Stagnicola pulustris*	×	..	×	×	..	..
50. *Stagnicola palustris papyracea***	..	..	×	..	..	×
51. *Stagnicola palustris perpalustris***	..	×	..	..	..	×
52. *Stagnicola newfoundlandensis***	×	..	..	..	..	×
53. *Fossaria obrussa**	×	..	..	..	..	×
54. *Fossaria obrussa brooksi***	×	..	..	..	..	×
55. *Fossaria umbilicata**	×	..	..	..	..	×
56. *Gyraulus parvus*	×	..	..	..	..	×
57. *Gyraulus hornensis**	×	..	..	..	..	×
58. *Helisoma campanulata davisii**	×	..	..	..	..	×
59. *Helisoma campanulata minor**	..	×	..	..	..	×
60. *Physa gyrina*	×	..	×	..	..	×
61. *Physa heterostropha*	×	×	..	..	..	×
62. *Valvata lewisii*	×	..	..	..	..	×
63. *Valvata sincera var.**	..	..	×	..	..	×
64. *Amnicola limosa var.**	..	×	×	..	..	×
65. *Margaritana margaritifera*	×	×	×	..	×	..
66. *Anodonta marginata*	×	..	×	..	..	×
67. *Anodonta brooksiana***	..	×	×	..	..	×
Totals	46	16	39	12	16	39
				17.90%	23.88%	58.20%
Holarctic	10	3	9			
European	4	3	16			
American	32	10	14			

*Marks the species added to the Newfoundland fauna by the authors.

**Marks the species new to science.

***Marks the species new to North America discovered by the authors.

ART. V. NOTES ON THE REPRODUCTION OF THE NORTHERN COPPERHEAD, *AGKISTRODON MOKASEN CUPREUS* (RAFINESQUE), IN PENNSYLVANIA

By Albert G. Smith
University of Pittsburgh

While assembling material for a distributional study of the Northern Copperhead in Pennsylvania, certain data on the breeding habits and young were secured which are of interest in connection with the results presented by Gloyd (1934) in his excellent account of the reproduction of this subspecies in Kansas.

I am indebted to Mr. M. Graham Netting for guidance in this study, and to the following persons for their helpful assistance: Rev. Maximilian Duman, O.S.B., and Rev. Alfred Grotzinger, O.S.B., Saint Vincent College, Dr. Howard K. Gloyd, Chicago Academy of Sciences, Mr. Roger Conant, Philadelphia Zoological Society, and Mr. George W. Koehler, Pennsylvania Game Commission.

Mating: The only observation upon the mating of the Copperhead in Pennsylvania is Hay's (1891:107) statement: "My friend, Rev. A. M. Hall, brought me from Western Pennsylvania two specimens of this species, which he took while pairing, on the 28th of August." In Kansas, Gloyd (p. 591) found that over 35 per cent of spring-collected adult females had mated shortly before capture and he concludes that the mating season there occurs during April and early May. Mating probably occurs in Pennsylvania following the emergence of the snakes from hibernation in late April or early May. In other snakes in which spring mating is customary occasional autumn matings are known, and Hay's record probably refers to an incident of this nature.

Gravid females: Four gravid females were collected in the latter part of August, 1938. Three (AGS 170-2) were taken between 10 A.M. and noon on August 21 in a dirt and rock dam at the Greensburg reservoir. All the specimens were found on the downstream slope of the dam, which is partially covered with vines; two were resting about two feet apart, inside a crevice, and the third, at a considerable distance from the others, was coiled with about one-half of its body in the sun and the remaining portion in a crevice. The fourth specimen (AGS 160) was taken under a rock in the early afternoon of August 26 at a stone quarry three miles

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northeast of Lycippus. These snakes were sluggish and refused food in captivity, although they drank water as often as it was offered. Gloyd (p. 591) mentions that the majority of his specimens were found under rocks or in crevices.

Parturition: Gloyd (p. 593) states that in his specimens "parturition took place at night in every case except one." Each of the four females collected near Lycippus in 1938 gave birth to her young sometime between 10 A.M. and 1 P.M., while the writer was attending classes, so that the act of parturition was not observed, with the exception of one occasion, when the extrusion of the last individual of a brood was observed at 1 P.M. A female collected at Sunneytown, Montgomery County, in 1934, which was under observation by Mr. George W. Koehler, a Pennsylvania Game Protector, gave birth to the first of a brood of ten young at 6:50 A.M., on Sept. 27, 1934. Mr. Koehler witnessed the birth of the last five young in this brood and has kindly given me permission to publish his careful observations which are embodied in the following table.

TABLE I.

	Labor			Emergence from membrane		
Order of Birth	Begun	Completed	Duration (minutes)	Begun	Completed	Duration (minutes)
6th	9:25 A.M.	9:37 A.M.	12	11:20 A.M.	12:31 P.M.	71
7th	9:42 A.M.	9:53 A.M.	11	12:29 P.M.	12:34 P.M.	5
8th	9:59 A.M.	10:08 A.M.	9	12:45 P.M.	12:39 P.M.	15
9th	10:22 A.M.	10:27 A.M.	5	11:23 A.M.	12:27 P.M.	64
10th	10:33 A.M.	10:39 A.M.	6	12:03 P.M.	12:48 P.M.	45

In this portion of one brood it will be seen that the duration of labor decreased rather regularly, but that the average length of time, a little over eight minutes, compares favorably with Gloyd's (p. 602) statement "The time for a single fetus was about ten minutes." The intervals between births, which were 5, 6, 14, and 6 minutes, appear to have been unusually brief, for Gloyd (p. 602) reports "the young of two females observed in parturition were expelled at intervals of approximately one hour." The period between the completion of parturition and the first signs of emergence from the prenatal membrane varied in these five young from 96 to 196 minutes, averaging 132. Gloyd (p. 603) mentions that the young snakes usually remained quiet within their membranes for nearly 45 minutes, unless rupture of the membrane had occurred in passage through the cloaca, but he states (p. 594) that in the case of one brood the young remained in the membranes for several hours, the delay being ascribed to

the unusual coolness and dampness of the day. It would appear, therefore, that environmental conditions may affect the period during which different broods remain inactive within their membranes, but that there is great individual variation in the snakes of a single brood as well. Furthermore, the length of time between first rupture of the membrane and final emergence, as listed in Table I, is highly variable.

Birth dates: About 1 P.M. on August 23, 1937 a female was found under a small log near the top of a sawdust pile. Excavation of this section of the sawdust pile to a depth of about six inches exposed a group of seven young, presumably those of the female collected. The young exhibited prominent umbilical scars and sulphur-yellow tails. It is impossible to state whether or not they had been born on that day. Rev. Grotzinger's report of a brood born on October 15 represents an unusually late date, but the fact that these young were stillborn may account for their long retention within the body of the female. As indicated in Table II, the dates of birth of Pennsylvania young range from August 23 (or slightly earlier) to October 15, but the majority of births occur between August 28 and September 17. The birth dates of Gloyd's Kansas *cupreus* range from August 23 to September 17, which corresponds closely to the dates of normal birth in Pennsylvania. Ditmar's (1896:23) mention of the birth of one New Jersey litter on August 9 and one on August 10 suggests that young may be born much earlier than August 23 in eastern Pennsylvania.

Number of young: The twenty known Pennsylvania broods are listed in Table II. For nineteen of these the size of the brood is given, indicating a variation in the number of young from three to ten, with broods of five occurring with the greatest frequency. The number of young in twenty Kansas broods varied from two to six, with broods of four occurring most frequently (Gloyd, p. 596). Gloyd has also tabulated the brood variation for the entire range of *A. mokasen*, the extremes being three and nine. Conant (1938:112) mentions two Ohio broods of six and ten young. It is interesting to note that five of the seven females taken at the Greensburg reservoir produced broods of five young. In other species of snakes there is some evidence that the brood size of wide ranging forms tends to be highest in the Appalachian region, and in some instances at least, larger broods in this area appear to be correlated with the larger size attained by the females. In the Copperhead, the size of females producing broods has been recorded in too few cases to justify any attempt to correlate body size of the female and brood size.

TABLE II.

BROODS FROM PENNSYLVANIA FEMALES

Source	Locality	Date of Birth	No. of Young
FMNH 27252	Westmoreland Co., Lycippus	Aug. 23, 1937[1]	7
Atkinson (1901:153)	Allegheny County	Aug. 28, 1900	6
Stadelman (1929:81)	Captive, probably from Pennsylvania	Aug, 28. 1929	
Stadelman (1928:67)	Captive, probably from Pennsylvania	Aug. 29, 1928	8
Dunn (1915:37)	Delaware Co., Haverford	Sept. 1	7
AGS 160	Westmoreland Co., Lycippus	Sept. 4, 1938	3
CM 18957	Westmoreland Co., Greensburg Reservoir	Sept. 4, 1939	4
AGS 170	Westmoreland Co., Greensburg Reservoir	Sept. 6, 1938	7
AGS 171	Westmoreland Co., Greensburg Reservoir	Sept. 6, 1938	5
CM 18958	Westmoreland Co., Greensburg Reservoir	Sept. 7, 1939	5
Grotzinger[2]	Westmoreland Co., Greensburg Reservoir	Sept. 8, 1939	5
Ditmars (1907:425)	Monroe Co., Delaware Water Gap	Sept. 11	9
Grotzinger[2]	Westmoreland Co., Greensburg Reservoir	Sept. 14, 1939	5
AGS 172	Westmoreland Co., Greensburg Reservoir	Sept. 17, 1938	5
CM 7726	Montgomery Co., Sunneytown	Sept. 27, 1934	10
Grotzinger[2]	Westmoreland Co., Lycippus	Oct. 15, 1939[4]	4
CM 9688	Montgomery Co., Sunneytown	1935	5
St. Vincent Dept. Biol.	Westmoreland Co.		5
St. Vincent College Mus.	Westmoreland Co.		5
Koehler[3]	Lycoming Co., Little Bear Creek		9

[1] See explanation above.

[2] Letter to the author of Jan. 15, 1940.

[3] Letter to M. Graham Netting of Oct. 30, 1934.

[4] Young stillborn.

SUMMARY

1. Mating probably occurs in late April or early May.
2. Four gravid females were found in crevices and under rocks in late August.
3. Parturition, in five known cases, took place during the day.
4. In the last five specimens of one brood the duration of labor for a single fetus varied from 6 to 12 minutes, average, 8. The period between extrusions was from 5 to 14 minutes, average, 8. The young snakes remained within the prenatal membrane from 96 to 196 minutes, average, 132.
5. Although the dates of birth for twenty litters ranged from August 23 to October 15 the majority occurred from August 28 through September 17.
6. The number of young per litter, in nineteen cases, varied from three to ten, with five being the most common.

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ART. VI. CHANGES IN BIRD LIFE AT PYMATUNING LAKE PENNSYLVANIA

By Ruth Trimble

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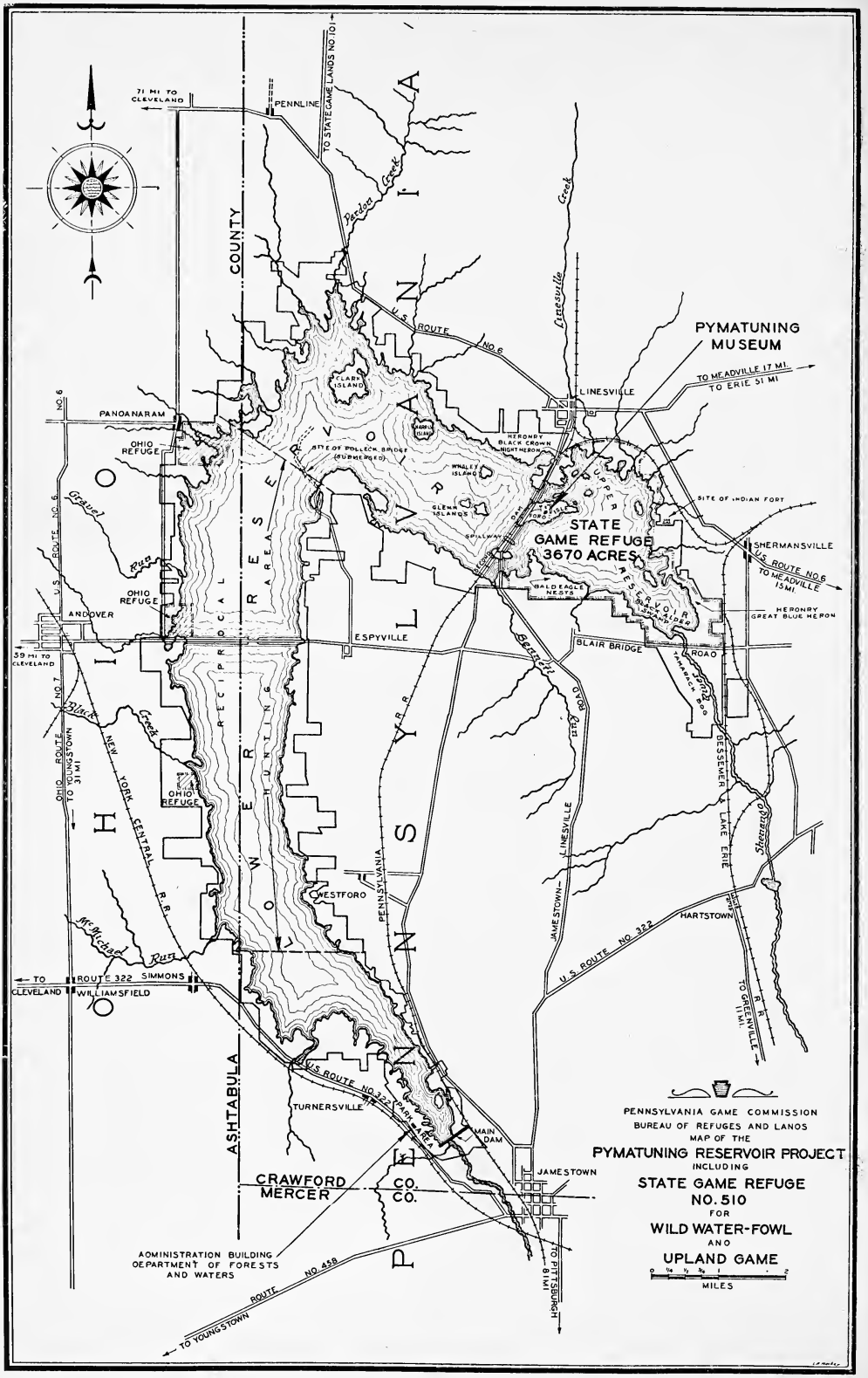

Courtesy, Pennsylvania Game Commission

ART. VI. CHANGES IN BIRD LIFE AT PYMATUNING LAKE, PENNSYLVANIA

By Ruth Trimble

(Plates VIII–XI)

In the eight years that have elapsed since the watercourses of Pymatuning Swamp in Crawford County, Pennsylvania, and Ashtabula County, Ohio, were dammed to create Pymatuning Lake, the ecological picture of the region has been greatly changed. The purpose of this paper is to outline the changes that have occurred in the bird life of the region as a result of converting a great forested swamp into a vast expanse of open water. The most outstanding developments are naturally those involving species that are directly affected by the presence of water, and only these species will be discussed at the present time. The clearing of the forest has destroyed much of the habitat formerly utilized by many woodland species and has thereby greatly reduced the numbers of this component of the avian population. Bird-lists made during the period from 1932-1940 indicate, however, that the usual species still occur in the wooded areas that are intact. How greatly the modified ecological conditions will affect the boreal species that breed there remains to be seen.

George M. Sutton, in a complete report on the bird life of Pymatuning Swamp,[1] estimated that the original swamp accommodated more nesting pairs of birds per square mile than any area of equal size in Pennsylvania. His total list of 244 species (137 breeding species) included those observed within Pymatuning Swamp and at Conneaut Lake as well. Most of the records of water birds applied to Conneaut Lake, where waterfowl were occasionally abundant as migrants but rare as summer residents. The small, open ponds of Pymatuning Swamp—Crystal Lake, Mud Lake, and Dollar Lake—did not attract water birds in any numbers. The absence of mud-flats and sandy beaches accounted for the dearth of shore-

[1] *Annals Carnegie Museum*, vol. 18, p. 19-239, pls. 2-10, 1 map (March 31, 1928).

Issued October 4, 1940.

bird records. It was assumed that most of the migrating waterfowl passed over the area completely in an uninterrupted flight from Lake Erie to the Atlantic Coast. In comparing present conditions at Pymatuning Lake with those of the former Pymatuning Swamp, I have excluded all Dr. Sutton's records that applied to Conneaut Lake and have considered only those made within the swamp proper. Only in consequence of great changes in ecological conditions has it been possible to add to Dr. Sutton's comprehensive investigations.

Each year since 1932, when the impounded water first began to rise, we have watched with acute interest the development of Pymatuning Lake. To R. L. Fricke, of the Carnegie Museum staff, was delegated the task of making collections and observations of its avifauna. Mr. Fricke's extensive records, gathered primarily for incorporation in W. E. Clyde Todd's "Birds of Western Pennsylvania" (1940), have with Mr. Todd's permission been utilized in this report. Messrs. Todd and Fricke have likewise co-operated generously and enthusiastically with the writer on many of her numerous excursions to Pymatuning Lake to study its birds. Grateful acknowledgment is made to them and to Burt L. Oudette, representative of the Pennsylvania Game Commission and keeper of the refuge at Linesville, who has also assisted greatly in advancing these studies. Many friends have participated in numerous field-trips to Pymatuning Lake, and their enthusiastic interest has contributed to the success and enjoyment of the work. The Pennsylvania Game Commission kindly supplied the engraving for the map used as a frontispiece in this paper. The illustrations have been reproduced from photographs taken by Mr. Fricke.

The dates and localities of field-trips undertaken by the writer are as follows: 1933: May 19-20, Linesville; May 21-22, Hartstown. 1934: April 17-19, Linesville, Springboro, and Shermansville; May 22-25, Linesville, Hemlock Island, and Hartstown. 1935: May 15-18, Linesville and Hartstown. 1936: May 18-20, Linesville and Hartstown; June 6-7, Hartstown, Linesville, and Andover; July 12, Linesville and Andover; October 23, Jamestown, Linesville, and Hartstown. 1937: April 5-7, Linesville and Hartstown; April 10-11, Jamestown, Linesville, Andover, and Hartstown; May 17-22, Linesville, Shermansville, and Hartstown; November 6-7, Hartstown, Linesville, Shermansville, and Jamestown. 1938: April 23-24, Linesville; May 27-30, Hartstown and Linesville; August 25-26, Hartstown, Shermansville, and Linesville; October 13, Linesville. 1939: October 28, Jamestown and Linesville. 1940: April 6,

Jamestown, Andover, and Linesville; April 27-28, Jamestown, Andover, Linesville, and Hartstown.

Pymatuning Lake has attracted many students of birds, and they have recorded in current ornithological journals numerous important observations. In addition, a great fund of manuscript notes has been submitted to Mr. Todd for use in his book, and these have most generously been placed at my disposal. The chief contributors have been: Willard Dilley, Grant M. Cook, Lawrence E. Hicks, Howard M. McQuiston, Burt L. Oudette, Stanley J. Seiple, and Merit B. Skaggs. The observations of the group as a whole have covered every season of the year, so that there has been ample data for analysing the status of each species. Published records are indicated in the text by the year of publication in connection with the name of the authority.

THE ORIGIN AND CHARACTER OF PYMATUNING SWAMP

For many years Pymatuning Swamp invited the attention of naturalists and ecologists who recognized in it a unique natural laboratory for the investigation of ecological succession in one of the few remaining "bog-type" areas in the eastern United States. Located mainly in Crawford County, Pennsylvania, it extended slightly across the eastern boundary of Ashtabula County, Ohio. In configuration like a great horseshoe, about sixteen miles in length, the swamp stretched northward from Adamsville through Hartstown and west of Shermansville; it curved west and northwest south of Linesville, and then bordered the Shenango River in a narrow belt south to the Espyville-Andover road. In area the swamp covered about twenty-five square miles.

Geological studies (Leverett, 1902 and 1934; Hice, 1903) have revealed that in preglacial times the streams of western New York, Ohio, and western Pennsylvania drained to the north and northwest as far as the present basins of Lake Erie and Lake Ontario. Pymatuning was then a valley in this northward drainage. The glaciers, travelling southward across the region, dammed the outlets of the ancient streams and forced them southward into new channels; the thick deposits of glacial drift and the recessional moraines converted the valley into a large postglacial lake. In the thousands of years that have elapsed since then, the lake has gradually filled in, "partly because of washed-in material, but mostly because of the encroachments of the plant associations bordering its margins.

As the plants that were adapted to shallow water throve and added their detritus to the edges of the lake, they built up, as it were, a false shore-line, consisting of a dense mat of vegetation. In this floating mat the plants of less wet habitats could, in turn, succeed in establishing themselves. Thus, as fast as the pioneer species built the shore-line farther out in the lake, behind them dry-land plants came in to establish a swamp forest."[2] Three small open lakes—Crystal, Mud, and Dollar—remain as reminders of the much larger body of water that in former years covered the entire area, and illustrate in the vegetational successions around their margins the process of development from an open-water succession through bog forest and alder-sumac association to swamp forest of hemlock and red maple, and finally the climax forest of sugar maple and beech.

Within the confines of Pymatuning Swamp, natural conditions provided for the continued existence of northern plants—relicts of a northward-moving vegetation—and an appreciable number of bird and animal species of northern affinities. According to O. E. Jennings (1927), the topography of the land previously covered by the ice, with its undrained or poorly drained kettle-holes and other depressions, is favorable for the retention of boreal islands of vegetation. In time, however, these islands slowly disappear. He believes that the tardy disappearance of the Pymatuning bog may, in part, be due to cool spring waters that feed into the deep depressions. The sphagnum-tamarack bog harbored the pitcher plant (*Sarracenia purpurea*) and sundew (*Drosera rotundifolia*), the calla (*Calla palustris*), clintonia (*Clintonia borealis*), cranberry (*Vaccinium macrocarpon*), cassandra (*Chamaedaphne calyculata*), and several rare bog orchids. The boreal component of the avifauna was expressed by such breeding species as the Yellow-bellied Sapsucker (*Sphyrapicus v. varius*), Slate-colored Junco (*Junco h. hyemalis*), Grinnell's Water-Thrush (*Seiurus noveboracensis notabilis*), Brown Creeper (*Certhia americana familiaris*), and Red-breasted Nuthatch (*Sitta canadensis*). This northern element was limited to isolated areas that were slowly but surely being superseded by a Carolinian, or southern, fauna and flora. Botanical studies of the original swamp have been made by A. Dachnowski (1912), O. E. Jennings (1913-15), John Bright (1916), W. R. Van Dersal (1933), and L. E. Hicks (1934). As previously stated, a complete report on the bird life of the area was published by George M. Sutton (1928).

[2] Netting, M. G., and W. R. Van Dersal, *Cardinal*, vol. 3, p. 152 (January, 1934).

HISTORY OF PYMATUNING LAKE[3]

Although the natural features of Pymatuning Swamp and the preservation of its original biota were of primary interest and importance to the scientific minority, more utilitarian-minded persons entertained a different view. The earliest suggestions for developing the swamp to "benefit mankind" dealt largely with the possibility of draining it to improve highways and to provide land for agricultural pursuits. The first drainage proposal on record was made in 1843. By an act of the General Assembly of Pennsylvania in 1868 a survey was made of the practicability of "reclaiming" Conneaut and Pymatuning marshes. No further action was taken at that time, but again in 1907 legislation authorized the State Highway Department to determine "the best course and method of making channels for draining the same [Pymatuning Swamp] and improving the highways therein . . . provided, however, that the plans shall be approved by the Water Commission." The drainage plan submitted was protested on the ground that the swamp was a valuable storage area and helped to maintain the flow of the Shenango River in dry weather. The Water Supply Commission refused to approve the drainage plan, and at its suggestion was provided by an Act of Legislature in 1911 with an appropriation to examine into the feasibility of a reservoir project. Upon the Commission's favorable report, the Legislature in 1913 passed the "Pymatuning Dam Act," which authorized establishing a reservoir by the construction of a dam at the outlet of Pymatuning Swamp. Subsequent legislation dealt largely with appropriations for the acquisition of lands. The State of Ohio also passed enabling legislation for the purchase by public subscription of the Ohio lands (a little more than 5000 acres) that would be affected by the proposed reservoir. The total land areas acquired for the Pymatuning reservoir project are as follows:

	Acres
Area in Pennsylvania	20,050
Area in Ohio	4,740
Total	24,790
Area to be flooded	16,730
Area not flooded	8,060

[3] Condensed in part from the report of the Chief Engineer, Charles E. Ryder, in *Proceedings Engineers' Society of Western Pennsylvania*, vol. 48, no. 5, p. 103-140 (May, 1932).

In 1925 the control of the Pymatuning Reservoir Project was transferred from the Water Supply Commission to the Department of Forests and Waters. By an amendment in 1931 to the Pymatuning General Act, provision was made that "the reservoir and land surrounding it acquired by the Commonwealth in connection with the project, or portions of such reservoir and land, may be developed and used for fishing, hunting, game refuges, recreation, park or other purposes; provided, such use or uses will not, in the opinion of the Water and Power Resources Board, materially interfere with the primary purpose of the reservoir for conserving the water entering Pymatuning Swamp and regulating the flow in the Shenango and Beaver rivers." About this time also the original plan for a single dam was modified to include a secondary dam to be formed by the railroad and highway embankment that cross the reservoir south of Linesville. The secondary, or upper, reservoir was designated as a wildlife refuge. To increase its efficiency in this respect, provision was made for constructing a spillway to maintain a constant water level of 1,010 feet in this portion of the reservoir. The area includes 2,500 acres of water and marsh as well as 1,170 acres of land, where no clearing has been undertaken. The upper reservoir is only a few feet in depth except where the old stream beds cut through. The shallow margins have an abundant growth of aquatic plants essential as food and cover for waterfowl. Many small islands, some several acres in extent, provide feeding and nesting sites within the sanctuary. Credit for maintaining this area as a wildlife refuge goes to former Governor Pinchot, the Pennsylvania Fish and Game Commissions, and many individuals and organizations interested in conservation. On Ford Island, which is accessible from the road south of Linesville, the Game Commission has built a small museum, where a number of locally collected specimens of waterfowl are exhibited. Control of the refuge has been vested in the Pennsylvania Game Commission.

The entire area is posted against trespassers, although permission to enter may be received upon application to the Commission. Hunting in the refuge is, of course, prohibited at all times, but it is permissible on the lower reservoir during the prescribed open seasons. The State of Ohio, through its Conservation Commission, has also established several refuges on the west shore of the lower reservoir.

The construction of the main dam near Jamestown, Pennsylvania, was begun on October 6, 1931. Clearing the forest was started on January 11, 1932, under the able direction of R. J. Ferris. The gate of the upper dam was closed December 5, 1933, and that of the main dam on January 23,

1934. The two reservoirs have a capacity of 64,275,000,000 gallons. The lower reservoir is subject to fluctuating level as the need arises for drawing off water during the dry weather to maintain a normal flow in the Shenango River.

The completed reservoir covers an area of 16,420 acres, or 25.7 square miles. It is 16 miles long and 1.6 miles in average width (2.2 miles maximum width, where the highway crosses from Espyville, Pennsylvania, to Andover, Ohio); it has a shoreline of 70 miles and a maximum depth of 35 feet. It is now the largest lake in Pennsylvania, being almost eighteen times the size of Conneaut Lake; in water-area it exceeds Lake Chautauqua in New York by almost 3,000 acres. About one quarter of Pymatuning Lake is located in the State of Ohio.

PYMATUNING LAKE AS A WATERFOWL REFUGE

The conversion of a forested swamp into a 16,000-acre lake with a 70-mile shore-line has provided entirely different ecological conditions and has set the stage for a variety of new events. Netting and Van Dersal (1934) attempted to forecast the future of the region from the standpoint of its fauna and flora. Aside from expressing an opinion that the waterfowl population would increase, they offered no specific data on the changes in the bird life.

When Pymatuning Lake became a certainty, the ornithologically-minded hoped that it might become an important resting and feeding ground for migrating waterfowl. It lies directly on the route of the great Atlantic Waterfowl Flyway,[4] which extends from the Atlantic Coast west to the Allegheny Mountains and curves northwestward across northern West Virginia, western Pennsylvania, and northeastern Ohio to the western end of Lake Erie. Many of the ducks and geese that breed in the North and in the interior of the Northwest follow this route in travelling to and from their wintering ground on the Atlantic Coast. Pymatuning Lake also lies not far distant from the Mississippi Flyway, another important migration route that extends through the Mississippi Valley eastward to Lake Erie.

Thus advantageously situated, the new lake has attracted migrating water birds in great numbers. More than that, it has become increasingly popular as breeding territory for a number of species. The extensive, irregular shoreline is interrupted by many small inlets and marshy bayous

[4] Lincoln, Frederick C., The Waterfowl Flyways of North America. *U. S. Department of Agriculture Circular*, no. 342, 12 p. (January, 1935).

that are ideal cover for waterfowl. About 8,000 acres of land bordering the lake are owned by the Commonwealth of Pennsylvania and the State of Ohio, and extensive areas in both states have been set aside as wildlife sanctuaries. Ducks of many species, such as the Mallard, Shoveller, Pintail, and Blue-winged Teal, that normally nest some distance from the water, profit from the upland areas in the refuge.

It is doubtful whether Pymatuning Lake will ever develop into a summer resort even in the portions that may be leased, because of the swampy, unstable character of the shore and the treacherous nature of the lake-bottom, covered as it is with stumps and debris from the clearing. Unpleasant as such conditions are for human tenants, they will aid in attracting and preserving wildlife. In this respect Pymatuning Lake will be greatly superior to Conneaut Lake, where people have long since crowded out the larger portion of the avian population.

The shallow waters of Pymatuning Lake permit the growth of lush aquatic vegetation along its margins. The swampy shores produce abundant stands of cat-tails (*Typha latifolia*), which grow out into the water to a depth of a foot. Interspersed with the cat-tails in the shallow water are several kinds of rushes (*Scirpus*), sedges (*Cyperus*, *Carex*), bur-reed (*Sparganium*), arrowhead (*Sagittaria*), pickerelweed (*Pontederia*), smart weed (*Polygonum*), Virginia arum (*Peltandra*), and others that are important factors among waterfowl food plants. In water from one to six feet deep are found the water willow (*Decodon verticulatus*), white water lily (*Castalia odorata*), purple water shield (*Brasenia schreberi*), and spatter-dock (*Nymphaea advena*), the seeds and tubers of which are eaten by many kinds of ducks. Growing on the bottom of the lake are important waterfowl foods such as pondweeds (*Potamogeton* spp.), wild celery (*Vallisneria spiralis*), waterweed (*Elodea canadensis*), and coontail (*Ceratophyllum demercum*). Duckweeds (*Lemna*, *Spirodela*) float on the water and densely cover the surface in many places; these tiny plants are themselves especially valuable as food for young ducks, and in addition harbor insect larvae, crustaceans, and mollusks that contribute to a balanced diet.

Comparison of Van Dersal's list of plant species for the Pymatuning region[5] with McAtee's list of wildfowl food plants[6] reveals that the native

[5] Van Dersal, W. R., An Ecological Study of Pymatuning Swamp. (Doctor's Dissertation, M.S., University of Pittsburgh, 1933).

[6] McAtee, W. L., Wildfowl Food Plants, p. i-x, 1-141, pls. 1-17, text-figs. 1-4 (Ames, Iowa, 1939).

growth includes 70 per cent of the plant families known to be utilized as food by waterfowl. The species already mentioned as occurring commonly at Pymatuning Lake are those that McAtee considers of prime importance. The abundance of a natural food supply is without doubt an outstanding factor in determining the extent of the waterfowl population of the lake. To supplement the natural growth until it becomes established, the Pennsylvania Game Commission has provided for artificial plantings of American lotus, wild celery, sago pondweed, floating-leaved pondweed, delta duck potato, bur-reed, pickerelweed, Pennsylvania smartweed, muskgrass, wampee, and water plantain. Most of these species, it may be noted, were already present in the area. Attempts to introduce wild rice (*Zizania aquatica*) have been unsuccessful. In the refuge fields bordering the lake, certain grains, such as wheat, corn, kaffir corn, buckwheat, etc., have been planted for feeding. Much of the grain is harvested and reserved for the peak flights in spring and fall, but at least a third of it is left standing in the fields, where it is accessible to the thousands of waterfowl that visit the region.

Numerous species of fish occur in the lake and are important dietary items for herons, egrets, bald eagles, and mergansers. There is an overabundance of carp in the reservoir, and their presence may have a harmful effect on the growth of the water plants. The damage they do consists in uprooting the bottom growth, and continued roiling of the waters cuts off the light and prevents the re-establishment of the vegetation. Carp have been seined from the lake in enormous quantities, and wire screening at the spillway tends to keep them from the Upper Lake. Many aquatic insects, crayfish, frogs, and snails also contribute to the local food supply for waterfowl.

Conforming with current terminology, I shall use the name Pymatuning Lake for this newly established body of water. The Pennsylvania refuge is the Upper (or Linesville) Lake.

WATERFOWL OCCURRING AT PYMATUNING LAKE

MIGRANTS

Pymatuning Lake thus provides a suitable habitat for waterfowl, and in the sanctuaries at least the birds are free from molestation by man. Beyond question, these are the factors that have permitted the development of the water-bird population. To the previous list of migrants at Pyma-

tuning Swamp have been added within a six-year period the following species:

Red-throated Loon
Double-crested Cormorant
Snowy Egret
American Egret
Lesser Snow Goose
Blue Goose
European Widgeon
Canvas-back
Old-squaw
White-winged Scoter
Ruddy Turnstone
Hudsonian Curlew
Golden Plover
Pectoral Sandpiper
White-rumped Sandpiper
Red-backed Sandpiper
Eastern Dowitcher
Marbled Godwit
Northern Phalarope
Ring-billed Gull
Caspian Tern

Shore birds were formerly extremely uncommon in the Pymatuning region because of its unsuitability as a feeding ground. In the absence of sandy beaches or mud-flats and because of the abruptness of the shores and the thickness of the vegetation around the small lakes, most of the migrating shore birds passed over the area without stopping to feed or rest. Now, the situation has been altered, and the beaches and low-lying islands afford shelter that is sought by even the rarer migrants.

Certain species formerly considered stragglers to the region are now regular migrants:

Little Blue Heron
Whistling Swan
Duck Hawk
Black-bellied Plover

Unusual visitors that have fortuitously appeared at Pymatuning Lake in recent years are:

(?)Great White Heron
American Brant
Western Willet
Wilson Phalarope
Red Phalarope

Breeding Species

Perhaps the most startling development in connection with the new lake is the increase in the number of breeding species. At the time Dr. Sutton published his report, breeding waterfowl were rare. There were a few records for the Mallard and Black Duck, species that now nest in great numbers at Pymatuning Lake. The Great Blue Heron, Pied-billed Grebe, and Blue-winged Teal, for which Dr. Sutton had no actual nesting records, now occur abundantly as summer residents, and many of their nests have

been examined in the course of our investigations. The Black-crowned Night Heron, previously considered a straggler, has become established in a thriving rookery. Dr. Sutton cited a single record of the Black Tern nesting at Conneaut Lake in 1910. A colony of a hundred or more has existed at Pymatuning Lake since 1934. The Common Tern, too, is apparently breeding there.

Among the ducks that have recently been found nesting are the Gadwall, Baldpate, Pintail, Green-winged Teal, Shoveller, Redhead, Ring-necked and Ruddy ducks. In several instances this development represents a considerable eastward extension of the normal breeding range. The easternmost breeding record for the Baldpate is from northern Indiana (Hogback Lake, Steuben County, May, 1889),[7] but the species is not common east of the Mississippi River. For the Gadwall, the western shore of Lake Michigan is the normal eastern boundary of its breeding range, although Cooke[8] reports one instance of its nesting at St. Clair Flats, Ontario. At the time John C. Phillips published his "Natural History of the Ducks" (1922-26) this was still considered an unusual and isolated occurrence. The Redhead has a comparatively restricted range in northwestern United States and southwestern Canada. Phillips cites early records (1880 and 1912) from St. Clair Flats, Michigan, as the easternmost breeding localities. Of its migration he says further (*l.c.*, vol. 3, p. 166): "In most of the area east of Lake Michigan the species is seen primarily or almost exclusively in autumn. It appears that the Redhead at this season takes a rather roundabout route going almost due east to reach its winter quarters on the Atlantic coast, while in spring a more direct line is chosen, up the Mississippi River Valley." At Erie Bay, Todd[9] found it "a regular migrant, most numerous in the fall, but never abundant." Such has been its status in western Pennsylvania until our investigations at Pymatuning Lake in 1936 proved otherwise.

The normal breeding range of the Ring-necked Duck lies west of the upper Mississippi Valley, and its main migration route is along the course of this river. A limited number of Ring-necks migrate to the Atlantic

[7] Butler, A. W., Birds of Indiana. *Indiana Department Geology and Natural Resources*, 22nd Annual Report, p. 601 (1898).

[8] Cooke, W. W., Distribution and Migration of North American Ducks, Geese, and Swans. *Bulletin Biological Survey*, U. S. Department of Agriculture, no. 26, p. 27 (1906).

[9] Todd, W. E. Clyde, Birds of Erie and Presque Isle. *Annals Carnegie Museum*, vol. 2, p. 518 (1904).

Coast by way of the Great Lakes, but until recent years the records for our region have been comparatively rare. The breeding of this species in western Pennsylvania was an unexpected development. The accepted eastern breeding limits were southwestern Ontario, northeastern Minnesota, and eastern Wisconsin. The breeding locality closest to our region is a recent one mentioned by Pirnie,[10] who found Ring-necked Ducks nesting on the Upper Peninsula, Michigan, in 1928 and 1930. In connection with these records should also be mentioned the breeding grounds recently discovered (or rediscovered?) in Maine and New Brunswick.[11]

Such species as the Shoveller, Ruddy, and even the Pintail have been known to breed irregularly in the East—whether as relicts of a former more extensive distribution, or as pioneers in range-extension is not apparent. Pymatuning Lake, as indicated above, is so completely disassociated from the recognized breeding territory occupied by the other above-mentioned species of ducks that the discovery of their nesting in western Pennsylvania is nothing less than sensational. The significance of these occurrences, which have been repeated in successive seasons, is not completely understood. It has been supposed from migration studies of waterfowl that lines of flight are traditionally inherent, not only for the species but for individual birds as well. "There appears to be a readily demonstrable natural law to the effect that, although groups of birds of the same species may share a common breeding ground, they are so strongly influenced by their ancestral lanes of migration that they will continue to follow them even though conditions en route or on the wintering grounds may become distinctly adverse to their welfare." (Lincoln, *l.c.*, 1933, p. 10). What hereditary nesting ground, then, has been forsaken by the species that have settled at Pymatuning Lake? If the Ring-neck, Redhead, and Gadwall once nested at Lake Erie, the Finger Lakes, or Conneaut Lake, the time is so long past that history has no record of it. It does not seem likely, therefore, that the Pymatuning incident is one of re-occupation of an ancient nesting territory. Some authors have suggested that the recent appearances of these western species in the Atlantic states may be a result of midwestern drought and dust-storms, which have followed extensive drainage and agricultural operations in what was once exceptionally favorable breeding territory. Another explanation,

[10] Pirnie, M. D., Michigan Waterfowl Management, p. 26 (Lansing, Mich. (1935).

[11] Mendall, H. L., Ring-necked Duck Breeding in Eastern North America. *Auk*, vol. 55, no. 3, p. 401-404 (July, 1938).

perhaps, is that under protected conditions a favorable habitat will be populated regardless of prescribed ranges. May it then be supposed from this development that these waning species will utilize as breeding territory other refuges that conservationists may in time establish along the major flyways? If so, the course of events at Pymatuning Lake may have significant and far-reaching implications in the program of restoration and conservation of the fast-vanishing waterfowl of North America.

TABULATION SHOWING COMPARISON IN 10-YEAR PERIOD

A comparison of the present status of certain species with that which obtained at the time of Dr. Sutton's investigations follows:

Species	1928 Report	Present Report
Common Loon	Migrant	Migrant
Red-throated Loon	.....	Migrant (rare)
Holboell's Grebe	Migrant (rare)	.....
Horned Grebe	Migrant	Migrant
Pied-billed Grebe	Breeding (?)	Breeding (!)
White Pelican	Straggler (rare)	Straggler (rare)
Double-crested Cormorant	.....	Migrant
(?) Great White Heron	.....	Straggler (rare)
Great Blue Heron	Breeding (?)	Breeding (!)
American Egret	.....	Migrant (common)
Snowy Egret	.....	Migrant (regular)
Little Blue Heron	Straggler	Migrant
Eastern Green Heron	Breeding	Breeding
Black-crowned Night Heron	.....	Breeding
American Bittern	Breeding	Breeding
Eastern Least Bittern	Breeding	Breeding
Whistling Swan	Migrant (rare)	Migrant (regular)
Common Canada Goose	Migrant	Breeding (feral)
American Brant	.....	Migrant (rare)
Lesser Snow Goose	.....	Migrant
Blue Goose	.....	Migrant
Common Mallard	Breeding	Breeding
Common Black Duck	Breeding	Breeding
Gadwall	.....	Breeding
European Widgeon	.....	Migrant
Baldpate	Migrant	Breeding
American Pintail	Migrant	Breeding
Green-winged Teal	Migrant	Breeding
Blue-winged Teal	Breeding (?)	Breeding (!)
Shoveller	Migrant	Breeding
Wood Duck	Breeding	Breeding

Species	1928 Report	Present Report
Redhead	.....	Breeding
Ring-necked Duck	.....	Breeding
Canvas-back	.....	Migrant
Greater Scaup Duck	Migrant	Migrant
Lesser Scaup Duck	Migrant	Migrant
American Golden-eye	Migrant	Migrant
Buffle-head	Migrant	Migrant
Old-squaw	.....	Migrant
White-winged Scoter	.....	Migrant
Ruddy Duck	Migrant	Breeding
Hooded Merganser	Breeding (?)	Breeding (?)
American Merganser	Migrant	Migrant
Red-breasted Merganser	Migrant	Migrant
Northern Bald Eagle	Occasional	Breeding
Osprey	Migrant	Migrant
Duck Hawk	Migrant (rare)	Migrant
King Rail	Migrant	Breeding
Virginia Rail	Breeding	Breeding
Sora	Breeding	Breeding
Yellow Rail	.....	Breeding
Black Rail	Migrant (rare)	.....
Florida Gallinule	Breeding	Breeding
American Coot	Breeding (rare)	Breeding (common)
Semipalmated Plover	Migrant (rare)	Migrant (common)
Killdeer	Breeding	Breeding
American Golden Plover	.....	Migrant (rare)
Black-bellied Plover	Migrant (rare)	Migrant (regular)
Ruddy Turnstone	.....	Migrant
American Woodcock	Breeding	Breeding
Wilson's Snipe	Breeding	Breeding
Hudsonian Curlew	.....	Migrant (rare)
Upland Plover	Breeding	Breeding
Spotted Sandpiper	Breeding	Breeding
Solitary Sandpiper	Migrant	Migrant
Western Willet	.....	Migrant (rare)
Greater Yellow-legs	Migrant	Migrant
Lesser Yellow-legs	Migrant	Migrant
Pectoral Sandpiper	Migrant	Migrant
White-rumped Sandpiper	.....	Migrant (rare)
Least Sandpiper	Migrant (rare)	Migrant (common)
Red-backed Sandpiper	.....	Migrant
Eastern Dowitcher	.....	Migrant
Semipalmated Sandpiper	Migrant	Migrant
Marbled Godwit	.....	Migrant
Red Phalarope	.....	Straggler (rare

Species	1928 Report	Present Report
Wilson's Phalarope	.....	Straggler
Northern Phalarope	.....	Migrant
Herring Gull	Migrant	Migrant
Ring-billed Gull	.....	Migrant
Bonaparte's Gull	Migrant	Migrant
Common Tern	Migrant	Breeding (?)
Caspian Tern	.....	Migrant
Black Tern	Migrant	Breeding

Pymatuning Lake is, therefore, ecologically suitable for providing shelter, a natural food supply, and freedom from molestation for waterfowl. Twenty-two migrants and five accidental visitants have been added to the list of birds previously recorded from the region. Fifteen species have been added to the list of breeding birds, and the supposed breeding of three species has been verified.

ANNOTATED LIST OF SPECIES

Gavia immer immer (Brünnich). COMMON LOON.

The Common Loon was recorded by Sutton as "a regular, but never abundant, migrant." His records, mainly from Conneaut Lake, included only one from the Pymatuning region—Lower Lake, Hartstown, May 30, 1923. A few sporadic occurrences were reported from Hartstown between 1925 and 1932. Since 1935 this species has commonly been observed on Pymatuning Lake during the spring migration. Although most reports are of single birds or pairs, as many as seven have been seen at one time. The only fall record available is that of a single loon at the main dam near Jamestown, October 23, 1936 (Trimble). The shallow waters of Pymatuning Lake seem to be no deterrent for this diver. The earliest spring record is March 28, 1932, for Hartstown (Seiple); and the latest is May 20, 1937, for Linesville (Trimble).

Gavia stellata (Pontoppidan). RED-THROATED LOON.

The Red-throated Loon must be considered a rare and irregular migrant. There are but two records for Pymatuning Lake: Linesville, April 10 and April 20, 1938 (Bergner, 1938; Skaggs, 1938).

Colymbus grisegena holboellii (Reinhardt). HOLBOELL'S GREBE.

The only record of this rather rare migrant in the Pymatuning region is that given by Sutton from Crystal Lake, Hartstown, on May 13, 1922.

Colymbus auritus Linnaeus. HORNED GREBE.

Sutton considered the Horned Grebe a regular migrant at Conneaut Lake and listed as well several occurrences at Crystal Lake, Hartstown. It is now regularly observed on Pymatuning Lake. Most of the records have been made in April (April 4-26); but there is one record for March 28, 1937, from Linesville (Skaggs) and one for the same locality for October 23 and 25, 1936 (Trimble; Skaggs).

Podilymbus podiceps podiceps (Linnaeus). PIED-BILLED GREBE.

In Sutton's report the Pied-billed Grebe was listed as "a fairly common migrant," that "doubtless occasionally nests . . . but we have no certain breeding records for the Pymatuning region at the present time." The first evidence of its breeding was obtained by S. J. Seiple, who observed an adult with three young at Hartstown on July 21, 1931. Latterly the floating islands of Pymatuning Lake and the marshy cat-tail growth along its irregular shoreline have been superlatively attractive as nesting territory for this species. On May 29, 1934, R. L. Fricke collected a set of six eggs. Since that time many of the floating, shapeless mats of decayed aquatic vegetation that hold the eggs of the Pied-billed Grebe have been discovered. "The young birds are a very common sight, in summer, swimming and diving within plain view from the roads that cross the lake" (Trimble, 1937). The birds nest during the latter half of May; from five to eight eggs comprise the usual set. When the incubating bird leaves the nest, it covers the eggs with water-soaked vegetation.

Pelecanus erythrorhynchos Gmelin. WHITE PELICAN.

The White Pelican is a rare straggler in the Pymatuning region. To Sutton's report of one "taken in May, 1905, at Pymatuning" we can now add the record of a pelican that remained on Pymatuning Lake, near Linesville, from June 19 until June 23, 1935 (Oudette, 1937). Its occurrence there, of course, is merely accidental, since the normal range of this species lies farther west.

Phalacrocorax auritus auritus (Lesson). DOUBLE-CRESTED CORMORANT.

Since 1936 the Double-crested Cormorant has been seen each spring at Pymatuning Lake (Linesville); hence it may now be considered a regular, if not common, migrant. R. L. Fricke saw a single cormorant on June 20, 1936; on May 23, 1937, he observed five. On April 24, 1938, I saw a flock of six. B. L. Oudette reports having seen this species on numerous occasions. According to Mr. Todd, the June record does not imply breeding.

Ardea occidentalis Audubon. GREAT WHITE HERON.

Perhaps the most startling episode in the story of the bird life of Pymatuning Lake occurred at Linesville on May 14, 1938, when B. L. Oudette secured a specimen that has been identified as a Great White Heron. The normal range of the species is in peninsular Florida, and there are but few undoubted outlying records.

This unusual visitor was first detected by Mr. Oudette on May 11 in the sanctuary. The first judgment of the report, naturally, was that the specimen was an albino Great Blue Heron. Mr. Todd and I compared the mounted specimen with authentic examples of the Great White Heron and found the results puzzling indeed. Its size was somewhat smaller than that of the average given for *Ardea occidentalis* but within the limits for the species as a whole. The feathers of the crest were similar to those characteristic of *occidentalis*, and the legs were bright yellow in color. Later Dr. Harry C. Oberholser examined the mounted specimen and pronounced it (1939) an undoubted Great White Heron. Measurements as we found them were: bill, 142 mm.; wing, 438 mm.; tarsus, 175 mm. As given by Christy (1938) they were: bill, 5.75 inches; wing, 18 inches; tarsus, 8 inches.

Even more amazing than the specimen collected in May is a motion-picture record made on October 21, 1938, by C. Gordon Krieble of an individual exactly like it at the same locality. The picture, according to Dr. Oberholser, substantiates Mr. Krieble's claim that this bird also had the yellow legs characteristic of the southern species.

Although it is admittedly unwise to question the opinion of experts, this alleged occurrence of a species that is normally restricted to southern Florida and exceedingly rare elsewhere, naturally leads to the suspicion expressed by Mr. Todd (1940) that "it is possible that after all the Great Blue Heron is actually a dichromatic species (like certain other herons), with its white phase localized in southern Florida but appearing rarely and fortuitously in other parts of its range."

Ardea herodias herodias Linnaeus. GREAT BLUE HERON.

Sutton regarded the Great Blue Herons of the Pymatuning region as regular and fairly common migrants. He suspected that they might nest in the area but stated that "no nest with eggs has been found in the region to the best of my knowledge." Pymatuning Lake has certainly been a factor in the shifting of populations and in the increasing numbers of this species. From March until November the Great Blue Heron is a common

and spectacular figure, and occasionally a bird may linger through the winter months.

The first rookery in the vicinity was discovered by L. E. Hicks (1933) in the "Jumbo Woods," near Wing, Pennsylvania, in June, 1931. This rookery, according to local report, had been in existence for about fifteen years. In 1932 it contained twenty-one occupied nests; in 1933, according to Mr. Hicks, thirty-four nests were in use. A year or so ago the tract of timber was cut, and the heronry despoiled. Another rookery was located in the northwest corner of Pymatuning Swamp, near the property of J. G. Crumb. At the time of our first visit on May 19, 1933, it contained about fourteen nests, already occupied by young birds. In the following years, the colony increased to more than forty nests, but by 1938 it had broken up. In 1934 we examined a small rookery, consisting of eight or ten nests, about three miles north of Hartstown. The Great Blue Herons apparently have recognized the safety of the Pymatuning sanctuary, and there is now an extensive rookery within the refuge. According to B. L. Oudette, more than fifty pairs nested there in 1938. Access to the rookery is very difficult, so that there is little danger of the herons being disturbed. The usual time for nesting is during the latter half of April. We found young birds in the nests on May 19, 1933; but in 1937, when the spring season was cold and wet, the herons were obviously still incubating on May 18.

Casmerodius albus egretta (Gmelin). AMERICAN EGRET.

The first record of the American Egret in the Pymatuning region was made by S. J. Seiple (1930), who observed a single individual in the Hartstown marsh on July 26, 1929. From July 8 until September 10 in 1930, he watched one, and sometimes two, American Egrets on the same marsh (Seiple, 1931); but his most extensive observations were made during the season of 1933 (in Christy, 1934). The first arrival was seen on July 12, and during the ensuing months faithful watch of the area produced an interesting tally of dates and numbers of specimens. The dates range from July 26 until September 23, when a lone specimen was seen for the last time that season. The period of greatest abundance was in early August, and the maximum number of twenty-five birds was recorded on August 5.

The occurrence of American Egrets in the Pymatuning region was part of a widespread invasion in the northern states.[12] It can be attributed to

[12] Lyon, W. I., *Bulletin Illinois Audubon Society* (1931); Hicks, L. E., *Wilson Bulletin*, vol. 43, p. 268 (1931); and Christy, B. H., *Cardinal*, vol. 3, pp. 164-169 (1934).

an increase in the numbers of this beautiful species as a result of rigid protection in its southern breeding grounds.

For this tropical wanderer, Pymatuning Lake is an equally suitable and much more commodious stopping-place than the Hartstown marsh, which has accommodated fewer specimens in recent years. Willard Dilley (in Christy, 1934) reported a single American Egret in the flooded area near Espyville on September 29, 1933. In subsequent years, the American Egret population of Pymatuning Lake from July until September has steadily risen. It is estimated that at least one hundred and fifty birds occupied the area during August, 1938. I counted forty-five individuals flying to roost on a little island in the Upper Lake on the evening of August 26.

The late summer appearances of this species may normally be expected in suitable areas. Most of the birds are presumably young of the year—as attested by specimens collected at Hartstown in 1933—the invasion representing the normal postbreeding wandering. The significance of certain spring records remains to be determined. R. L. Fricke observed one egret near Linesville on May 14, 1934. I was a member of a party that detected another on May 17, 1935, in the same area. This was doubtless the same bird that was seen by Edmund Arthur (1936) on May 11 of the same year. It is not altogether unlikely that the American Egret may in the future choose Pymatuning Lake as a breeding station.

Egretta thula thula (Molina). SNOWY EGRET.

Like the American Egret, this smaller species has apparently profited from the efforts of conservationists. S. J. Seiple's record (1931) of a single Snowy Egret at Hartstown on August 1, 26, 28 and on September 10, 1930, seemed to indicate that then it might be accounted a rare visitor in our region. Much more gratifying are recent developments in the vicinity of Pymatuning Lake. Merit B. Skaggs (1937) observed one bird on September 27, 1936, and again on October 4, 1936, near Linesville. R. L. Fricke found several there on August 25, 1937; and on September 13, 1937, he collected two young males. Other published records for the same locality are by I. N. Boggs (1937), who reported two specimens on September 4, 1937; and R. T. Peterson (1938), who recorded two on September 18, 1937. Manuscript records include Willard Dilley's report of several Snowy Egrets on Linesville Creek, September 6, 1937, and my own personal observation of four in the refuge on August 26, 1938. On that date

B. L. Oudette told me he had counted eleven birds at one time during August.

In view of the above records, one may logically suppose that the area will continue to attract a growing number of Snowy Egrets, and that the species may now be considered an uncommon but regular visitant.

Florida caerulea caerulea (Linnaeus). LITTLE BLUE HERON.

The nomadic tendencies of the heron tribe bring many of its representatives north of their normal breeding ranges. Generally the birds observed in this postbreeding movement are immature. Such are the white-plumaged examples of the Little Blue Heron that are occasionally detected in our region. Sutton reported a single bird at Lower Lake, Hartstown, August 29, 1925. From the same area S. J. Seiple (1931) recorded two in company with the American and Snowy Egrets on August 1, 26, and 28 and on September 10, 1930. During August, 1935, L. E. Hicks observed one in the region of Pymatuning Lake. M. B. Skaggs (1937) saw one along the margin of the Lake near Linesville on September 27, 1936. At the same locality I saw three on August 26, 1938, in flight with several American Egrets and one Snowy Egret. Pymatuning Lake has become a mecca for this species as well as other members of its family. Thus far only the white-plumaged, or immature, examples have been observed.

Butorides virescens virescens (Linnaeus). EASTERN GREEN HERON.

Sutton considered the Green Heron an abundant migrant and summer resident in the Pymatuning region and recorded a number of nests in the vicinity of Hartstown. It is now commonly observed at Pymatuning Lake, which is in all ways well adapted for providing more extensive nesting territory and a corresponding increase in the numbers of this species. It arrives shortly after the middle of April and is common until the end of September. May is the usual time for nesting.

Nycticorax nycticorax hoactli (Boddaert). BLACK-CROWNED NIGHT HERON.

On the basis of four records—all from Conneaut Lake—Sutton termed the Black-crowned Night Heron a "rare summer resident, or possibly merely a summer wanderer." During the spring of 1934 (April 2, Dilley; May 28, Fricke) adults were noted at Pymatuning Lake, near Linesville. The following year on May 18, R. L. Fricke observed an immature Black-crown. On May 14, 1936, one-half mile west of Linesville he discovered a

breeding colony that consisted of thirty pairs. During the summer of 1936, and indeed until October 24, these birds were commonly seen fishing in the waters of Pymatuning Lake, where they were particularly active at dusk. On May 17, 1937, we saw several at the site of the rookery west of Linesville, but it was not occupied that season. A new colony, however, was established within the sanctuary, and there were two others not far away. In 1938, according to B. L. Oudette, the Black-crown nests numbered approximately ninety. The birds were already nesting when we visited the area on April 24. The Lake, with its abundant supply of fish and small aquatic animals, and the safety of the refuge are the factors that have permitted the Black-crowned Night Heron to become established there as a breeding species.

Botaurus lentiginosus (Montagu). AMERICAN BITTERN.

"A common migrant throughout the region, and a locally abundant summer resident in the marshy areas of Pymatuning Swamp" (Sutton). The nests recorded by Sutton were found in the Hartstown region. L. E. Hicks (1933) reported finding two nests in the Ohio portion of the swamp on July 11, 1928. The creation of Pymatuning Lake has greatly extended the area suitable for colonization by the American Bittern, and field-work from 1933 until 1940 has indicated that the species is taking advantage of the new territory. Numerous nests have been found, and this bittern is common throughout the summer. It arrives in April, and nesting is underway by the middle of May. The latest fall record for Pymatuning Lake is October 23, 1936 (West, 1936).

Ixobrychus exilis exilis (Gmelin). EASTERN LEAST BITTERN. Pl. XI, fig. 2.

"A fairly common migrant and irregular and local summer resident in the marshy sections of Pymatuning . . . . In the cat-tail marshes of Pymatuning it was not detected prior to June 29, 1927, on which date several were noted, but no nests found" (Sutton). "Two nests with eggs were found in Pymatuning Bog [Ohio portion] on July 11, 1928" (Hicks, 1933). The open-marsh habitat created by the clearing and flooding of Pymatuning Swamp has reacted beneficially for the Least Bittern, and its numbers are increasing. This species is more secretive than the American Bittern, and its nest is not easily detected. R. L. Fricke's records, however, indicate that it is common as a breeding species. In June of 1936 he found eight nests containing either eggs or young; on June 19, three nests;

and on June 21, five nests. A set of five eggs collected on June 19 was half incubated. The Least Bittern nests later in the season than the American Bittern and apparently chooses a wetter and less accessible location.

Cygnus columbianus (Ord). WHISTLING SWAN.

"A rather rare and irregular migrant, which sometimes occurs in immense flocks, and then again may be absent for years at a stretch . . . On November 26, 1904, Mr. Kirkpatrick saw a flock near Linesville. . . . On December 21, 1924, a swan, believed to be of this species, was seen at Crystal Lake by Merl Hutchens and others . . . On April 1, 1925, several citizens of Hartstown observed a flock of seventeen at Crystal Lake" (Sutton). Each year since 1933 Pymatuning Lake has been a stopping-place during the spring and fall for scores of migrating Whistling Swans, so that now this species is a regular and fairly common transient. It is observed oftener in the spring; the earliest record for this season is March 10, 1936 (Oudette), and the latest, April 27, 1933 (Dilley). One bird that lingered for several weeks in May, 1935, presumably was injured. Fall occurrences are usually in October and November (October 28, 1934, Seiple; November 3, 1935, Skaggs; November 7, 1937, Oudette).

Branta canadensis canadensis (Linnaeus). COMMON CANADA GOOSE.

"A common and regular migrant . . . While these great birds customarily stop at Conneaut Lake, they are also often seen at Crystal and Lower Lakes, where they have been known to remain for several days at a time" (Sutton). The wide expanse of Pymatuning Lake has proved much more attractive than the tiny lakes of the old swamp, and every year since 1933 many migrating Canada Geese have stopped there to rest and feed. The Lake is directly on the course of the flyway from the wintering grounds on the coast of the southeastern states. In spring the main flights occur in March and April, although February records are not unusual. The return movement in the fall takes place during late October and November. Great flocks of geese sometimes alight to feed in grain fields many miles from the Lake.

In 1936, about fifty pinioned geese were released in the refuge by B. L. Oudette. These birds nested in the sanctuary in May, 1937, according to R. L. Fricke. Mr. Oudette reports finding nests in 1938 of birds fully able to fly; he supposed them to be progeny of the captive geese.

Branta bernicla hrota (Müller). AMERICAN BRANT.

The Brant is essentially a maritime species that seldom occurs on in-

land waters. B. L. Oudette's record (1936) of a flock of Brant on Pymatuning Lake near Linesville is, therefore, of unusual interest. On March 15, 1936, he saw four birds, and on the following day there were thirty-one. The Brant were in that part of the sanctuary where grain was being scattered as food for waterfowl. They remained in the vicinity until March 20. They may have been driven from their normal course by storms that prevailed a few days earlier.

Chen hyperborea hyperborea (Pallas). LESSER SNOW GOOSE.

The Lesser Snow Goose apparently passes through western Pennsylvania on its migration flights, but records of its occurrence are sufficiently rare to be noteworthy. "B. L. Oudette reports having seen a single snow goose in early March, 1938, at Pymatuning Lake and three on October 20, 1939" (Todd, 1940). The species in life could be confused only with the Greater Snow Goose, an Atlantic Coast form that is unlikely to occur so far inland.

Chen caerulescens (Linnaeus). BLUE GOOSE.

"The Blue Goose nests in Baffin Land and Southampton Island, and migrates along the east coast of Hudson Bay and though the Mississippi Valley to winter on the coast of Louisiana. Our region thus lies to the east of its regular route of migration" (Todd, 1940). B. L. Oudette (1937) reports this species on Pymatuning Lake from October 14 until October 23, 1936, the number of birds varying from seven to twenty. He observed several in the refuge on November 7, 1937; in early March of 1938 he saw seven; and he writes (1940) that "on Friday, October 20, [1939] while in the vicinity of Polick Bridge, north of Espyville, on the Pymatuning Lake, I flushed sixty Blue Geese." These and additional recent records from Lake Erie fix the status of this species as a semi-regular transient.

Anas platyrhynchos platyrhynchos Linnaeus. COMMON MALLARD.

Sutton listed the Mallard as "an abundant migrant, equally common in spring and fall, an occasional winter resident, and rather common summer resident, which has been known to nest in Pymatuning." The breeding records supplied by Dr. Sutton referred mainly to observations of broods of flightless young; only two nests—both from the Hartstown area—had been recorded at that time. Later, Dr. Sutton (1929) described two nests of eleven and nine eggs found near Shermansville in 1926.

As breeding territory, Pymatuning Lake is so much more satisfactory

and extensive than the old swamp that the Mallard population has multiplied tremendously since 1933. The first nests were found there by R. L. Fricke in May, 1934; and in the ensuing seasons numerous nests have been found in situations varying from low stumps and willow growth just above the level of the water in the shallow areas to marshy fields some distance from the shore. The usual time of nesting is in May, but April nestings are frequent, according to B. L. Oudette. Harold Bergner (1938) reports the finding of a nest with thirteen eggs on April 10. A great influx of Mallards during the fall migration augments the local breeding population. A waterfowl census taken in October, 1935, estimated the number of Mallards at 1190.

Anas rubripes rubripes Brewster. RED-LEGGED BLACK DUCK.

Anas rubripes tristis Brewster. COMMON BLACK DUCK. Pl. IX, fig. 1.

If there are two forms of the Black Duck, as indicated in the American Ornithologists' Union *Check-List*, both of them should occur in the Pymatuning region, *rubripes* as the wintering species and *tristis* as the breeding form. By some authors the character of red legs is considered solely a variation that depends on age. The two races are here considered as one.

Sutton produced evidence of the nesting of the Black Duck at Pymatuning Swamp near Hartstown. According to report, a nest with twelve eggs had been found in May, 1919; and during Dr. Sutton's field-work from 1923 until 1927, several broods of young were discovered. Pymatuning Lake is so well adapted for the Black Duck that it has taken possession of the area in great numbers. R. L. Fricke located the first nest for the Linesville region on May 15, 1934. Since that time many nests have been found, and during late May females with broods are a common sight. "In general, the Black Duck nests earlier than the Mallard. . . A brood of young was once noted as early as May 12 (1931)" (Todd, 1940). When we visited Pymatuning Lake on April 24, 1938, Mr. Oudette told us the Black Ducks were already nesting. My notes of nests examined on May 18, 1937, reveal a variety of situations: "one beside a stump on a floating island; one in a clump of willows on a high spot; one under a little pine at the edge of an island."

In the seasons of migration, the Black Duck is one of the most numerous species on the Lake. The spring flight usually begins early in March and continues through April. In the fall this species is most common in October and November and occasionally remains throughout the winter in stretches of open water.

Chaulelasmus streperus (Linnaeus). GADWALL.

Sutton regarded the Gadwall as "one of the rarest members of its family" and had no records for the Pymatuning region. Todd (1940) states that "its main breeding area lies in western United States and adjoining British Provinces. East of the Mississippi it is accounted uncommon even during the season of migration, and it is certainly one of the rarest ducks in western Pennsylvania at large."

It is somewhat surprising, therefore, that the first appearance of the Gadwall on Pymatuning Lake should be as a breeding species. On May 18, 1934, just west of Linesville, R. L. Fricke flushed a female Gadwall from a nest that contained ten eggs almost ready to hatch. On May 22 we visited the nest with Mr. Fricke and discovered that the brood had left, but two unhatched eggs remained in the nest. The eggs contained well-developed young Gadwalls, which were preserved for the Museum collection. The Gadwall has been observed in limited numbers during each subsequent summer. On May 27, 1935, Mr. Fricke saw a female with three young. I. N. Boggs (1939) reported a female and four young on May 22, 1938. On August 25, 1938, I saw a Gadwall fly from Ford Island, and on the following day flushed one from the western edge of the Lake at the old Padanarum Road. B. L. Oudette told me of two broods of nine and seven young birds that he had seen during the summer of 1938; and on June 23, 1939, he found a nest that held eleven eggs. The breeding of the Gadwall so far east of its normal range prompts one to believe that breeding ranges are not entirely a question of latitude and longitude, but rather selection of suitable habitat.

Mareca penelope (Linnaeus). EUROPEAN WIDGEON.

"This European duck was at one time thought to be of merely accidental occurrence on this side of the Atlantic, but in recent years so many American records have appeared that the latest authority[13] is inclined to think that it may breed somewhere in our North Country" (Todd, 1940). There are a number of records of its occurrence in the Pymatuning region, both on Pymatuning Lake and at Hartstown. In chronological order they stand as follows: Linesville: one, April 26, 1936 (Seiple); one, October 23, 1936 (Trimble, *et al.*); one, March 27, 1937 (Skaggs); one, April 3, 1937 (Skaggs); four, April 6, 1937 (Trimble); seven, October 2, 1938 (Oudette). Hartstown: one, April 10, 1927 (Dilley); five, April 11, 1937 (Cook). The

[13] J. C. Phillips, *A Natural History of the Ducks*, 1923, 2: 176.

European Widgeon is always associated with its American cousin, the Baldpate.

Mareca americana (Gmelin). BALDPATE.

Sutton listed the Baldpate as "a rather uncommon migrant," and gave one record (March 20, 1925) for Lower Lake, Hartstown. Pymatuning Lake lies directly in the path of Baldpates migrating from the Atlantic Coast to their breeding grounds in the interior of the Northwest, and it has thus become a popular stopping-place for this species. During the fall migration particularly, Baldpates are scattered over the Lake in thousands, October being the month of greatest abundance. In the spring they occur regularly but in somewhat smaller numbers, although on April 11, 1937, we saw at Hartstown a flock that must have contained a thousand or more. March 2 is the earliest date of arrival (Oudette), but the big flights are usually in April. The incident of the Baldpate breeding in the Pymatuning region was a great surprise, and involves a considerable extension of the previously known breeding range. When mated pairs were seen in the sanctuary on June 7, 1936, our suspicions were aroused. In July of that year B. L. Oudette told Mr. Todd of seeing adults with young. In late May of 1937 and 1938 paired adults were seen again; and on August 26, Mr. Oudette told me that he had observed three broods of young. The shallow waters of the new lake and its lush aquatic vegetation provide suitable food for this surface-feeder, and the marshy recesses of its irregular shore insure safe retreat for nesting.

Dafila acuta tzitzihoa (Vieillot). AMERICAN PINTAIL. Pl. IX, fig. 2.

The American Pintail "breeds in Canada and the northern United States, commonly in the western parts, but only casually in the East" (Todd, 1940). Sutton found it common as a migrant in the Pymatuning region, since its migration flights between the Northwest and the Atlantic Coast carry it directly over the area. Pymatuning Lake now offers greater advantages than did the small lakes and watercourses of the original swamp. Moreover, the Pintail is one of those species that strangely enough have elected to stop far short of their usual goal and adopt the new lake as breeding territory. The first nests were found by R. L. Fricke in May, 1934, and the Pintail has been observed regularly in the summer of every subsequent year. It is one of the early migrants among the ducks (February 28, 1936—Oudette), and in the fall lingers well into November. It may even occasionally winter in limited numbers.

Nettion carolinense (Gmelin). GREEN-WINGED TEAL.

Sutton considered the Green-winged Teal a fairly regular migrant, although he had but few records for the small ponds of Pymatuning Swamp. As compared with the other species of ducks that now frequent Pymatuning Lake, it is by no means common. Our only actual evidence of its nesting there is that supplied by R. L. Fricke, who found a nest with an incomplete set of three eggs on May 25, 1936. No more eggs were deposited, and the nest was later abandoned. Mated pairs were observed late in May of the following year. L. E. Hicks tells me that in the Pennsylvania refuge, he has seen broods of young ducklings that were from one to two weeks old, and that he has numerous records of nests and young observed and collected along the Ohio shore. The first arrivals are generally noted in March (March 13, 1936—Oudette; March 25, 1937—Seiple; March 27, 1937—Skaggs); fall records are mainly for October (October 23, 1936—Trimble; October 25, 1936—Skaggs).

Querquedula discors (Linnaeus). BLUE-WINGED TEAL.

According to Sutton, the Blue-winged Teal has always been a common migrant in the Pymatuning region; and, having observed a female along the Shenango River in mid-summer, he suspected that it might breed in the area. L. E. Hicks (1935) considered it "local and rare" as a breeding species in the Ohio portion of the swamp, although more recently it has increased in numbers there. The new lake with its shallow bays and marshy areas provides for the Blue-winged Teal excellent territory that has been abundantly utilized. Commonly observed since 1933, this species was first found nesting on May 16, 1935, and since that time many nests have been located. They are placed in the tall grass of the tiny islands or in the waste fields that border the lake. The largest set of eggs was one of twelve that I found west of Linesville on May 21, 1937. The Hartstown marsh now supports a limited summer population.

The Blue-winged Teal is easily observed because of its tendency to frequent the shallow, marshy shores of the lake rather than the stretches of open water. In the spring it arrives in March (March 4, 1936—Oudette) and is very common until mid-April; teal seen thereafter may well be considered summer residents. In September, migrants swell the number of Blue-wings on the Lake, and by late October (October 23, 1936) the last have passed through.

Spatula clypeata (Linnaeus). SHOVELLER.

Sutton considered the Shoveller a "rather rare transient" in the Pymatuning region. He suggested that it "may formerly have nested," but gave no records to substantiate the claim, which was evidently adduced from the fact that the species "formerly or occasionally" (A. O. U. *Check-List*, 1931) nested in western New York. The Shoveller breeds mainly in the prairie region of the Northwest and in the interior of the United States. W. W. Cooke (1906) and L. E. Hicks (1935) report its breeding on Lake Erie. It was noted on Pymatuning Lake in April of 1934 (Seiple), and when paired Shovellers were still present in May of the following year, nesting seemed to be indicated. To R. L. Fricke belongs the credit for finding the first nest on May 27, 1935. "In this case the Shoveller apparently was so enthusiastic about the new territory that to save time it moved in with a Ring-neck Pheasant. When the nest was found, it contained eight eggs of the Ring-neck and eight of the Shoveller" (Trimble, 1937). On May 27, 1936, Mr. Fricke located a typical Shoveller nest that contained ten eggs. It was situated in a tussock of high grass in a marshy area of an open field, some distance north of the Upper Lake. The breeding population has apparently increased within the last two years, although the Shoveller is by no means abundant even in migration, when it crosses the Pymatuning region in passing between its main breeding grounds and its wintering station on the south Atlantic Coast. The spring migrants arrive as early as the middle of March and are commonest in April; the return movement takes place during September and October.

Aix sponsa (Linnaeus). WOOD DUCK.

The most important development with regard to the Wood Duck from the standpoint of the new lake and refuge is a gratifying increase in its numbers there. Since the Wood Duck prefers slow-running water and woodland conditions, it is much more generally distributed than other members of its family. Sutton reported it as a common migrant and locally a regular and common summer resident. He cited numerous instances of its nesting near the ponds at Hartstown, at Conneaut Lake, and also along French Creek and the Shenango River. The wooded sections that border Pymatuning Lake are well adapted to the breeding needs of this species. The Wood Duck's habit of nesting in hollow trees makes discovery of its nest rather difficult, but females with their broods are commonly seen during July and August. On June 6, 1936, we saw a female and twelve young on the Hartstown marsh. Three nests located

by R. L. Fricke in May, 1935, near Linesville, were in natural cavities in beech trees.

Nyroca americana (Eyton). REDHEAD.

The Redhead is one of the many species of migrating waterfowl that cross our region diagonally in following the Atlantic Flyway from the main breeding grounds in the central and western parts of North America to a wintering station on the Atlantic Coast. The Redhead has suffered a great deal from the destruction in recent years of its hereditary breeding grounds in the prairie sloughs and marshes of the West, as well as from its popularity with duck hunters. Occasionally it is very numerous on Pymatuning Lake in the migration seasons, but usually it occurs in much smaller numbers than the other species of ducks. In the spring it is commonest during the last week of March and the first week or ten days of April; we saw a number of Redheads on April 11, 1937. The autumn migrants arrive in October and remain throughout November if there is open water.

Pymatuning Lake is far to the eastward of the normal breeding range of the Redhead, hence it was surprising, indeed, in 1936 to find it among the summer residents there. On July 2, Mr. Todd (1936) collected a few young ducklings to verify the breeding of this species, the females of which are easily confused with those of the Ring-necked Duck. No nests have have yet been found, but it has been estimated that at least fifteen or twenty pairs have been present each summer since 1936. The Redhead "is a typical diving duck and seeks its food by plunging beneath the surface, sometimes descending to a considerable depth in search of the aquatic plants and animals which constitute its fare" (Todd, 1940). At Pymatuning it keeps out in the open waters of the lake, where it no doubt finds the deeper channel of the old Shenango River adequate for its method of feeding.

Nyroca collaris (Donovan). RING-NECKED DUCK.

Although the Ring-necked Ducks that winter on the Atlantic Coast fly diagonally over the lake region of western Pennsylvania in passing from their breeding grounds in the Northwest, there are comparatively few records available. The normal breeding range of this species lies west of the upper Mississippi Valley. When the waters first began to rise in Pymatuning Lake, a few Ring-necks were observed (Linesville, April 5, 1933, and March 7, 1934—Dilley). In the following years these ducks were not uncommon, and in May of 1935 and May and June of 1936,

mated pairs were observed in the sanctuary. On June 19, 1936, R. L. Fricke discovered a brood with a female that he felt certain was a Ring-necked Duck. Since the females of this species are easily confused with those of the Redhead, Mr. Todd secured permission to collect some ducklings from various broods. These were taken on July 2, 1936, and proved conclusively that both the Ring-necked Duck and the Redhead were breeding at Pymatuning Lake. It was estimated that about fifteen pairs of the former were present during the summer of 1936. That this was not a sporadic nesting, is attested by the presence of equally as many summering pairs in 1937, 1938, and 1939. During the migration period the Ring-neck is now very common. On April 6, 1937, it outnumbered even the Scaups at the baited area in the sanctuary.

Nyroca valisineria (Wilson). CANVAS-BACK.

The Canvas-back is not a common species at Pymatuning Lake, although like a number of other ducks it crosses our region in its flights between the Atlantic Coast and its breeding grounds in the Northwest. It was first observed on Pymatuning Lake in 1935 (November 17—Skaggs). Since then it has been noted regularly in the spring and fall, although in limited numbers. An early spring date is March 6, 1936 (Oudette), and a late record for this season is April 26, 1936 (Skaggs). It will be interesting to ascertain whether the Canvas-back, like other "diving" species such as the Ring-neck and Redhead, will adopt Pymatuning Lake as breeding territory. At the present time there is no indication that such a condition exists.

Nyroca affinis (Eyton). LESSER SCAUP DUCK.

The Lesser Scaup is a regular migrant at Crystal Lake, Hartstown, according to Sutton. A female collected there on June 16, 1898 (not June 28, 1899, as recorded by Sutton) was not considered to be breeding. Since the creation of Pymatuning Lake, the Lesser Scaup has appeared there in increasing numbers during every migration season since 1934. It is common until the middle of May, and a few mated pairs have been observed as late as May 21 (1937). According to L. E. Hicks (1935), it is presumed to breed in Ashtabula County, Ohio, but he feels that individuals seen in the summer are probably not breeding. This species, like others of similar haunts and habits, however, is a potential summer resident. Conclusive evidence such as nests or broods of young, is not yet forthcoming; and in view of the tendency for non-breeding Scaups to linger on many of the

larger bodies of water in the East, these are the only dependable evidence.

In life the Lesser Scaup is not easily distinguished from the Greater Scaup (*Nyroca marila*), but, generally speaking, it is a later migrant in the spring.

Nyroca marila (Linnaeus). GREATER SCAUP DUCK.

Both species of Scaup are common migrants in the Pymatuning region, although they are very difficult to distinguish in the field. Sutton records collecting a pair of Greater Scaups at Crystal Lake, Hartstown, on May 1, 1922; the specimens in question, however, are actually Lesser Scaups. The larger species is conceded to be an earlier migrant than *affinis* (Linesville, March 4, 1936—Oudette) and is apparently less common, although the paucity of records may be attributed to a laudable tendency to lump sight identifications under the indefinite heading of "scaup." Harold Bergner (1938) records both species at Linesville on April 10, 1938. The variable character of length of white wing-stripe (presumably more extensive in *marila*) and the color of the gloss on the head (green in the Greater; dull purple in the Lesser) are too elusive to count for much as field-marks.

Glaucionetta clangula americana (Bonaparte). AMERICAN GOLDEN-EYE.

Sutton considered the American Golden-eye a fairly common and regular migrant and occasionally a winter resident at Conneaut Lake. He cited E. E. Hunter as authority for records of it at Pymatuning in late February. Its status is much the same at Pymatuning Lake, where it has been observed in small numbers since 1934. Its apparent scarcity may be explained by its usual avoidance of shallow waters. It is commoner during the spring migration and is one of the first ducks to arrive (February 4, 1939—Oudette). Most of the migrants pass through in March, but we saw a number in the sanctuary on April 6, 1937, and on April 28, 1940; R. L. Fricke reports one female as late as May 27 in 1936.

Charitonetta albeola (Linnaeus). BUFFLE-HEAD.

This handsome duck is a common and regular migrant in the Pymatuning region. It was so recorded by Sutton, who gave several instances of its occurrence on the small lakes at Hartstown. R. L. Fricke considered it very rare on Pymatuning Lake until 1936. Thereafter, however, it has been observed more frequently and in increasing numbers. M. B. Skaggs gives the following dates for the area near Linesville: November 17, 1935

(seven); April 19, 1936 (ten); April 26, 1936 (ten); November 15, 1936 (two); March 27, 1937 (six); May 8, 1937 (two). On October 23, 1936, we saw a few in the sanctuary; on November 7, 1937, we observed two females; on April 24, 1938, we found the species fairly numerous on the deeper waters of the Upper Lake; and on April 27 and 28, 1940, a few were observed there and at Hartstown.

Clangula hyemalis (Linnaeus). OLD-SQUAW.

This arctic and circumpolar species winters in the East along the Atlantic Coast and occasionally on the Great Lakes if there is open water. Sutton was unable to cite any records of it on the small lakes of Pymatuning Swamp. On April 6, 1937, we found one female among a flock of Scaups at the spillway near Linesville. The Old-squaw, of course, is a deep-water duck, which when it visits Pymatuning Lake usually remains far out in the open water where it is not easily observed. It probably occurs more frequently than our single record indicates.

Melanitta deglandi (Bonaparte). WHITE-WINGED SCOTER.

The White-winged Scoter winters on both the Atlantic and the Pacific coasts, as well as on the Great Lakes. In migration it is sometimes found on the smaller lakes, where it frequents the deepest water. The shallow waters of Pymatuning Lake are, therefore, not particularly attractive to this species. Sutton (1929) records the capture of a male from a flock of five scoters that alighted on Crystal Lake in the fall of 1928. Floyd Chapman (1937) reports a flock of seven observed on Pymatuning Lake near Linesville on May 16, 1936. This is the only scoter for which there are authentic records from this area.

Erismatura jamicensis rubida (Wilson). RUDDY DUCK. Pl. X, fig. 1.

Sutton found the Ruddy Duck common in migration at Crystal and Lower lakes, Hartstown. Its appearance on Pymatuning Lake in 1934, therefore, was not unexpected. The following year L. E. Hicks (1935) observed two broods of flightless young on the Ohio portion of the Lake. J. K. Terres told me of a brood that he had seen in the Linesville section in early July of that same year. On June 7, 1936, we saw eight male Ruddy Ducks in the deeper portion of the Upper Lake; and on June 19, R. L. Fricke found a nest with four eggs in a clump of bur-reed that was growing in about eighteen inches of water. The complete set of seven eggs was collected on June 22 and is the first to have been found in western Penn-

sylvania. The number of Ruddy Ducks summering at Pymatuning Lake has apparently increased slightly within the last few years.

This species breeds in most of the western states and as far north in western Canada as Great Slave Lake. Isolated instances of its nesting in the East are known from Michigan, New York, and parts of New England; its breeding at Pymatuning Lake is, consequently, not entirely unusual.

Lophodytes cucullatus (Linnaeus). HOODED MERGANSER.

The Hooded Merganser is widely distributed throughout the United States and southern Canada. In the breeding season it is not dependent upon large bodies of water for nesting sites but frequents wooded streams as well. The watercourses and small lakes of the original Pymatuning Swamp were well adapted for this species; but Sutton had no evidence of its nesting, although he found it to be a fairly common migrant. In recent years it has been a regular, if not particularly common, migrant at Pymatuning Lake. Most of the records are for March and April. May records are surprisingly scarce, and definite information to establish the breeding of the Hooded Merganser in the area is still wanting.

Mergus merganser americanus Cassin. AMERICAN MERGANSER.

The American Merganser occasionally visited the small lakes of Pymatuning Swamp during migration (Sutton). Since 1936 it has been fairly common at Pymatuning Lake during the spring migration, and rather less abundant in the fall. Most of the records are for March and April, but B. L. Oudette reports nine individuals arriving on February 10, 1939. On April 24, 1938, which is a rather late date for this species, Mr. Oudette and I saw a flock of a hundred or more fly over the Upper Lake. My only fall record is for October 23, 1936, at the dam near Jamestown.

Mergus serrator Linnaeus. RED-BREASTED MERGANSER.

Sutton cites spring migration records (March and April) for the Red-breasted Merganser from Lower Lake, Hartstown. S. J. Seiple observed it at Crystal Lake in 1926. It has been recorded at Pymatuning Lake regularly each spring since 1932. Most of the occurrences have been in late March (March 28, 1934—Dilley; March 29, 1934—Seiple). R. L. Fricke (1931) and M. B. Skaggs have both observed it during May, and a number of females were present at Jamestown and at Linesville on April 27 and 28, 1940. The area is not far removed from the normal breeding range ascribed to this species, and one might reasonably expect that it will in the future be found nesting at Pymatuning Lake.

Haliaeëtus leucocephalus alascanus Townsend. NORTHERN BALD EAGLE.

Although Sutton believed that the Bald Eagle must formerly have nested in the Pymatuning region, he listed the species merely as an occasional visitor. During our investigations we saw Bald Eagles for the first time at Pymatuning Lake in the spring and summer of 1935. These newcomers were immature birds. In 1936 and 1937 there were at least two pairs in the sanctuary, and in the latter season B. L. Oudette found a nest. A bird as conspicuous as the Bald Eagle is not overlooked, and its predilection for prominent perches on dead stubs makes it easy to observe. An unfailing food supply of fish, and freedom from molestation have attracted this all too uncommon species to the area. Although the breeding population is probably limited to a few pairs, the Lake is a focus for migrating eagles. On August 26, 1938, Mr. Oudette made good his boast that Bald Eagles in numbers I had never before witnessed would come to roost on the dead hemlocks of the islands in the Upper Lake. From our lookout on one of the small islands we could count twenty-one Bald Eagles in sight at one time; and as we left the island just at dusk, still another flew in to join the assembly. Some of these were immature birds, but a goodly number were white-headed adults. On a later date Mr. Oudette was able to raise his tally to twenty-eight. This remarkable development at Pymatuning Lake is indeed gratifying.

Pandion haliaëtus carolinensis (Gmelin). OSPREY.

The Osprey, according to Sutton, is a fairly regular and common migrant at Conneaut Lake, and he gives a record for September 8, 1925, from Crystal Lake, Hartstown. It was to be expected, therefore, that this species would appear at Pymatuning Lake. It has been observed there regularly in the spring during every year since 1935, although it is by no means common. No evidence of its nesting in the region has thus far been found.

Falco peregrinus anatum Bonaparte. DUCK HAWK.

"A rare and irregular transient" (Sutton). The facilities of Pymatuning Lake are much better adapted to this species than were the small lakes and watercourses of the old swamp. It is not common, however. R. L. Fricke observed one Duck Hawk on May 24, 1935. In 1938 I saw one in the sanctuary near Linesville on April 24 and again on August 26; according to B. L. Oudette, this bird had been present throughout the summer.

Rallus elegans elegans Audubon. KING RAIL.

"A rare and infrequently recorded migrant, which sometimes occurs locally in the summer and should occasionally nest, although we have no breeding record at present" (Sutton). S. S. Dickey found an adult with two young in the marsh near Hartstown on June 18, 1922. S. J. Seiple (1931) reported an adult and two young at the same locality in August, 1930. L. E. Hicks (1933) records "an adult with at least four young at Pymatuning Bog on June 16, 1931."

The King Rail is present also in the environs of Pymatuning Lake; it has been observed near Linesville each summer since 1934. At the latter locality on May 23, 1935, R. L. Fricke found a nest containing nine eggs, and definitely established the breeding of the King Rail in the Pymatuning region. Our earliest spring migration date at the Lake is April 13, 1934 (Dilley). The King Rail evidently remains quite late in the fall, since Mr. Oudette found a dead bird in December of 1937.

Rallus limicola limicola Vieillot. VIRGINIA RAIL.

Sutton found the Virginia Rail to be an abundant summer resident in the marshy cat-tail growth of Pymatuning Swamp near Hartstown He located many nests on dates varying from May 4 until May 31. The cat-tail areas and open marsh that now border many parts of Pymatuning Lake are suitable territory for this rail, and a great number of nests have been found. Rails are so furtive in their movements that they are observed with difficulty, but their presence is quickly detected from their characteristic calls. The Virginia Rail seems to select a rather dry location for its nest. Complete sets contain ten or eleven eggs that are laid about the middle of May. The eggs of the Virginia Rail are lighter in color, less heavily spotted, and less glossy than those of the Sora. The young are hatched in early June (Blair Road, June 7, 1936). Rails suffer a great deal from predators, their common enemies being snakes, frogs, and turtles, which devour the eggs and young. Sutton refers also to the depredations by severe hailstorms.

Porzana carolina (Linnaeus). SORA.

As reported by Sutton, the Sora has long been a common summer resident in the cat-tail marshes near Hartstown, and there is as well an early (1895) nesting record for this species at Linesville. Like the Virginia Rail with which it is commonly associated, the Sora has profited from the increase of suitable open-marsh habitat in the vicinity of Pymatuning Lake.

The summer population of Soras probably outnumbers that of the Virginia Rail. Nests have been found every season since 1932. The usual time for full sets (usually 10 to 12 eggs) is during the latter half of May, although Sutton found newly hatched young on May 25, 1922. The local population is increased by the arrival of migrants in September, and C. A. Bergstrom gives November 7, 1928, as a late date for the species at Shermansville.

Coturnicops noveboracensis (Gmelin). YELLOW RAIL.

Sutton's efforts to find the Yellow Rail at Pymatuning Swamp were unsuccessful. L. E. Hicks (1933), however, reports on this species as follows: "No nests found but an adult seen in the Pymatuning Bog [Ashtabula County, Ohio], July 2, 1938, and an immature bird about half grown found dead at the same place on the Pennsylvania-Ohio line, August 9, 1932." The only other record for the area is that of one specimen observed by H. M. McQuiston two miles west of Linesville on October 6, 1934.

Creciscus jamaicensis stoddardi Coale. BLACK RAIL.

Sutton's report of a Black Rail observed along the southern shore of Crystal Lake, Hartstown, on September 7, 1925, still remains the only record at the present time The scarcity of this species may be more apparent than real, for it is so seclusive that it may easily be overlooked.

Gallinula chloropus cachinnans Bangs. FLORIDA GALLINULE. Pl. X, fig. 2.

Sutton published the first account of the Florida Gallinule breeding in western Pennsylvania. He observed a family group at Lower Lake, Hartstown, on September 5, 1925, and on June 30, 1927, discovered the first nest of this species in the area. It was found "at the very edge of the channel of the Shenango river about four miles north of Hartstown." In May of 1931, R. L. Fricke (1931) found the Florida Gallinule common in the Hartstown marsh, and in August of that year S. J. Seiple (1931) observed a number of birds, including young. Two nests were located by Mr. Fricke in May, 1933; the first was practically a floating nest, and the second was in the cat-tails near the edge of the marsh. The Florida Gallinule, like so many other water-loving species, has taken advantage of the situation created by the formation of Pymatuning Lake. It is commonly observed there throughout the summer, arriving in late April and leaving in September or early October. A nest of nine eggs was collected by Mr. Fricke near Linesville on May 27, 1936.

Fulica americana americana Gmelin. AMERICAN COOT.

According to Sutton, the Coot nested near Hartstown, where he saw an adult accompanied by two young birds on May 31, 1923. The species was common as a migrant on the small lakes there. Since 1933 it has been observed on Pymatuning Lake. On May 22, 1934, Messrs. Fricke, Todd, and Dilley found four nests with sets of seven, three, and nine eggs. Other nests had just been started. They were in the flooded area that was grown over with cat-tails. Foundations of sticks supported nest linings of rushes and cat-tails. The nests were built up from four inches to a foot above the water, which was then about eighteen inches deep. L. E. Hicks (1935) reported the breeding of this species on the Ohio portion of the Lake in Ashtabula County. "In the two years following, coots became so numerous and their floating nests were so often and so easily found that they were no longer a novelty" (Trimble, 1937). There were hundreds of nesting pairs; during the seasons of migration the coots occurred in thousands; and some were even observed during the winter.

As the cat-tail growth, which practically covered the shallow lake from 1933 until 1936, was gradually flooded out except along the margins, the numbers of summering Coots fluctuated. The diminution was apparent in 1937, although a number of nests were found in the shallow places where the vegetation was more dense. According to B. L. Oudette, however, the coots had been absent from the Lake all summer during 1938, until we saw a raft of several hundred on August 26. They were common that season in the marsh at Hartstown, where their numbers have increased greatly since the time of Dr. Sutton's observations.

Charadrius semipalmatus Bonaparte. SEMIPALMATED PLOVER.

The Semipalmated Plover was considered by Sutton a "rather rare migrant" at the small lakes near the southern end of Pymatuning Swamp. The shores of Pymatuning Lake, its floating islands, and sandbars are much more ample as resting and feeding places for this migrant. In the spring it is fairly common from the middle until the end of May. The return movement brings it back about the end of July (Skaggs); it is common in August, and has been observed as late as October 14 (Seiple).

Oxyechus vociferus vociferus (Linnaeus). KILLDEER.

"Abundant as a migrant, common as a summer resident, and occasional in winter" was Sutton's estimate of the status of the Killdeer in the Pymatuning region. The statement is still apropos, for the species is one of the

most common and conspicuous members of the Pymatuning colony. An unusually early record of nesting is that of a set of four eggs found near Mr. Oudette's home on April 24, 1938. Another unusual record was a set of *seven* eggs in a nest found by R. L. Fricke on May 16, 1938, near Linesville.

Pluvialis dominica dominica (Müller). AMERICAN GOLDEN PLOVER.

The Golden Plover occasionally reaches western Pennsylvania in its southward migration, but spring occurrences are exceptional (Todd, 1940). The only record for the Pymatuning region at the present time is of a single specimen observed by S. J. Seiple near Linesville on October 8, 1938.

Squatarola squatarola (Linnaeus). BLACK-BELLIED PLOVER.

Sutton gives one record of this "rare and irregular migrant" at Crystal Lake on September 8, 1925. It can now be considered a regular migrant at Pymatuning Lake, where it occurs in both spring and fall, although never in large numbers. R. L. Fricke saw three birds on May 30, 1934. Other dates and authorities are as follows: three, May 29, 1935 (Fricke); two, June 2, 1935 (Fricke); twelve, August 20-21, 1935 (Hicks); eight, October 17, 1935 (Fricke); three, May 18-20, 1936 (Trimble, *et al.*); four, October 4, 1936 (Skaggs); October 23, 1936 (Trimble) and (West, 1936); thirteen, May 24, 1937 (Fricke).

Arenaria interpres morinella (Linnaeus). RUDDY TURNSTONE.

The Ruddy Turnstone was recorded by S. J. Seiple (1931) at Hartstown on August 16, 1930. "During migration it prefers the seacoast, but some individuals traverse the interior of the country and regularly visit the shores of the Great Lakes" (Todd, 1940). There are a number of reports of its occurrence at Pymatuning Lake: September 29, 1933 (Dilley); October 9, 1933 (Seiple); May 26, 1934 (Fricke); May 8, 1937 (Skaggs); May 24, 1937 (Fricke)—the last record was of a flock of seventy-five.

Philohela minor (Gmelin). AMERICAN WOODCOCK.

In 1928 Sutton wrote of the Woodcock in the Pymatuning region: "Today it is common only occasionally as a migrant and decidedly uncommon as a summer resident, save in a few favored localities. When Mr. Todd visited the Crystal Lake region in 1895 he found nesting Woodcocks amazingly abundant. Today only a pair or two remain of all that host." The diminution in numbers was attributed to excessive hunting, natural causes, and the increase of predators, as well as the gradual disappearance

of suitable habitat. Latterly the Woodcock seems to have regained some ground, and in the vicinity of Pymatuning Lake it is now considered a fairly common summer resident. The protection afforded by the new sanctuary has undoubtedly been an important factor in replenishing—even if slightly—the fast diminishing numbers of this interesting species.

Capella delicata (Ord). WILSON'S SNIPE.

Sutton found Wilson's Snipe a "common and fairly regular migrant and irregularly common and local summer resident at Pymatuning Swamp." He has published (1923) a full account of its habits as he studied them near Hartstown, where he located a number of nests. L. E. Hicks (1933), whose observations were made in the Ohio portion of the Swamp, found the Snipe fairly numerous there. "In 1928 a careful census on several successive evenings indicated that no less than fourteen pairs were breeding in the Ohio portion of the Pymatuning Bog or within three-quarters of a mile of the state line. In 1929 about sixteen pairs bred, in 1930 only six pairs were indicated, in 1931, eleven pairs, and in 1932, eight pairs." He observed young birds several times, and found one nest on Hemlock Island on May 30, 1931. The Snipe is still relatively common in the area. It is sometimes quite numerous in migration. Willard Dilley reported at least seventy-five birds in a short distance along Linesville Creek on October 14, 1933; and S. J. Seiple observed thirty-five a few miles north of Jamestown on October 12, 1934. Wilson's Snipe is an early migrant, arriving in March (March 8, 1925—Bergstrom; March 28, 1930—Seiple). Indeed, according to Sutton, it sometimes winters in the region. Fall migration dates are mainly for October. The numbers of Snipe fluctuate from year to year, but conditions at Pymatuning Lake seem more favorable for this species, which inhabits open marsh, low, overflowed meadows or the weedy growth along shore.

Phaeopus hudsonicus (Latham). HUDSONIAN CURLEW.

The Hudsonian Curlew is a rare and irregular transient in the region of Pymatuning Lake. "On May 23, 1937, G. M. Cook saw a flock of thirteen flying over Pymatuning Lake, north of Andover, Ohio. The following day R. L. Fricke counted twenty-three birds in a flock flying over the lake west of Linesville, calling vociferously" (Todd, 1940).

Bartramia longicauda (Bechstein). UPLAND PLOVER.

The Upland Plover was considered by Sutton a rather rare transient and a rare and very local summer resident in the region of Pymatuning

Swamp. He observed newly hatched young near Hartstown on June 2, 1922, and recorded a nest found by J. G. Crumb near Linesville about 1900.

The changed ecological conditions in the area make it more acceptable as breeding territory for the Upland Plover, which is now fairly common. The open, grassy fields that border some parts of the Lake are ecologically suitable for this species, which is primarily characteristic of the Great Plains. It arrives in April (April 9—Dilley; April 26—Skaggs), and by mid-July its southward migration is already underway.

Actitis macularia (Linnaeus). SPOTTED SANDPIPER.

The Spotted Sandpiper is widely distributed as a breeding species. Sutton did not find it common at Crystal and Lower Lakes "because the shores are not satisfactory as feeding or nesting-grounds." Pymatuning Lake is, of course, well adapted to the needs of this species, and the number of breeding pairs and migrants has greatly increased. The Spotted Sandpiper arrives after the middle of April (April 23—Dilley; April 26—Skaggs). In the fall migration it is most numerous in August, but a few stragglers have been recorded in October

Tringa solitaria solitaria Wilson. EASTERN SOLITARY SANDPIPER.

The Solitary Sandpiper is a common migrant, for which there are a few summer records, but as yet no positive evidence of its breeding. Sutton saw one bird in June, 1922, at Crystal Lake. He further recounts the actions of a mated pair observed from May 9 to 19, 1922; he believed they were searching for a nesting site. There are no recent June records, and July and August dates may pertain to migrating birds.

Catoptrophorus semipalmatus inornatus (Brewster). WESTERN WILLET.

The Western Willet sometimes strays eastward in migration, and Todd (1940) has recorded two specimens that were collected by W. D. Hunter on the edge of Pymatuning Swamp south of Linesville in early April of 1929.

Totanus melanoleucus (Gmelin). GREATER YELLOW-LEGS.

Sutton considered the Greater Yellow-legs a fairly common migrant in the Pymatuning region and gave records from Linesville, Shermansville, Hartstown, and Crystal Lake. The marshy shores of Pymatuning Lake are ideal feeding grounds for this species during its spring and fall migration. It arrives there early in the spring (April 6, 1937—Todd). Non-

breeding birds have been noted near Linesville in June by L. E. Hicks. The returning migrants appear in July (July 9, 1938—Seiple), and a late date for Linesville is November 7, 1937 (Trimble.)

Totanus flavipes (Gmelin). LESSER YELLOW-LEGS.

The Lesser Yellow-legs frequents the same kind of marshy shores that are chosen by its larger relative, *T. melanoleucus*. Sutton found it to be even commoner than the latter in the region of Pymatuning Swamp. In fact these two species were the only shore birds that regularly visited the small ponds of the swamp. The new lake now attracts these species in far greater numbers. The Lesser Yellow-legs arrives a little later in the spring (April 27, 1929—Seiple) and has completed its fall migration in October (October 14, 1933—Seiple).

Pisobia melanotos (Vieillot). PECTORAL SANDPIPER.

Sutton wrote of this species: "The wooded Pymatuning is altogether unsuitable as a feeding-ground." Pymatuning Lake, however, provides the overflowed fields, wet, grassy meadows, shallow pools, and mud flats that this species frequents during its migration through the area in spring and fall. It is common and regular there, flocks of from twenty-five to thirty individuals having been observed both by L. E. Hicks and M. B. Skaggs. The spring migration occurs in April and May (April 6, 1937—Todd; May 20, 1937—Trimble). The Pectoral Sandpiper reappears in July or August (July 30, 1937—Skaggs), and its fall migration is usually completed by the end of October (October 23, 1936—Trimble; and West, 1936).

Pisobia fuscicollis (Vieillot). WHITE-RUMPED SANDPIPER.

The White-rumped Sandpiper is rare in western Pennsylvania. There is but one record for Pymatuning Lake: a specimen collected by R. L. Fricke on May 8, 1929, near Linesville.

Pisobia minutilla (Vieillot). LEAST SANDPIPER.

Sutton considered the Least Sandpiper "a rather rare and irregular migrant, which occurs only along the muddy pools near the roads and in the open fields." He collected a male near Hartstown on May 13, 1922. During migration the Least Sandpiper is now regularly observed along the marshy shores and on the little sandbars and floating islands of Pymatuning Lake. It arrives in May (May 17, 1935—Todd; May 18, 1927—Seiple). In the fall migration it appears in late July or early August (July 30, 1937—Skaggs; August 5, 1935—Hicks) and all have passed through by mid-October (October 14, 1933—Seiple and Dilley).

Pelidna alpina sakhalina (Vieillot). RED-BACKED SANDPIPER.

The Red-backed Sandpiper is one that frequents only the larger lakes and pools. Formerly it probably covered the distance from the Great Lakes to the bays and estuaries of the Atlantic Coast in a single flight and was for that reason unrecorded from the small ponds of Pymatuning Swamp. The changed conditions created by the new lake favor its occurrence there, and it has been seen near Linesville on a number of occasions: October 14, 1933 (Seiple); May 15, 1934 (Fricke); May 8, 1937 (Skaggs); May 20, 1937 (Trimble and Todd); October 23, 1936 (Trimble; and West, 1936).

Limnodromus griseus griseus (Gmelin). EASTERN DOWITCHER.

The Eastern Dowitcher usually migrates along the Atlantic Coast and is not common in the interior, but conditions at Pymatuning Lake favor its occurrence there in limited numbers. R. L. Fricke (1930) supplied the first record for the region. He observed three birds one mile south of Linesville on May 20, 1930. and collected a female. Mr. Fricke has seen this species in the same locality during May of 1933, 1934, and 1936, in numbers varying from one to a dozen birds. S. J. Seiple has recorded the Dowitcher at Hartstown on May 17, 1930 (three); on May 12, 1932 (one); and on August 1, 1930 (one).

Ereunetes pusillus (Linnaeus). SEMIPALMATED SANDPIPER.

During migration the Semipalmated Sandpiper occasionally visited the small lakes of Pymatuning Swamp, according to Sutton. He gave three records of its occurrence at Crystal Lake and Hartstown. S. J. Seiple (1931) supplies a record of five birds at the latter locality in August, 1930. This sandpiper is now regularly observed in the fall at Pymatuning Lake and occasionally appears there in the spring migration as well. I saw it on May 18, 1936, at Linesville. The return movement begins in July (July 9, 1938—Seiple) and continues into October (October 23, 1936—Trimble).

Limosa fedoa (Linnaeus). MARBLED GODWIT.

Sutton had no Pymatuning records for this rare straggler, although he reported two specimens that were taken many years ago at Conneaut Marsh and Edinboro Lake, respectively. More recently, W. D. Hunter collected two birds near Linesville on October 2, 1929. There have been no reports of the occurrence of this species since the creation of the new lake.

Phalaropus fulicarius (Linnaeus). RED PHALAROPE.

The Red Phalarope is primarily a pelagic species that breeds only in the far North. Its occurrence anywhere in the interior of the United States is unusual, as is L. E. Hicks's report of a female that he collected on the Ohio shore of Pymatuning Lake on July 16, 1937. Dr. Hicks has written me that the specimen is in breeding plumage and that the exact locality for it is "two miles north of the Andover Fill."

Steganopus tricolor (Vieillot). WILSON'S PHALAROPE.

The only authentic record of the occurrence of this Mississippi Valley species in western Pennsylvania has been supplied by R. L. Fricke. He collected a female near Linesville on May 15, 1934.

Lobipes lobatus (Linnaeus). NORTHERN PHALAROPE.

According to Sutton, three specimens of the Northern Phalarope were collected at Conneaut Lake. The species was first recorded at Pymatuning Lake by Harold D. Mitchell (1940), who observed one bird at close range near Linesville on October 7, 1939.

Larus argentatus smithsonianus Coues. HERRING GULL.

On the basis of several May records from Crystal Lake, Hartstown, Sutton considered the Herring Gull an irregularly common migrant at Pymatuning Swamp. It is now very common at Pymatuning Lake. There are records for this species in the winter (Andover-Espyville Road, January, 1934—Dilley; and Linesville, January 12, 1934—Seiple), and immature or non-breeding birds even linger through the summer months. The spring migration usually begins in February and extends into May (May 21, 1936—Todd). In the fall the Herring Gull is most numerous in September.

Larus delawarensis Ord. RING-BILLED GULL.

Apparently the Ring-billed Gull did not occur on the small lakes of Pymatuning Swamp, but it has been common every spring and fall at Pymatuning Lake since 1935. Some non-breeding birds remain there even throughout the summer (June 6, 1936—Trimble; July 2-4, 1936—Todd; July 9, 1938—Seiple). The spring migration takes place in April and May (April 5, 1937—Todd; April 10, 1937—Trimble). August marks the beginning of the reverse movement (August 5-8 and 20-21, 1935—Hicks). There are no wintering records for Pymatuning Lake; our latest fall record for the region is November 15, 1936 (Skaggs).

Larus philadelphia (Ord). BONAPARTE'S GULL.

"A regular and sometimes abundant transient visitant, occurring not only at Conneaut Lake, but at Crystal and Lower Lakes in Pymatuning and along all the larger water-ways" (Sutton). Pymatuning Lake is a favorite stopping-place for this gull on its migrations from the Atlantic Coast to northwestern North America. It is most abundant during April and May. On May 18, 1937, near Linesville, we saw a flock of about two hundred, all of which seemed to be young birds. The earliest spring date for the region is April 8, 1937 (Todd). A number of Bonaparte's Gulls were observed at the Jamestown Dam on October 28, 1939.

Sterna hirundo hirundo Linnaeus. COMMON TERN.

The Common Tern, according to Sutton, was common and regular as a migrant at Crystal Lake, Hartstown. Since 1926 a successful breeding colony has been maintained at Presque Isle, Erie. Pymatuning Lake has attracted this species each year since 1933, and many Common Terns have been observed there during the summer months (June 7, 1936—Trimble; July 2-4, 1936—Todd; August 5-6, 1935—Hicks). It is quite likely that the birds are breeding there, although no nests have yet been discovered. There is no great extent of sandy beach, such as this species prefers, but the many summer records are suggestive.

Hydroprogne caspia imperator (Coues). CASPIAN TERN.

The Caspian Tern was first noted at Pymatuning Lake in 1936 by M. B. Skaggs, who saw three on April 26. It was observed in May of that year by Messrs. Todd and Fricke. Its status is that of a transient, although S. J. Seiple reports a single tern of this species on July 9, 1938. The Caspian Tern is not common on the new lake.

Chlidonias nigra surinamensis (Gmelin). BLACK TERN. Pl. XI, fig. 1.

Sutton found the Black Tern a fairly regular and sometimes abundant transient on the small ponds and waterways of Pymatuning Swamp. He recorded (*fide* Welshons) the instance of its nesting at Conneaut Lake. A nesting colony of about fifty pairs was located in the region of Pymatuning Lake northwest of Linesville in May, 1934. On May 21, nesting was just beginning, and on May 30 Mr. Fricke collected a set of eggs. It was placed on water-soaked reeds and grasses floating on water that was about a foot deep. The type and location of this nest are typical of nests that were found in subsequent seasons. The young are flying by the end

of July (July 29 and 30, 1937—Skaggs). The Black Tern population of the Upper Lake has continued to grow, and the species is common also on the Hartstown marsh during the summer season. It is not an early migrant in the spring, May 8 (Skaggs) being the earliest date for the Linesville area. The species has disappeared from the Lake in September.

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Photograph by R. L. Fricke

FIG. 1. Nest and eggs of Black Duck.

Photograph by R. L. Fricke

FIG. 2. Nest and eggs of Pintail Duck, situated in clump of swamp dogwood (*Cornus* sp.)

Photograph by R. L. Fricke

FIG. 1. Nest and eggs of Ruddy Duck, situated in clump of bur-reed (*Sparganium*).

Photograph by R. L. Fricke

FIG. 2. Nest and eggs of Florida Gallinule, in cat-tails (*Typha latifolia*).

Photograph by R. L. Fricke

FIG. 1. Nest and eggs of Black Tern, on floating mass of vegetation.

Photograph by R. L. Fricke

FIG. 2. Nest and eggs of Least Bittern, in clump of spatter-dock (*Nymphea advena*). Duckweed (*Spirodela* sp.) covers the water.

ART. VII. *BELINURUS CARTERI*, A NEW XIPHOSURAN FROM THE UPPER DEVONIAN OF PENNSYLVANIA

By E. R. Eller

Xiphosurans were probably fairly abundant in the Upper Devonian seas of the Penn-York embayment. Although the geological and geographical ranges of the known records are widespread, fossil remains of Xiphosurans are rather rare. Casts or tracks have been reported from near the following localities in Pennsylvania: LeBoeuf, Lanesboro, Ridgeway, Warren, Uniontown, Corry, and Lewis Run, and in New York from Olean and Wellsville. Any new record of the occurrence of Xiphosurans is therefore of interest. Probably many more specimens would be found if a specific search was made.

Through the kindness of Dr. I. G. Reimann of the Buffalo Society of Natural Sciences, Buffalo, New York, a Xiphosuran belonging to the genus *Belinurus* was intrusted to me for study. The specimen was collected from the lower Cattaraugus beds at the Hanley Quarry, Lewis Run, Pennsylvania, six miles south of Bradford, Pennsylvania, by Mrs. A. L. Carter of Kenmore, New York, for whom the species is named. Although it is a rather poorly preserved specimen, almost all of the cephalothorax and abdomen are present and the telson is complete.

Belinurus carteri sp. nov.

The general shape of the specimen is similar to the modern king crab or horseshoe crab, *Limulus*. It has been flattened in preservation but there is no evident distortion which might change its proportions. Dimensions of the form are as follows: length 27.3 mm.; width 29.6 mm.; the telson is 10.9 mm. long and at the anterior end, 3.1 mm. wide.

The cephalothorax is semi-elliptical with the anterior margin probably well rounded. The posterior margin curves from the genal spines over the first abdominal segment, then forward to the rachial furrow. The genal spines are thick, of medium size in length, and extend backward to a point opposite the third pleural segment of the abdomen. The cardiac lobe is highly convex and irregularly triangular in outline. The lobe is partly missing and that which is present is so poorly preserved that very little

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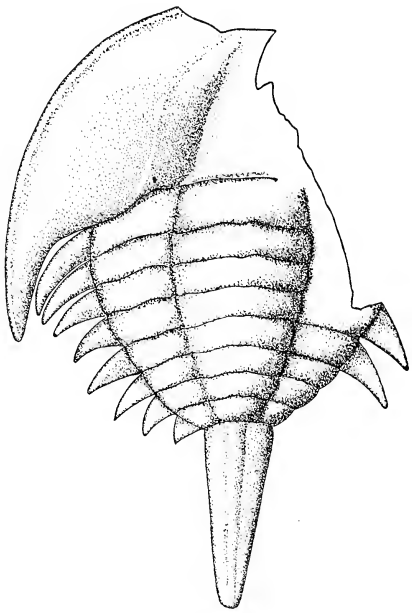
description of it is possible. The ophthalmic ridge is not very well preserved and is only faintly expressed on the form. It slopes gradually to the posterior of the cephalothorax at which point it blends into the curve of the margin where it overlaps the first segment of the abdomen. A slight widening of the ridge at about the midpoint may constitute the position of the compound eye.



TEXT FIGURE. Type of *Belinurus carteri* Eller, × 2.

This specimen is in the Museum of the Buffalo Society of Natural Sciences, no. E9644.

The flattened abdomen is sub-triangular in shape. It consists of eight segments separated from each other by well defined grooves. The first segment is the widest and the remaining seven are fairly uniform in width. It is not possible to determine from the specimen which segments are movable and which are anchylosed. The rachis is wide but narrows rapidly to the posterior. The pleural region is narrow. Each pleura bears a spine. The spines are long at the anterior segments but decrease in size posteriorly.

A short but wide and thick telson is present. At the anterior end it extends across the full width of both the rachis and pleura. In most

forms the telson is usually only as wide as the rachis. A ridge less than one third the width of the telson extends along its full length.

REMARKS

This form fits rather well within the characteristics of the Xiphosuran genus *Belinurus*. It has, however, two minor characters quite different, as far as the writer knows, from other species of *Belinurus*. The wider telson is especially a distinct character while the width of the rachis, as compared to the pleura, is exceptional. In other respects the form has individual characters similar to other species of the genus. The cephalothorax is similar to *Belinurus alleganyensis* Eller (1938) except that the posterior margin of *Belinurus carteri* m. is not as straight. The abdomen, except for the width and character of the rachis, is similar to *Belinurus koenigianus* Woodward (1866-1878), *Belinurus trechmanni* Woodward (1918), *Belinurus grandoeous* J. and W. (1899), and *Belinurus baldwini* Woodward (1908).

Caster (1930) figures a fragment of *Protolimulus eriensis* Williams from the same locality as the presently described form (Hanley Quarry, Lewis Run, Pennsylvania) and a Protolimulus, Caster (1930), from near Warren, Pennsylvania. The specimens figured by Williams (1885) and by Caster are shown in ventral views so they cannot be compared readily with *Belinurus carteri* m. The telsons of *Protolimulus eriensis* Williams and *Belinurus carteri* m. are very much alike. The long genal spines and the position, number, and character of the pleural spines differ greatly in both species. From the figures of *Protolimulus eriensis* Williams it would appear that the abdomen is short and the pleural segments must curve backwards since the pleural spines seem to originate along the posterior margin and point in a more or less perpendicular manner to the margin. There is evidence of only five (?) segments on *Protolimulus eriensis* Williams but the genal spines may hide additional ones from view. In examining a cast of Williams' specimen in a former study (Eller 1938), the writer was interested in its inorganic appearance. It resembled very much some of the mud-slipping structures so common in the Upper Devonian of that area. Perhaps the ventral side of the various specimens of *Protolimulus eriensis* Williams is somewhat distorted or was partially destroyed during burial and the result is its present appearance. If this is true, then there is a possibility that *Protolimulus eriensis* Williams is in reality a *Belinurus* and *Belinurus carteri* m. might be referred to that species after further study of better specimens.

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ART. VIII. A NEW GOPHER FROG FROM THE GULF COAST, WITH COMMENTS UPON THE *RANA AREOLATA* GROUP

By Coleman J. Goin, University of Florida
and
M. Graham Netting, Carnegie Museum

(Plate XII)

A study of Florida amphibians has shown that the Gopher Frog which inhabits extreme eastern Louisiana and southern Mississippi is sharply distinct from *Rana capito* Le Conte, the Gopher Frog of Florida, Georgia, and the Carolinas, and equally distinct from *Rana areolata* Baird and Girard, the Crayfish Frog, which ranges from Texas to Indiana. Although well represented in various collections, this frog has remained undescribed principally because there are no examples of it in the United States National Museum collection, which includes the types of *areolata*, *aesopus*, and *capito*. A worker as careful as Francis Harper would not have overlooked this frog when he synonymized *aesopus* with *capito* (Harper, 1935) if specimens of it had been at hand for comparison with the several types.

The new species, with a wartier and more heavily pitted dorsum than any other North American *Rana*, probably secretes large quantities of mucus, and may, therefore, be called

Rana sevosa[1], new species

(Plate XII)

Dark Gopher Frog

1922. *Rana areolata* Löding (not of Baird and Girard), Alabama Mus. Nat. Hist., paper no. 5:19.
1931. ?*Rana aesopus* Viosca (not of Cope), Southern Biol. Supply Co., Price List no. 20—Herpetology: 7.
1932. *Rana aesopus* Allen (not of Cope), Amer. Mus. Novitates, no. 542: 9.
1938. *Rana areolata* Burt (not of Baird and Girard), Trans. Kansas Acad. Sci., 41: 349 (part).

Type.—Carnegie Museum No. 16809, adult male, collected at Slidell, Saint Tammany Parish, Louisiana, April 11, 1926, by Percy Viosca, Jr.

[1]Medieval Latin *sevosa* (slimy, tallowy) from classical Latin *sebosa* (tallowy).

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Paratypes.—Fifty, all from Mississippi, as follows: CM 4944, CM 18116-18117, CM 18184-18197, from Van Cleave, Jackson County; MZUM 76921 (9 specimens) and MZUM 71777 (2 specimens) from Vestry, Jackson County; FMNH 11511-11514 and MCZ 15803-15806 from Jackson County; AMNH A37089-37099 and FMNH 21610 from Biloxi, Harrison County; and CM 5407-5408 from near Biloxi, Harrison County.

Diagnosis.—A dark, medium-sized *Rana* with a very warty dorsum and a heavily spotted venter. Its dorsal spots are frequently indiscernible from the dark ground color, but when distinct they are irregular in shape and are not outlined with a light color. *Rana sevosa* can be distinguished from both races of *areolata* by its spotted venter, lack of circular, light-bordered dorsal spots, warty dorsum with broad dorsolateral folds, and broad head. *Rana sevosa* differs from *capito* in having a darker ground color, heavier and more extensive ventral markings, broader waist, narrower dorsolateral folds, wartier dorsum, and dark hind limb bars which are broader than the light spaces between the bars.

Description of type.—Form moderate; body depressed; limbs short and stout; head broad posteriorly and tapering rapidly to snout, triangular in outline from above, moderate in profile, and with the dorsal surface slightly depressed; muzzle subacuminate; snout protruding beyond lower jaw; a small, indistinct, semicircular vocal sac behind the angle of the jaw and below the postlabial fold on each side of the head.

External nares halfway between eye and tip of snout, slightly below canthus rostralis; internarial distance greater than interorbital distance; canthus prominent; loreal region concave; eyes medium-sized, slightly longer than their distance from the nares; tympanic membrane nearly round, separated from the eye by about two-thirds of its own diameter, which is in turn about two-thirds the diameter of the eye; angle of jaws extending to below rear of tympanum, separated from it by about one-half the diameter of the latter; tympanum partly encircled posteriorly by a narrow groove which extends from posterior margin of eye to above axilla; this groove is overlapped by a heavy diagonal post-tympanic fold that leaves the dorsolateral fold immediately above the tympanum and extends obliquely downward to the postlabial fold on left side of head but fails to reach this fold on right side; the upper jaw becomes increasingly swollen posteriorly and gives rise to a broad, longitudinal postlabial fold that terminates at a point above the posterior insertion of the forelimb.

Dorsolateral folds, broader than high and heavily pitted, originate on the canthus rostralis slightly anterior to the nares, diverge backwards and cover the entire median halves of the upper eyelids; then curve sharply outwards immediately behind the eyelids, expand greatly at the points of junction with the post-tympanic folds, and extend backward as broad folds

(occasionally broken by deep, narrow, transverse creases) to the posterior third of the body.

Entire dorsum (between dorsolateral folds) and sides—but not top of head—studded with numerous, rounded, elongate, glandular warts, which are similar to the dorsolateral folds in texture; most of the dorsal warts twice as long as broad and some fused to form short folds; lateral warts round or slightly elongate but more widely spaced and invariably separate; top of head and spaces between warts finely pustular.

Ventral surfaces of body and limbs smooth except for femora and posterior part of belly, which are very slightly granular; no subgular fold present; a conspicuous interaxillary fold of skin on breast; from interaxillary fold on each side an oblique fold extends towards, but does not reach, angle of jaw.

Forelegs short, rather heavy, skin of body extending out only slightly on humerus; free portion of upper arm shorter and more slender than forearm; hand longer than forearm; palm with one large, rounded tubercle at base of central digits, a smaller elongate tubercle at base of fourth, and an indistinct, rounded tubercle above base of thumb; subarticular tubercles prominent; fingers four, stout, not webbed at base, not dilated at tips—third longest, first shorter, fourth and second nearly equal; thumb slightly swollen, with pale gray nuptial pad.

Hindlegs medium length, stout; tibio-tarsal articulations overlap slightly when femora are at right angles to body; tibio-tarsal articulations reach orbits when legs are adpressed; a transverse fold of skin across knee, another across heel, a rather indistinct tarsal crease; a narrow, longitudinal fold on upper surface of tibia; a distinct tarsal fold from fold of skin across heel to base of inner metatarsal tubercle; a short, indistinct fold along outer edge of tarsus; tibia slightly longer than femur; tarsus slightly more than one-third the length of whole foot; two metatarsal tubercles, the inner larger, elongate, and about one-third the length of first toe, the outer small and rounded; subarticular tubercles distinct; toes slender, not dilated at tips—4-3-5-2-1 in order of decreasing length, the third reaching to middle of the antepenultimate phalanx of the fourth; toes fully webbed to proximal half of antepenultimate phalanx of fourth, penultimate of third and fifth, ultimate articulation of first and second; ultimate phalanx of each toe completely free of web; toes three, four, and five margined to ultimate articulation.

Tongue large, obovate, greatest width slightly less than half that of mouth at angles of jaws, widest just posterior to center; anterior two-thirds broadly attached; two short horns on posterior margin indented from posterior corners and separated by median notch; internal nares subcircular, well forward; maxillary teeth small, distributed along whole length of jaw; vomerine teeth small, few in number, on two oval clumps between internal nares from which they are separated by the width of a naris; widest apart anteriorly and almost in contact posteriorly.

Coloration of type (preserved).—Ground color above buff gray, changing

to ash gray on sides; the former color largely, and the latter partially, concealed by numerous dark brown, irregular spots; spots largest on central portion of back and generally extending on each side of oval dorsal warts, superimposed on dorsolateral folds, usually co-extensive with rounded lateral warts; spots bordered only by adjacent ground color and without light centers. Lower half of upper lip, loreal, and postocular regions buff gray with small fuscous markings; upper portion of upper lips and also top of head with irregular, dark brown spots; tympanum with asymmetrical light gray blotch surrounded by, and partially overlaid with, small brown spots. Forelegs with four or five short, dark bars; femur, tibia, and tarsus crossed by about four heavy, dark brown bars, separated by narrow interspaces of ash gray; distinct brown bands on toes four and five; small pale spots on toes one to three; concealed surface of tarsus heavily spotted; rear surfaces of thighs with large black blotches separated by gray interspaces. Entire ventral surface buff, all except central portions of thighs thickly sprinkled with fuzzy gray markings, largest on distal halves of thighs.

Measurements of type (in millimeters).—Snout-to-vent length, 82.5; head length (snout to posterior edge of tympanum), 28.5; head width (at posterior angles of jaws), 35; snout to naris, 7; naris to eye, 6.5; internarial distance, 6.5; interocular distance, 5.5; length of eye, 8; diameter of tympanum, 6; forearm, 18.5; hand, 20; longest finger, 15; femur, 36.5; tibia, 37.5; tarsus, 22; whole foot, 60; fourth toe, 38; interolecranal extent (distance between elbows when humeri are extended in the same line at right angles to longitudinal axis of body), 59.5; intergenual extent (distance between knees when femora are extended in the same line at right angles to longitudinal axis of body), 69; tongue length on median line, 18.5; length of horn, 3; tongue width, 15; interior internarial distance, 9; distance between ostia pharyngea, 22.5; distance from internal nares to ostia pharyngea, 14.

Variation.—The numerous paratypes of *sevosa* are remarkably uniform in all important characters. The one that shows the greatest variation, namely, the prominence of the dorsal warts, probably reflects differences in preservation rather than significant variation in nature. Dorsal warts are always present, numerous, and readily visible, but they vary considerably in elevation and in shape; some are circular, some are elongate-oval, and some are long ridges. The wartiest specimens are without any areas of smooth skin on the sides or back, the large warts being separated by a pebbling of fine granules and small warts. The large warts, the secondary warts, and the various folds are heavily and uniformly pitted.

The dorsolateral folds begin at the nostrils, extend backwards over the upper eyelids, and terminate at a point opposite the sacral hump, or extend beyond this point halfway to the hind limbs. A glandular ridge extends from the coccyx forward to about the presacral articulation, on each side of

the mid-dorsal line, in some specimens. A narrow, longitudinal tibial fold of variable length is visible in the more rugose specimens, and short, accessory folds or rows of warts may occur. Two tarsal folds are normally present, but these are difficult to see in soft specimens.

The fingers are usually 3-1-4-2 in order of decreasing length but occasionally 3-4-2-1 or 3-1-2-4. The toes are normally 4-3-5-2-1, but one specimen has 4-5-3-2-1 on one side. The webbing on the fourth toe is usually broadly attached at, or beyond, the antepenultimate articulation and extends forward as a margin of decreasing width to the ultimate; in one specimen it is broadly attached at the penultimate. The vomerine patches are not in contact in any specimen, but they vary from very slight separation to separation equalling their short diameter.

In dorsal coloration the paratypes range from an almost uniform black to a pale gray or light brown ground color with superimposed reddish brown or dark brown spots. None of the specimens is as light in ground color as *capito*, and none has dorsal spots encircled with light borders as in *areolata*. The venter is invariably thickly spotted anteriorly, but the spots, which lack sharp edges, vary in shape from amoeboid or vermiculate to mere concentrations of fine stippling and range from light gray or brown to red-brown in color. They are superimposed on a dirty white or tan background, which may be finely stippled with gray. The chin, throat, and pectoral areas are always spotted; the posterior portion of the belly and the central lower surfaces of the thighs are usually well-spotted in males and immaculate or lightly marked in females.

The femur, tibia, and tarsus are usually crossed with dark bars, but in a few specimens these are distinct only upon the anterior face of the femur. The bars vary in width, and the gray or brown interspaces that separate them range from very narrow to almost the width of the bars. When the interspaces are broad they may contain irregular dark spots or short lenticular interbars. The concealed surface of the tarsus is invariably well-spotted.

Secondary sexual characters.—No sexual differences in general body form have been observed. Variations in relative head length, head width, tibial length, and tympanic size appear to be individual rather than sexual. The forelegs of adult males are moderately enlarged. A nuptial pad, uniform gray in color, is present on the inner side of the first finger of all males except the three smallest specimens. The external vocal sacs, consisting of loose folds of dark skin above the forearm, may be hard to distinguish in preserved specimens; in undetermined specimens, slitting the

skin in this region is usually sufficient to demonstrate the presence or absence of the subdermal vocal pouch. The feet of males are somewhat more extensively webbed than are those of females. In the series examined, the males average much darker above than the females, but this distinction may not hold good with living material. The posterior portion of the belly, the inner surfaces of the forearms, and the central inferior thigh surfaces are normally well-spotted in males and immaculate or lightly spotted in females. There is a marked difference in adult size of the two sexes: 21 Mississippi males range from 62-84 mm (average, 73.6) in snout-to-vent length; 29 Mississippi females range from 73-92.5 mm (average, 82.3).

Habits and habitat.—Allen's (1932: 9) account of *Rana aesopus* in Harrison County, Mississippi, was based entirely upon observations of *Rana sevosa*. Practically all extant specimens of *sevosa* were collected by Morrow J. Allen, Stewart Springer, or their associates, in southern Mississippi. Neither they nor any other collectors have secured either *capito* or *areolata*, as now restricted, in this area. Furthermore, Allen states that he deposited specimens of each species in the American Museum of Natural History, and eleven Biloxi specimens of "*Rana areolata*," from that institution, have been examined by us and are here listed as paratypes of *sevosa*. Allen's account is quoted in full: "This species has been abundantly found throughout the months of October, November, and December in the burrows made by *Gopherus polyphemus*. When the temperature rises, these frogs become active and may be seen sitting in the openings of the tunnels down which they disappear at the least indication of danger. In colder weather they are never at the surface and can only be taken by digging to the bottom of the gopher hole, where never more than one is found in company of one or two turtles. The only specimen taken near the coast was found in a pool of water on January 25, 1931. Ten or twenty miles inland gopher holes are numerous and it is in this region that this frog has been found in quantity."

Fortunately, while this description was in course of preparation, Stewart Springer visited Pittsburgh and contributed additional information upon the habits of *sevosa* from memory. He recalled finding these frogs breeding in the water in southern Mississippi concurrently with *Hyla gratiosa* and *Hyla cinerea cinerea;* Allen (*supra cit.:* 8) reports the former breeding near Biloxi on April 18 and 19, and the latter "as soon as the weather becomes warm and settled." Mr. Springer further reported that the eggs, in masses about the size of two fists, are laid under water at a depth of approximately

one foot and are attached to plant stems. He stated that *sevosa* is less restricted to cypress swamps for breeding sites than is *gratiosa*, since the former occurs also in pine barren ponds, even those of temporary character. The call, as he remembered it, is less snore-like than is that of *capito*. He found that frightened individuals dive and swim along the bottom of the pond.

DISCUSSION OF THE *RANA AREOLATA* GROUP

COMMENTS UPON THE MEASURING OF FROGS

At the beginning of this study we decided to test the validity of certain measurements that are frequently made on frogs by measuring our series independently and comparing our results. Measurements are usually made to prove that individual animals differ from others of their kind in actual size; that body proportions depend upon age and/or sex; and that size ranges and growth ratios vary in different populations (ecologic, geographic, subspecific, specific, etc.). Published tabulations are frequently accepted as accurate merely because the component figures have been carried to several decimal places, because some mathematical device or formula has been used, or because the columns of figures appear too formidable for analysis. The following appear to be the chief variables that affect the accuracy of frog measurements: (1) the use of different techniques, instruments, and standards by different workers; (2) the factor of personal bias even in those rare instances in which the same methods of mensuration are used; and (3) the condition of the preserved specimens. The first variable can be eliminated entirely by establishing standard practices; the second can be discounted by measuring test series and determining the percentage of error due to personal bias; and the third, which cannot be avoided in all studies, can be eliminated from statistical studies by the use of fresh, uniformly preserved material. In our investigation we used the same instruments and agreed upon a definite method of taking each measurement, as detailed below. We determined our personal errors in mensuration, and upon this basis we recommend dropping from current usage those frog measurements in which the differences resulting from personal bias approach the magnitude of the actual size variations in the specimens. In this descriptive study we were obliged to use specimens that ranged in condition from flabby to well preserved.

Snout-to-vent length.—Previous tests have convinced the junior author

that the average worker can measure snout-to-vent length with more consistent accuracy than snout-to-coccyx length, at least in frogs of the genus *Rana*. In smaller frogs of certain genera the latter measurement may be preferable. The decision as to which of these measurements should be used in a particular group should be left to the individual monographer, but it is incumbent upon all writers to indicate which measurement is taken. In measuring snout-to-vent length, we placed each frog upon its belly on the table with its head to the left; exerted pressure with the fingers to flatten any unusual sacral curvature, and tightened vernier calipers until the righthand point touched, but did not compress, the tissue surrounding the vent. Readings were taken to the nearest half millimeter. In this method our individual readings did not differ more than one millimeter in 95 per cent of the test series, and the maximum divergence was two millimeters.

Head length.—Herpetologists measure the head length of frogs in three fashions: (1) snout to the posterior border of the tympanum; (2) snout to articulation of the skull with the vertebral column; and (3) snout to the angle of the jaws. The first method should not be used with frogs which have sexually dimorphic tympana, but in others it is a rapid and accurate measurement. We measured the distance on the left side of the head from the center of the snout to the posterior edge of the tympanic membrane, exercising care to avoid pressing the caliper point into the snout. In 80 per cent of our test series the readings agreed exactly or differed by one-half millimeter; in the remainder the difference did not exceed one millimeter.

Head width.—This measurement can be taken in two ways: by passing the calipers, held vertically, back over the head to the exact angles of the jaws; or by holding the calipers horizontally and sliding the arms back along the upper lips to the same point (in the *areolata* group specifically to the crease marking the beginning of the postlabial fold). The latter method is more accurate in forms with lateral vocal sacs, since in male frogs the anterior folds of these sacs may prevent closing vertically placed calipers to the exact head width. In 25 of a test series of 27 specimens our figures agreed to one-half millimeter or less; they differed by one millimeter in two instances.

Tibia (=*tibio-fibula*) *length.*—The measurement of the distance from the convex surface of the "knee" to the convex surface of the "heel," with both tibia and tarsus flexed, proved slightly more variable than the preceding measurements but it is sufficiently accurate for routine taxonomic studies. In 70 per cent of the test series our figures agreed to one-half millimeter or less; in the remainder, usually to one millimeter.

Fourth toe length.—This measurement is far less accurate than any of the preceding and should be attempted only in forms that display wide variation in this character. If the toe is measured from the tip to the distal side of the subarticular tubercle, two variables are present: uniform flattening and straightening of the toe is difficult; and the tubercle, which is attached to loose skin, may slide several millimeters in either direction as the measurement is taken.

Interolecranal extent.—The distance between the elbows when the humeri are extended at right angles to the long axis of the body is affected by preservation, by the position in which the frog is held when the measurement is taken, and by the amount of tension exerted to bring the humeri to right angles. We have found that if this measurement is taken with the frog held ventral side uppermost, the resulting figure is always considerably lower than that obtained when the measurement is taken from the dorsal side. The arms of a specimen may be broken very easily in attempting this measurement.

Intergenual extent.—The distance between the knees when the femora are extended at right angles to the body may be measured by different persons with reasonable consistency if the frog is placed belly downwards and its legs are pressed against the table and into a right angle position. It cannot be taken accurately upon large frogs held in the hand. Furthermore, specimens preserved with the hindlegs extended cannot be used for an accurate intergenual measurement.

Conclusion.—We believe that in routine studies of moderate-sized frogs (50-100 mm), by workers using the same techniques but differently preserved material, snout-to-vent length, head length, head width, and tibia length are the only measurements that can be taken with sufficient accuracy to be worth tabulating or publishing. A single worker using uniform material may be justified in making other measurements. Two investigators, using exactly the same methods, should be able to measure distances of over 50 mm in frogs with an individual error of about 2 per cent when using miscellaneous specimens and about 1 per cent when using uniformly preserved material. Features less than 10 millimeters in size are rarely worth measuring in frogs of this group, since the errors in mensuration often exceed the individual variation that occurs in specimens of comparable size. Comparison of various small features in the same specimen by means of general statements, such as "tympanum one-half diameter of eye" is preferable to using measurements with large inherent errors.

KEY TO THE FORMS OF THE *RANA AREOLATA* GROUP

1. Chin and throat thickly spotted; belly spotted or unspotted; dorsal spots irregular in shape and without distinct light borders; head relatively broad, width of head in snout-to-vent length 2.1—2.6 times.....2

   Chin and throat unspotted except at sides; belly immaculate; dorsal spots rounded and encircled with light borders; head relatively narrow, width in snout-to-vent length 2.6—3.1 times.....3

2. Head triangular in outline; dorsolateral folds high and relatively narrow; dorsum with numerous prominent warts; dorsal spots poorly differentiated from gray, brown, or black ground color; venter always spotted at least from chin to midbody; dark bars on hindlegs separated by interspaces that are never wider than the bars..*Rana sevosa*, sp. nov.

   Head subtriangular in outline; dorsolateral folds low and very broad; dorsum smooth or lightly warty; dorsal spots distinct against pale ground color; chin and throat spotted; belly usually immaculate posteriorly; dark bars on hindlegs separated by light interspaces that are wider than the bars.....*Rana capito* Le Conte

3. Head U-shaped in outline when viewed from above; dorsum often smooth, or nearly so; tibia length less than 40 mm in adults; post-tympanic fold poorly developed; dorsolateral folds narrow or only slightly raised, or both.....*Rana areolata areolata* Baird and Girard

   Head orbiculate in outline when viewed from above; dorsum rugose; tibia length more than 40 mm in adults; post-tympanic fold well developed; dorsolateral folds prominent..*Rana areolata circulosa* Rice and Davis

COMPARISON OF THE SPECIES

Size.—The largest of the forms is *a. circulosa* in which males reach 108 mm in snout-to-vent length (our measurement) and females, 113 mm (Wright and Wright, 1933: 150). The largest of 6 Oklahoma males of *a. areolata* was 87 mm in length and the single Oklahoma female was 91 mm long. The largest male *sevosa* among 22 specimens was 84 mm long, and the largest of 29 females was 92.5. Wright and Wright (1933: 148) give 101 and 108 mm as the maximum size of male and female *capito*. On the basis of maximum size attained the forms may be arranged in descending order as follows:

a. circulosa———*capito*———*sevosa*———?———*a. areolata*

Body form.—The form with the stoutest body and largest limbs is *a. circulosa*. In general proportions *a. areolata* and *sevosa* are quite similar; both have rounded bodies that are broadest about midway between the fore and hind limbs, and both have moderately heavy limbs. In contrast, *capito* is broadest in the pectoral region and tapers rapidly to a distinct "Gibson Girl" waist. From a rounded body to a triangular body the order is:

a. circulosa———*a. areolata*———*sevosa*———*capito*

Actual head shape.—The shape of the head when viewed from above is

orbiculate in *a. circulosa*, U-shaped in *a. areolata*, triangular in *sevosa*, and subtriangular in *capito*. The general head shape is affected by the length of the snout anterior to the orbits, as well as by the relative breadth and width of the head. *R. capito* has the broadest head in proportion to body length and also has the longest snout, but the tip of the snout is obtusely rounded; *sevosa* stands next in relative head width and in snout length, but its snout is acute rather than obtuse as in *capito;* both races of *areolata* have short snouts, but specimens of typical *areolata* have relatively narrower heads than specimens of *circulosa* and they differ further in exhibiting but little increase in head width posterior to the rear corner of the eye. From a relatively short to a relatively long snout the order of arrangement is:

a. circulosa———*a. areolata*———*sevosa*———*capito*

Ratio of head width in snout-to-vent length.—Both visual observations and measurements indicate that the ratio of head width to body length differs in each species, although Burt (1938: 349) denies that any significant difference in head width occurs between *areolata* and *capito*. This ratio ranges from 2.2-2.3 (average, 2.3-) in 7 *capito;* from 2.1-2.6 (average, 2.4) in 51 *sevosa;* and from 2.6-3.1 (average, 2.9) in 24 *areolata*. No intra-specific trend in proportionate head width is to be expected in stenotopic *sevosa*. Such a trend may be demonstrable in *capito* when series from the extremes of its range are available for comparison. A geographic gradient occurs in eurytopic *areolata;* 7 Indiana males of *a. circulosa* have ratios of 2.6-3.0 (average, 2.8), while 6 Oklahoma males of *a. areolata* have 2.7-3.1 (average, 2.9). From a relatively narrow to a relatively broad head the order of arrangement is:

a. areolata———*a. circulosa*———*sevosa*———*capito*

Ratio of head length in snout-to-vent length.—Measurements confirm the easily observed fact that both *sevosa* and *capito* have longer heads in proportion to body length than *areolata*. The head length enters the snout-to-vent length in 7 *capito* 2.6-2.7 times (average, 2.7-); in 51 *sevosa* 2.5-3.0 times (average, 2.8); and in 24 *areolata* (both races) 2.8-3.3 (average, 3.1). The *areolata* ratios suggest that on the average *a. circulosa* has a relatively shorter head than *a. areolata*, but much larger series are necessary to establish this gradient. From a relatively short head to a relatively long head the order is:

a. circulosa———?———*a. areolata*———*sevosa*———*capito*

Actual tibia length.—The length of the tibia is a useful character in separating the two races of *areolata;* in 8 specimens of *a. areolata* the tibia

length ranges from 33 to 38.5 mm while in 17 *a. circulosa* the range is from 40.5 mm to 50.5 mm. The length of the tibia in *sevosa* and *capito* seems closer to that of *a. areolata* but in both species the actual length of the tibia is sometimes more than 40 mm; the largest *capito* we have seen has a tibia length of 41.5 mm and the largest *sevosa* 43.5 mm. There is some indication that Coastal Plain *a. circulosa* have slightly shorter tibiae than Central Lowland specimens, but larger series are necessary to establish this gradient.

Ratio of tibia length in snout-to-vent length.—In 24 specimens of *areolata* the tibia length is contained in the snout-to-vent length from 1.7-2.5 times (average, 2.1); in 7 *capito* the range is from 2.0-2.2 (average, 2.1); and in 51 *sevosa* the range is from 1.9-2.3 (average, 2.1). The *areolata* ratios are so variable that no generalization regarding subspecific variation in relative tibia length can be made until much larger series have been measured.

Finger length.—The three species of the *areolata* group do not exhibit any extra-specific variation in relative lengths of the fingers. The third finger is invariably the longest, but it projects beyond the tip of the next longest finger (usually the first, rarely the fourth) by only the length of its short terminal phalanx. The remaining three fingers are of very nearly equal length, but the first is generally slightly longer than the fourth, which in turn is slightly longer than the second. Thus, in 77 specimens of the group, the formula in order of decreasing length was 3-1-4-2 in 63, 3-1-2-4 in 12, and 3-4-2-1 in 2. The observed variations are not significant in view of the close similarity in actual length of fingers 1, 2, and 4.

Toe length.—In relative lengths of toes there is more variation between individuals than between the species. From 2 to 2.5 phalanges of the fourth toe project beyond the tip of the third; the latter is variable in length, ranging from much longer than the fifth (occasionally) to slightly longer (usually) or shorter (rarely). The second and first toes are much shorter than the other toes and exhibit little variation in relative length. The toe formula was 4-3-5-2-1 in 80 specimens and 4-5-3-2-1 in 2.

Webbing.—Intra-specific variations in extent of webbing exhibited by frogs of the *areolata* group are of three kinds: (1) subspecific, (2) sexual, (3) individual. Subspecific variations in the species *areolata* indicate a geographical gradient in foot character similar to that which occurs in the *Rana pipiens* group and in certain other eastern frogs. Specimens of *a. circulosa* have large feet with toes that are broad, blunt, and capable of wide spread. Specimens of *a. areolata*, however, have much smaller feet with narrower and less blunt (but not pointed) toes which cannot be

spread so widely. The total amount of web is much greater in *circulosa*, and the broad portion of the web tends to extend a little farther on the fourth toe in this race. Males of both races of *areolata* and males of *sevosa* have slightly greater palmation than do females. The same condition may occur in *capito*, although the nature of our specimens prevents a definite statement. There is some individual variation in the extent of webbing in all three species; part of this may be the result of differences in preservation. It should be noted also that many of the extant specimens of *sevosa* were kept alive for some time after collection and many have the tips of the toes badly abraded. Nonetheless, one well-preserved male of *sevosa* has the web broadly attached at the penultimate articulation of the fourth toe, although the normal condition is attachment a little beyond the antepenultimate articulation.

In foot and toe characters and in amount of webbing *sevosa* is extremely similar to *a. areolata*. In both the feet are of moderate size, the toes are of moderate width, and the web is broadly attached at or beyond the antepenultimate articulation of the fourth toe and extends as a narrow margin to the ultimate articulation. In *a. areolata* the marginal web is usually quite narrow back to its junction with the broad web, but in *sevosa* the marginal portion gradually increases in width proximally so that it forms a small triangle on either side of the antepenultimate phalanx of the fourth toe. Of the four forms *capito* has the smallest feet. Its toes are narrow and definitely pointed, the broad portion of the web does not quite reach the antepenultimate articulation of the fourth toe, and the marginal portion extending to the penultimate or ultimate articulation is quite narrow. From greatest to least amount of webbing the order is:

a. circulosa———sevosa———a. areolata———capito

Vomerine separation.—Each species has two short, more or less oblique series of vomerine teeth situated close together between the choanae. These are widely separated anteriorly and vary posteriorly from contact to slight separation (permitting insertion of a knife blade) or wide separation (permitting passage of a paper clip). Tabulation in these three categories indicates that there is a greater tendency toward fusion of the vomerine patches in *areolata* than in *capito* or *sevosa*. Thus, of 22 *areolata*, the vomerines were in contact in 6, slightly separated in 14, and well separated in 2; of 9 *capito* the vomerines were slightly separated in 4, and well separated in 5; of 51 *sevosa* the vomerines were slightly separated in 10, and widely separated in 41. Our figures fail to indicate a trend in vomerine separation within the species *areolata*, but they permit arrange-

ment of the three species in order from closely placed to well-separated vomerines, as follows:

areolata———*capito*———*sevosa*

Glandular folds.—The dorsolateral folds are least prominent and narrowest in *a. areolata*, in which they appear to originate at the rear of the upper eyelids, to broaden slightly above the tympana, and to extend backwards to the groin as narrow, slightly raised folds. In *a. circulosa* the folds originate on the upper eyelids, become very broad above the tympana where strong post-tympanic folds branch downward, and then extend backward as narrow, well-elevated folds to the groin. In *sevosa* the folds diverge from a common point of origin near the nostrils; pass over the upper eyelids, forming a depressed triangle on the top of the head between their inner margins; curve outward above the tympana; and extend backward as well-elevated folds of uniform and moderate width to the sacral region or slightly beyond; a more or less interrupted post-tympanic fold occurs in most specimens. In *capito* the folds follow the same course as in *sevosa*, but they are not nearly so distinct anteriorly, and posterior to the upper eyelids they become low, very broad folds which extend to, or almost to, the groin; no distinct post-tympanic fold is evident in the specimens which we have examined. *R. sevosa* has the shortest dorsolateral folds and longest and best defined postlabial folds; *a. circulosa* has the best developed post-tympanic folds; and *capito* has the broadest dorsolateral folds. From narrow to broad dorsolateral folds the order of arrangement is:

a. areolata———*a. circulosa*———*sevosa*———*capito*

Coloration and markings.—Of the three species *Rana sevosa* has the darkest dorsal coloration and the least amount of contrast between ground color and dorsal spots. Many of the paratypes are uniform black above, a condition that appears to be more characteristic of males than of females. The lightest specimens have a gray or brown ground color and dorsal spots that range from red brown to dark brown but are not black. The dorsal color and pattern are continued over the folds, which are never distinctively colored. The preserved specimens offer no indication that yellow was present on any part of the body in life. Metachrosis has not been reported in this species but may be expected to occur within a narrow color range.

R. capito has the lightest ground color, varying from creamy white to dark brown through various shades of yellow or purple; the dorsal spots are dark brown or black (Dickerson, 1908: 195). Males frequently have bright yellow dorsolateral folds, and the same color may occur on the warts,

along the upper jaw, and in the axillae and groin. Wright (1932: 338) states that color change in this species is not so rapid as in tree frogs, and he questions whether an individual frog in its normal environment would change from nearly black to white, as reported by Dickerson. The light coloration of *capito* is responsible for the vernacular name "White Frog" which is used in some parts of its range. When examined under very low magnification, most *sevosa* and *capito* display innumerable, minute pale gray or whitish spines over the entire dorsal surface, as illustrated in pl. XII, fig. 2.

The dorsal coloring and pattern of *areolata* vary individually, seasonally, and subspecifically. Color change within a period of a few hours has not been reported in this species, although Wright and Wright (1933: 151) state "When plowed out in early spring they [*circulosa*] are so dark as to be almost blackish" and "When cold and wet the frogs were very dark." The brown or black dorsal spots are variable in number and size; they are sharper edged and more nearly circular than in the other species and are usually distinctly bordered with yellowish, whitish, or cream color. The dorsolateral folds, the groin, and the concealed portions of the limbs are frequently yellow or greenish yellow in males. On the basis of preserved material and published descriptions it appears that *circulosa* has dorsal spots that are larger, darker, more constant in number, and more broadly light-bordered than *areolata*. Some *circulosa* are among the most marked North American Ranas, but even in our limited series considerable variation in amount of contrast between spots and ground color is evident. Until adequate series of fresh specimens of the two forms permit a careful appraisal of the extent of pattern variation in each subspecies, the identification of single, preserved specimens on the basis of pattern alone is inadvisable.

Although the appearance of the frogs is profoundly affected by metachrosis and by amount of contrast between spots and ground color it is possible to arrange the forms in a linear sequence on the basis of ground color alone; from light to dark ground color the order is:

capito———*a. areolata*———*a. circulosa*———*sevosa*

In ventral pattern *capito* is the most variable; *sevosa* is less variable; and *areolata* is surprisingly constant, with the two subspecies failing to exhibit any differentiation in this character. All specimens of *capito* have more or less separated vermiculations of brown or black on the chin and throat. In some the spotted area includes the anterior half of the belly as well, and occasionally (probably in males only) almost the entire

venter is spotted. In *sevosa* the entire anterior half of the lower surface is thickly covered with spots and dusky markings; in males the remainder of the lower surface, except for a small pubic area, is spotted, whereas in females the central lower thigh surfaces and the posterior portion of the belly are usually immaculate. Ventral markings in *areolata* are restricted to a few spots along the mandibles and to small concentrations anterior to, or between, the fore limbs; the latter spots may almost form a narrow bridge across the pectoral region. The concealed surfaces of the hindlegs are invariably spotted in *sevosa*—more heavily in males than in females; *capito* has the concealed surfaces entirely immaculate or spotted laterally; and *areolata* always has the concealed surfaces immaculate. From an immaculate to a heavily spotted venter the order of arrangement is:

areolata———*capito*———*sevosa*

Secondary sexual characters.—Adult males of the three species of this group agree in having slightly enlarged forearms, a gray nuptial pad on the inner side of the inner finger (frequently blotched with dark in *circulosa*) and lateral vocal pouches. In each form the maximum size is attained by females. The forms differ in sexual dichromatism and in the size and distinctness of the vocal sacs. Male *capito* often have the dorsolateral folds, warts, axillae, and groin marked with yellow; some yellow or greenish yellow is evident in certain males of both races of *areolata; sevosa* males generally tend to be darker and more heavily marked than females, but there is no evidence that yellow enters into the coloration of either sex. The external vocal sacs of *capito* begin at the posterior angle of the jaws and extend as plated folds of skin above the arms to or beyond the axillae. In life the vocal pouches of *capito* may inflate almost as far back as the groin. Wright (1932: 340) says, "It constitutes the most striking development in vocal sacs I have seen in North American Salientia." The external vocal sacs of *sevosa* are similar in position to those of *capito* but they are not distinctively colored and hence are less prominent in preserved specimens than those of the other forms. The sacs in *a. areolata* are gray or gray-spotted ovals of loose skin extending from the angle of the jaw to above the forearm in preserved material. The vocal pouches of *a. circulosa* are similar in position and color but much larger. Published descriptions of calling males indicate that the sacs of *circulosa* are reniform or sausage-shaped when inflated and approximately the size of the frog's head. The size and shape of the inflated pouches of *a. areolata* or *sevosa* cannot be inferred from the appearance of the sacs in preserved specimens. In order of prominence, from small and indistinct to large and very dis-

tinct vocal sacs, preserved specimens of the forms may be arranged as follows:

sevosa———*capito*———*a. areolata*———*a. circulosa*

COMPARATIVE LIFE HISTORIES

The published references that can be allocated to *a. areolata* alone contain no life history data. Information upon the life history given in general discussions of the species *areolata* most probably refers solely to *a. circulosa.*

Breeding season.—*Rana a. circulosa* has been reported as breeding in March and April, and Smith (1934: 479) says it may breed in May. The breeding season of *capito*, as would be expected, extends over a greater period of time. The earliest breeding date on record is February 26 (Carr, 1940b: 55), and the latest is November 3 (Carr, 1940a: 64). The latter date is probably a "calling" rather than a "breeding date" for neither Carr, nor any other writer, offers evidence that *capito* lays eggs later than June. As reported elsewhere in this paper *sevosa* has been found breeding, in the Biloxi region, in mid-April.

Voice.—The voice of *circulosa* has been variously described: Gloyd (1928: 118) says that the call is as deep as that of *catesbeiana* but with more carrying power and less resonance; Thompson (1915: 6) states that it is a loud trill, hoarser than the call of *pipiens* and higher than that of *catesbeiana;* and Smith (1934: 479) reports that the call carries a mile or so. All writers agree that the call of *capito* is best described as a snore or snore-like groan. The voice of *sevosa* is of the same type as that of *capito*, but it is less like a snore.

Eggs.—Smith (1934: 479) states that the eggs of *areolata* [*circulosa*] are laid in large plinth-like masses that are five or six inches in diameter and about one and one-half inches thick; the masses are attached to the stems of plants and contain about 7000 eggs. In describing a clutch of *capito* eggs Wright (1932: 344) says: "A large mass was attached to a sedge stem. Its top was level with the surface of the water. The water was 9 inches deep. The mass was 4 x 5 inches square and 1½ inches thick. At first the mass impressed all of us as bluish. . . . The whole mass when turned over reveals the same white mass impression *R. sphenocephala* and *R. pipiens* egg masses give." Other masses have been reported which varied from 4 x 5 x 1 inches to 12 x 4 x 2 inches in dimensions. "They may be attached to grass, sedges, pickerel weed, or other aquatic plant stems, twigs and brush or be free at times on the bottom. . . ." (Wright, 1932:

344). The eggs of *sevosa* are deposited in masses about the size of two fists and are attached to plant stems about a foot below the surface of the water.

Larvae.—The tadpoles of *sevosa* and *areolata* are unknown; that of *circulosa* has been collected but not described; and the tadpole of *capito* has been described in detail by Wright (1929: 29-30; 1932: 345-6). Wright (1932: 347) reports that some captive *capito* tadpoles transformed on August 27 and 28. No other dates of metamorphosis have been reported, but Wright (*loc. cit.*) states that the tadpoles probably transform from August to October 1, and measure from 27 to 35 or 36 mm at transformation. Wright and Wright (1933: 151) state that *areolata* [*circulosa*] metamorphoses during the first week in July at a size of 30 mm. Transformation has not been observed in *sevosa*.

Growth.—Nothing is known of the growth of *sevosa*, *areolata*, or *circulosa*. Wright (1932: 349) gives the age groups of *capito* as "28-38-(?) mm at transformation; 38 (?)-52 mm first-year-olds; 52-65 mm for 2-year-olds; 66-77 mm 3-year-olds; 78-88 mm 4-year-olds; 89-102 mm 5-year-olds; 102-108 mm, 6-year-olds." Age groups should be defined on the basis of large series from a single locality; and since the above computations were obviously based upon relatively small series from various localities little reliance can be placed upon them.

Food.—*Rana a. circulosa* has been reported to feed upon beetles, spiders, crickets, ants, and crayfish (Smith, 1934: 480). Dickerson (1908: 196) and other authors have called attention to the batrachophagous proclivities of *capito*, and have described the manner in which this frog ejects the toad mucus. The species feeds upon beetles, hemiptera, and grasshoppers (Carr, 1940a: 64); birds (Dickerson, *loc. cit.*); and earthworms (Deckert, 1920: 6), as well. The mouth of *sevosa* is almost as large as that of *capito* and this species probably has similar feeding habits, preying largely upon toads and insects.

Habitat.—Crayfish holes are the preferred habitat of *circulosa* but the species has been taken under logs, in mammal holes, holes in road-side banks, and in sewers. Wright (1932: 336) states that *capito* "seems to be restricted almost solely to the burrows of the Gopher Turtle," but it can and does, live in other situations. Carr (1940a: 63) reports it in burrows of *Peromyscus polionotus*, crayfish burrows, and post holes. Furthermore, the species has been reported in Beaufort County, North Carolina, by Brandt (1936: 220) and since this locality is not within the range of *Gopherus polyphemus* other hiding places than turtle holes must be selected here. Allen (1932: 9) records *sevosa* taken from burrows of the

gopher tortoise but he does not state whether it is restricted to such burrows.

Odor.—Dickerson (1906: 195) reports that *capito* produces an offensive odor when disturbed, but such defensive behavior has not been mentioned for the other forms.

DISTRIBUTION

Rana areolata areolata occurs from Matagorda County, Texas, north to McCurtain County, Oklahoma, and Lafayette County, Arkansas; and it probably occurs in extreme northwestern Louisiana also. *R. a. circulosa* ranges from Rogers and Tulsa counties, Oklahoma, north through eastern Kansas, eastward across central Missouri and Illinois to Benton and Monroe counties, Indiana (possibly to Greene County, Ohio), and southward in the Mississippi Valley through western Tennessee to Pontotoc County,

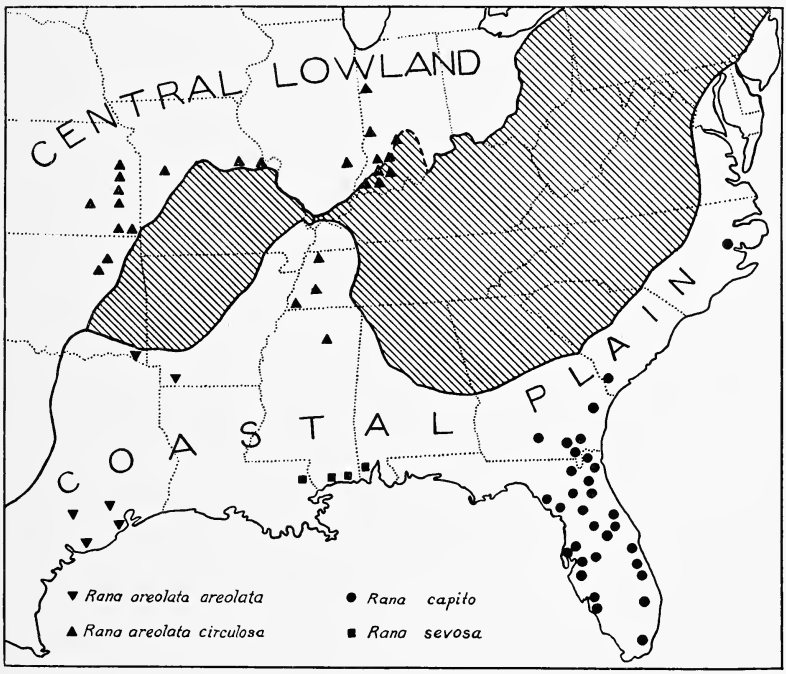

FIG. 1. Map of the distribution of the *Rana areolata* group, based upon county records as listed in this paper. Upland areas hatched.

Since the above map was prepared we have examined four specimens of *R. a. circulosa*, from Paducah, Kentucky.

Mississippi. The known range of *sevosa* extends along the Gulf coast from St. Tammany Parish, Louisiana, to Mobile County, Alabama. *R. capito* ranges from Beaufort County, North Carolina, south to Dade County, Florida, and westward to Berrien County, Georgia, and Dixie County, Florida. The easternmost station for *sevosa* is three hundred miles west of the westernmost *capito* locality; the ranges of *sevosa* and *areolata* are separated by about two hundred miles.

The frogs of the *areolata* group are lowland forms widely distributed in the Coastal Plain and Central Lowland provinces, as illustrated on the accompanying map (fig. 1). Certain *circulosa* stations in southern Indiana lie south of the plateau-lowland boundary as it is tentatively located on physiographic maps. A detailed distributional study of *circulosa* in Indiana should indicate whether or not this race has penetrated the plateau country. It appears to be significant, however, that records for all members of the group fall outside of the upland boundary except in the one region where this boundary is poorly delimited.

The following list is not a complete tabulation of museum specimens[2] but a list of those that we have examined. We have included the first published record for each county, also. Records that may be incorrect are preceded by a question mark and followed by discussion.

Rana areolata areolata

ARKANSAS:

Lafayette Co. KU 9278; Smith, 1934: 481

?*Lawrence Co.* A misquotation by Black and Dellinger (1938: 20) who state: "Taylor (1935) has reported one specimen from Lewisville, Lawrence County." Smith (*supra cit.*) and Taylor (1935: 210) both list Kansas University 9278 with the data "Lewisville, Lafayette County."

LOUISIANA:

"northwest." Viosca, 1931: 7

?NEW MEXICO:

USNM 3302 from "the Rio San Pedro of the Gila" (Baird and Girard, 1852: 173) was mentioned in the original description of *areolata*. It was later listed as *berlandieri* by Yarrow (1883: 180) and as *brachycephala* by Cope (1889: 405). USNM 3382 from the "St. Francisco Mountains, N. Mex." was listed by Yarrow (*op. cit.*: 178) as *Rana areolata areolata*.

[2] AMNH, American Museum of Natural History; CA, Chicago Academy of Sciences; CM, Carnegie Museum; FMNH, Field Museum of Natural History; KU, University of Kansas; MCZ, Museum of Comparative Zoölogy; MZUM, University of Michigan Museum of Zoology; MVP, private collection of Malcolm V. Parker; TZS, Toledo Zoological Society; USNM, United States National Museum.

Both of these specimens were most probably *pipiens* but this assumption cannot be confirmed since Dr. Cochran has informed us that the specimens have been missing from the USNM collection for many years.

OKLAHOMA:

McCurtain Co. CM 18662-68

TEXAS:

Colorado Co. Burt and Burt, 1929: 6

Galveston Co. Dickerson, 1906: 193

Harris Co. Wright and Wright, 1938: 25

Matagorda Co. USNM 3304 (type of *areolata*); Baird and Girard, 1852: 173 (original description of *areolata*)

Rana areolata circulosa

ILLINOIS:

"northern." USNM 9386

Richland Co. USNM 13828, 49590; Cope, 1889: 415

INDIANA:

Benton Co. CA 160 (type of *circulosa*); Davis and Rice, 1883: 22

Daviess Co. Swanson, 1939: 688

Du Bois Co. Swanson, 1939: 688

Martin Co. Swanson, 1939: 688

Monroe Co. Wright and Myers, 1927: 173

Pike Co. CM 13371-75; Swanson, 1939: 688

Vandenburg Co. CM 13378; Swanson, 1939: 688

Vigo Co. Blatchley, 1900: 543

Warrick Co. Swanson, 1939: 688

KANSAS:

Allen Co. Smith, 1934: 482

Anderson Co. Smith, 1934: 482

Cherokee Co. Smith, 1934: 482

Douglas Co. Hartman, 1907: 228

Franklin Co. CM 9889-90; USNM 89031; Gloyd, 1928: 117

Greenwood Co. Smith, 1934: 482

Labette Co. USNM 90318-19; Smith, 1934: 482

KENTUCKY,

McCracken Co. TZS 707-710

LOUISIANA:

?*Tangipahoa Parish.* FMNH 11980-81 (unquestionably *circulosa*) were received from the General Biological Supply House with "Louisiana" as the only original data. At our request, D. Dwight Davis of Field Museum, communicated with the donor in 1939 and received supplementary data for these specimens as follows: "Tangipahoa Parish; Ponchatoula, Martin Bankston, 1931." We question the correctness of this locality, since Tangipahoa Parish adjoins St. Tammany, where *sevosa* occurs; and since Viosca (1931: 7), on the basis of wide local experience, restricts *areolata* to northwest Louisiana.

MISSISSIPPI:

Pontotoc Co. USNM 99359; Burt, 1938: 349

MISSOURI:

Johnson Co. Hurter, 1911: 116

Montgomery Co. USNM 48697-98, 38358, 57844-48; Hurter, 1911: 116

St. Charles Co. CA 4757 and 5094

?OHIO:

Greene Co. Wright and Wright (1933: 150) list Ohio in the range of *areolata*. Dr. Charles F. Walker informs us that tadpoles hatched from eggs collected by an Antioch College student at a fish hatchery near Yellow Springs were sent to Dr. Wright and identified by him as *areolata*. Until adult *areolata* are collected in the region we feel that it is inadvisable to accept this record, especially in view of the fact that the tadpole of *areolata* has never been described. Even if adults are secured the possibility that they may have been accidentally introduced at the hatchery must be considered.

OKLAHOMA:

Rogers Co. USNM 94247; Harper, 1935: 79

Tulsa Co. Force, 1930: 27

TENNESSEE:

Obion Co. Parker, 1939: 79

Shelby Co. MVP 2827-28, 2884; Parker, 1939: 79

Rana capito

FLORIDA:

Alachua Co. USNM 4743 (type of *aesopus*); Cope, 1886: 517-518 (original description of *aesopus*)

Baker Co. Wright, 1932: 334

Brevard Co. CM 3233-34

Charlotte Co. Carr, 1940a: 63

Clay Co. Burt, 1938: 350

Dade Co. Burt, 1938: 350

Dixie Co. Carr, 1940a: 63

Duval Co. Deckert, 1914a: 3

Hillsborough Co. Loennberg, 1894: 339

Indian River Co. Wright, 1932: 348

Lake Co. Wright, 1932: 348

Lee Co. Carr, 1940a: 63

Levy Co. USNM 57533-35, 57658; Wright, 1932: 348

Manatee Co. CM 16547

Marion Co. USNM 61062; CM 9832-34; CA 21741-43; Wright, 1932: 348

Nassau Co. Wright, 1932: 348

Orange Co. Loennberg, 1894: 339

Palm Beach Co. Boulenger, 1920: 467

Pasco Co. Harper, 1935: 80

Pinellas Co. Dickerson, 1906: 194

Polk Co. USNM 50576, 59413; MVP 42; Boulenger, 1920: 467
Putnam Co. USNM 20513-14, 21702-04; Boulenger, 1920: 467
St. Lucie Co. Burt, 1938: 350
Seminole Co. Fletcher, 1900: 47
Volusia Co. Wright, 1932: 348

GEORGIA:

Berrien Co. USNM 11897; Cope, 1889: 412
Brantley Co. Wright, 1932: 334
Charlton Co. Wright, 1932: 334
?*Fulton Co.* Burt (1938: 350) lists this county from "literature" but we have not been able to locate any such record. The occurrence in this region of a species that is coastal plain in distribution is highly improbable.
Liberty Co. USNM 5903 (type of *capito*); Le Conte, 1855: 425 (original description of *capito*)
Ware Co. Wright, 1932: 334

NORTH CAROLINA:

Beaufort Co. Brandt, 1936: 220

SOUTH CAROLINA:

?*Hampton Co.* Deckert (1920: 26) states that he received a specimen from "near Pinelands, Hampton Co." This locality does not occur on any maps examined by us.
Jasper Co. Chamberlain (1939: 28) suggests that Deckert's specimen may have come from Pineland, Jasper County. The two counties are contiguous and an error in county location may easily have been made.

Rana sevosa

ALABAMA:

Mobile Co. Löding, 1922: 20

LOUISIANA:

Saint Tammany Parish. CM 16809 (type of *sevosa*)

MISSISSIPPI:

Harrison Co. CM 4944, 18116-17, 18184-97; FMNH 11511-14; MCZ 15803-06; MZUM 76921, 71777; Allen, 1932: 9
Jackson Co. AMNH A37089-99; CM 5407-08; FMNH 21610

ORIGIN AND EVOLUTION OF THE *RANA AREOLATA* GROUP

Previous writers have failed to agree upon the affinities of *areolata* and *capito*. Cope (1889: 409) writes of *areolata* (including *capito*): "This well-marked species is related to the *R. palustris*, but is easily distinguished." Dickerson (1906: 194) states that *aesopus* agrees with *palustris* and *pipiens* in color and markings, but that it is very distinct from them in general appearance. Wright (1932: 351) says, "Our second consideration that *R. aesopus* is closely related to *R. pipiens* and *R. sphenocephala* does not mili-

tate against some relationship with *R. palustris* but *R. palustris* is not the nearest relative." Boulenger (1920: 418) groups *pretiosa*, *cantibrigensis*, *sylvatica*, *godmani*, and *areolata* (including *capito*) together on the basis of the outer metatarsi being bound together in their basal portions.

All too little attention has been devoted to the elucidation of primitive and specialized characters in North American frogs. Writing of *Rana* Boulenger (1920: 418) says, "I conceive the most primitive type as with large nasal bones in contact with each other and with the fronto-parietals entirely covering the ethmoid; pointed, fully webbed toes with the outer metatarsals separated by web to the base; a distinct tympanum; no glandular dorso-lateral fold." Toe character and amount of palmation are so subject to geographic variation that they must be used with extreme care in phylogenetic inquiries. The members of the *areolata* group agree in having small, well-separated nasals, fronto-parietals that leave the ethmoid largely exposed, well-developed folds, and outer metatarsals partly joined. In these characters they are specialized, if Boulenger's ideas are accepted; the distinct tympanum is the only supposedly primitive character retained by the group.

Since the *areolata* group appears to have had a southwestern center of origin, we have examined the principal reports upon Mexican frogs in searching, unsuccessfully, for a possible ancestral stock. Two names, discussed below, have been applied to Mexican frogs that resemble *areolata* (judging from published descriptions and figures only) in several respects. While it is geographically improbable that any actual relationships are involved the similarities are worth mentioning.

Rana forreri Boulenger[3] was based upon a female from Sinaloa which was subsequently figured by Günther.[4] Later Boulenger (1920: 430) himself referred *forreri* to the synonymy of *halecina* (=*pipiens*), and Kellogg[5] concurred in this disposition of the form. Surprisingly Günther's figure of transmontane *forreri* bears a remarkable resemblance to certain cismontane *areolata*. For example, CM 18666, from Oklahoma, differs in having a slightly more triangular head, a few more dorsal spots, interbars between the dark bars on the hind legs, and slightly less webbing. The fact that some Mexican *pipiens* agree with certain *areolata* in dorsal pattern may indicate an ancestral connection between the two forms that provided potentialities for similar pattern development, but it must not be taken

[3] 1883. Ann. & Mag. Nat. Hist., (5), 11: 343

[4] 1900. Biologia Centrali-Americana, Reptilia and Batrachia, pl. 60, fig. A.

[5] 1932. Bull. U. S. Nat. Mus., no. 160: 203

to mean that a Sinaloa *pipiens* population was involved in the ancestry of *areolata*.

Rana montezumae Baird was based upon specimens from the City of Mexico and upland specimens correctly referred to this form are certainly not close to *areolata*. At various times, however, specimens have been referred to *montezumae* which are certainly not conspecific and which in some cases, at least, merit re-examination in the light of possible affinities with *areolata*. For example, Baird (1859, pl. 36, fig. 1-6) illustrates two very different frogs, unfortunately without locality data, as *montezumae*. Fig. 5 is referred to as a young specimen, but it is obviously a breeding male of a frog similar to *areolata*. Furthermore its vomerines, as shown in Fig. 6, are strikingly different from those of the "adult" *montezumae* shown in Fig. 3. We suggest that museum series of *montezumae* should be re-checked, and that specimens which resemble Baird's Fig. 5 merit comparison with *areolata*.

Similarities in life history, vocal equipment, pattern, and general structure offer a preponderant weight of evidence that the *Rana areolata* group developed from a *pipiens*, or a *pipiens*-like, stock by reduction in amount of webbing, increase in glandular folding, slight multiplication of dorsal spots, and increase in size of vocal sacs. Confirmatory evidence is offered by Cope (1889: 410) who states, "As a whole, the *Rana areolata* is pretty well distinguished by its very short palmation. Nevertheless, I have seen a specimen from Guatemala with similar posterior feet, which is otherwise not different from the *R. virescens*."

Although the affinities of the group as a whole may be open to question, we believe that the trend lines listed above present definite indication of the evolution of the forms in the group. Since *circulosa* is only subspecifically distinct from typical *areolata* it may reasonably be considered to be a fairly modern race that evolved in the Central Lowlands, and then extended its range southward in the Mississippi Valley in post-glacial times. Boulenger's (1883: 16) synonymizing of *circulosa* with *septentrionalis* was the result of his having received Canadian frogs that had been erroneously identified as *circulosa*. Later (1920: 430) he transferred *circulosa* to the synonymy of *areolata*. Examination of a larger series of specimens enables us to restore it to subspecific rank.

At any time from the upper Miocene on, the stem stock of *areolata* could have migrated eastward along the Gulf Coastal Plain, its route being either north or south of the present coastline, depending upon the date of the migration. This eastward movement probably antedated the for-

mation of the present Mississippi delta and may well have occurred in the late Pliocene. All morphological evidence indicates that *sevosa* and *capito* arose from a common ancestral stock; that neither one can have been directly derived from the other; and that they are more closely related to each other than either is to *areolata*. The development of the modern Mississippi River may conceivably have served as the barrier that isolated the eastern population from its Texas progenitor and permitted differentiation toward the gopher-frog type. At some later date a barrier developed somewhere between the Apalachicola River in Florida and Mobile Bay; it effectively divided the gopher-frog stock and led to the differentiation of *sevosa* and *capito*. What this barrier may have been can only be conjectured, but we venture to suggest that it may have been an early interglacial (first?) increase in sea level,[6] which submerged most of peninsular Florida except for a few islands, produced the Brandywine Terrace (270 feet above present sea level), submerged the entire Apalachicola River, and embayed its western fork, the Chattahoochee. *R. sevosa* apparently developed in a humid region, and *R. capito* in a more arid environment. The hypothesis of the evolution of the former *in situ* in Mississippi swamps and of the latter on a relatively small island in the region of north-central Florida is in accord with the present environments of the two forms. A salt-water barrier may not have been required for the isolation of the Mississippi and Florida populations, however; at the present time, with no such barrier intervening, the ranges of *sevosa* and *capito* are well separated. Further study of the zoögeography of the Gulf coast will probably serve to emphasize the faunal dissimilarities of Florida and Mississippi. Many forms that are thought to have continuous ranges from Florida to New Orleans may be expected to exhibit discontinuities between the Apalachicola River and Mobile Bay. The present barrier in this region may be climatic, but its exact location and character must await detailed studies of many species. It is suggestive that the westernmost Florida record for *Gopherus polyphemus* listed by Carr (1940a: 105) is Liberty County, which has the Apalachicola as its western boundary. The gopher turtle occurs commonly west of Mobile Bay, but we do not know of any definite records from southeastern Alabama. If, on further study, the range of this turtle proves to be discontinuous, it will afford an interesting parallel to the *sevosa-capito* distribution. Its absence in an area must not, however, be considered a barrier to gopher frog occupancy; for, since Harper's statement (1935: 81)

[6] See Cooke (1939, Florida Geol. Bull. no 17, fig. 12–16) for illustrations of Pleistocene shore lines in the southeast.

that the range of *capito* lies wholly within that of *G. polyphemus*, *capito* has been reported from Beaufort County, North Carolina (Brandt, 1936: 220), and *polyphemus* is not known to occur north of the Aiken region of South Carolina.

Our conclusions as to the phylogeny of the *areolata* group are expressed graphically below.

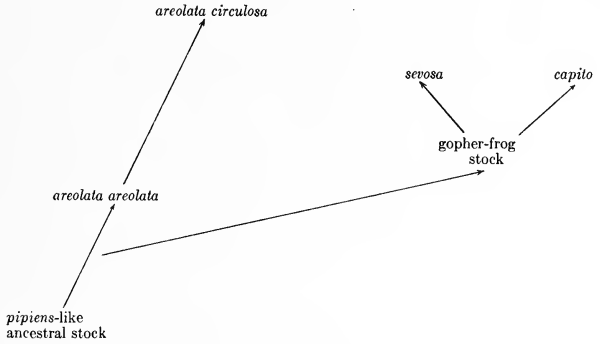

FIG. 2. Diagram of the probable relationships of the forms of the *Rana areolata* group.

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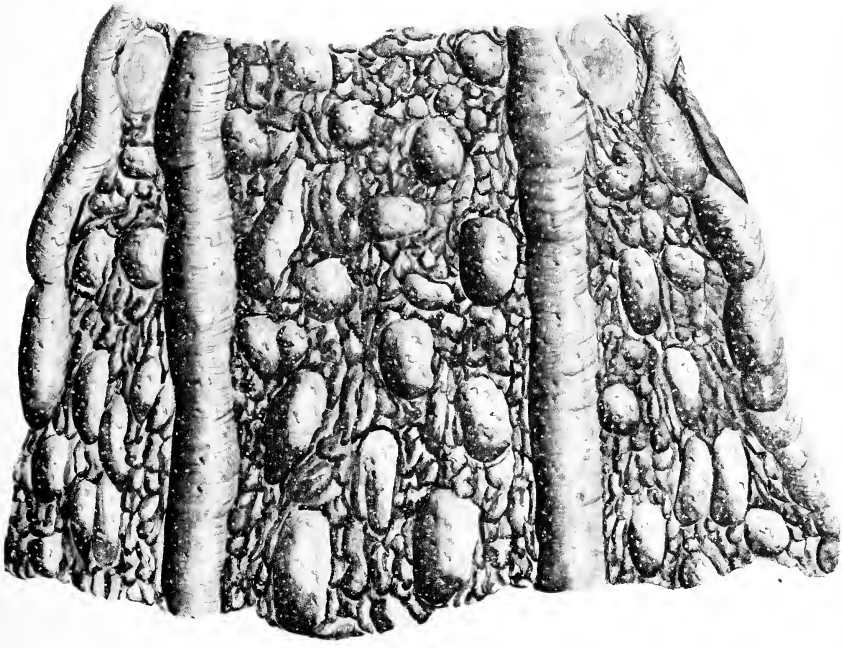
EXPLANATION OF PLATE XII.

MISS OLIVE BEAN, del.

FIG. 1. Adult male *Rana sevosa*, sp. nov., drawn from preserved specimens. Natural size.

FIG. 2. A portion of the dorsum of *Rana sevosa*, sp. nov., to show folds and warts; drawn from an enlarged photograph of a preserved specimen. About twice natural size.

1



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ART. IX. BIRDS RECORDED IN THE STATE OF HIDALGO, MEXICO, BY THE SEMPLE EXPEDITION OF 1939[1]

By George Miksch Sutton and Thomas D. Burleigh[2]

During the course of field work carried on in 1939 in eastern Mexico by Mr. John B. Semple and the authors, eleven days (March 27-30 and April 7-13) were spent in Hidalgo. Most of this time the party was stationed at Jacala, in the northwestern part of the State, but in going to and from Jacala important stops were made at El Barrio (near Chapulhuacan, not far south of the San Luis Potosí state-line) and at the Cuesta Texquedo, a so-called "pass" about 13 miles south of Zimapan, not far from the point where the Mexico City highway crosses the Tasquillo River.

Jacala is a picturesque village situated at the edge of a broad, semi-arid, extensively cultivated valley. Its elevation is 4500 feet. About it rise bold mountains whose higher slopes are well forested. To the north these reach an altitude of 6000 feet. To the south they are perceptibly higher, individual peaks attaining an elevation of well over 7000 feet. Four miles east of town the valley drops rapidly, narrowing to a rugged ravine.

The forest on the high land north of town is principally of oak and pine. Bold outcroppings of rock protrude from the trees and deep, well-like caverns gape amongst the thickets. Under the pines the shrubbery is thin, but where oaks dominate there are dense tangles of smilax and poison sumac. The woodland about La Placita, six miles south of town, is composed largely of deciduous trees. Seven miles farther south the highway itself reaches what may be called "pine level."

The valley east of and below town is so extensively cultivated that it is virtually devoid of trees. It is bordered with a thorny thicket, however, and this sort of vegetation, with an admixture of live oaks, cedars, and junipers, extends along the lower slopes of the mountains. Here and there among the ravines are narrow flats that are thicketed exclusively with

[1] Third of a series of papers on the 1939 John B. Semple Expedition to eastern Mexico.

[2]The authors wish to thank the several staff members of the U. S. National Museum, the Fish and Wildlife Service of the U. S. Department of the Interior, the Museum of Comparative Zoology at Harvard College, and the American Museum of Natural History for their cooperation and assistance.

Issued January 10, 1941

mesquite. These are recognizable at considerable distance because of their fresh, pleasant greenness.

The woodland near El Barrio (3500 feet), where collections were made March 27 and April 13, is moist and luxuriant, quite unlike any found near Jacala. It is tropical by comparison, though less dense than that growing at the foot of the mountains, in the vicinity of Tamazunchale, San Luis Potosí.

The Cuesta Texquedo (6000 feet) is a rough, arid, comparatively treeless place where cactus and thorny shrubbery line the parched arroyos. A brief stop was made there April 7.

The following list of 130 birds (four not fully identified) is thought to include most of the breeding and many of the wintering and transient forms of the Jacala district. It probably represents but inadequately, on the other hand, the bird-life of any other part of the State.

LIST OF SPECIES

Chaulelasmus streperus (Linnaeus). GADWALL.

A mixed flock of eight Gadwalls and five Pintails was seen April 8, resting at a shallow artificial pond two miles south of Jacala.

Dafila acuta (Linnaeus). PINTAIL.

Five (three males and two females) were seen near Jacala, April 8, as noted above.

Cathartes aura (Linnaeus). TURKEY VULTURE.

Common. Seen daily wherever we went.

Coragyps atratus (Bechstein). BLACK VULTURE.

Seen infrequently at Jacala and at other towns along the main highway. Not as common as the Turkey Vulture, however.

Accipiter striatus velox (Wilson). SHARP-SHINNED HAWK.

A male, in immature plumage (testes slightly enlarged), of this northeastern race was taken March 29 in a thicket in mixed woodland at 6000 feet, six miles north of Jacala. Adult (subspecies ?) seen at El Barrio, April 13.

Circus cyaneus hudsonius (Linnaeus). MARSH HAWK.

A female (with unenlarged, paired ovary) was taken March 29, *in mixed woodland* rather than in open country, at 6000 feet, six miles north of Jacala (Semple). Not otherwise recorded.

Falco sp.

A Duck Hawk or Prairie Falcon swooped at the Gadwalls and Pintails seen April 8 near Jacala, causing them to flop about wildly in the shallow water.

Falco sparverius Linnaeus. SPARROW HAWK.

Noted repeatedly along the highway on the open, semi-arid plateau about Zimapan, March 30 and April 7. Seen infrequently in open country near Jacala.

Tringa solitaria Wilson. SOLITARY SANDPIPER.

A single bird was seen April 8, at a small pond near Jacala.

EROLIINAE.

Small, grayish "peeps," thought to be Least or Semipalmated Sandpipers, were noted at a pond south of Jacala, April 8. The sudden appearance of a falcon caused them to dash off before they could be identified.

Columba fasciata Say. BAND-TAILED PIGEON.

A flock of eight was seen April 12, in pine woods, seven miles north of Jacala (Semple).

Zenaidura macroura (Linnaeus). MOURNING DOVE.

Small flocks were seen in open country about Jacala at from 4000 to 4500 feet, April 9-11.

Zenaida asiatica (Linnaeus). WHITE-WINGED DOVE.

Noted infrequently near Jacala at from 4000 to 5000 feet during both our visits.

Columbigallina passerina (Linnaeus). GROUND DOVE.

A pair was seen flying along a stone wall, two miles south of Jacala, April 8.

Scardafella inca (Lesson). INCA DOVE.

A single bird was seen among houses at the western edge of Jacala, April 12.

Leptotila verreauxi (Bonaparte). WHITE-FRONTED DOVE.

Identified with certainty only at El Barrio, March 27 and April 13. Common there.

Antrostomus vociferus setosus van Rossem. MEXICAN WHIPPOOR-WILL.

Recorded but once: a female, found dead on the highway six miles north of Jacala, April 11 (Semple). Though we searched diligently for goatsuckers, by night as well as by day, we failed to see or hear one alive.

Chaetura sp.

Some small, dark swifts were seen April 7 at the Cuesta Texquedo. They were flying toward the Tasquillo River.

Aëronautes saxatalis saxatalis (Woodhouse). WHITE-THROATED SWIFT.

Large flocks were seen at El Ocote (a village north of Jacala), March 27, and at La Placita, April 8 and 10. Two female specimens taken are of the present race (wing: 137 mm.; 141.5).

Calothorax lucifer (Swainson). LUCIFER HUMMINGBIRD.

Encountered only at the Cuesta Texquedo, where a female was taken April 7 (Sutton).

Selasphorus sp.

A female hummingbird, apparently *Selasphorus rufus*, was seen repeatedly at El Barrio, feeding about a flowering tree, April 13.

Eugenes fulgens fulgens (Swainson). RIVOLI'S HUMMINGBIRD.

Noted only at Jacala where it was fairly common, April 7-13, male and female specimens being taken at from 4500 to 5500 feet. Seen repeatedly about flowers in town. In all males collected or observed the glittering feathers of the forehead and crown were molting extensively.

Hylocharis leucotis leucotis Vieillot. WHITE-EARED HUMMINGBIRD.

Identified with certainty only in mixed woodland 13 miles south of Jacala (7000 feet), where a breeding male was taken, March 30 (Sutton).

Cynanthus latirostris latirostris Swainson. BROAD-BILLED HUMMINGBIRD.

Common at the Cuesta Texquedo, where breeding males were taken April 7 (Sutton and Semple). Rare at Jacala, where a single male was seen repeatedly at the edge of town; and a young female, not long out of the nest, was taken at 4000 feet, in a wooded ravine southeast of town, April 11 (Burleigh). This interesting specimen is identifiable chiefly from the broad, gray-tipped, steel-blue rectrices. It is dark gray below

(with white under tail coverts) and green above, the feathers of the crown, neck, back, and rump being tipped with dull brown. The remiges are all sheathed at the base.

Trogon ambiguus ambiguus Gould. COPPERY-TAILED TROGON.

Recorded with certainty only at Jacala (4000 to 7000 feet). In the mixed woodland north of town it was common, a flock of ten or twelve birds sometimes being encountered at the mouth of a deep, thicket-fringed cavern. Males taken April 9-12.

Trogon mexicanus mexicanus (Swainson). MEXICAN TROGON.

Two specimens were taken by Sutton: a subadult male, at El Barrio, March 27; and a female, near La Placita, seven miles south of Jacala (5500 feet), April 8. Not certainly identified otherwise.

Aulacorhynchus prasinus prasinus (Gould). EMERALD TOUCANET.

This interesting bird, which apparently has not heretofore been recorded from Hidalgo, was seen repeatedly at El Barrio, March 27 and April 13, a female being taken there on the latter date (Burleigh). Since the species was found to be fairly common also at Tamazunchale, in southeastern San Luis Potosí, we believe that it occurs in suitable woodlands throughout the district, presumably at elevations below 3500 feet.

Colaptes cafer mexicanus Swainson. MEXICAN RED-SHAFTED FLICKER.

Noted only at Jacala, where it was fairly common in mixed woodland. Two breeding males, taken six miles north of town, March 28 (Semple and Burleigh), do not agree very well *inter se* in size or color. One of them (wing, 151 mm.; tail 100; bill, 35), we have no hesitation in calling *mexicanus*. The other (wing, 165; tail, 108; bill, 39) is very gray throughout the upperparts, and if we call it *mexicanus* we do so principally because it is altogether too large for *nanus*, the form it most closely resembles in color.

Balanosphyra formicivora formicivora (Swainson). ACORN-STORING WOODPECKER.

Noted only about openings in mixed woodland near Jacala (6000 to 7000 feet), a mated pair being taken six miles north of town, April 11 (Semple).

Dryobates villosus intermedius Nelson. INTERMEDIATE HAIRY WOODPECKER.

Noted only in mixed woodland on slopes above Jacala, breeding male

and female specimens being taken 6 miles north of town respectively on March 28 and April 12. These are definitely browner on the throat and chest than February examples of *intermedius* from the Mesa de Chipinque, Nuevo Leon, but they are not nearly dark enough for *jardinii*.

Dryobates scalaris bairdi (Malherbe). BAIRD'S LADDER-BACKED WOODPECKER.

Noted infrequently in valley below Jacala (4000 to 4500 feet); and at the Cuesta Texquedo, where a breeding male was taken on April 7 (Semple).

Lepidocolaptes affinis affinis (Lafresnaye). ALLIED WOODHEWER.

Noted on two occasions by Sutton: at El Barrio, where a female was taken April 13; and near Jacala, where the female of a mated pair was taken in deciduous woodland at 5500 feet, seven miles south of town, April 10. The song, a descending series of thin whistles, was not nearly so noticeable as that of *Xiphorhynchus flavigaster* (as heard at Tamazunchale and Valles, San Luis Potosí).

Pachyramphus major major (Cabanis). MEXICAN BECARD.

Noted once at Jacala: a male taken by Burleigh, April 8, in deciduous woodland (5500 feet), 7 miles south of town. Commoner at El Barrio, where a mated pair were taken, April 13 (Sutton). This species apparently has not heretofore been recorded from Hidalgo.

Tyrannus melancholicus Vieillot. TROPICAL KINGBIRD.

Mated pairs were noted near Jacala, April 9-11. Similarly colored kingbirds, seen along the highway in the Zimapan district, may have been of other species. No specimen collected.

Myiarchus cinerascens cinerascens (Lawrence). ASH-THROATED FLYCATCHER.

Identified with certainty only at the Cuesta Texquedo, where several were seen and a female taken, April 7.

Myiarchus nuttingi inquietus Salvin and Godman. GUERRERO NUTTING'S FLYCATCHER.

Identified with certainty only at Jacala, April 12, when a male was taken at about 4200 feet, in a wooded ravine 2 miles south of town (Burleigh). Other examples of *Myiarchus* seen in the same place that day were thought to be of the same species. Nutting's Flycatcher apparently has not heretofore been recorded from Hidalgo.

Myiarchus tuberculifer lawrenceii (Giraud). LAWRENCE'S DUSKY-CAPPED FLYCATCHER.

Noted at El Barrio, March 27, and at Jacala (4500 to 5500 feet), April 7-13, a male being taken in a wooded ravine northeast of town, April 11.

Empidonax hammondii (Xantus). HAMMOND'S FLYCATCHER.

Identified with certainty only at Jacala, where specimens were taken (5500 to 7000 feet) March 28 and April 10-12.

Empidonax wrightii Baird.[3] WRIGHT'S FLYCATCHER.

Recorded only at Jacala, where a male was taken (4500 feet), April 9.

Empidonax difficilis salvini Ridgway. SALVIN'S WESTERN FLYCATCHER.

Male specimens were taken in mixed woodland near Jacala (6000 feet), March 28 and 29 (Burleigh).

Empidonax difficilis hellmayri Brodkorb. HELLMAYR'S WESTERN FLYCATCHER.

A female was taken on March 28 in mixed woodland, six miles north of Jacala (Sutton). This specimen is noticeably less brown on the upperparts and chest than a specimen of *E. d. salvini* taken the same day.

Empidonax albigularis Sclater and Salvin. WHITE-THROATED FLYCATCHER.

Noted only at Jacala, where a male was taken at 4000 feet in a wooded ravine southeast of town, April 9 (Burleigh). Not heretofore reported from Hidalgo.

Mitrephanes phaeocercus hidalgensis Sutton and Burleigh. HIDALGO TUFTED FLYCATCHER.

Fairly common in deciduous and mixed woodlands at Jacala, where specimens were taken on March 28 and April 8 at from 5000 to 7000 feet. Noted also at El Barrio, where a female was taken, April 13.

Myiochanes pertinax pallidiventris (Chapman). COUES'S PEWEE.

Noted only at Jacala, where a singing male with somewhat enlarged testes was taken in pine woods at 6000 feet, six miles north of town, March 28 (Sutton).

[3] Allan Phillips (Auk, 1939, 56: 311-312), believing Baird's type of *wrightii* to be an example of *griseus*, has given this species the name *oberholseri*. We have not yet had an opportunity to compare these types.

Camptostoma imberbe Sclater. BEARDLESS FLYCATCHER.

Encountered only at the Cuesta Texquedo, where a male was taken April 7 (Burleigh).

Tachycineta thalassina thalassina (Swainson). MEXICAN VIOLET GREEN SWALLOW.

Noted only at Jacala, where a male (testes somewhat enlarged) was taken from a flock, April 10 (Sutton).

Progne chalybea (Gmelin). GRAY-BREASTED MARTIN.

Noted only at Jacala, where several pairs were observed, April 8-13.

Aphelocoma sordida sordida (Swainson). HIDALGO JAY.

Common in deciduous and mixed woodland about Jacala at from 5500 to 7000 feet. Among the breeding specimens taken there, March 28 and April 8-10, is a male that is considerably darker below than the others, the gray of the chest extending over virtually the whole of the belly. This variation, in a comparatively small series of breeding birds, lends support to Hellmayr's belief that Nelson's *potosina* is a synonym of *sordida* (Birds of the Americas: Part VII, 1934, p. 56).

Xanthoura luxuosa luxuosa (Lesson). GREEN JAY.

Common at El Barrio, where a male and a female were taken, April 13. Uncommon at Jacala, where it was noted, April 9-11, in wooded ravines northeast of town (4000 to 4500 feet).

Corvus corax Linnaeus. RAVEN.

Noted repeatedly at Jacala (where a flock of twenty were seen, April 9), and at the Cuesta Texquedo.

Parus atricristatus atricristatus (Cassin). BLACK-CRESTED TITMOUSE.

Fairly common at El Barrio. Uncommon at Jacala, males being taken there, March 27 and April 11 (4000 to 5000 feet).

Parus wollweberi wollweberi (Bonaparte). WOLLWEBER'S TITMOUSE.

Encountered only at Jacala, where, in mixed woodland (6000 to 7000 feet), it was common. Specimens taken, March 28 and April 8, are of this dark, southward ranging race.

Auriparus flaviceps (Sundevall). VERDIN.

Common at the Cuesta Texquedo, where several pairs were seen building their nests, April 7.

Troglodytes brunneicollis brunneicollis Sclater. BROWN-THROATED WREN.

Noted repeatedly at Jacala in mixed woodland (6000 to 7000 feet), a male being taken on March 28 (Burleigh).

Troglodytes domesticus parkmanii Audubon. WESTERN HOUSE WREN.

The House Wren was noted infrequently at lower elevations near Jacala, March 27-29 and April 9-11. A male of the present race was taken on March 27, at 4500 feet (Sutton).

Thryomanes bewickii murinus (Hartlaub). HARTLAUB'S WREN.

T. bewickii was noted infrequently at about 4500 feet near Jacala, April 9-13. At the Cuesta Texquedo a male of the present race (wing, 59.5 mm.; tail, 57) was taken, April 7 (Burleigh).

Heleodytes brunneicapillus guttatus (Gould). MEXICAN CACTUS WREN.

Common at the Cuesta Texquedo, where two breeding males were taken on April 7. One of these is much more heavily spotted on the throat than the other, but both agree fairly well with Nelson's type of *obscurus* (with which they were directly compared) in that the white markings of the upper parts are inconspicuous. Hellmayr (1934, 149) has made it clear that *obscurus* is a synonym of *guttatus*.

Henicorhina leucosticta (Cabanis). BLACK-CAPPED WOOD WREN.

Common at El Barrio, at from about 3000 to 3500 feet. No specimen taken.

Catherpes mexicanus mexicanus (Swainson). MEXICAN CANYON WREN.

Common at Jacala, where it was noted at all elevations visited. Especially common about stone walls separating fields in the valley below town. Breeding specimens collected April 9-12 represent this large, dark race, which was described from Real del Monte, Hidalgo.

Mimus polyglottos (Linnaeus). MOCKINGBIRD.

Noted at the Cuesta Texquedo (where it was fairly common, April 7), and here and there along the highway in the Zimapan district.

Melanotis caerulescens caerulescens (Swainson). BLUE MOCKINGBIRD.

Noted only at Jacala, where a female was taken in mixed woodland six

miles north of town, March 28 (Semple), and where two mated pairs were seen in deciduous woodland at lower elevations (4500 to 5000 feet) April 9-11.

Toxostoma longirostre longirostre (Lafresnaye). LONG-BILLED THRASHER.

Noted only at Jacala where, in a wooded ravine southeast of town (4000 feet), several were seen April 9-12, a male being taken on the 12th (Burleigh). This specimen has the short bill (26.5 mm.) and long tail (131 mm.) of *sennetti* but the strongly rufescent tone on the upper parts and the short wing (94 mm.) of *longirostre*. It may represent a more or less local breeding population that is intermediate between these two forms.

Toxostoma curvirostre (Swainson). CURVE-BILLED THRASHER.

Several seen at the Cuesta Texquedo, April 7. Not noted elsewhere.

Turdus migratorius phillipsi Bangs. VERACRUZ ROBIN.

Small numbers of Robins were seen at Jacala wherever we went. A breeding male taken near town by Burleigh is of the present race (wing, 131 mm.; tail, 93). The worn outermost rectrices of this specimen show no indication of white thumb-marking.

Turdus assimilis assimilis Cabanis. JALAPA ROBIN.

Noted only at El Barrio, where a breeding female was taken, April 13 (Sutton).

Turdus grayi tamaulipensis (Nelson). TAMAULIPAS GRAY'S ROBIN.

Seen only about Jacala, where it was uncommon. A male was taken in deciduous woodland near La Placita, April 8 (Sutton).

Hylocichla guttata auduboni (Baird). AUDUBON'S HERMIT THRUSH.

Hermit Thrushes were seen at Jacala during both our visits. The only specimen taken (female, March 28, Semple) is of this race (wing 98 mm.).

Myadestes obscurus obscurus Lafresnaye. BROWN-BACKED SOLITAIRE.

Taken at El Barrio and at Jacala. At the latter locality it was encountered principally in mixed woodland.

Myadestes unicolor unicolor Sclater. SLATE-COLORED SOLITAIRE.

Common at El Barrio, where breeding males were taken, April 13 (Sutton). Not seen at Jacala.

Catharus mexicanus mexicanus (Bonaparte). BLACK-HEADED NIGHTINGALE-THRUSH.

Noted only at El Barrio, where several were seen and a singing male was collected, April 13 (Sutton).

Polioptila caerulea mexicana (Bonaparte.). MEXICAN BLUE-GRAY GNATCATCHER.

Identified with certainty only at Jacala where, in opener woodland, it was noted at from 4500 to 6000 feet. A pair with a nest and two fresh eggs was found on a mesquite flat three miles northeast of town at about 5000 feet, April 11 (Sutton). Gnatcatchers seen at the Cuesta Texquedo, April 7, were not identified specifically.

Corthylio calendula (Linnaeus). RUBY-CROWNED KINGLET.

Noted at El Barrio, March 27, and at Jacala during the course of our two visits. No specimen taken.

Ptilogonys cinereus cinereus Swainson. MEXICAN SILKY FLYCATCHER.

Noted but once: eight miles north of Jacala, at 6000 feet, where a male was taken, April 11 (Semple).

Phainopepla nitens nitens (Swainson). MEXICAN PHAINOPEPLA.

Noted only at the Cuesta Texquedo, where a male (wing, 99.5 mm.) and female (wing, 96) were taken on April 7 (Burleigh).

Lanius ludovicianus mexicanus Brehm. MEXICAN SHRIKE.

Seen at several points along the highway in the Zimapan district, a male (tail, 102 mm.), being taken near the Tasquillo bridge, March 30 (Semple).

Cyclarhis flaviventris flaviventris Lafresnaye. MEXICAN PEPPER-SHRIKE.

Noted only at Jacala, where male specimens were taken by Sutton, March 29 and April 11, in thickets in mixed woodland (5000-6000 feet), north of town.

Vireo griseus micrus Nelson. LEAST WHITE-EYED VIREO.

Fairly common in woods bordering cultivated fields near Jacala, at about 4000 feet, a male (wing, 59.5 mm.; tail, 48) being taken on April 9 by Burleigh.

Vireo huttoni mexicanus Ridgway. MEXICAN HUTTON'S VIREO.

Fairly common (4000 to 6000 feet) at Jacala, where a male was taken, March 28, and a female, April 9 (Burleigh).

Vireo solitarius Wilson. BLUE-HEADED VIREO.

Noted at Jacala in deciduous woodland (5000-5500 feet), March 28 and April 8-12. No specimen taken.

Vireo gilvus eleanorae Sutton and Burleigh. ELEANOR'S WARBLING VIREO.

Common at El Barrio and Jacala. At the latter locality it was commonest in deciduous woodland at from 5500 to 6000 feet. Males sang constantly, April 7-13.

Mniotilta varia (Linnaeus). BLACK AND WHITE WARBLER.

Seen repeatedly at Jacala (in deciduous and mixed woodlands at from 4500 to 7000 feet) during both our visits. Male (molting extensively on head) taken on March 29 (Burleigh).

Vermivora celata orestera Oberholser. ROCKY MOUNTAIN ORANGE-CROWNED WARBLER.

V. celata was seen repeatedly at Jacala both in the opener country at 4500 feet and in heavier woodland at greater elevations. Male specimens of the present race, taken April 11 and 12, had not quite completed the prenuptial molt of the head feathers.

Vermivora ruficapilla ruficapilla (Wilson). NASHVILLE WARBLER.

Common about Jacala during both our visits, male and female specimens of the eastern race being taken March 28-29 and April 10.

Vermivora superciliosa mexicana (Bonaparte). MEXICAN HARTLAUB'S WARBLER.

Common at Jacala (5500 to 7000 feet) during both our visits, males being collected March 28 and 29.

Compsothlypis pitiayumi nigrilora (Coues). SENNETT'S WARBLER.

Noted only at Jacala where, in wooded ravines at from 4000 to 4500 feet, occasional singing males were noted and a male and female specimen taken, April 9-12.

Dendroica coronata coronata (Linnaeus). MYRTLE WARBLER.

Noted infrequently in mixed woodland near Jacala, March 27-29. A male in worn immature plumage, taken March 29, is of the eastern race (wing, 72 mm.; tail 57).

Dendroica auduboni (Townsend). AUDUBON'S WARBLER.

Common about Jacala, April 8-13. No specimen taken.

Dendroica townsendi (Townsend). TOWNSEND'S WARBLER.

Noted daily at Jacala, at from 5500 to 7000 feet, specimens being taken March 28-30 and April 8-11. The commonest warbler seen there.

Dendroica virens virens (Gmelin). BLACK-THROATED GREEN WARBLER.

Fairly common at Jacala during both our visits, from one to ten birds being seen daily at higher elevations. Female taken March 28; male, April 8.

Dendroica occidentalis (Townsend). HERMIT WARBLER.

Noted infrequently at higher elevations about Jacala, specimens being taken during both our visits.

Oporornis tolmiei (Townsend). MACGILLIVRAY'S WARBLER.

Noted but once, a single bird near Jacala (4000 feet), April 12.

Geothlypis trichas (Linnaeus). MARSH YELLOW-THROAT.

Recorded but once, a single bird in a thicket near Jacala, April 9.

Wilsonia pusilla pileolata (Pallas). PILEOLATED WARBLER.

Wilsonia pusilla was noted at the Cuesta Texquedo, April 7, and at El Barrio, where a male of the present race (wing 61 mm.; tail 53) was taken April 12 (Burleigh).

Setophaga picta picta Swainson. PAINTED REDSTART.

Mated pairs noted daily at higher elevations near Jacala during both our visits. Two males taken April 8 in deciduous woodland near La Placita.

Myioborus miniatus miniatus (Swainson). RED-BELLIED REDSTART.

Fairly common on high slopes about Jacala, males being collected six miles north of town (5500 to 6000 feet), March 29.

Basileuterus culicivorus culicivorus (Lichtenstein). LICHTENSTEIN'S WARBLER.

On April 9, in a dry ravine near Jacala (4500 feet), Sutton took what he thought to be a mated pair of *B. culicivorus*, but one of these, the male, has the grayish upperparts of *B. c. culicivorus*, the other, the female, the *yellowish* gray upperparts of *B. c. brasheri*.

Basileuterus belli belli (Giraud). BELL'S WARBLER.

Noted only in brushy thickets in mixed woodland north of Jacala (6000 feet) on April 12, on which date two males were taken by Sutton.

Basileuterus rufifrons jouyi Ridgway. JOUY'S WARBLER.

Noted only about Jacala, where it was fairly common at higher elevations and where two specimens were taken, a male on March 29 and a female on April 8.

Icterus wagleri wagleri Sclater. WAGLER'S ORIOLE.

Three were seen at the Cuesta Texquedo, April 7. Noted at Jacala only on April 11 when a male was taken at 4000 feet in a wooded ravine southeast of town (Burleigh).

Icterus graduacauda Lesson. BLACK-HEADED ORIOLE.

Noted infrequently at Jacala, at from 5500 to 7000 feet, April 8-12.

Icterus cucullatus cucullatus Swainson. HOODED ORIOLE.

From one to four noted daily on the outskirts of Jacala, a male being taken there, April 11 (Burleigh).

Icterus parisorum Bonaparte. SCOTT'S ORIOLE.

Two males were seen on April 7, at the Cuesta Texquedo.

Tanagra elegantissima Bonaparte. BLUE-HEADED EUPHONIA.

Noted twice by Sutton in mixed woodland six miles north of Jacala: March 29, when a mated pair were taken; and April 12, when a male was taken.

Piranga bidentata sanguinolenta (Lafresnaye). LAFRESNAYE'S TANAGER.

Noted infrequently at Jacala, breeding males being taken, April 11 and 12, in open deciduous woodland.

Piranga leucoptera leucoptera Trudeau. WHITE-WINGED TANAGER.

Recorded only at El Barrio, where males were taken on March 27 and April 13.

Piranga flava hepatica (Swainson). HEPATIC TANAGER.

Common at Jacala, especially in pine and oak woods at from 6000 to 7000 feet. Specimens taken, March 27-29 and April 8-12.

Chlorospingus ophthalmicus ophthalmicus (Du Bus). BROWN-HEADED CHLOROSPINGUS.

Noted at El Barrio where it was common, and where, on March 27 and April 13, breeding specimens were collected. Noted also along the highway between El Barrio and the San Luis Potosí state-line.

Richmondena cardinalis canicauda (Chapman). GRAY-TAILED CARDINAL.

Fairly common at the Cuesta Texquedo, where a male was taken on April 7; and at 4000 to 4500 feet in the Jacala district, where a female was taken on April 9.

Hedymeles melanocephalus melanocephalus (Swainson). BLACK-HEADED GROSBEAK.

Fairly common at Jacala, single birds and small flocks being seen repeatedly during both our visits. A male was taken on April 10, thirteen miles south of town (Semple).

Guiraca caerulea interfusa Dwight and Griscom. WESTERN BLUE GROSBEAK.

Seen repeatedly in thickets near Jacala, April 8-12. A male of the present race was taken on April 9 (Burleigh).

Passerina cyanea (Linnaeus). INDIGO BUNTING.

Male taken in thicket near Jacala, at 4500 feet, April 11 (Burleigh).

Passerina versicolor (Bonaparte). VARIED BUNTING.

Male seen at the Cuesta Texquedo, April 7; flock of five seen, April 12, in thickets south of Jacala (4000 feet).

Tiaris olivacea pusilla Swainson. MEXICAN GRASSQUIT.

Noted daily at Jacala, where it was rare. Male taken, March 29, in mixed woodland six miles north of town (Sutton).

Carpodacus mexicanus (Müller). HOUSE FINCH.

Common at the Cuesta Texquedo, April 7. No specimen taken.

Spinus psaltria (Say). ARKANSAS GOLDFINCH.

Noted only at Jacala, where a flock of thirty was seen along the borders of a field near town on April 9.

Atlapetes pileatus pileatus Wagler. RUFOUS-CAPPED ATLAPETES.

Recorded only at Jacala where, in mixed woodland at from 5500 to 7000 feet, it was seen infrequently, male and female specimens being taken near La Placita on April 8.

Atlapetes brunnei-nucha brunnei-nucha (Lafresnaye). CHESTNUT-CAPPED ATLAPETES.

Common at El Barrio, where breeding specimens were taken, March 27 and April 13 (Sutton and Semple).

Arremonops rufivirgatus (Lawrence). TEXAS SPARROW.

Noted infrequently about Jacala. A male taken by Burleigh at about 5500 feet near that place is so dark, large billed, and short tailed that it cannot be called *A. r. rufivirgatus*, though it is obviously not large billed nor dark enough for *A. r. crassirostris*. Specimens taken by us at Tamazunchale, San Luis Potosí are similarly intermediate and unnameable.

Forty years ago, Ridgway (Birds of North and Middle America, Part 1, 448) called attention to the fact that specimens of *Arremonops rufivirgatus* "from southern Tamaulipas and Nuevo Leon and San Luis Potosí" baried "toward *A. r. crassirostris*," but this able systematist did not, with material at hand at the time, perceive how definitely intermediate in color and bill-size San Luis Potosí birds were, nor did he have specimens from Hidalgo. With fresh material from both these States for comparison, we believe that this intermediate race should be described and feel that no better name for it could be found than

Arremonops rufivirgatus ridgwayi subsp. nov.

Type.—Adult male in breeding plumage, Louis Agassiz Fuertes Memorial Bird Collection at Cornell University no. 7491; La Placita, near Jacala, Hidalgo (5500 feet elevation), April 8, 1939; collected by Thomas D. Burleigh.

Subspecific characters.—Too dark throughout upper parts and on throat, chest, sides and flanks, and too large-billed for *A. r. rufivirgatus* (Lawrence's type, from "Rio Grande in Texas" = Brownsville, Texas, we have examined); but not dark enough nor large-billed enough for *A. r. crassirostris* (type, from "Cordoba and Orizaba, Veracruz," also examined), hence definitely intermediate between the two races. Dissimilar to *verticalis*, *sinaloae*, *sumichrasti*, *chiapensis*, and *superciliosus* (all of which are considered by Hellmayr to be conspecific with *rufivirgatus*) in having uniform, comparatively light brown, crown stripes.

In tail- and wing-length *ridgwayi* is not, apparently, so constantly intermediate as in bill-size and color, but it *tends* to be short-tailed, the tail of our type specimen measuring only 58 mm. (58.67 mm. being the *average* tail-length of six male *crassirostris* examined by Ridgway).

Measurements.—Specimens collected by the authors: Type, wing, 61 mm.; tail 58; exposed culmen, 13.5; tarsus, 24. Male and female from Tamazunchale, San Luis Potosí: wing, 64, 61; tail, 64, 61; tail 64, 58; exposed culmen, 13.5, 13; tarsus, 24, 24.

Range.—Hidalgo, southeastern San Luis Potosí, and probably contiguous parts of southern Tamaulipas and northern Veracruz, from about sea-level to possibly 6000 feet.

Pipilo maculatus montanus Swarth. SPURRED TOWHEE.

Fairly common in the mixed woodlands about Jacala, specimens being taken there, April 8-12.

Pipilo fuscus potosinus Ridgway. PLATEAU BROWN TOWHEE.

Fairly common in opener country about Jacala, where a breeding male (wing, 92 mm.; tail, 96) was taken, April 11 (Burleigh). Noted also at the Cuesta Texquedo, April 7.

Ammodramus savannarum pratensis (Vieillot). EASTERN GRASSHOPPER SPARROW.

Three Grasshopper Sparrows were seen at the edge of an open field near Jacala, April 9. One of these, a female of the present race (wing, 60.5 mm.; tail, 43), was collected by Burleigh.

Pooecetes gramineus (Gmelin). VESPER SPARROW.

Three were seen feeding at the edge of an open field near Jacala on April 9. No specimen taken.

Chondestes grammacus (Say). LARK SPARROW.

Flock of eight seen April 9, near Jacala. No specimen taken.

Aimophila ruficeps eremoeca (Brown). ROCK SPARROW.

Identified with certainty but once: a female taken at 5000 feet near Jacala, April 11 (Sutton). This subspecies presumably winters in the region.

Aimophila ruficeps boucardi (Sclater). BOUCARD'S SPARROW.

Most *A. ruficeps* noted at Jacala were thought to be of this race. A male was taken there at 6000 feet, March 28 (Burleigh).

Junco phaeonotus phaeonotus Wagler. MEXICAN JUNCO.

Noted only at and near Jacala, where mated pairs were seen several times in mixed woodland at 6000 feet north of town, more frequently at from 6500 to 7000 feet, 13 miles south of town. Specimens were taken, March 29-30 and April 10.

Spizella passerina arizonae Coues. WESTERN CHIPPING SPARROW.

Seen at El Barrio, Jacala, and the Cuesta Texquedo, but nowhere common. Male of present race (wing, 72 mm.; tail, 60) taken at Jacala, April 12 (Semple).

Spizella pallida (Swainson). CLAY-COLORED SPARROW.

Noted only at the Cuesta Texquedo, where a male was taken from a small flock, April 13 (Semple).

Spizella atrogularis atrogularis (Cabanis). MEXICAN BLACK-CHINNED SPARROW.

Noted at the Cuesta Texquedo, where a male was taken on April 7 (Burleigh); and infrequently about Jacala (4000-4500 feet), April 8-12, a female being taken on April 12 (Burleigh).

Melospiza lincolnii (Audubon). LINCOLN'S SPARROW.

Noted at Jacala (4500 to 5500 feet), April 8-12.

ART. X. A NEW SPECIES OF CYMOTHALES (MYRMELEONIDAE)

By Nathan Banks
Museum of Comparative Zoology

(Plate XIII)

While looking over some West African Neuroptera in the Carnegie Museum, I noted a specimen of *Cymothales* that was unfamiliar to me. Dr. Kahl kindly loaned it for study, and I find it is new.

There are about a dozen species of this fine genus already known from Africa. Navas, not knowing of Gerstaecker's genus, described two species in a new genus, *Mironius*. I have not seen either of his species, but from the figures and descriptions, it may form a section or subgenus, for in those that I have seen there are two sections, readily separated by the condition of the anal veins in the fore wings.

Cymothales gerstaeckeri sp. nov. (Plate XIII)

In general appearance it is similar to *C. johnstoni* (of which *C. regalis* is probably a synonym). It differs in having a large costal spot between the oblique pre-median streak and the apical marks, as well as in various minor points.

The face has a broad, dark brown cross-band on upper part of the clypeus; above the antennae it is brown to top of the vertex where there is a row of darker brown spots, and behind is another row, the laterals adjoining the eyes, the median pair close together and longitudinal. The antennae are black for about six joints beyond the second, then pale, but getting dark toward the black tip. The pronotum has a broad median dark stripe, with a pale narrow stripe on each side, these reaching back over the thorax (as in several other species); on each side on the hind part of pronotum are two oblique dark streaks; pleura pale above, brown below; abdomen dark above, pale on venter except at tip; legs mostly pale, front femora darkened except on base, hind femora with a brown streak on outer side.

Wings hyaline, with the usual brown marks somewhat as in *C. johnstoni*. Fore wing with a subbasal band; before the middle of wing the usual

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oblique band, the upper part rather broad and from its tip an oblique line extends back to the hind margin, the lower part of this band is more slender, and basad of it are a few dark spots. A little beyond middle of wing is a large spot reaching from the costa to the first branch of the radial sector; the apical mark is broken up somewhat like *johnstoni*, and shows the longitudinal streak, and several large pale areas, one over stigma, one at apex, and one just beyond rhegma. The small marks along the cubitus are not as distinct as in some species.

In the hind wing the mark from hind margin is very oblique, and from its upper end a line goes down in a curve to the hind margin, along the hind margin and then up in a curve indicating a circle; the apical mark is broken by one large and several small pale spots, somewhat like *C. excentros;* several of the radial cross-veins are bordered with dark.

In structure this species belongs with *C. mirabilis*, *liberiensis*, and *delicata* in which the second anal vein of the fore wing unites for some distance with the third anal (not so in *speciosus*, *excentros*, and *hermosa*). The antennae are longer than usual, reaching to the submedian band. The pronotum is long and slender; the vertex is elevated and straight across on top as in *liberiensis*. The fore wings are broader than in *liberiensis*, the hind wings are much longer than the front ones, and the tip behind is deeply excavate. In the fore wings before the radial sector there are two rows of cells except near base; the radial sector at the postmedian costal mark bends upward more than in allied species; there are about ten radial sectors; before the cubital fork none of the cells are crossed.

In the hind wings the venation is much as in *liberiensis*, but the medius and cubitus are further apart. Abdomen is somewhat longer than many species. The legs are very slender, the front femora not thickened nor with the dense black hair, the bristles on femora and tibiae are black.

Length of fore wing 42 mm., width 14 mm.

Length of hind wing 50 mm., width 10 mm.

Type specimen from Lolodorf, Kamerun, collected by J. A. Reis, unique, in collections of Carnegie Museum.

Cymothales gerstaeckeri Banks, sp. nov.
About twice natural size.

ART. XI. AN ARCHAEOLOGICAL COLLECTION FROM THE BELCHER ISLANDS IN HUDSON BAY

By Diamond Jenness

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ART. XI. AN ARCHAEOLOGICAL COLLECTION FROM THE BELCHER ISLANDS IN HUDSON BAY

By Diamond Jenness[1]
National Museum of Canada

(Plates XIV-XXII)

Through the kindness of Mr. J. Kenneth Doutt and Mr. Lawrence C. Woods, of Pittsburgh, the National Museum of Canada has received a collection of about a thousand archaeological specimens that Eskimos had gathered from old camp-sites in the Belcher Islands and delivered to Mr. Robert Cruickshank, the factor of the Hudson's Bay Company's trading post. The exact location of these camp-sites, and the extent to which they were ransacked, is unknown.

About half the specimens are of stone, the other half of bone and ivory. Except for some teeth of seals, bears, dogs, and perhaps beluga, all the ivory has come from walrus tusks. The sources of the bone are more uncertain. A few objects have been made from the flipper bones of seals; two mouth-pieces of bow drills from the astragali of caribou; and the handle of a snow-knife from what seems to be a whale rib.

Of the stone implements more than ninety-five per cent are made from slate, which is apparently very abundant in the islands. The slate was first battered or, occasionally, sawn into shape, then finished by grinding on slabs of either slate or sandstone. Many specimens were drilled for attachment to handles, or for lashing two broken parts together; and this drilling was done sometimes from one side only, sometimes from both. Drills with stone points were used, presumably, although no actual drills appear in the collection.

Two specimens, both arrowheads, are of quartz, chipped but not polished. In addition, there are two unworked quartz crystals.

[1] The author gratefully acknowledges the help he has received from his colleagues in the National Museum of Canada, Mr. W. J. Wintemberg and Mr. J. D. Leechman. For additional information on Belcher Islands' archaeology he would refer the student to the excellent article by Quimby, G. I. "The Manitunik Eskimo Culture of East Hudson's Bay," American Antiquity, Vol. 6, No. 2, October, 1940, which was not in print when this paper was submitted.

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Eight specimens are of sandstone. Six of these are whetstones, one a bead. The use of the eighth is unknown.

Three implements, two of them small knives and one a lance-point, are of nephrite. A fourth implement, of uncertain use, is from a hard stone that looks like impure nephrite.

Soapstone appears in the form of a toy lamp. Six pebbles, probably juggling stones, are of some undetermined igneous rock; two small knife-blades and what looks like a toy arrowhead are of a greyish-green amphibole; and one arrowhead of a black, basaltic rock.

The source of the nephrite is unknown. Odd specimens made from it are distributed rather widely throughout the eastern Arctic, even as far south as northern Newfoundland.

The soapstone probably came from somewhere in the Labrador Peninsula. Implements made from black basalt seem to be common along the east coast of Hudson Bay; the arrowhead of that material may therefore have come from the mainland.

HUNTING AND FISHING WEAPONS

Harpoon Heads

In this collection from the Belcher Islands are nineteen harpoon heads, nine of which—two made from ivory and seven from bone—have open sockets. Of these nine heads, one which carries a single spur and lashing holes for the foreshaft is broken at the fore-end so that it is impossible to determine whether or not it was slotted for a blade. A second specimen, very small and without a blade-slot, conforms to Mathiassen's type AIa.[2] A third, very flat but broken at the line hole, probably belongs to Mathiassen's type BI; its base is bevelled to an edge and serrated, and there is only one hole on each side for the foreshaft lashing.

The other six heads with open sockets (Plate XIV, figs. 5-7) have blade-slots parallel with the line-hole and belong to Mathiassen's type AIcl. One specimen (Plate XIV, fig. 7) still retains its original iron blade. In every case barbs are lacking, and the base terminates in a single spur. Five heads carry holes for the foreshaft lashing; the sixth (Plate XIV, fig. 5) has a row of notches along each side.

Of closed socket harpoons there are likewise nine examples, all barbless;

[2] Mathiassen T. Archaeology of the Central Eskimos, Report of the Fifth Thule Expedition, 1921-24, Vol. IV, Pts. I and II, Copenhagen, 1927; particularly Pt. II, pp. 12-26.

seven are made of ivory, two of bone. Four of them are quite thin, with line holes running from side to side and blade-slots parallel with them (Plate XIV, figs. 1, 2); and of these four three have bifurcated spurs, the other a single median spur. They belong to Mathiassen's type AIIcl.

The remaining five harpoon heads with closed sockets are very flat, belonging to Mathiassen's type BIIc. All have bifurcated spurs. Four have also blade-slots, three parallel to the line-hole, the fourth at right angles to it (Plate XIV, fig. 3). The fifth specimen is a toy weapon only.

One harpoon head, of bone, has two barbs and no blade-slot (Plate XIV, fig. 4). Its base is broken, so that the character of the socket is uncertain.

It is noticeable that the type of harpoon-head Mathiassen found most frequently recurring in Thule culture remains, a type with open socket and two opposing barbs, is lacking in this Belcher Island collection, though Mathiassen obtained one specimen from Port Harrison, on the coast of Labrador to the northward. There are six specimens of another common Thule type, that with open socket and blade-slits parallel to the line-hole; but one of these specimens bears an iron blade, showing that it persisted into early historic times. This may well have been the case also with the small specimen without a blade-slot (Mathiassen's type AIa), and with the other specimen that is broken at the line-hole (Mathiassen's type BI). The harpoon heads with closed sockets definitely belong to the later stages of the Thule culture and to the recent culture that succeeded it in the Central Arctic.

HARPOON FORESHAFTS

There are two foreshafts, both of ivory, and both used, probably, on walrus harpoons. One was a fixed foreshaft, *i.e.*, firmly lashed to the shaft, the other was detachable.

The fixed foreshaft (Plate XVII, fig. 3) is cut off square at the base, and its two lashing holes run parallel side by side, not at right angles to each other as was customary in the central Arctic from the late Thule period to comparatively recent times. It has also a third and larger hole, 4 cm. along the stem, that served for a reinforcing lashing.

The detachable or movable foreshaft (Plate XVII, fig. 4) has a rounded base and, 6 cm. down the stem, a central hole whose grooves indicate a lashing down to the shaft. It has its counterpart in a toy specimen, 7 cm. long, which may have been deposited on a grave. This type of foreshaft has been used in the central Arctic from early Thule times (Mathiassen found it at Naujan) down to the 19th century.

Socket-pieces for Harpoon Shafts

Two types of socket-pieces are represented, each by two examples. The first (Plate XX, fig. 1) is a solid piece of bone hollowed at the top and scarfed at the bottom for attachment to the shaft; the second (Plate XX, fig. 6) is the cap-shaped type in common use today throughout the Central Arctic. The second specimen of this latter type (Plate XX, fig. 4) is a hollow tube with two large holes in the side, in addition to the two holes at the base for pegging to the shaft; possibly it has been reworked for some purpose.

Mathiassen states that the cap-shaped type is a later form which, in the central and eastern areas of the Arctic, has replaced the heavy, solid type.

Finger-rest of Harpoon

There are two finger-rests for the throwing harpoon, both of ivory. One (Plate XXI, fig. 2) has two small holes for lashing to the shaft, the other (Plate XXI, fig. 3) only one. Neither shows any unusual features.

Swivel for Harpoon Line

A bone swivel to prevent the harpoon line from entangling is shown in Plate XXI, fig. 11. Similar swivels are still used in Baffin Island and in Greenland. Their antiquity is a little uncertain, for Mathiassen seems not to have found any in Thule age remains.

Bladder-inflator

An ivory bladder-inflator is shown in Plate XXI, fig. 7. A second specimen differs only in being a little smaller. The type has remained constant from Thule times to the present day.

There are also two stoppers for bladder-inflators, one of ivory (Plate XXI. fig. 8), and the other of bone. They do not differ from stoppers found in other parts of the Arctic from the earliest times onward.

Harpoon Rest on Kayak

A bone rest for the harpoon is shown in Plate XX, fig. 3. In addition to the end hole there are two holes on the underside, near the widest part, that meet in the middle and serve to lash the object to the deck of the kayak.

Mathiassen considers the harpoon rest a late feature among the Central Eskimos because he did not find it in any Thule site except the very late one at Qilalukan, on the north end of Baffin Island. In the National Museum of Canada, however, there is a 'hoop' made from musk-ox horn (text-figure 1) that was found in the old site at Birnirk, north Alaska, and

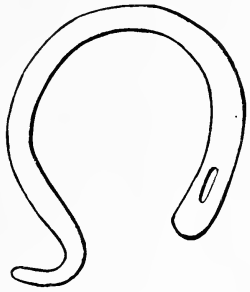


FIG. 1. Harpoon rest from Birnirk, northern Alaska.

immediately identified by the local Eskimos as an appliance lashed to the deck of the kayak to keep the spear from falling overboard. It may be, therefore, that some kind of a rest is an ancient and wide-spread feature.

BLADDER-DART HEAD

On Plate XVII, fig. 1, is shown an extraordinarily long (38 cm.) ivory dart-head, cleverly spliced together to mend a break. It has four barbs on one side, six on the other, all made in the same peculiar way, by drilling two overlapping holes close to the edge. The base tapers to a point and is roughened for attachment to the shaft, besides which a small hole has been drilled in the edge, presumably for a lashing.

Bladder-dart heads appear not to have been very common in the eastern Arctic (outside of Greenland). All those that have been discovered hitherto seem to be rather shorter, and to have either unilateral barbs, or two opposing barbs. Mathiassen illustrates a whale-bone head from Port Harrison (*Op. cit.*, Plate 77, fig. 1), on the Labrador mainland to the north of the Belcher Islands, which seems to have barbs made by drilling two overlapping holes; I know of no other example.

It may be worth recording that from the east coast of Hudson Bay, "somewhere between Port Harrison and Cape Smith, there was obtained a long slate pencil which was said to be a weight attached to the seal-

spear (bladder-dart?) to give it the correct balance." The specimen is now in the Hudson's Bay Company's Museum in Winnipeg, but a drawing of it is shown in text figure 2.

FIG. 2. Weight attached to a seal-spear to give it the correct balance. About one-fourth natural size. From ruined rock dwellings between Port Harrison and Cape Smith.

LANCE-HEAD

There are four lance-heads; all have open sockets, three of them flattened at the fore-end for a blade (Plate XIV, fig. 8), the other slit. A fifth specimen (Plate XIV, fig. 9), rather flat, exactly resembles these heads except that it lacked a blade, tapering instead to a rounded point very like certain harpoon-heads.

All five lance-heads are of the 'loose' variety, attachable to the harpoon fore-shaft. The type seems to have been known in the Central Arctic from the Thule period until comparatively recent times. No 'fixed' lance-heads are present in the collection.

ARROWHEADS

There is only one bone arrowhead (Plate XV, fig. 10), with a barb on each side. The base is broken, so that it is uncertain whether it was tanged or scarfed.

PRONGS FOR SALMON SPEARS

There are two bone prongs for the salmon spear (Plate XV, fig. 5), of a type common in the Central Arctic from the earliest times. Mathiassen

has illustrated a third from the Belcher Islands that does not differ from them in any essential feature.

PRONGS FOR BIRD SPEARS

Five side prongs for bird spears have one or more barbs on the inside, none on the outside (Plate XV, fig. 8); but a sixth prong (Plate XV, fig. 9) has a barb on the outside also, as was customary during the Thule period. An unusual feature in this specimen is the hole in the base for lashing to the shaft.

SINKERS FOR FISH-HOOKS

The fish-hooks, or rather sinkers for fish-hooks, are of very unusual types. Seven are of bone, and seven of stone.

At least four of the bone sinkers are fashioned from flipper bones of the seal. At one end is a hole for the fishing line; in the curve of the other end is a hole for the barbed bone or ivory hook. One specimen (Plate XV, fig. 2) has a hook still in place, but it appears newer than the rest of the implement and may have been made recently. There is, however, another hook of exactly the same shape, but much older-looking, that seems to fit the hole of another sinker (Plate XV, fig. 1).

All the stone sinkers are made from slate (Plate XV, figs. 3, 4, 7). Four have single notches for the attachment of the barb (which was presumably bone or ivory); three have two diverging notches. Five are grooved at both ends for lashings; the upper ends of the remaining two are broken.

Both the stone and the bone sinkers were doubtless used for catching cod. Since neither type seems to have been recorded hitherto, they may be peculiar to the Belcher Islands, or perhaps to those islands and the adjacent shores of the Labrador peninsula.

BLADES AND POINTS FOR HUNTING WEAPONS

Apart from two bone points, all the blades are made of stone. Four types seem distinguishable.

Type 1: Thin triangular slate blades, with straight bases and with sides, as a rule, slightly curving; they are commonly bevelled towards the three edges so as to leave a ridge from the point to near the middle, where the blade is thickest (Plate XVI, figs. 1-8 and 10). In a few specimens the corners of the base are rounded or ground diagonally. The majority of the

blades range from 3 to 6 cm. in length, but one unfinished specimen, only slightly ground, measures 12.5 cm.; possibly it was intended for a knife.

In one specimen (Plate XVI, fig. 5) the base has been ground straight across except in one corner, where there is a small spur or barb. A similar spur appears in another specimen, which may conceivably have carried two spurs, for the opposite corner is broken. Mathiassen illustrates a single-spurred slate blade (*Op. cit.*, Plate 44, fig. 12), that he found at Mitimatalik, on the north end of Baffin Island. A third blade in the collection (Plate XVI, fig. 10) has been ground straight across, then rendered slightly concave by chipping. Possibly in these three specimens the Belcher Islanders have been influenced by their concave-based arrow-points of chipped quartz or basalt (Plate XVI, figs. 11, 12). Mathiassen illustrates an unground slate point with concave base that came from Port Harrison (*Op. cit.*, Plate 77, fig. 5).

The smallest of these slate blades were doubtless arrow-heads, and the larger ones used for harpoons and lances. Seventeen lack any holes or notches for securing them to the shafts; presumably they were expected to slip out and remain in the quarry. An almost equal number have one hole either through the middle or to one edge; and two specimens (Plate XVI, fig. 3) have two holes, one above the other.

Slate blades of this type (excluding the three specially noted) were widely distributed throughout both the eastern and the western Arctic from early times right down to the introduction of iron. The Belcher Island collection contains two points of bone that are exactly similar (Plate XVI, figs. 13, 14). They also seem equally wide-spread, though not so common as slate ones.

Type 2: Long slender slate blades, flat on both faces but with bevelled edges, and with one or more notches on each side of the base for attachment to the handle (Plate XVI, figs. 16-19). In two specimens (Plate XVI, fig. 17) the point is very sharp, which suggests that they were arrow-points or small lance-points; two others (Plate XVI, figs. 19, 18), one with a rounded point, the other with a chisel-shaped one, may have been knives; the points of the remaining two specimens are broken. One of these broken specimens (Plate XVI, fig. 16) is ground steeply to an edge on one face, and on the opposite face to produce the edge on the other side. The same feature reappears in two other slate blades (*Cf.* Plate XV, fig. 11, and Plate XVIII, fig. 9), so that it was probably intentional.

Blades of this type, made from ground slate, seem unknown outside of the Belcher Islands and the west coast of the Labrador Peninsula, whence

Mathiassen also obtained some specimens. One blade with three notches on each side was found in a ruined stone dwelling between Port Harrison and Cape Smith; it is now in the Hudson's Bay Company's museum in Winnipeg. Mathiassen illustrates three others from Port Harrison; one has one notch, one two, and the third three notches on each side (*Op. cit.*, Plate 77, figs. 18-20). Blades of the same type, but chipped from chert, seem to have a rather wider distribution around the Labrador Peninsula and even extend into Newfoundland, where they are associated with Dorset Eskimo remains.

Type 3: Flat, triangular blades, probably lance-points, with long flat tangs for insertion in a handle. The collection contains only three certain examples, one (Plate XVI, fig. 9) made from nephrite, the other two (Plate XVI, fig. 15) from slate; but a fourth specimen, broken at the base, seems to have belonged to the same type, which has been widely spread throughout the Arctic since early times.

Type 4: Chipped points, unground. There are only three in this collection, two (Plate XVI, fig. 12) of quartz and one (Plate XVI, fig. 11) of a black basaltic stone. All are triangular and have the concave bases that seem specially associated with Dorset culture remains.

In addition to the four types listed above, there are one or two anomalous blades. Plate XVI, fig. 24, shows what seems to be a tiny arrow-point of amphibole. The chip at the base was accidental. One of the two holes has been drilled from both faces to meet in the middle, but the workman made a mistake and his first hole did not meet the one from the opposite side. It should be noted that Wintemberg found a rather similar specimen, but of ground slate and with its two holes sawn out, not drilled, on the Dorset Eskimo site at Portland Creek in Newfoundland; and that another from the same island has been illustrated by Patterson (Transactions of the Royal Society of Canada, Sect. II, Pl. X, 1, 1891).

Another peculiar specimen is shown in Plate XV, fig. 11. From its shape, and its sharp point and edges, one suspects that it was a lance-head, but the base is unusually thick. Like the specimens shown in Plate XVI, fig. 16, and Plate XVIII, fig. 9, the edges are bevelled on opposite faces. One face, too, is quite rounded, so that the blade has a twisted appearance. I have found no other blades bevelled on opposite faces in the National Museum of Canada's collections from the Central Arctic except one small point from Pond's Inlet, in which the bevelling is much less pronounced, and a broken slate knife-blade from the Dorset Eskimo site at Port-au-Choix, Newfoundland.

HOUSEHOLD TOOLS AND ORNAMENTS

SNOW-KNIVES

There are five curving snow-knife blades made of ivory and two bone handles for such knives. Four of the blades (Plate XVII, fig. 5) are cut off square at the base, where there are holes for lashing to the handles. The fifth, (Plate XVII, fig. 2), for a left-handed person, is double-shouldered, tapering in to a hollowed-out tang that is pierced with eight holes joined in pairs on one face by grooving. In breadth all the blades are intermediate, neither very wide nor very narrow.

Both handles, like the blade just described, are double-shouldered. One seems to fit the largest blade, as shown in Plate XVII, fig. 5. The other closely resembles it, but is a little smaller.

Snow-knives of similar shape, with double-shouldered handles, persisted in many parts of the Central Arctic (*e.g.*, Southampton Island) from Thule times down to the introduction of iron.

MEN'S KNIVES

Out of nearly fifty men's knives, or parts of such knives, all but about six are single-edged (Plate XVIII, figs. 1-9; Plate XIX, figs. 1-2). The backs are almost straight, but the curved cutting edge tapers in to produce a long tang. In the larger specimens this tang made a satisfactory handle even without a wrapping, provided the hand was protected with a mitten; the smaller and thinner specimens (Plate XVIII, figs. 6, 7) were doubtless hafted or wrapped.

One specimen (Plate XVIII, fig. 1) has the shape of a single-edged knife, but its almost straight back has also been ground to a sharp edge. In another specimen (Plate XVIII, fig. 9) the edge has been produced by unusually steep bevelling on one face only, and the almost straight back is also steeply bevelled, but on the opposite face, thus giving the blade a twisted appearance (Plate XV, fig 11 and Plate XVI, fig. 16). Plate XVIII, fig. 3 shows the fore-end of a blade with an unusually curved back.

Of the double-edged knives, three are perfectly symmetrical, with both edges tapering in to the long tang. In two of them the points are rounded; in the third (Plate XVIII, fig. 4) it is broken off. The largest of these three knives, 36 cm. long, (Plate XIX, fig. 2) may be unfinished; only the edges have been ground, and they are not ground sufficiently to produce a uniformly smooth bevel. That this grinding was usually the final stage in

manufacture becomes clear from the well-formed single-edged specimen shown in Plate XIX, fig. 1, which has been battered and chipped into shape, and only awaits the grinding of its edges and surfaces.

A fourth double-edged knife (Plate XVIII, fig. 2), broken, unfortunately, at the fore-end, shows no sharp separation between blade and tang, but in the tang, which has rather sharp edges, three holes have been drilled as though for lashing to a heavy handle. Were it not for its size one would be tempted to consider this blade a lance-head.

One of the double-edged knives, and a few of the single-edged, have holes in the tangs for suspension handles. When the blade of one neatly-made single-edged knife broke in two, its owner drilled four small holes to lash the two parts together (Plate XVIII, fig. 6).

Besides these single- and double-edged slate knives with blade and handle in one piece, known from several other parts of the Arctic (according to Mathiassen, wherever slate was plentiful), there are two slate knives, also single-edged, of a type not hitherto recorded. The handle of the one shown in Plate XV, fig. 13, is but slightly worked, but that of Plate XV, fig. 14, is both chipped and ground. Its edge, too, has been bevelled from both sides. Although the blades of the two specimens are broken, they seem from their thinness to have been very short, perhaps not exceeding 3 cm. Possibly they were used for sawing or graving.

In Plate XVI are shown some very small knife-blades made from greenish-grey amphibole (figs. 26 and 27) or nephrite (figs. 21 and 22). Three of them were probably side-blades, but one of the two nephrite specimens (fig. 21) seems to have been an end-blade, admirably adapted for cutting bone and ivory.

The slate implement shown in Plate XVI, fig. 25, is broken. Both of its faces have been carefully bevelled to a chisel-like end and its edges are finely notched. This implement may be the base of a knife.

The only separate knife-handle is the bone fragment shown in Plate XX, fig. 7, which has a deep slot at the side of the fore-end and traces of the hole through which the blade was lashed. It was adapted, apparently, for a whittling knife such as was common in the Central Arctic from Thule times onward.

WOMEN'S KNIVES (*ulos*)

There are thirty-four ulos or fragments of ulos (Plate XVIII, figs. 10-12, Plate XIX, figs. 3-5), all made of slate. They range in size from a very neat specimen less than 7 cm. long to an enormous blade (Plate XIX, fig.

3) over 27 cm., the largest I have seen recorded.[3] This extraordinary knife, however, is unfinished, for its edge, though chipped all round, has been left unground.

In some of these ulos the edges are only slightly ground; others resemble in outline a crescent moon. All except one are tanged for the reception of a handle, a feature characteristic of the old Thule culture, but whether of the Dorset also is not certain. Several have a hole near the base of the tang, and one has two holes near the corners. In one knife (Plate XIX, fig. 4) there is a small hole in the tang, and, below it, a much larger hole, made by grinding on both faces, for the insertion of a finger; probably the maker was here copying the open frame handle of bone so common in the Thule period, thereby making it unnecessary to attach any handle (*Cf.* Mathiassen, *Op.cit.*, Plate 50, fig. 3).

The specimen without a tang (Plate XVIII, fig. 10) had two holes in the body of the blade for lashing on a handle or wrapping (*Cf.* Mathiassen, *Op.cit.*, Plate 50, fig. 10), but it is broken across one of the holes.

The only two ulo handles in this Belcher Island collection are of modern form, with the handles morticed and also riveted to slender tangs, that in turn were riveted to the blades. One specimen, with an ivory handle and bone tang, is a mere toy; the other (Plate XX, fig. 5) has a wooden handle and bone tang pierced by iron rivets.

Adzes

There are no adze handles in the collection, and only one adze head (Plate XX, fig. 2) which is made of bone. The socket for the blade, which was evidently of stone, is almost oval and very shallow; on each side of it is a hole for the lashing. The body tapers off to a blunt point, and, in addition to roughened edges, has a vertical hole through the middle to secure the handle.

Of adze-blades there are three, all of slate. The largest (Plate XIX, fig. 7), 15.5 cm. long by 6 cm. wide and 3 cm. thick, has been smoothed on both faces and bevelled to an edge at one end. By chipping and grinding, three grooves were formed on each edge of its upper surface for securing the lashing that fastened it to the handle. I know of no other blade shaped in this manner.

The two other adze-blades were roughly chipped into shape and left

[3] Mathiassen records one 25 cm. long, also from the Belcher Islands (*Op. cit.*, p. 291).

unfinished. One was ground at the end on both faces to produce a symmetrically bevelled edge; the other was ground a little on one side and on the upper surface, and the fore-end of this surface bevelled to an edge. The maker then proceeded to dress it, apparently, by more chipping, and in so doing broke the implement in two.

WHETSTONES

Of the twenty-four whetstones, eighteen are of slate and six of sandstone. The majority are rectangular, some fairly broad, others long and narrow. On some, both surfaces have been used, on others only one. One specimen (Plate XV, fig. 16), of a reddish sandstone, has three rude triangles scratched on one surface, but the marks seem recent and were probably made by the finder.

SKIN SCRAPERS

There is only one skin scraper, of slate, with blade and handle in one piece and a foot on the handle (Plate XIX, fig. 6). Mathiassen illustrates a rather similar specimen from Port Harrison (*Op. cit.*, Plate 77, fig. 7). The type is known from Thule remains, and is still used occasionally in the Central Arctic.

Another slate blade, chipped along the rounded front edge, seems to have been intended for a scraper, but broke in manufacture.

CHISEL (?) OR BOOT-CREASER (?)

On Plate XVI, fig. 20 is shown a small implement fashioned from some hard rock that is probably nephrite. The fore-end has been bevelled to a sharp, chisel-like edge, one side-edge ground smooth, and the other side-edge bevelled from both faces, but not to an edge. The base is broken off. Near the front end is a notch, presumably for hafting.

Wintemberg found a slate tool almost identical with this one at Portland Creek, on the northwest coast of Newfoundland; it differed only in lacking the notch. In northern Newfoundland, too, have been found several other specimens, all but one of nephrite, that are similar in every respect except that they are triangular (and the chisel-edge, therefore, much narrower) and are notched near the base. (It should be noted that these Newfoundland specimens are associated with Dorset culture remains, the only Eskimo culture found on the island.) Still another

FIG. 3. Chisel of nephrite from Brodie Bay, east coast of Baffin Island.

nephrite chisel (?), text-figure 3, with two notches on each side, comes from Brodie Bay, on the east coast of Baffin Island. Finally, Mathiassen illustrates what may be the same type of implement from Admiralty Inlet, in the north of Baffin Island (*Op.cit.*, Plate 1, fig. 64).

Just what purpose these specimens served is unknown. Their edges seem too sharp for boot-creasers; possibly they were really chisels. Mathiassen calls his specimen a knife.

DRILLS

No drills are present in the collection, but there are two mouth-pieces for a bow-drill, each of them a caribou astragalus. One (Plate XIV, fig. 13) has been used so frequently that the socket is worn right through to the top.

Mouthpieces of caribou astragalus were in common use throughout the Central Arctic from the earliest times.

The cylindrical ivory object shown in Plate XXI, fig. 17, deeply grooved in the middle, may have been attached to the thong of a fire-drill. There is a second specimen very much like it, but a trifle smaller.

LAMPS

The only lamp is the tiny specimen of soapstone shown in Plate XV, fig. 15. It is oval in outline and has a flat bottom, but, being a toy, may not represent the usual shape of Belcher Island lamps.

TOGGLES FOR DOG HARNESS

There are three toggles for dog harnesses. Two conform to the usual Central Eskimo type, that is to say, they are oval bone plates with two holes, one large and one small, drilled in the same direction (Plate XIV, fig. 10). The third toggle (Plate XIV, fig. 11) has the holes at right angles. Mathiassen records only two specimens of this latter type (*Op.cit.*, II, p. 63), both from Naujan, his oldest Thule culture site; but the National

Museum of Canada has three from Cape Dorset, in the south of Baffin Island, and two from Strathcona Sound, in the north of the same island.

On Plate XIV, fig. 12, is shown a blank for a toggle, lacking only the holes, which would evidently have been drilled in the same direction.

BUCKLES

Four belt-buckles (Plate XXI, fig. 13) have been fashioned from teeth, probably of the harbour seal. The two holes in each under side run together.

The bone buckle shown in Plate XXI, fig. 9, has all the characteristics of a thimble-holder except that it is rather large. It may have been used as a belt-buckle, or as a handle for carrying things.

On Plate XXI, fig. 12, is shown a slightly different type of buckle, neatly carved from ivory. Four small holes drilled close to one another on its under side make a channel for the passage of a thin cord, probably of sinew. Possibly, then, this specimen was not a belt-buckle, but attached to a needle-case. Six pairs of parallel lines, the two middle and the two outermost bordered by a zigzag line, run three-fourths of the way round the circumference. This design closely resembles one on a needle-case from Port Harrison illustrated by Mathiassen (*Op. cit.*, Plate I, fig. 98).

COMBS

The collection contains two combs, both of ivory. One (Plate XX, fig. 8) has a solid handle, undecorated; the other (Plate XX, fig. 9) a handle divided into two 'windows' surmounted by an hexagonal 'head.' On the 'head' are numerous hatched lines, too faint to decipher, that extend into the frame. This second comb closely resembles two from Southampton Island illustrated by Boas (Bull. Am. Mus. Nat. Hist., vol. XV, pt. II, fig. 216).

Mathiassen considers the solid handle typical of the Thule period, the open-handle both later and restricted to the Hudson Bay region.

HAIR ORNAMENTS

Of two hair ornaments one (Plate XXI, fig. 18) is a thin oval plaque of ivory (unfortunately broken), ornamented with numerous rows of dots. The other (Plate XXI, fig. 19) is leaf-shaped, and has a broken suspension hole in the top. It is probably unfinished, however, since both surfaces are rough.

Similar hair ornaments were common among the Southampton Islanders down to recent times, but there the usual shape was rectangular (*Cf.* Boas, Bull. Am. Mus. Nat. Hist., vol. XV, pt. I, fig. 102; pt. II, fig. 217).

Pendants

In addition to some forty teeth of seals, dogs, and bears that are drilled with holes, and were evidently attached to women's dresses as pendants, there are twenty-one drop pendants carved from walrus ivory, all of the same form (Plate XXII).

Both teeth pendants and drop pendants of ivory have been common throughout the Central Arctic from the Thule period to the present day.

The large bear canine (Plate XX, fig. 10) with two holes, may have been a pendant, a lure on a fish-line, or a knife-sharpener. Bear teeth have been used for all these purposes in recent times within the Central Arctic.

Two problematical objects, the bird-like figure (Plate XXI, fig. 10), of slate, the other specimen (Plate XXI, fig. 4) of limestone, may have been intended for pendants. One edge of the latter shows the marks of sawing and breaking. The slate specimen shown in Plate XVI, fig. 23, shaped like a knife, may also have been a pendant.

Beads

There are two small disc-shaped stone beads, one of black slate, the other of limestone (Plate XXI, fig. 14). No similar beads seem to have been reported from the Central Arctic, though Mathiassen found a semi-spherical one of serpentine at Naujan.

The pencil of red slate (Plate XXI, fig. 20), notched on all sides in several places, may be in process of manufacture into beads.

Juggling Stones

Six nearly spherical pebbles that show no signs of battering (Plate XXI, fig. 22) were probably used as juggling stones, being too large to hurl from a sling. The smallest has axes of 3.2 cm. and 2.6 cm., the largest 5 cm. and 4.5 cm. Eskimo children from northern Alaska to Coronation Gulf still juggle with pebbles about the size of the smallest of these specimens.

Counters (?)

There are eighteen thin, flat slate discs, ranging from 2.5 to 5.5 cm. in diameter, some only slightly polished, others ground smooth on both

sides. One is illustrated in Plate XXI, fig. 21. Their use is unknown, but they may have served as counters or markers in some game.

PROBLEMATICAL OBJECTS

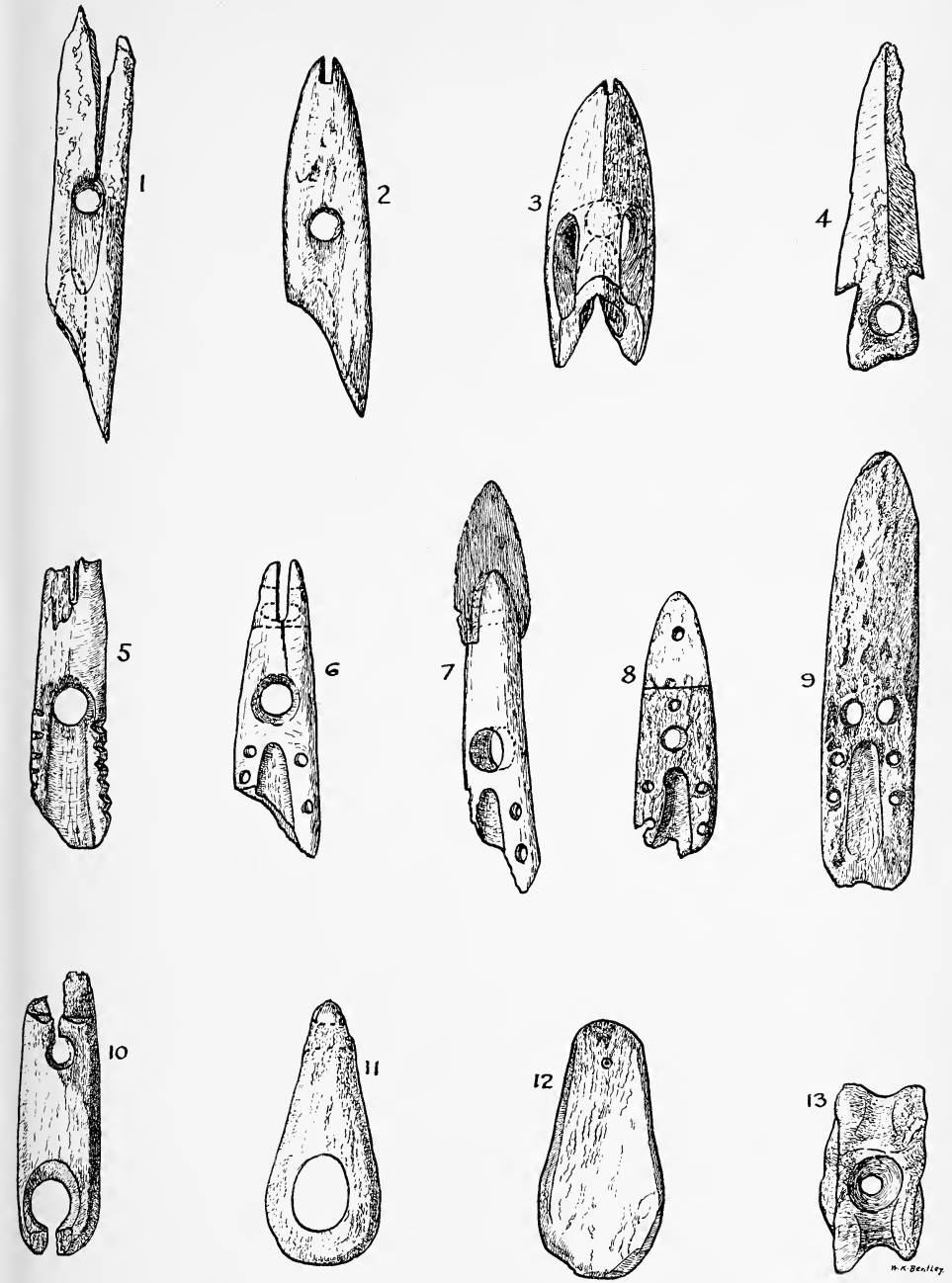
On Plate XV, figs. 6, 12 are shown fragments of two slate points. One (6) is a fore-end bearing a barb on each side; the other and longer fragment (12) lacks the point, but carries traces of a small barb and has a base that is ground to a knife-like tang. These implements resemble bone arrowheads, and also central prongs of leisters, but they seem impracticable for any such purposes.

Some of the bone and ivory objects are equally puzzling. Plate XXI, fig. 5, shows an ivory plaque that resembles a pair of toy snow-goggles without slits; it would make an excellent gut-scraper. Plate XXI, fig. 15, is an ivory pin, rectangular in cross-section and broken at the tip; its use is also uncertain, for it seems too fragile for a wound- or meat-pin. Another pin, of bone, is shown in Plate XXI, fig. 16; it is flat on the underside as though for lashing on some object, perhaps on the side of a dish. The flat ivory specimen illustrated in Plate XXI, fig. 6, is slightly bevelled at each end; it may be a splicing piece, but the holes seem too close together. The 'violin bridge' made of bone shown in Plate XXI, fig. 1, may have been a wedge between the handle and rim of a drum. A few other objects of bone and ivory are too fragmentary for analysis.

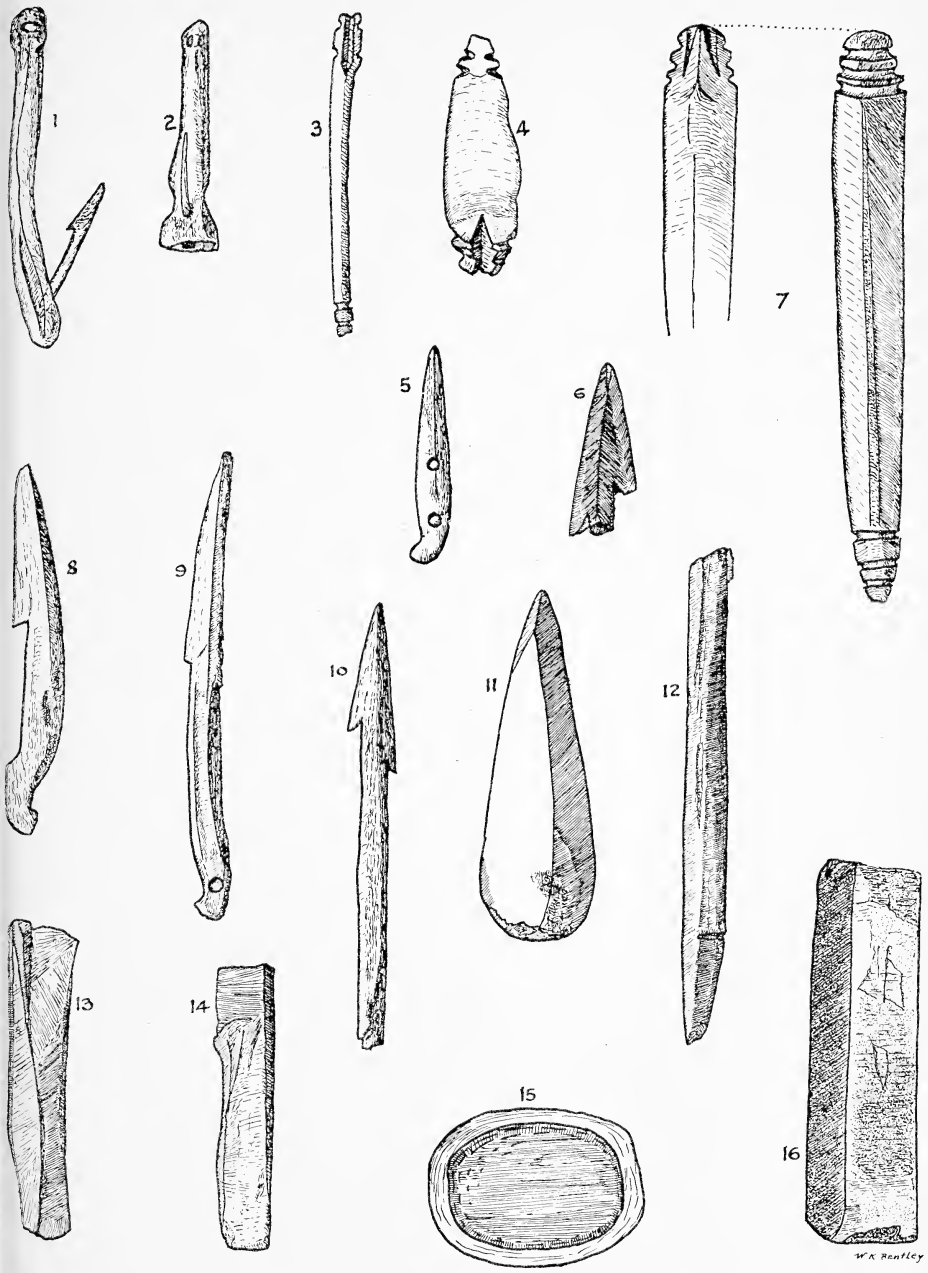
CONCLUSION

The collection from the Belcher Islands, like the smaller one secured by Mathiassen, seems greatly mixed. The extensive use of slate, bone, and ivory, indicates that most of the specimens pre-date the historical period, but at least three of them, and probably more, must be subsequent to the introduction of iron, *i.e.*, they cannot be earlier than the middle of the 16th century, and may well date from the 17th or even later. The open-socketed harpoon-heads (Plate XIV, figs. 5-7), the tanged ulo blades (Plate XVIII, figs. 10-12; XIX, 3-5), and the double-shouldered snow-knives (Plate XVII, figs. 2, 5) suggest the presence of an Eskimo community in the later stages of the Thule culture, a community that had been influenced from the direction of Southampton Island in the matter of combs and hair ornaments. On the other hand, here as in so many other places within the Central Arctic, the mysterious Dorset culture has also left its traces in the form of triangular chipped arrowheads with con-

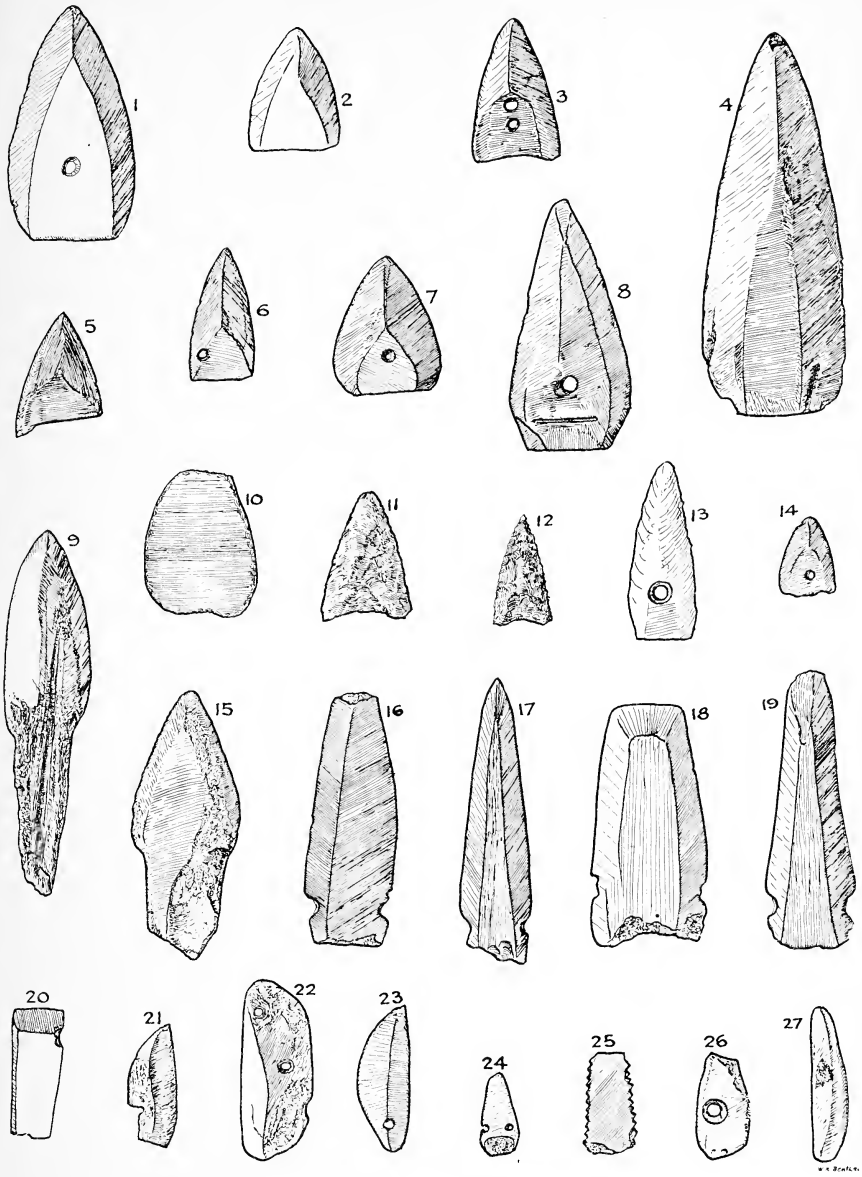
cave bases (Plate XVI, figs. 12, 11), stone blades with one or more notches along each side (Plate XVI, figs. 16-19), a peculiar chisel or boot-creaser (Plate XVI, fig. 20), slate blades ground on opposing edges (Plate XV, fig. 11; XVI, 16; XVIII, 9), and a small ground arrow-point pierced with two holes side by side (Plate XVI, fig. 24). Finally we have a few elements that seem entirely new, *viz.*, the bone and stone sinkers (Plate XV, figs. 1-4, 7), the slate barbs (Plate XV, figs. 6, 12), the slate knives for sawing or graving (Plate XV, figs. 13, 14), the stone counters (Plate XXI, fig. 21), the harpoon foreshaft with parallel lashing-holes (Plate XVII, fig. 3), and the stone beads (Plate XXI, fig. 14). We should notice, also, the extraordinarily long bladder-dart head (Plate XVII, fig. 1), which seems rather different from other dart-heads known from the Central Arctic.



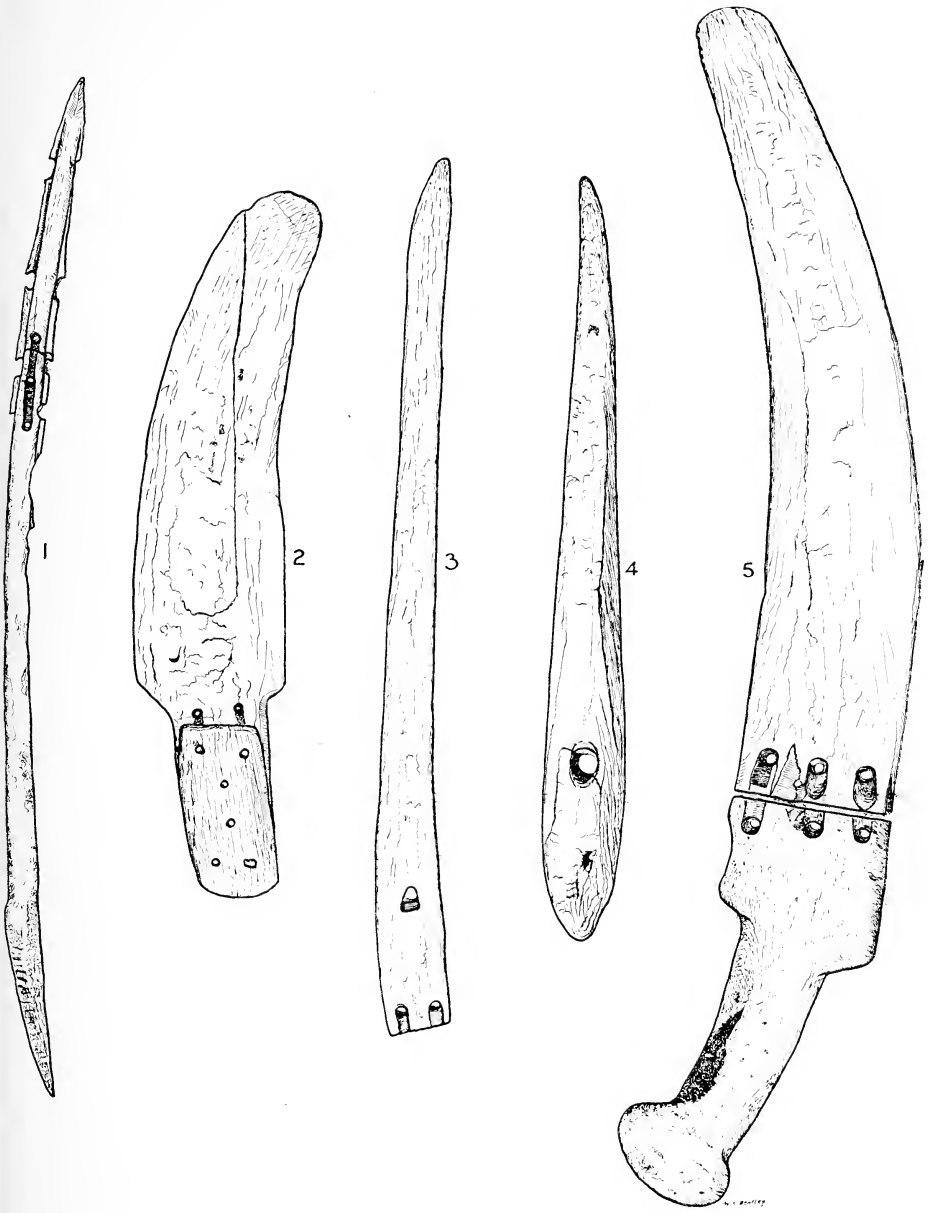
Archaeological objects from the Belcher Islands in Hudson Bay.
(One-half natural size)



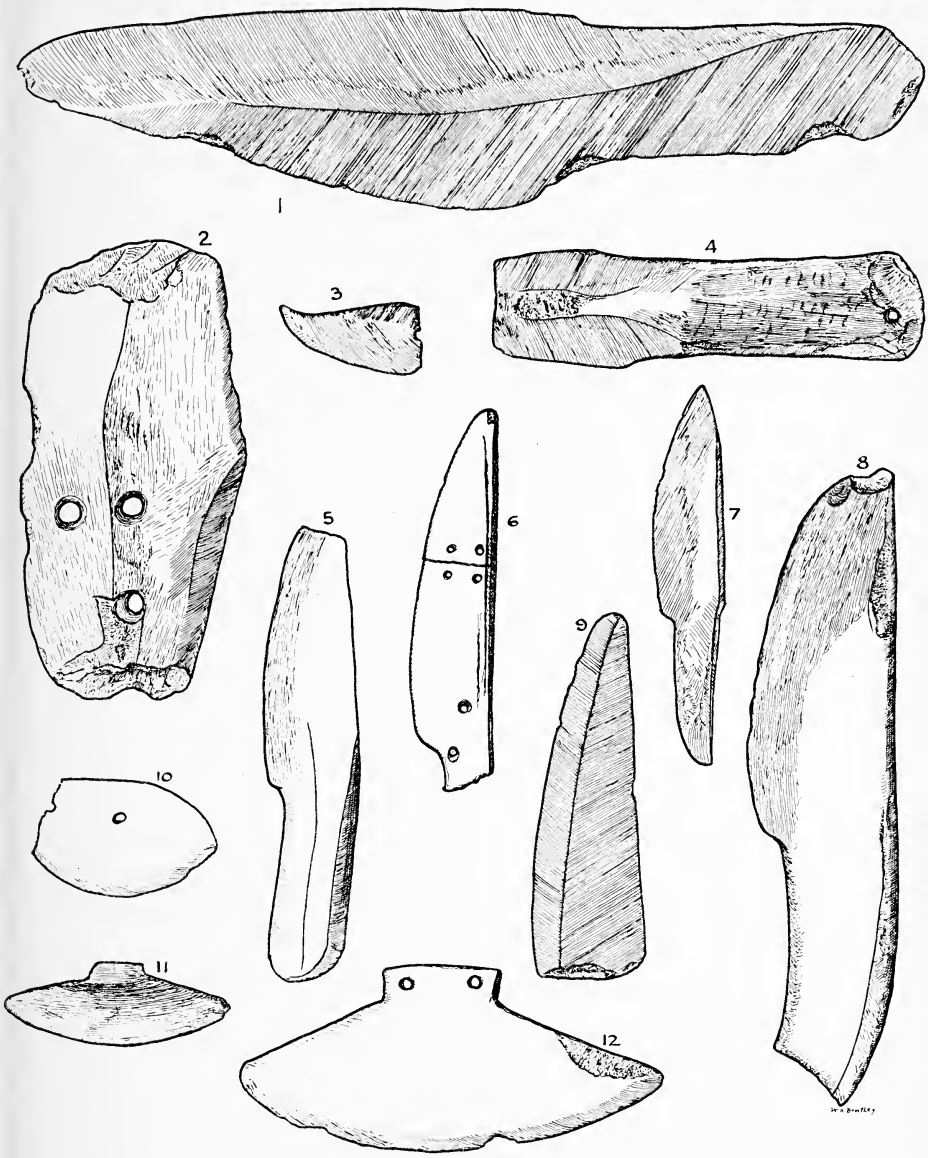
Archaeological objects from the Belcher Islands in Hudson Bay.
(One-half natural size)



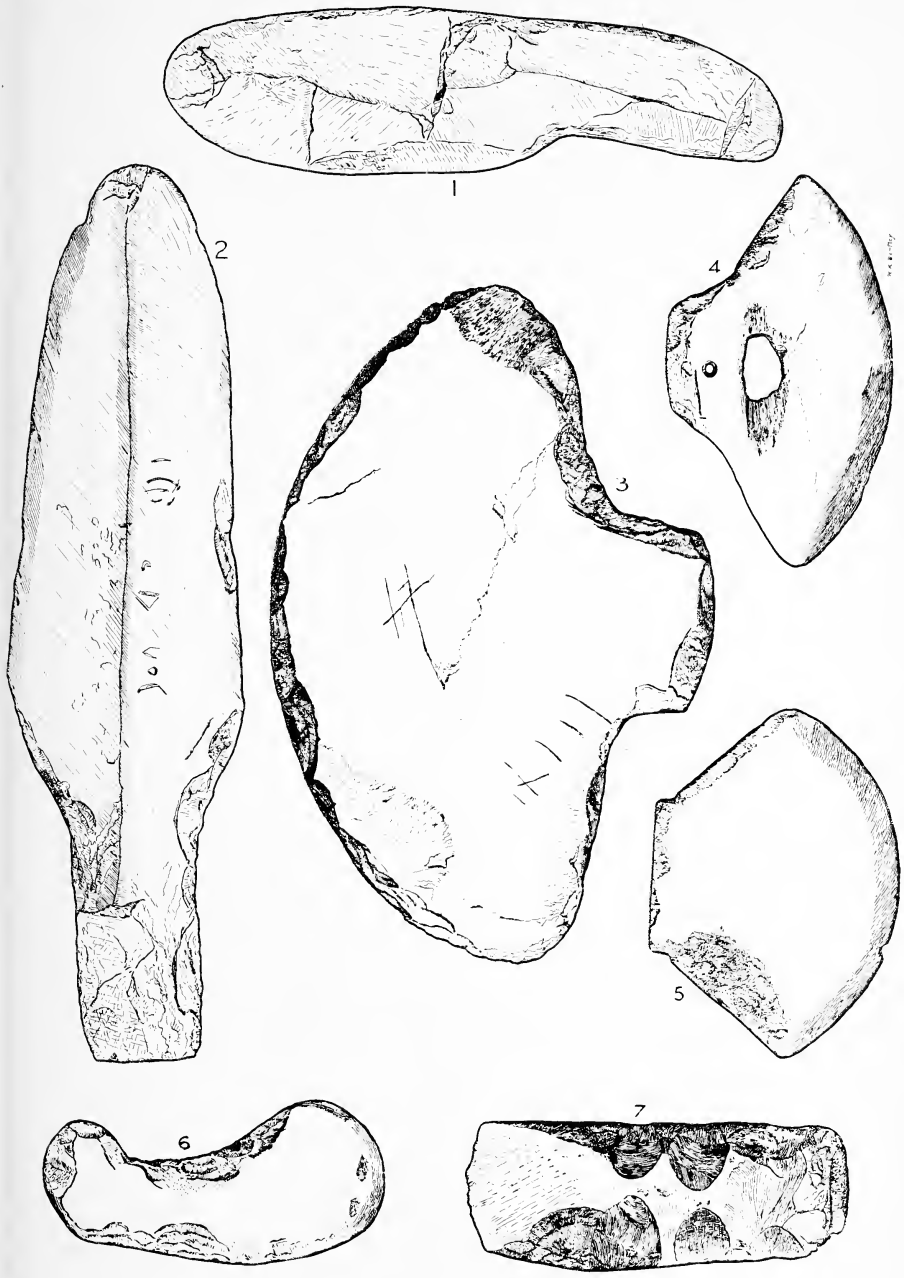
Archaeological objects from the Belcher Islands in Hudson Bay.
(Slightly under one-half natural size)



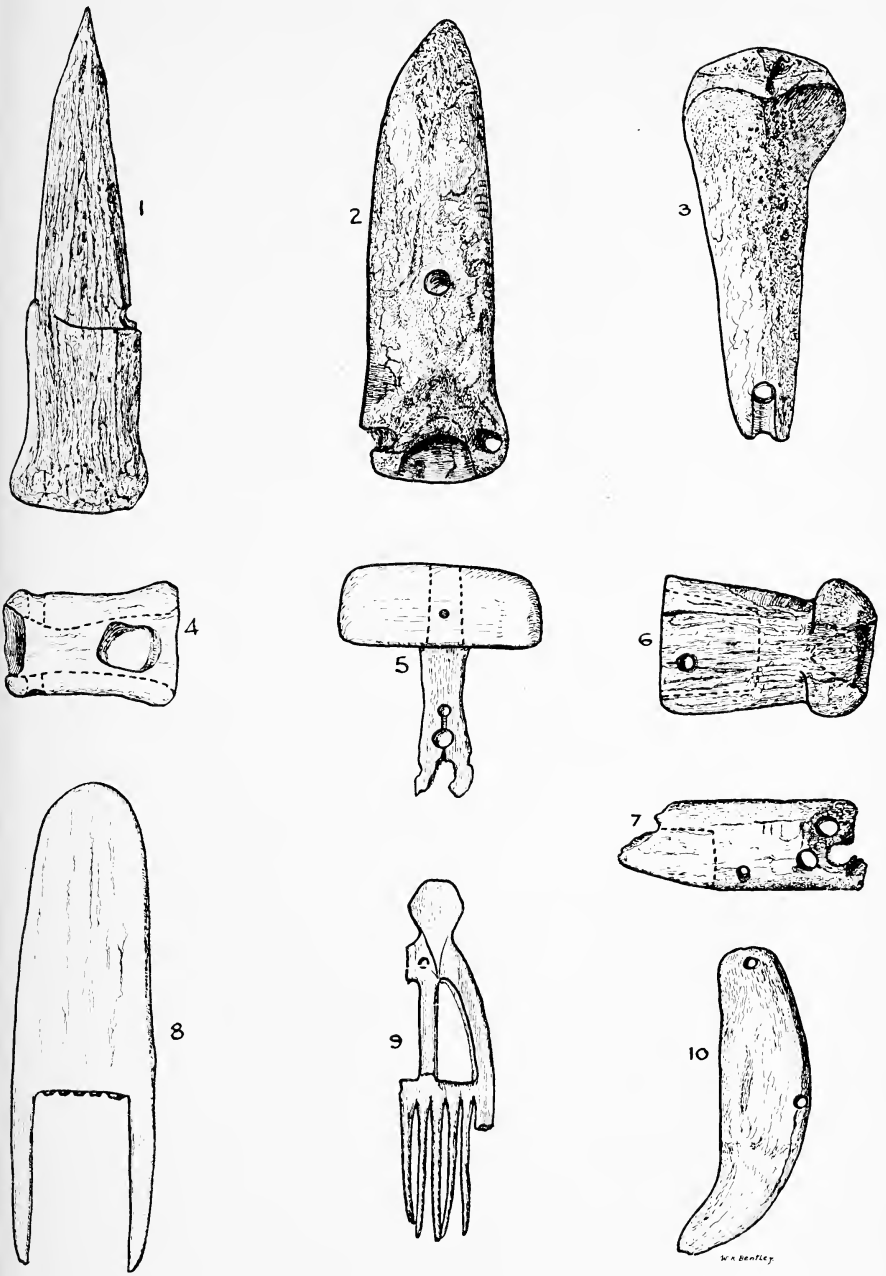
Archaeological objects from the Belcher Islands in Hudson Bay.
(About one-third natural size)



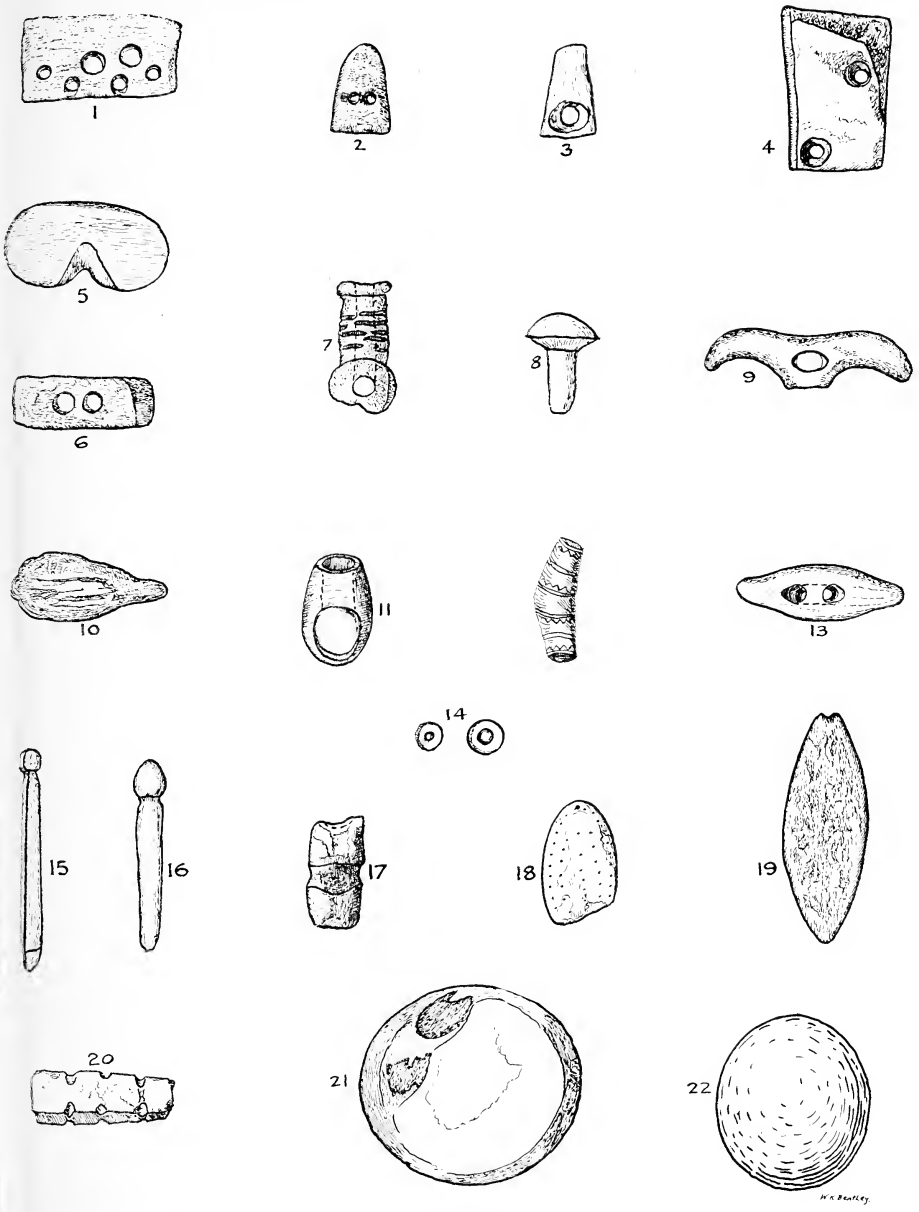
Archaeological objects from the Belcher Islands in Hudson Bay.
(Slightly under one-half natural size)



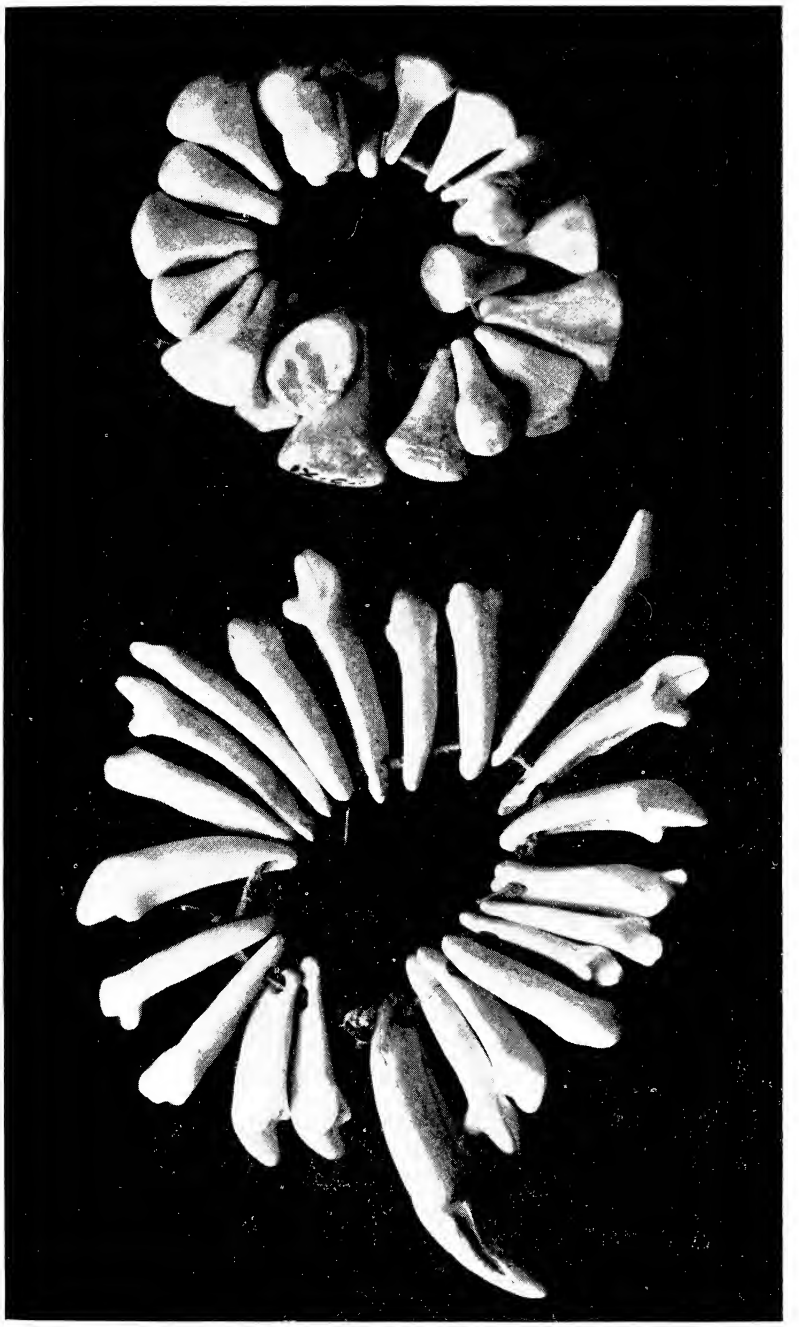
Archaeological objects from the Belcher Islands in Hudson Bay.
(About one-third natural size)



Archaeological objects from the Belcher Islands in Hudson Bay.
(About one-half natural size)



Archaeological objects from the Belcher Islands in Hudson Bay.
(One-half natural size)



Pendants of carved ivory (above) and of teeth (below). Belcher Islands.

ART. XII. A NEW CROCODILIAN, *HASSIACOSUCHUS KAYI*, FROM THE BRIDGER EOCENE BEDS OF WYOMING

BY CHARLES C. MOOK

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ART. XII. A NEW CROCODILIAN, *HASSIACOSUCHUS KAYI*, FROM THE BRIDGER EOCENE BEDS OF WYOMING

By Charles C. Mook
Brooklyn College[1]

(Plates XXIII-XXV)

During the field season of 1936 an unusually well preserved fossil crocodilian skeleton was discovered in the Bridger Eocene Beds near Mountain View, Wyoming, by Mr. J. LeRoy Kay of the Carnegie Museum. This specimen consists of a nearly perfect skull with jaws and a practically complete postcranial skeleton with the dorsal scutes in place. The skeleton now comprises Carnegie Museum No. 9600. It was referred to me for study by Mr. Kay. I wish to express my appreciation for the privilege of describing this fine specimen. The drawings and photographs for this article were made by Sydney Prentice.

The individual preserved was young and rather immature but hardly to be called juvenile. In many respects the characters of this specimen agree with those exhibited in the type of *Hassiacosuchus haupti*, recently described by Weitzel.*

In some details the characters differ from those of *H. haupti*. The specimen is therefore made the type of a new species which is referred to the genus *Hassiacosuchus* Weitzel. The specific name *kayi* is indicated in honor of Mr. J. LeRoy Kay of the Carnegie Museum. The designation becomes therefore:

Hassiacosuchus kayi sp. nov.

Generic characters: Those designated for *Hassiacosuchus* as far as preservation permits determination.

Specific characters: This form differs from *H. haupti* in having the skull more elongate as a whole and also with respect to individual bones; the supratemporal fenestrae are more pointed anteriorly; the orbits are more pointed anteriorly; the degree of lateral festooning of the upper jaw is less; there was probably an additional mandibular tooth in each ramus.

*Notizblatt des Vereins für Erdkunde und der Hessischen Geologischen Landesanstalt zu Darmstadt, V, Heft 16, Darmstadt, 1935.

[1] "Contributions to the Osteology, Affinities, and Distribution of the Crocodilia," No. 33.

Issued March 24, 1941.

Type: Skull and skeleton, Carnegie Museum no. 9600.

Type locality and level: Black's Fork Member, Bridger Eocene Formation: Levitt Creek, about 5 miles east and south of Mountain View, Uinta County, Wyoming.

Detailed Description of Type Skeleton

Preservation: The anterior portion of the snout is missing. The right side is preserved forward almost to the premaxillary. The left side extends forward only slightly beyond the orbit. The skull is very slightly depressed by crushing. There is a very slight lateral distortion. Both rami of the jaw are complete posteriorly; they extend far enough forward to indicate the position of the symphysis. The tips are missing. The vertebral column is nearly complete but the individual vertebrae are in close contact with each other, are buried in matrix, or are covered by scutes, so their characters are difficult to make out for comparison. The limb bones are well preserved but the feet are incomplete. The dorsal scutes are well preserved and are in position. The ventral scutes are fairly well preserved and are partly in position.

General form: The skull is relatively short in proportion to its breadth. The cranial table is low and is not sharply separated from the snout; its external borders are convex outward. There is a slight festooning of the lateral borders of the upper jaw.

Cavities of the skull: The orbits are very large. This condition may be emphasized because of the relatively immature age of the specimen. Due to crushing, the left orbit is somewhat larger than the right. Each orbit is longer than it is broad and is rather acuminate anteriorly. Its lower border is nearly straight, while its upper border is broadly rounded. The orbits face almost directly upward with a very slight outward component of direction. The interorbital space is broad, being about half as broad as the right orbit.

The supratemporal fenestrae are relatively small occupying about one-sixth of the space occupied by the orbits. The length of each fenestra is about twice its breadth. The long axes of the two fenestrae diverge in the anterior direction. The inner sides are strongly curved while the outer sides are nearly straight. In depth the fenestrae are small, only a small portion of each extending through to the orbital cavity above the pterygoids. The posterior portion of each fenestra is floored by the expanded brain-case. This is a character of immaturity. The interfenestral plate is broad, being broader than either fenestra. The left lateral temporal

fenestra is quadrangular with no two sides parallel with each other. It is about one-fifth the size of the orbit. The bones surrounding the right cavity are distorted by crushing.

The palatine fenestrae are relatively short and broad. Two-thirds of their length lies beside the posterior four teeth on each side; the remaining third is farther back. The length of each fenestra is less than twice its maximum breadth. The anterior ends are not acute. The outlines are irregular. The interfenestral plate is narrow but the plate of the maxillary between the external border of each fenestra and the tooth row is broad.

The posterior narial aperture is almost circular. It is situated almost in the center of the combined pterygoid bones but is very slightly nearer the posterior than the anterior borders of the latter. The anterior rim is smooth but the posterior rim is slightly uprolled.

Bones of the skull: The premaxillaries are missing. The maxillaries are incomplete on each side. On the right side the maxillary faces more outward than upward.

The nasals are broad, the two together at the level of the anterior ends of the orbits occupying nearly half the breadth of the skull. Their contacts with the prefrontals are short. Their contacts with the lachrymals appear to be longer but the sutures are indistinct and the exact boundaries are difficult to determine. The lachrymals are relatively large. They appear to have long contacts with both nasals and prefrontals. The prefrontals are small and their long axes diverge anteriorly. The frontal is large. It has short contacts with the nasals and moderately long contacts with the prefrontals. It occupies most of the inner margin of each orbit. Its suture with the parietal is distinctly posterior to the anterior ends of the supratemporal fenestrae. The area of the bone posterior to the level of the posterior ends of the orbits is unusually large.

The postorbitals are small. Each comprises only about one-third of the external border of the cranial table and about one-fourth of the external border of the corresponding supratemporal fenestra. The squamosals are large, each comprising two-thirds of the external border of the cranial table and three-fourths of the external border of the supratemporal fenestra. The two squamosals together comprise over two-thirds of the posterior border of the cranial table. The postero-external corner of each squamosal is rounded and turned slightly downward. The parietal is rather large as it is exposed on the cranial table, the interfenestral plate being broad. The parietal occupies two small areas along the posterior border of the cranial table; these areas, or rather lines, are separated from each other

by the superior process of the supraoccipital. The jugals are thick vertically in their posterior portions. The thick portion of each is slightly longer than the thin portion; the superior edges of these thick portions are rolled inward slightly. The ascending bar of each jugal which meets the descending bar of the postorbital is slender. The suture of the right jugal with the right maxillary extends the distance of three teeth forward beyond the anterior tip of the orbit. The quadrato-jugal is short. Its pitted area is relatively large and the pitting in this area is coarse. The quadrate is short and stout. Its articular surfaces are distinctly anterior to the postero-external corners of the cranial table. It apparently occupies no part of the border of the lateral temporal fenestra.

The supraoccipital occupies a considerable area of the posterior surface of the skull. It is separated from the foramen magnum by two slender processes of the exoccipitals. It occupies about one-tenth of the posterior border of the cranial table, where a small, symmetrically curved process wedges apart the posterior processes of the parietal. The exoccipitals are large. They comprise most of the area of the posterior surface of the skull. They almost surround the foramen magnum; they evidently formed no part of the occipital condyle, but this region is crushed and the details of its structure are not clear. The basioccipital is not well exposed on the specimen. It occupies a considerable portion of the inferior surface of the skull and, seen from below, is not cut off by the pterygoid. This may be due partly but not entirely to crushing. The basisphenoid is not sufficiently well shown to warrant description.

The pterygoids appear to be two separate elements united by suture. Together their breadth is about twice their length. The posterior ends of the pterygoids lie directly beneath the anterior ends of the supratemporal fenestrae. The pterygoids occupy most of the posterior borders of the palatine fenestrae. The sutures with the palatines are distinctly anterior to the posterior ends of the palatine fenestrae. The ectopterygoids are relatively large. They occupy most of the external borders of the palatine fenestrae and their anterior bars lie opposite four maxillary teeth. The palatines are comparatively small. Their sutures with the maxillaries extend forward beyond the palatine fenestrae for the distance of four teeth only.

The tooth row is incomplete on each side. On the right side twelve teeth, or alveoli of teeth, are observable. The last six teeth are small and have the crowns and roots sharply separated from each other. The crowns are low, blunt, and do not appear to be striated. In front of these

six teeth are two alveoli, of equal size with that of the sixth, then a slightly larger tooth with crown and root confluent and moderately sharp. Anterior to this is the largest tooth preserved, a strong tooth resembling the fifth maxillary tooth of typical specimens of *Crocodilus*. Whether it is the fourth or the fifth is impossible of determination at present. Anterior to this tooth is a smaller one and anterior to this is a small alveolus. Beyond this point the snout is missing.

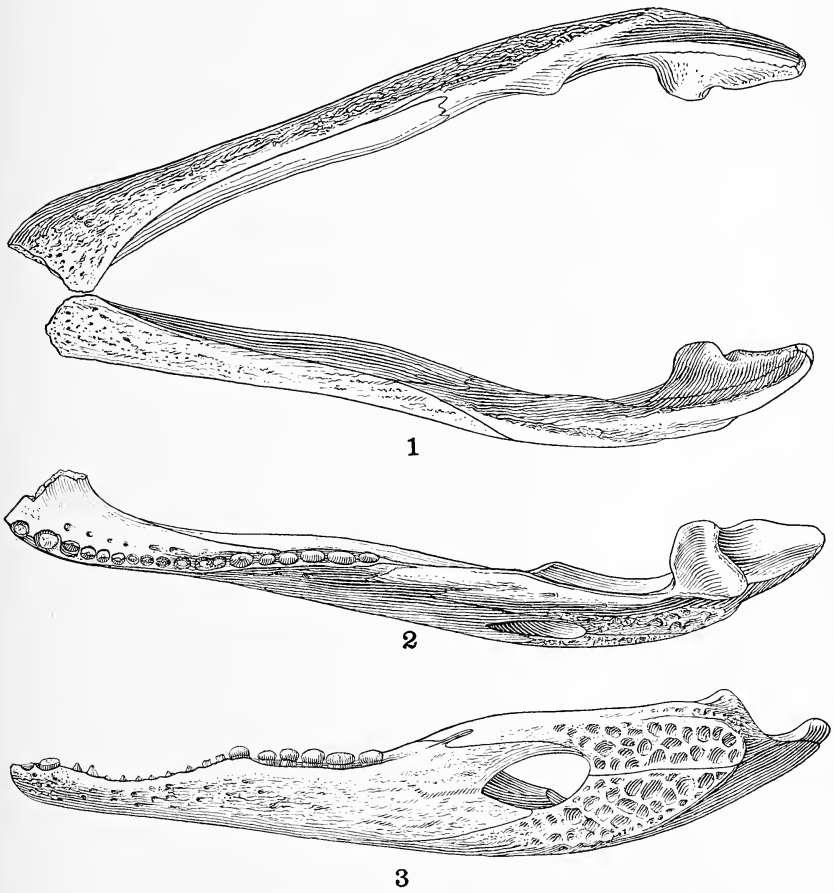


FIG. 1. Lower jaws of *Hassiacosuchus kayi* n. sp. Natural size. Type specimen. 1. Inferior view. 2 Superior view of left ramus. 3. Lateral view of left ramus.

Lower jaws: The two rami diverge posteriorly at a moderate angle only. The symphysial region is not completely preserved, but it is clear that the symphysis was not long, at most lying opposite six mandibular teeth on each side, possibly only five. The external mandibular foramen is of moderate size. The anterior portion of the jaw is low and is slightly festooned. The splenial bones are not completely preserved but grooves on the dentaries indicate that they extended forward to the symphysis although they probably did not participate in the latter. The posterior portion of the jaw is moderately high. The tooth row is not complete in either ramus, but is nearly enough complete in the left ramus to indicate fairly clearly that the first alveolus preserved is the third of the mandibular series. The largest alveolus is the second preserved, probably the fourth of the series. It contains a vestige of a tooth. Posterior to this are ten small alveoli with bases of tiny teeth. Back of these are five small, low-crowned teeth with distinct roots. This indicates the tooth row to be composed of nineteen teeth altogether. An accurate ratio cannot be determined because of the absence of the tip, but it is clear that the tooth row is shorter than the post-dental portion of the jaw. The articular process is short.

Postcranial skeleton: The postcranial skeleton, with the exception of the ribs and feet, is nearly complete. It is in matrix and both dorsal and ventral aspects are visible. The individual bones are articulated or are covered with matrix or with scutes, in many cases, in such a way that the detailed characters of the bones cannot be made out. On the dorsal aspect three pairs of cervical scutes are in position. The first and second of these are very large. In the dorsal region there are three rows of almost square scutes in their original positions, with an irregular row of external scutes that are rounded externally. All of the dorsal scutes are finely pitted and none of them have median keels. The sacral scutes resemble those of the dorsal region. The caudal region contains two rows of large scutes, most of which are keeled. A third outer row of smaller scutes is less complete. The limb bones may be seen to some extent from above but their characters can be made out better from below.

The ventral aspect of the skeleton reveals most of the girdle bones, although the scapulae and ilia are scarcely visible. The limb bones are well exposed. The only feature of distinction in connection with the limb bones is the relatively great length of the humerus and femur compared with the radius and ulna and the tibia and fibula. The manus and pes of each side is incomplete. Twenty presacral vertebrae are visible, probably

including the axis. The characters of the vertebrae are obscured by concealment. The centrum of the last presacral differs from the rest in being unusually short and broad. Seventeen caudals are clearly shown in position and several more centra are scattered in the matrix.

Affinities: This form and also *Hassiacosuchus haupti*, are clearly alligatorids with dental specialization in the direction of that of *Allognathosuchus*, but the specialization is less extreme. On the other hand these species appear to be more highly specialized than the modern alligators and caimans. The relationships as interpreted may be expressed in the following diagram.

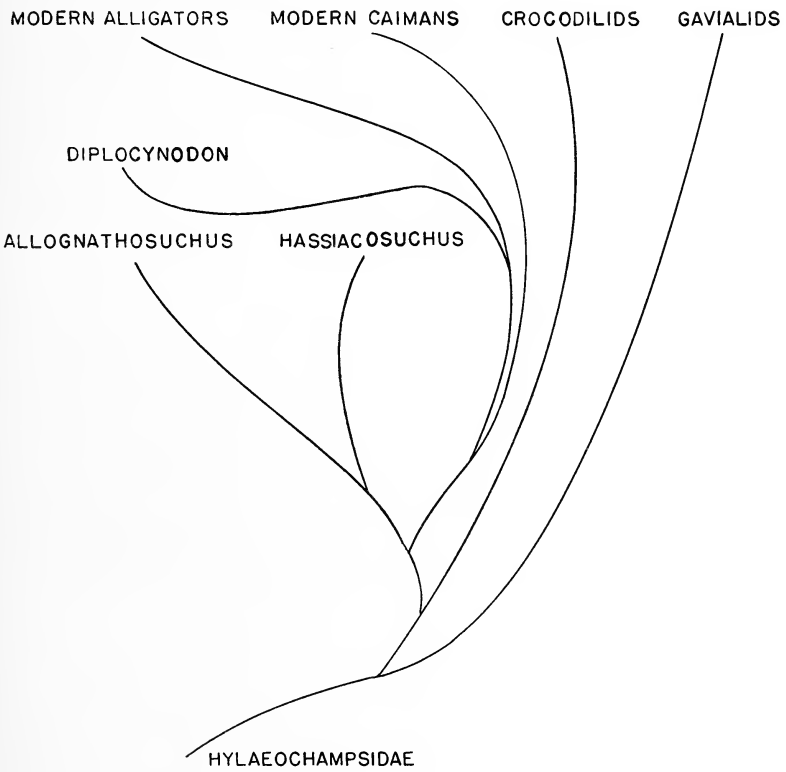


FIG. 2. Affinities of *Hassiacosuchus*.

MEASUREMENTS

SKULL	mm.	
Length skull and portion of right ramus of mandible as preserved	98	
Length right orbit	31	
" left orbit	30	
" right S.T.F.	14	
" left S.T.F.	14	
Breadth nasals, maximum	15	
" right orbit	16	
" left orbit	21	d
" snout, anterior ends of orbits	40	
" interorbital plate	9	
" cranial table	37	
" right S.T.F.	8	
" left S.T.F.	8	
" interfenestral plate	10	
" across quadrates	55	
" " quadrato-jugals	59	
" " pterygoids	42	
" interpalatine fenestral plate	7	
Length pterygoids	22	
Maximum height	32	
Length I.N.A.	8	
Breadth I.N.A.	10	

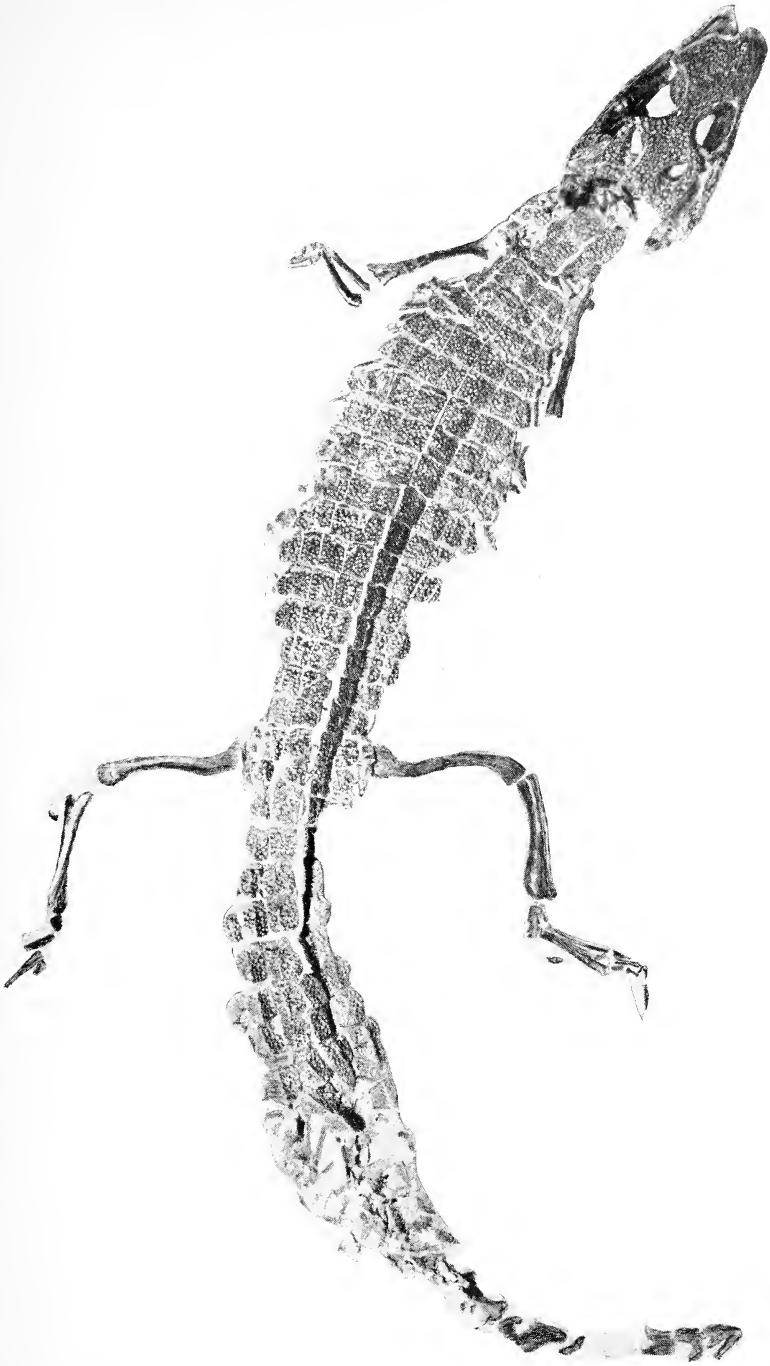
LOWER JAW	mm.	
Length left ramus as preserved	106	
" posterior to last tooth	56	
Maximum height	18	
Length E.M.F.	13	
" tooth row	50	e
Breadth of lower jaws, maximum	57	
" across symphysis	21	
Length of symphysis	12	e

POST-CRANIAL SKELETON		
Length right humerus	48	e
" " ulna	30	e
" " coracoid	31	
" " femur	63	
" " tibia	57	
" longest right metatarsal	32	
" left pubis	30	
" right ischium	28	e
" last 12 presacral centra	157	

EXPLANATION OF PLATE XXIII

Hassiacosuchus kayi Mook.

Dorsal view. One-third natural size. Type specimen, Carnegie Museum, no. 9600.



EXPLANATION OF PLATE XXIV

Hassiacosuchus kayi Mook.

Ventral view. One-third natural size. Type specimen, Carnegie Museum, no. 9600.

EXPLANATION OF PLATE XXV

Hassiacosuchus kayi Mook.

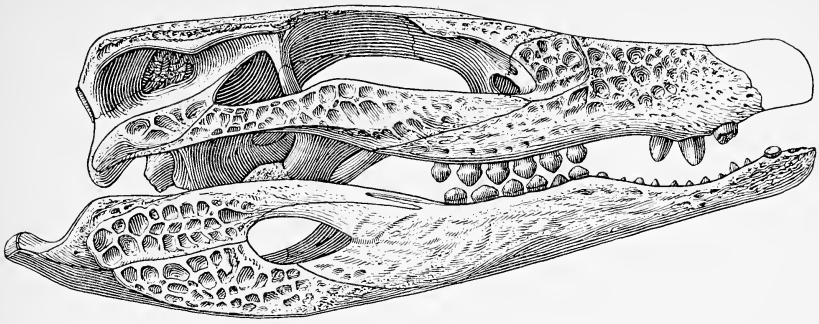
All figures, natural size.

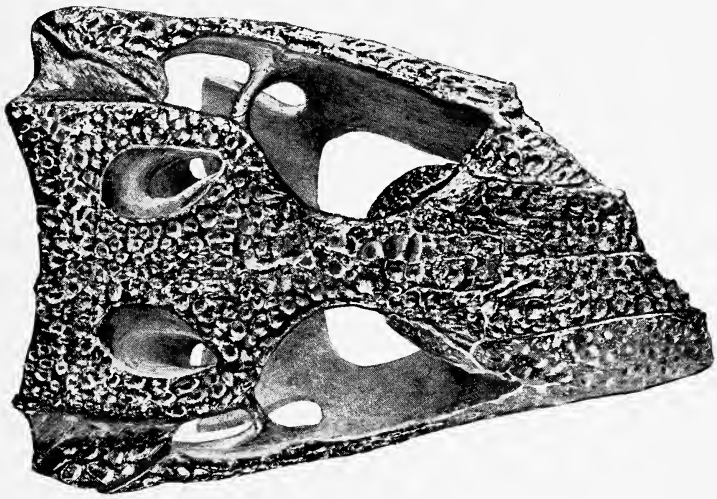
Type specimen, Carnegie Museum, no. 9600.

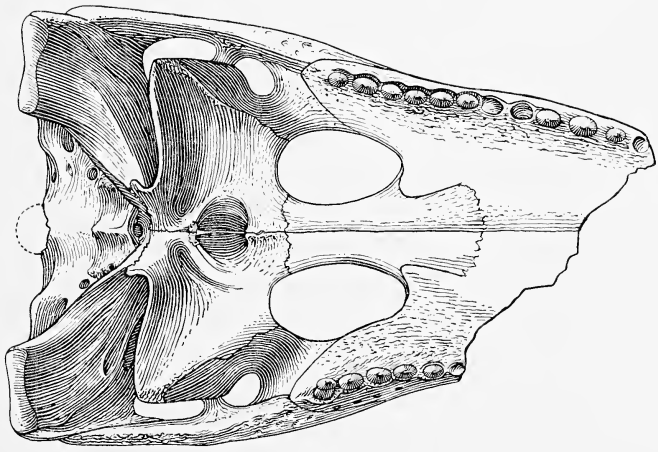
Upper figure, skull, lateral view of right side.

Middle figure, skull, superior view.

Lower figure, skull, inferior view.







ART. XIII. A REVIEW OF THE PILEATE POLYPORES OF WESTERN PENNSYLVANIA

BY LEROY K. HENRY

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ART. XIII. A REVIEW OF THE PILEATE POLYPORES OF WESTERN PENNSYLVANIA

By LeRoy K. Henry

(Plates XXVI-XXIX)

INTRODUCTION

The majority of the polypores grow upon dead trunks, branches, and twigs of trees and shrubs and bring about their decay, but a few grow on the ground and some even grow on living trees. The family of the pore fungi, Polyporaceæ, may be divided into two sections: annual and perennial.

The annual ones are mostly leathery or corky, while the perennial ones are woody. The perennial polypores add a new layer of pores or tubes each season, and thus a section cut through them shows successive layers of tubes. In the annual polypores there is but one layer of tubes, although a new plant may grow from the cap of the old one. The entire plant, as we know it, is called the sporophore. The pileate sporophore may grow out from the side of a log to form a cap or pileus or it may have a central stem or stipe for attachment. The under surface of the cap consists of tiny pores or tubes lined with the spore bearing layer, the hymenium. Those pilei attached by one side have given rise to the term "bracket fungi" and by far the greater number of them are of this type. This paper does not include the entirely resupinate polypores belonging in the genus *Poria*.

As the eastern boundary for Western Pennsylvania, I have arbitrarily chosen the eastern borders of Potter, Clinton, Centre, Huntingdon, and Fulton Counties. The terms common, frequent, infrequent, and rare are used to indicate the abundance of the species within this area. The initials following the collection data are to be interpreted as follows: L.K.H.—L. K. Henry; O.E.J.—O. E. Jennings; M.B.K.—Marie B. Knauz; and D.R.S.—D. R. Sumstine. The numerals following the author's initials are his field numbers.

Issued March 27, 1941.

ENUMERATION OF SPECIES

Cylomyces Greenei Berk. (Plate XXVI, figs. 1, 2)
On ground in woods. Rare. *Fayette County:* Ohio Pyle, 9/1/07, O.E.J.

Daedalea ambigua Berk.
On dead wood of deciduous trees. Rare. Identification checked by L. O. Overholts. *Allegheny County:* On *Acer*, Guyasuta Hollow, Sharpsburg, 8/20/07, D.R.S.

Daedalea confragosa (Bolt.) Pers.
On dead wood of many species of deciduous trees, occasionally on conifers or on living trees. Variable and common. *Allegheny County:* Coraopolis, Sept. 1905, D.R.S.; Bradford Woods, 9/29/16, O.E.J.; Tom's Run Ravine, Dixmont, 11/11/16, O.E.J.; Valley of Big Sewickley Creek, 7 miles above Ambridge, 10/14/16, O.E.J.; Black's Run, N. of Oakmont, 10/30/26, O.E.J.; on *Betula lutea*, along creek 1 mile above the Station near Groveton, 10/22/27, O.E.J.; along Pine Creek, one half-mile S.E. of Wildwood, 9/28/38, L.K.H., 2575; Warden Mine region, opposite Sutersville, 7/23/39, H. Roslund; 1 mile W. of Mt. Nebo, 8/1/39, L.K.H., 2952; Glenshaw, 8/15/39, L.K.H., 3025; near Sewickley, 8/24/39, D.R.S. *Armstrong County:* Meredith's Hill, Oct. 1901, D.R.S.; Kittanning, 1903, D.R.S.; on *Betula lutea*, Roaring Run, near Apollo, May 1915, O.E.J.; valley of Buffalo Creek, W. of Slate Lick, 10/17/30, O.E.J. *Beaver County:* near Ambridge, 1922, E. H. Graham; and Camp Konokwee, 1 mile S. of Fombel, 4/5/36, L.K.H., 227. *Bedford County:* Morrison Cove region, 7 miles N.E. of Everett, Nov. 1934, L.K.H., 193; Sulphur Springs, 8/7/40, D.R.S. *Butler County:* Little Buffalo Creek, near Monroe Station, 9/26/36, L.K.H., 871; Watson's Run, 2 miles S. of Leasuresville, 9/15/37, L.K.H., 1636; along Route 528, one quarter-mile S.E. of junction with Route 8, 9/16/40, L.K.H., 4227; near Zelienople, 11/2/40, D.R.S. *Cambria County:* on log near Cresson, Aug. 1909, D.R.S.; near Armagh, 11/12/38, D.R.S.; and 1½ miles E. of Patton, 10/13/40, R. Little. *Cameron County:* on *Betula Papyrifera*, one half-mile N. of Driftwood, 8/29/25, O.E.J.; along Route 872, 10 miles N.E. of Sinnemahoning, 8/15/37, L.K.H., 143. *Centre County:* near Woodward, 9/6/39, D.R.S. *Clarion County:* Cook Forest, 10/2/26, Dorothy Rome; gilled form near Clarion, 10/14/38, D.R.S. *Clearfield County:* on *Betula*, Medix Run, 8/26/25, O.E.J. *Crawford County:* Conneaut Park, 7/16/06, D.R.S.; on *Betula lutea*, Hartstown, Pymatuning Swamp, 11/18/29, O.E.J. *Elk County:* near Saint Marys,

8/23/25, O.E.J.; Route 555, 2 miles E. of Medix Run, 8/15/37, L.K.H., 1516. *Erie County:* Girard, Dec. 1911, R. H. Daily; Mercyhurst College, S. of Erie, 10/8/31, M. P. Wilbert; Presque Isle, August 1933, O.E.J. *Fayette County:* Ohio Pyle, 9/16/06, D.R.S.; Indian Creek Reservoir region, 4/13/35, L.K.H., 334 and gilled form, L.K.H., 338. *Forest County:* Cook Forest, 10/5/38, L.K.H., 2695; on dead *Betula*, 1 mile N.W. of Brookston, 7/24/40, L.K.H., 3782. *Indiana County:* Homer, Dec. 1901, D.R.S.; Chambersville, 10/16/37, O.E.J.; near Glen Campbell, 8/4/38, L.K.H., 2128. *Lawrence County:* Kennedy's Mills, Slippery Rock Creek, 1/30/26, E. H. Graham; Muddy Creek Falls, 10/7/37, L.K.H., 1715. *McKean County:* on *Betula lutea*, Mt. Jewett, 9/16/22, O.E.J.; Kane, Exp. Forest, 6 miles S.W. of Kane, 10/18/35, O.E.J.; near Kane, 8/4/37, D.R.S.; Tionesta Tract, near Brookston, 7/25/40, L.K.H., 3795. *Potter County:* Walgren's place near Odin, 8/18/35, O.E.J.; Route 872, 7 miles N.E. of Austin, 8/15/37, L.K.H., 1451. *Somerset County:* Laurel Hill Mt., 3 miles S. of Bakersville, July 1932, C. M. Hepner; Buckstown, 10/1/38, O.E.J.; near Jennerstown, 9/5/40, D.R.S. *Venango County:* Scrub Grass Creek near Lisbon, 11/3/35, M.B.K.; Little Scrubgrass Creek, 1 mile N.E. of Lisbon, 9/19/36, L.K.H., 825 and lenzitoid form, L.K.H., 844. *Warren County:* Tionesta Tract, near Brookston, 7/25/40, L.K.H., 3852. *Washington County:* along branch of Wheeling Creek, 3 miles S. of Burnsville, 9/22/40, L.K.H., 4435. *Westmoreland County:* above Millbank, 12/3/16, O.E.J.; Chestnut Ridge above Youngstown, 5/21/22, O.E.J.; on dead *Betula lutea*, Forbes Forest vicinity of Rock and Lynn Runs, 3 miles S.E. of Rector, 6/25/22, O.E.J.; on *Prunus pennsylvanica*, ibid, 11/4/33, O.E.J.; Forbes Forest, 2 miles S.E. of Laughlintown, 8/24/34, M.B.K.; Laurel Ridge, 1 mile E. of Kregar, 10/14/34, L.K.H., 186; Jones's Mills, 8/17/35, D.R.S.; on *Prunus serotina*, Buttermilk Falls near Ligonier, 9/21/35, H. S. Wieand; near Saltsburg, 10/10/36, L.K.H., 927; Shades Ravine, 2 miles E. of Trafford, 8/11/37, L.K.H., 1369; Laughlintown, 11/11/38, D.R.S.; Vicinity of Loyalhanna Creek Dam, 9/11/40, L.K.H., 4115.

Daedalea quercina (L.) Fr.

On logs and stumps of deciduous trees, usually oak and chestnut. Common. *Allegheny County:* on old *Salix*, Stoop's Ferry, 9/3/01, O.E.J.; Thorn Hill, 8/28/21, W. H. Emig; 2 miles W. of Bradford Woods, 8/29/22, O.E.J.; Carnegie, 9/11/26, Dorothy Rome; Glenfield, 6/30/30, C. K. Henlen; Frick Park, Pittsburgh, 9/10/34, L.K.H., 117; South Hills, Pittsburgh, Oct. 1935, Mrs. Paul Wible; Nine-mile Run, Frick Park, 10/6/35,

H. S. Wieand; along Pine Creek, ½ mile S.E. of Wildwood, 4/4/36, O.E.J.; 1 mile N.E. of Ben Avon Hts., 7/19/37, L.K.H., 1191; South Branch Little Sewickley Creek, N.E. of Sewickley, 9/17/38, L.K.H., 2228; near Aspinwall, Sept. 1939, D.R.S.; 1-2 miles N.E. of Mt. Nebo, 6/5/40, L.K.H., 3073; Warden Mine region, opposite Sutersville, 6/27/40, L.K.H., 3319. *Armstrong County:* across river from Jonetta, 10/23/21, O.E.J.; Kittanning, 3/5/27, Amy Neale. *Beaver County:* along road to Red Oak Hollow, 12/25/21, H. W. Graham; Camp Konokwee, 1 mile S. of Fombell, 4/5/36, L.K.H., 240; Temple Hollow, 1 mile N.W. of Aliquippa, 6/30/38, L.K.H., 1900. *Bedford County:* Bedford Springs, 9/13/19, O.E.J.; Morrison Cove Region, 7 miles N.E. of Everett, Nov. 1934, L.K.H., 210. *Butler County:* uplands, 4 miles N.E. of Harmony, June 1931, L.K.H., 40; Watson's Run, 2 miles S. of Leasuresville, 9/15/37, L.K.H., 1635; near Slippery Rock, 9/24/38, D.R.S. *Centre County:* 1 mile N. of Shingletown, 9/22/09, O.E.J.; Bald Eagle Creek, 7 miles W. of Bellefonte, Nov. 1935, Mrs. Paul Wible. *Clarion County:* Cook Forest, 6/22/35, C. K. Henlen; near Clarion, 10/14/38, D.R.S. *Elk County:* Route 555, 2 miles E. of Medix Run, 8/15/37, L.K.H., 1511. *Fayette County:* Kilarney Park, July 1919, D.R.S.; Indian Creek Reservoir region, 4/13/35, L.K.H., 336. *Forest County:* Cook Forest, 9/15/22, C. K. Henlen. *Greene County:* Holbrook, 11/20/25, Sarah Marley. *Mercer County:* One mile S. of Swamp Root, 7/15/34, L.K.H., 97. *Somerset County:* Winber, 1924, O.E.J.; Laurel Ridge, 10 miles E. of Indian Creek Reservoir, 10/14/34, L.K.H., 325; Laurel Hill Mt. above Ligonier, 5/9/36, D.R.S.; one mile E. of Buckstown, 8/14/36, O.E.J. *Venango County:* Little Scrubgrass Creek, 1 mile N.E. of Lisbon, 9/19/36, L.K.H., 820. *Washington County:* along Chartiers Creek, 1 mile S.E. of Houston, 5/11/40, L.K.H., 3040; 5 miles S.E. of Houston, 5/13/40, L.K.H., 3046. *Westmoreland County:* 2 miles E. of Rector, 7/1/22, O.E.J.; Forbes Forest, 3 miles S.E. of Rector, 1925, O.E.J.; Hillside, Chestnut Ridge, 5/26/26, O.E.J.; near Delmont, 11/13/29, L.K.H., 41; Congruity, 4 miles E. of Delmont on Route 22, 9/27/34, L.K.H., 141; Laurel Ridge, 1 mile E. of Kregar, 10/14/34, L.K.H., 178; Jones's Mills, 8/16/35, D.R.S.; across river from Saltsburg, 10/10/36, L.K.H., 953; Route 22, 1½ miles E. of New Alexandria, 7/29/37, L.K.H., 1283; Shades Ravine, 2 miles E. of Trafford, 8/11/37, L.K.H., 1333.

Daedalea unicolor (Bull.) Fr.

On wood of deciduous trees. Common. *Allegheny County:* Frick Park, Pittsburgh, 9/17/05, O.E.J.; Verona, 8/14/06, D.R.S.; Wilkinsburg,

8/10/08, D.R.S.; near Sandy Creek, 8/25/35, L.K.H., 435; along Pine Creek, one half-mile S.E. of Wildwood, 8/26/36, D.R.S.; 1 mile W. of Mt. Nebo, 8/1/39, L.K.H., 2971; Gourdhead Run, near Allison Park, 7/4/40, M.B.K. *Armstrong County:* Kittanning, 1904, D.R.S. *Beaver County:* Rock Point, 7/18/07, D.R.S.; near Economy, 1/21/22, H. W. Graham. *Bedford County:* Sulphur Springs, 8/7/40, D.R.S. *Butler County:* uplands, 4 miles N.E. of Harmony, Oct. 1925, L.K.H., 33; near Zelienople, 8/18/34, D.R.S.; along Route 528, one quarter-mile S.E. of junction with Route 8, 9/16/40, L.K.H., 4228; 1 mile S.E. of Whitestown, 9/17/40, L.K.H., 4298. *Cambria County:* Cresson, Aug. 1909, D.R.S. *Crawford County:* Linesville, 8/3/09, O.E.J. *Erie County:* near Corry, 7/1/08, D.R.S.; Presque Isle, 8/13/29, C. K. Henlen. *Fayette County:* Ohio Pyle, 9/10/05, O.E.J. *McKean County:* Tionesta Tract, near Brookston, 7/25/40, L.K.H., 3696. *Mercer County:* Transfer, 8/9/12, D.R.S. *Somerset County:* near Jennerstown, 9/5/40, D.R.S. *Venango County:* Little Scrubgrass Creek, 1 mile N. of Lisbon, 11/8/36, M.B.K. *Washington County:* near Amity, 9/19/39, D.R.S. *Westmoreland County:* Byers, 7/28/08, D.R.S.; Ligonier, 7/28/08, D.R.S.; on *Aesculus Hippocastanum*, Ligonier, 8/27/23, D.R.S.; Shades Ravine, 2 miles E. of Trafford, 8/11/37, L.K.H., 1360.

Favolus canadensis Kl.

On dead wood of deciduous trees, especially hickory. Frequent. *Allegheny County:* Frick Park, Pittsburgh, 7/5/06, D.R.S. *Armstrong County:* Kittanning, 1905, D.R.S.; Kingston, 6/28/07, D.R.S. *Beaver County:* Rock Point, 7/18/07, D.R.S.; Raccoon Creek, 2 miles W. of Aliquippa, 7/13/37, L.K.H., 1152. *Butler County:* uplands, 4 miles N.E. of Harmony, 9/12/35, L.K.H., 512; near Slippery Rock, 7/3/40, D.R.S. *Cameron County:* Route 872, 10 miles N.E. of Sinnemahoning, 8/15/37, L.K.H., 1501. *Centre County:* Musser's Gap, 6/30/36, M.B.K.; State Game Lands, S.E. of Philipsburg, 7/11/40, L.K.H., 3626. *Crawford County:* Pymatuning Swamp Region, 7/19/06, D.R.S. *Erie County*: Presque Isle, 1904, O.E.J.; near Corry, 7/1/08, D.R.S.; near Wallburg, 7/31/28, C. K. Henlen; DeWitt Farm, 8 miles S.E. of Erie, 8/8/33, O.E.J. *Fayette County:* Ohio Pyle, 1905, D.R.S. *Forest County:* 1 mile N.W. of Brookston, 7/24/40, L.K.H., 3783. *Greene County:* Waynesburg, 8/30/04, O.E.J. *Lawrence County:* Muddy Creek Falls, 10/7/37, L.K.H., 1759; E. of Volant, along Route 278, 6/9/40, O.E.J. *McKean County:* Kane, 7/3/38, D.R.S. *Mercer County:* Transfer, 8/9/12, D.R.S. *Somerset County:* Pickings, Laurel Hill, 7/8/06, D.R.S.; near Jennerstown, 9/5/40, D.R.S. *Warren County:* 3 miles W. of Tidioute,

7/16/40, A. G. Shields. *Westmoreland County:* Hillside, Chestnut Ridge, 5/25/07, O.E.J.; Idlewild Park, 7/21/07, D.R.S.; Rachelwood near New Florence, 9/7/07, O.E.J.; 2½ miles N. of Bolivar, 1933, H. S. Wieand; Jones's Mills, 8/17/35, D.R.S.; Ligonier, 5/28/40, D.R.S.

Fomes applanatus (Pers.) Wallr.

Very common on logs and stumps of deciduous trees, rarely on conifers. *Allegheny County:* near McKeesport, 1900, D. A. Atkinson; Darlington Hollow, Sharpsburg, 10/27/01, J. A. Shafer; on *Populus grandidentata*, Narrows Hollow, Moon Twp. 2/23/03, J. A. Shafer; Braddock, 3/20/04, O.E.J.; Power's Run, opposite Verona, 7/31/04, O.E.J.; Schenley Park, Pittsburgh, 8/16/05, O.E.J.; Sandy Creek, July 1906, D.R.S.; Verona, August 1906, D.R.S.; Wilkinsburg, 1907, D.R.S.; Frick Park, Pittsburgh, 6/4/13, S. H. Ashe; West End Park, 1916, Neil McCallum; Valley of Little Sewickley Creek above Edgeworth, 10/21/16, O.E.J.; Thorn Hill, 11/18/16, Wm. Millward; along Pine Creek, one half-mile S.E. of Wildwood, 4/30/17, O.E.J.; Black's Run Ravine, N. of Oakmont, 10/4/19, O.E.J.; Ravine N.W. of Saunders, 10/2/21, M. Bomhard; Sewickley Hts. Park Estate, 2/21/30, C. K. Henlen; 1 mile N.E. of Ben Avon Hts., 7/19/37, L.K.H., 1178; Union Avenue between Bellevue and West View, 4/2/38, L.K.H., 1828; near Glen Campbell, 8/4/38, L.K.H., 2126; South Br. Little Sewickley Creek, N.E. of Sewickley, 9/17/38, L.K.H., 2230; 1-2 miles N.E. of Mt. Nebo, 6/5/40, L.K.H., 3072; Bellevue Reservoir, 9/15/40, J. A. Schatz. *Armstrong County:* Kittanning, 1900, D.R.S.; Big Buffalo Creek across from West Winfield, 8/12/39, M.B.K. *Beaver County:* near Ambridge, 1922, H. W. Graham; Camp Konokwee, 1 mile S. of Fombell, 4/5/36, L.K.H., 229. *Bedford County:* Sulphur Springs, 7/7/40, D.R.S. *Butler County:* Valencia, 9/27/04, O.E.J.; near Nixon Station, Butler Short Line, 2/3/17, Wm. Millward; uplands, 4 miles N.E. of Harmony, June 1931, L.K.H., 42; Little Buffalo Creek, near Monroe Station, 9/26/36, L.K.H., 872; near Saxonburg, 9/18/39, D.R.S.; Muddy Creek Falls, 10/16/40, L.K.H., 4517. *Cameron County:* on *Betula papyrifera* along creek N. of Driftwood, 8/27/25, O.E.J.; Route 872, 10 miles N.E. of Sinnemahoning, 8/15/37, L.K.H., 1473. *Centre County:* Bald Eagle Creek, 7 miles W. of Bellefonte, Nov. 1935, Mrs. Paul Wible; near Woodward, 9/8/39, D.R.S.; State Game Lands, near Port Matilda, 7/11/40, L.K.H., 3674. *Clarion County:* Cook Forest, 10/7/38, L.K.H., 2599; near Clarion, 10/14/38, D.R.S. *Crawford County:* Conneaut Park, 7/17/06, D.R.S.; Hartstown, Pymatuning Swamp, 5/18/08, O.E.J.; Linesville, Pymatuning

Swamp, 5/30/30, O.E.J. *Erie County:* Girard, Dec. 1911, R. H. Daily; Presque Isle, 5/30/16, O.E.J.; near Wessleyville, 7/24/30, C. K. Henlen. *Fayette County:* Ohio Pyle, 7/20/02, J. A. Shafer; Meadow Run Valley, 4 miles S. of Ohio Pyle, 9/2/07, O.E.J.; near New Geneva, 8/21/40, D.R.S. *Forest County:* Cook Forest, 10/5/38, L.K.H., 2686. *Indiana County:* Chambersville, 10/16/37, O.E.J. *Lawrence County:* near New Wilmington, 4/9/30, C. K. Henlen; Muddy Creek Falls, 10/7/37, L.K.H., 1416. *McKean County:* Larabee, 7/21/04, O.E.J.; Kane, 9/8/20, O.E.J.; on *Betula lutea*, Mt. Jewett, 9/16/22, O.E.J.; Kane Exp. Forest, 6 miles S.W. of Kane, 10/18/35, O.E.J.; Tionesta Tract, near Brookston, 7/25/40, L.K.H., 3698. *Mercer County:* 1 mile S. of Swamp Root, 6/21/36, L.K.H., 584. *Potter County:* on *Tsuga* stump, near Odin, 4/1/06, W. H. Emig; Route 872, 7 miles N.E. of Austin, 8/15/37, L.K.H., 1449. *Somerset County:* Pickings, 7/8/06, D.R.S.; on dead *Quercus alba*, 1 mile N. of Jenners, 6/9/16, O.E.J.; near Somerset, 10/30/21, D.R.S.; near Windber, 1934, O.E.J. *Venango County:* Little Scrubgrass Creek, 1 mile N.E. of Lisbon, 9/19/36, A. J. Deer. *Warren County:* on trunk of *Fagus grandifolia*, Tamarack Swamp, near Pine Valley, 12/19/33, E. H. Graham; Tionesta Tract, near Brookston, 7/25/40, L.K.H., 3853. *Washington County:* along Chartiers Creek, 1 mile S.E. of Houston, 5/11/40, L.K.H., 3041; 5 miles S.E. of Houston, 5/13/40, L.K.H., 3047; along Buffalo Creek, above junction with Buck Run, 5/23/40, L.K.H., 3057; vicinity of Hanlin Station, 9/13/40, L.K.H., 4188; vicinity of Houston, 9/21/40, L.K.H., 4419; along branch of Wheeling Creek, 3 miles S. of Burnsville, 9/22/40, L.K.H., 4436. *Westmoreland County:* on stump of *Tilia americana*, Jacob's Creek above Laurelville, 5/21/03, J. A. Shafer; Latrobe, June 1906, D.R.S.; Idlewild Park, 8/11/06, D.R.S.; Hillside, 5/25/07, O.E.J.; on *Quercus* log, lower slope of hill, 1 mile W. of Laughlintown, 12/3/16, O.E.J.; on dead *Quercus prinus* trunk, top of Chestnut Ridge back of Ridgeview Park, 10/14/17, O.E.J.; W. of Export towards Logan's Ferry, 10/15/17, W. H. Emig; Game Refuge, Forbes Forest, 3 miles S.E. of Rector, 9/1/28, Miss Stewart; Congruity, 4 miles E. of Delmont on Route 22, 9/27/34, L.K.H., 144; Laurel Ridge, 1 mile E. of Kregar, 10/14/34, L.K.H., 188; across river from Saltsburg, 10/10/36, L.K.H., 934; Bethel Church, 10/22/39, M.B.K.; Loyalhanna Creek, above the Dam, 6/12/40, L.K.H., 3106; 1 mile E. of Mt. Pleasant, 6/13/40, I. H. Horner.

Fomes conchatus (Pers.) Gill.

On dead wood of deciduous trees, chiefly ash and maple. Frequent. *Allegheny County:* on *Crataegus*, Duff City, 2/18/22, H. W. Graham; along Pine Creek, one half-mile S.E. of Wildwood, 10/30/27, C. K. Henlen. *Bedford County:* Sulphur Springs, 8/7/40, D.R.S. *Butler County:* Watson's Run, 2 miles S. of Leasuresville, 9/15/37, L.K.H., 1612; near Slippery Rock, 8/29/39, D.R.S. *Cambria County:* Cresson, August 1909, D.R.S. *Crawford County:* Dollar Lake, Hartstown, 9/10/38, L.K.H., 2201. *Fayette County:* Kilarney Park, 7/31/19, D.R.S. *Lawrence County:* near Portersville, 11/26/26, H. M. Roup. *Westmoreland County:* on *Crataegus*, near Ligonier, 7/28/08, D.R.S.; across river from Saltsburg, 10/10/36, L.K.H., 924.

Fomes connatus (Weinm.) Gill. (Plate XXIX, figs. 3, 4)

On wounds of living maple, rarely on other hardwoods. Frequent. *Allegheny County:* Frick Park, Pittsburgh, October 1905, D.R.S.; Power's Run, opposite Verona, 9/4/20, D.R.S.; on *Populus canadensis* var. *Eugenie*, Pittsburgh, October 1920, D.R.S.; on *Acer rubrum*, Sewickley Water Works Park, 10/11/36, M.B.K.; on living *Acer rubrum* along Pine Creek, one half-mile S.E. of Wildwood, 9/28/38, L.K.H., 2582. *Armstrong County:* on *Acer*, Kittanning, 1902, D.R.S.; Leechburg, 10/8/38, D.R.S. *Beaver County:* Rock Point, 7/18/07, D.R.S.; Camp Konokwee, 1 mile S. of Fombell, 4/5/36, L.K.H., 571. *Butler County:* uplands, 4 miles N.E. of Harmony, 9/13/36, L.K.H., 783. *Cambria County:* 1½ miles E. of Patton, 10/13/40, R. Little. *Centre County:* on *Acer*, near Woodward, 9/6/39, D.R.S. *Erie County:* near Corry, 7/1/08, D.R.S. *Fayette County:* Kilarney Park, July 1919, D.R.S.; on live *Acer*, Ohio Pyle, 10/18/36, M.B.K. *Venango County:* Little Scrubgrass Creek, 1 mile N.E. of Lisbon, 9/19/36, L.K.H., 812; on *Acer*, along Little Scrubgrass Creek, N.E. of Sutton's Mills, 11/8/36, M.B.K. *Westmoreland County:* Jones's Mills, 8/17/35, D.R.S.

Fomes everhartii (Ellis & Gall.) von Schrenk

On trunks of living deciduous trees, usually oak. Frequent. *Allegheny County:* Pittsburgh, October 1903, J. A. Shafer; on *Quercus*, Frick Park, Pittsburgh, 8/16/07, D.R.S.; on *Quercus imbricaria*, Brush Creek Swamp, 8/27/21, O.E.J.; on live *Quercus rubra*, S. Br. of Little Sewickley Creek, N.E. of Sewickley, 9/17/38, L.K.H., 2233. *Armstrong County:* Kittanning, 1903, D.R.S.; Latrobe, 8/10/07, D.R.S. *Beaver County:* Rock Point, 7/18/07, D.R.S. *Butler County:* near Saxonburg, 9/18/39, D.R.S. *Erie*

County: Presque Isle, 8/1/29, O.E.J. *Westmoreland County:* Ligonier, 7/9/06, D.R.S.; New Florence, Mellon Estate, 9/7/07, O.E.J.

Fomes fraxinophilus Peck

On trunks of living ash. Infrequent. *Allegheny County:* on trunk of *Fraxinus americana*, Warden Mine region, opposite Sutersville, 7/30/39, H. Roslund.

Fomes fomentarius (L.) Gill.

On living and dead deciduous trees, especially birch. Common. *Beaver County:* near Ambridge, 1922, H. W. Graham. *Cambria County:* on *Betula lutea*, Cresson, 8/24/09, D.R.S.; Ebensburg, August 1915, D.R.S. *Crawford County:* Conneaut Park, 7/17/06, D.R.S.; Exposition Park, 7/5/08, D.R.S.; on *Betula lutea*, Crystal Lake, Hartstown, 11/18/29, O.E.J. *Erie County:* near Erie, 7/21/28, C. K. Henlen; on dead *Betula lutea*, DeWitt farm, 8 miles S.E. of Erie, 8/8/33, O.E.J.; on *Betula lutea*, Wintergreen Gulch, near Erie, 8/5/35, O.E.J. *Indiana County:* near Glen Campbell, 8/4/38, L.K.H., 2121. *Lawrence County:* Muddy Creek Falls, 10/7/37, L.K.H., 722. *McKean County:* on *Betula lutea*, Mt. Jewett, 9/16/22, O.E.J.; on *Fagus grandifolia*, Tionesta Tract, near Brookston, 7/25/40, L.K.H., 3698. *Mercer County:* on dead *Betula lutea*, near Swamp Root, 6/8/35, L.K.H., 313; 1 mile S. of Swamp Root, 6/21/36, L.K.H., 585. *Potter County:* near Odin, September 1926, H. W. Graham; on *Betula lutea* trunk, ridge above Sinnemahoning Creek near Odin, 5/19/35, L.K.H., 330; Route 872, 7 miles N.E. of Austin, 8/15/37, L.K.H., 1450. *Somerset County:* Windber, 1924, O.E.J.; on *Acer* trunk, 1 mile E. of Buckstown, 8/14/36, O.E.J. *Venango County:* Allegheny River, 1 mile N. of Perry Run, 6/7/33, L.K.H., 2380. *Warren County:* 3 miles W. of Tidioute, 7/16/40, A. G. Shields; Tionesta Tract, near Brookston, 7/25/40, L.K.H., 3854. *Westmoreland County:* on *Betula lutea* stump, Jacob's Creek near Laurelville, 5/31/03, J. A. Shafer; Laurel Hill near Laughlintown, 7/8/06, D.R.S.; on *Betula lutea*, crest of Laurel Hill Mt., E. of New Florence, 5/22/21, O.E.J.; 2½ miles N. of Bolivar, October 1933, H. S. Wieand.

Fomes igniarius (L.) Gill.

On living deciduous trees, occasionally on dead trees. Frequent here although considered rare in most sections of the state, except the northern counties. It seems that future collecting should increase our records. *Allegheny County:* on *Carpinus*, Bradford Woods, 9/26/36, O.E.J.; on dead *Quercus*, Wildwood, 9/28/38, L.K.H., 2291. *Butler County:* West

Winfield, 5/26/06, D.R.S.; Wolf Creek, 1934, Keller Sheeler; near Saxonburg, on *Fraxinus*, 10/19/35, D.R.S. *Erie County:* on dead *Populus*, Presque Isle, 7/10/28, C. K. Henlen; Wintergreen Gulch, near Erie, 8/5/25, O.E.J. *Westmoreland County:* Pike Run, N.E. of Hopewell, 9/5/36, D.R.S.

Fomes lobatus (Schw.) Cooke

On logs and stumps of deciduous trees. Infrequent. *Armstrong County:* near Kittanning, 1904, D.R.S. *Butler County:* near Saxonburg, 9/18/39, D.R.S. *Washington County:* near Finleyville, 8/13/15, O.E.J.

Fomes ohioensis Berk.

On wood of deciduous trees. Rare. *Bedford County:* Sulphur Springs, 8/7/40, D.R.S.

Fomes pini (Thore) Lloyd (Plate XXIX, figs. 1, 2)

On living or dead wood of coniferous trees. Rare here, although considered frequent in Pennsylvania. *Allegheny County:* on slab of *Pinus*, Jackman's Hollow, back of Avalon, October 1903, J. A. Shafer.

Fomes pinicola (Sw.) Cooke

On dead wood of conifers and often on certain deciduous trees. Frequent. *Cambria County:* Ebensburg, August 1916, D.R.S. *Clarion County:* on *Tsuga canadensis*, Cook Forest, 8/21/32, C. K. Henlen. *Crawford County:* on *Larix*, Hartstown, Pymatuning Swamp, 6/12/05, O.E.J.; Exposition Park, 7/15/08, D.R.S.; on *Larix*, Linesville, 5/30/08, O.E.J. *Erie County:* Corry, 7/1/08, D.R.S. *McKean County:* Kane, 9/5/37, D.R.S.; on *Tsuga*, Tionesta Tract, near Brookston, 7/23/40, L.K.H., 3699. *Potter County:* on *Tsuga canadensis* stump, Odin, 4/1/26, W. H. Emig. *Warren County:* on *Tsuga*, Tionesta Tract, near Brookston, 7/25/40, L.K.H., 3855. *Westmoreland County:* Kingston, 9/21/07, D.R.S.; Idlewild, 7/18/08, D.R.S.; Kissell's Spring, 5/30/10, D.R.S.

Fomes rimosus Berk.

Only on living black locust. Common. *Allegheny County:* Back of Avalon, October 1902, J. A. Shafer; near Carnot, October 1903, J. A. Shafer; Sandy Creek, 7/23/06, D.R.S.; Verona, 8/14/06, D.R.S.; Darlington Hollow, Sharpsburg, 8/20/07, D.R.S.; 1½ miles E. of Ambridge, 9/16/23, E. H. Graham; Warden Mine region, opposite Sutersville, 7/13/39, H. Roslund. *Armstrong County:* Kittanning, September 1904, D.R.S.; near Kiski Junction, July 1905, D.R.S. *Beaver County:* Rock Point,

7/18/07, D.R.S. *Bedford County:* Sulphur Springs, 8/7/40, D.R.S. *Cambria County:* Cresson, July 1909, D.R.S. *Erie County:* Presque Isle, 7/31/30, C. K. Henlen. *Lawrence County:* on *Robinia pseudoacacia* stump, Elliot's Mills, 5 miles S.W. of Slippery Rock, 8/19/22, O.E.J.; Kennedy's Mill, Slippery Rock Creek, January 1926, E. H. Graham. *Somerset County:* 3 miles W. of Bakersville, 4/23/33, C. M. Hepner. *Washington County:* near Washington, 9/19/39, D.R.S.; Finleyville, 8/13/05, O.E.J. *Westmoreland County:* near Latrobe, 1903, D.R.S.; near Jacob's Creek, August 1903, O. P. Medsger; Dairy, 8/6/06, D.R.S.; near Youngstown, 7/8/07, D.R.S.; Chestnut Ridge above Youngstown, 7/17/08, J. A. Shafer; New Florence, 7/24/08, D.R.S.; Shades Ravine, E. of Trafford, August 1923, O.E.J.; Kiski Campus, 9/12/37, D.R.S.

Fomes scutellatus (Schw.) Cooke

On dead wood of alder, rarely on other hosts. Rare here. *Fayette County:* on twigs lying under *Rhododendron maximum*, Ohio Pyle, 6/24/39, L.K.H., 2802.

Fomes subroseus (Weir) Ovlts.

On dead wood of conifers, rarely on hardwood trees. Infrequent. Our records indicate that this species grows in non-mountainous regions as well as in the mountainous sections of the state. *Beaver County:* Dark Hollow, 1/7/22, H. W. Graham. *Centre County:* Alan Seeger region, 7/26/36, L. O. Overholts. *Erie County:* Presque Isle, 1927, C. K. Henlen.

Lenzites betulina (L.) Fr.

On logs and stumps of deciduous trees, rarely on conifers. Common. *Allegheny County:* Jackman's Hollow Creek, Avalon, October 1903, J. A. Shafer; Stowe Twp., October 1903, J. A. Shafer; Allegheny Cemetery, Pittsburgh, 1905, D.R.S.; Wilkinsburg, 8/15/06, D.R.S.; near Elizabeth, 2/26/32, C. M. Hepner; North Park, 8/24/35, L.K.H., 411; along Route 856, 2 miles N.E. of Emsworth, 10/31/37, L.K.H., 1774; Pine Creek, one half-mile S.E. of Wildwood, 9/28/38, L.K.H., 2529; near Sewickley, 10/30/38, D.R.S.; Warden Mine region, opposite Sutersville, 7/15/39, H. Roslund. *Armstrong County:* Kittanning, 1901, D.R.S. *Beaver County:* Saw Mill Hollow, 12/28/21, H. W. Graham; Temple Hollow, 1 mile N.W. of Aliquippa, 6/30/38, L.K.H., 1860; Raccoon Creek Park, 5/4/40, O.E.J. *Butler County:* Tributary of Crab Run, 4 miles N.E. of Harmony, 9/11/36, L.K.H., 740. *Centre County:* near Woodward, 9/6/39, D.R.S.; State Game Lands, S.E. of Philipsburg, 7/11/40, L.K.H., 3625. *Crawford County:*

Exposition Park, 1908, D.R.S. *Fayette County:* Ohio Pyle, 9/16/06, D.R.S. *Lawrence County:* near Westminster College, New Wilmington, 9/25/32, C. K. Henlen. *Mercer County:* near Sheakleyville, 9/5/36, M.B.K. *Somerset County:* Laurel Ridge, 10 miles E. of Indian Creek Reservoir, 10/14/35, L.K.H., 333. *Warren County:* Possum Pond, S.E. edge of Tamarack Swamp, 2 miles N.W. of Pine Valley, 10/15/36, L.K.H., 959; Tionesta Tract, near Brookston, 7/25/40, L.K.H., 3857. *Washington County:* near Snodgrass Station on Washington Car line, 11/23/35, H. McCullough; on *Fagus* log, Buffalo Creek above junction with Buck Run, 5/23/40, L.K.H., 3058; vicinity of Hanlin Station, 9/13/40, L.K.H., 4189. *Westmoreland County:* Dairy, 11/10/06, D.R.S.; Idlewild, 1906, D.R.S.; Rock Run, 3 miles S.E. of Ligonier, 1923, O.E.J.; Wild Life Lodge, New Kensington, 9/21/35, M.B.K.; across river from Saltsburg, 10/10/36, L.K.H., 907; near Saltsburg, 9/27/39, D.R.S.; Shades Ravine near Trafford, 9/11/39, M.B.K.; near Waterford, 9/1/40, D.R.S.

Lenzites saepiaria (Wulf.) Fr.

Mostly on dead wood of coniferous trees, occasionally on hardwoods. Common. *Allegheny County:* Jackman's Hollow, back of Avalon, October 1903, J. A. Shafer; Frick Park, Pittsburgh, 7/27/06, D.R.S.; near Harmarville, 7/6/39, D.R.S. *Armstrong County:* Kittanning, October 1904, D.R.S.; near Ford City, 7/10/39, D.R.S. *Bedford County:* Sulphur Springs 8/7/40, D.R.S. *Cambria County:* Ebensburg, August 1916, D.R.S. *Centre County:* Bald Eagle Creek, 7 miles W. of Bellefonte, November 1935, Mrs. Paul Wible. *Crawford County:* Linesville, Pymatuning Swamp, 6/10/07, O.E.J.; Hartstown, Pymatuning Swamp, 8/5/30, C. K. Henlen. *Clarion County:* near Clarion, 10/14/38, D.R.S. *Fayette County:* Ohio Pyle, 9/16/06, D.R.S. *Forest County:* 1 mile N.W. of Brookston, 7/24/40, L.K.H., 3784. *Warren County:* Tionesta Tract, near Brookston, 7/25/40, L.K.H., 3856. *Westmoreland County:* Idlewild Park, 7/21/07, D.R.S.; New Florence, 9/8/07, D.R.S.

Lenzites trabea (Pers.) Fr.

On dead wood of deciduous trees, occasionally on conifers. Common. *Allegheny County:* Frick Park, Pittsburgh, 8/16/06, D.R.S.; Turtle Creek, 9/28/06, D.R.S.; Darlington Hollow, Sharpsburg, 6/10/08, D.R.S.; on dead spot on *Platanus occidentalis*, 9-mile Run, Frick Park, Pittsburgh, 11/7/15, O.E.J.; on railroad ties, Montour Run, near Groveton, 9/9/22, O.E.J.; Pine Creek, one half-mile S.E. of Wildwood, 9/28/38, L.K.H., 2529; Fallen Timber Hollow, opposite Sutersville, 8/22/39, H. Roslund; 1-2 miles N.E.

of Mt. Nebo, 6/5/40, L.K.H., 3079; on dying *Amygdalus persica*, Rosedale, 7/31/40, R. Fricke. *Butler County:* uplands, 4 miles N.E. of Harmony, 9/12/35, L.K.H., 475. *Crawford County:* Linesville, Pymatuning Swamp, 6/30/35, L.K.H., 321. *Erie County:* Presque Isle, 6/11/05, O.E.J.; Corry, 7/1/08, D.R.S.; woods at Mercyhurst College, 10/8/31, M. P. Wilbert. *Fayette County:* Kilarney Park, July 1919, D.R.S.; Ohio Pyle, 6/18/40, L.K.H., 3170. *McKean County:* on railroad ties in valley below Mt. Jewett, 9/16/22, O.E.J. *Mercer County:* near Swamp Root, 6/8/35, L.K.H., 340. *Westmoreland County:* vicinity of Hillside, 10/11/24, O.E.J.; Rock Run, 3 miles S.E. of Rector, 10/9/27, O.E.J.

Merulius lacrymans (Wulf.) Fr.

On coniferous logs, and on timbers in buildings. Infrequent. *Allegheny County:* Wilkinsburg, 10/3/06, D.R.S.; Frick Park, Pittsburgh, 10/13/06, D.R.S. *Armstrong County:* Kittanning, October 1902, D.R.S.

Merulius rubellus Pk. (Plate XXVII, figs. 5, 6)

On stumps and logs of deciduous trees. Rare. *Armstrong County:* Kittanning, 1905, D.R.S.

Merulius tremellosus Schrad.

On dead wood of deciduous trees, rarely on conifers. Common. *Allegheny County:* Frick Park, Pittsburgh, 9/22/06, D.R.S., Sandy Creek, 11/3/06, D.R.S.; Guyasuta Hollow, Sharpsburg, 9/19/16, D.R.S.; valley of Little Sewickley Creek above Edgeworth, 10/21/16, O.E.J.; on Route 8, near Wildwood Road, 9/18/38, M.B.K.; near Allison Park, 9/23/39, D.R.S.; on *Carpinus*, Beaver Grade Road near Montour Run, 7/3/40, L.K.H., 3386. *Armstrong County:* Kittanning, 1904, D.R.S. *Bedford County:* Sulphur Springs, 8/7/40, D.R.S. *Butler County:* uplands, 4 miles N.E. of Harmony, 10/7/34, L.K.H., 107; Little Buffalo Creek, near Monroe Station, 10/25/36, L.K.H., 993; near Saxonburg, 9/19/39, D.R.S.; near Zelienople, 10/16/39, D.R.S.; 1 mile S.E. of Whitestown, 9/17/40, L.K.H., 4287. *Clarion County:* Cook Forest, 10/7/38, L.K.H., 2631; near Clarion, 10/12/39, D.R.S. *Crawford County:* Hartstown, Dollar Lake, 9/19/35, L.K.H., 525. *Fayette County:* Ohio Pyle, 9/16/06, D.R.S. *Lawrence County:* Muddy Creek Falls, 10/7/37, L.K.H., 1769. *Venango County:* along Little Scrubgrass Creek, N.E. of Sutton's Mills, 11/8/36, M.B.K. *Westmoreland County:* on *Prunus pennsylvanicus*, Rock Run, 3 miles S.E. of Rector, 9/1/24, O.E.J.; Congruity, 4 miles E. of Delmont on Route 22, 9/27/34, L.K.H., 147; Shades Ravine, Trafford, 10/27/34, H. S. Wieand; Waterford, 10/17/39, D.R.S.

Polyporus abietinus (Dicks.) Fr.

On wood of coniferous trees. Frequent. *Allegheny County:* Pine Creek, one half-mile S.E. of Wildwood, 9/28/38, L.K.H., 2589. *Armstrong County:* Kittanning, 1903, D.R.S. *Bedford County:* on *Tsuga*, Sulphur Springs, 8/7/40, D.R.S. *Butler County:* Little Buffalo Creek, near Monroe Station, 10/25/36, L.K.H., 999. *Cambria County:* Ebensburg, August 1916, D.R.S. *Centre County:* on *Tsuga*, State Game Lands, near Port Matilda, 7/11/40, L.K.H., 3673. *Clarion County:* Cook Forest, 10/7/38, L.K.H., 2659. *Crawford County:* Pymatuning Swamp, near Linesville, 6/30/35, L.K.H., 303. *Fayette County:* Ohio Pyle, 7/4/05, O.E.J. *Forest County:* Cook Forest, 10/5/38, L.K.H., 2746. *Lawrence County:* Muddy Creek Falls, 10/7/37, L.K.H., 1704. *McKean County:* on *Tsuga*, Tionesta Tract, near Brookston, 7/25/40, L.K.H., 3700. *Warren County:* Possum Pond, S.E. edge of Tamarack Swamp, 2 miles N.W. of Pine Valley, 10/15/36, L.K.H., 963. *Westmoreland County:* Shades Ravine, 2 miles E. of Trafford, 8/11/37, L.K.H., 1361.

Polyporus adustus (Willd.) Fr.

On dead wood of deciduous trees. Common. *Allegheny County:* Coraopolis, 9/4/05, O.E.J.; Frick Park, Pittsburgh, October 1905, D.R.S.; Sandy Creek, 7/26/06, D.R.S.; along Pine Creek, one half-mile S.E. of Wildwood, 9/22/39, C. K. Henlen; Ross Twp., 8/20/33, L.K.H., 32; near Sewickley, 10/3/36, D.R.S.; Squaw Run, near Aspinwall, 10/1/38, H. S. Wieand; Schenley Park, Pittsburgh, 6/7/39, D.R.S.; 1 mile N.E. of Ben Avon Hts., 8/1/39, L.K.H., 2987. *Armstrong County:* Kittanning, September 1901, D.R.S. *Beaver County:* on *Quercus* logs, Camp Konokwee, 1 mile S. of Fombell, 4/5/36, L.K.H., 267, and on *Platanus occidentalis*, Ibid, 376. *Butler County:* near Zelienople, 8/11/34, D.R.S.; on dead *Castanea dentata*, 4 miles N.E. of Harmony, 9/12/35, L.K.H., 474; Little Buffalo Creek, near Freeport, 10/10/36, H. S. Wieand; Little Buffalo Creek, near Monroe Station, 9/9/37, L.K.H., 1557; near Zelienople, 8/15/40, D.R.S.; 1 mile S.E. of Whitestown, 9/17/40, L.K.H., 4288. *Cambria County:* Ebensburg, August 1916, D.R.S. *Clarion County:* near New Bethlehem, 9/19/40, D.R.S. *Crawford County:* Exposition Park, 7/15/08, D.R.S. *Erie County:* Corry, 7/1/08, D.R.S.; woods at Mercyhurst College, S. of Erie, 10/8/31, M. P. Wilbert. *Fayette County:* Kilarney Park, July 1919, D.R.S.; Ohio Pyle, 10/13/34, H. S. Wieand; near Normalville, 8/20/40, D.R.S. *Greene County:* Holbrook, 11/11/35, Sarah Marley. *Jefferson County:* Cook Forest, 8/12/32, C. K. Henlen. *Lawrence County:*

Muddy Creek Falls, 10/7/37, L.K.H., 1723. *McKean County:* Mt. Jewett, 9/16/22, O.E.J.; Kane, 9/5/36, D.R.S.; Tionesta Tract, near Brookston, 7/22/40, L.K.H., 3701. *Mercer County:* near Swamp Root, 6/8/35, L.K.H., 329. *Warren County:* Possum Pond, S.E. edge of Tamarack Swamp, 2 miles N.W. of Pine Valley, 10/15/36, L.K.H., 957. *Washington County:* vicinity of Hanlin Station, 9/13/40, L.K.H., 4190. *Westmoreland County:* Hillside, 5/19/06, D.R.S.; New Florence, 7/24/08, D.R.S.; Rock Run, 3 miles S.E. of Rector, 11/11/30, O.E.J.; Little House Woods, 10/19/36, M.B.K.; Shades Ravine, E. of Trafford, 8/11/37, L.K.H., 1350; one half-mile S. of Smithdale, 6/27/40, L.K.H., 3343.

Polyporus albellus Pk.

On dead wood of deciduous trees. Common. *Allegheny County:* Coraopolis, August 1905, D.R.S.; Frick Park, Pittsburgh, 8/22/06, D.R.S.; Darlington Hollow, Sharpsburg, 6/10/08, D.R.S.; near Sandy Creek, 8/25/35, L.K.H., 449; 1 mile N.E. of Ben Avon Hts., 7/19/37, L.K.H., 1232; near Sewickley, 9/25/37, D.R.S.; Pine Creek, one half-mile S.E. of Wildwood, 6/25/38, L.K.H., 1836; near Dorseyville, 6/15/39, M.B.K.; 1 mile W. of Mt. Nebo, 8/1/39, L.K.H., 2967; on *Prunus malus*, N.S. Pittsburgh, 7/9/40, A. G. Shields. *Armstrong County:* Kittanning, 1904, D.R.S.; across river from Jonetta, 10/23/21, O.E.J.; Leechburg, 10/22/38, D.R.S. *Beaver County:* Temple Hollow, 1 mile N.W of Aliquippa, 6/30/38, L.K.H., 1874. *Butler County:* uplands, 4 miles N.E. of Harmony, 10/7/34, L.K.H., 173; near Butler, 9/17/35, D.R.S.; along tributary of Crab Run, 4 miles N.E. of Harmony, 9/11/36, L.K.H., 762; Little Buffalo Creek, near Monroe Station, 9/26/36, L.K.H., 891; Watson's Run, 2 miles S. of Leasuresville, 9/15/37, L.K.H., 1845; Slippery Rock, 9/24/38, D.R.S.; along Route 528, one quarter-mile S.E. of junction with Route 8, 9/16/40, L.K.H., 4229. *Cambria County:* Cresson, 8/24/09, D.R.S.; Armagh, 11/12/38, D.R.S.; 1½ miles E. of Patton, 10/13/40, R. Little. *Centre County:* Millheim, 7/14/35, D.R.S.; Pine Hall, 7/28/36, M.B.K.; Woodward, 8/18/38, D.R.S.; State Game Lands, S.E. of Philipsburg, 7/11/40, L.K.H., 3624. *Clarion County:* 4 miles N.E. of Parker's Landing, 7/27/35, L.K.H., 355; Cook Forest, 10/13/39, D.R.S.; near Clarion, 7/1/08, D.R.S. *Crawford County:* near Linesville, 10/8/39, M.B.K. *Elk County:* South of Kane, 7/4/39, D.R.S. *Erie County:* Corry, 7/1/08, D.R.S. *Fayette County:* on *Betula lenta*, Ohio Pyle, 8/12/08, D.R.S.; Kilarney Park, July 1919, D.R.S.; near Normalville, 8/20/40, D.R.S. *Forest County:* Cook Forest, 10/5/38, L.K.H., 2761; 1 mile N.W. of Brookston, 7/24/40, L.K.H., 3785. *Indiana*

County: near Glen Campbell, 8/4/38, L.K.H., 2096. *Lawrence County:* Muddy Creek Falls, 10/7/37, L.K.H., 1761. *McKean County:* Kane, 9/5/37, D.R.S.; Tionesta Tract, near Brookston, 7/25/40, L.K.H., 3702. *Mercer County:* Transfer, 8/9/12, D.R.S.; 2 miles S.W. of Mercer, 9/11/35, L.K.H., 463. *Potter County:* Route 872, 7 miles N.E. of Austin, 8/15/37, L.K.H., 1462. *Somerset County:* Jennerstown, 11/11/38, D.R.S. *Venango County:* Scrubgrass Creek, 1 mile N. of Lisbon, 9/19/36, L.K.H., 810. *Warren County:* Tionesta Tract, near Brookston, 7/25/40, L.K.H., 3858. *Westmoreland County:* Dairy, 8/8/06, D.R.S.; Idlewild, 9/21/07, D.R.S.; on *Prunus pennsylvanica*, Forbes Forest, 3 miles S.E. of Rector, 8/9/25, O.E.J.; Laurel Ridge, 1 mile E. of Kregar, 10/14/34, L.K.H., 108; Buttermilk Falls near Ligonier, 9/21/35, H. S. Wieand; across river from Saltsburg, 10/10/36, L.K.H., 941; near South Greensburg's Swimming Pool, 6/21/37, L.K.H., 1014; 1½ miles E. of New Alexandria, off Route 22, 7/29/37, L.K.H., 1267; Shades Ravine, 2 miles E. of Trafford, 8/11/37, L.K.H., 1366; Waterford, 10/17/39, D.R.S.; Kiski Campus, near Saltsburg, 8/17/37, D.R.S.; along Loyalhanna Creek, above the Dam, 6/12/40, L.K.H., 3127.

Polyporus albiceps Peck

On rotted wood. One of the rarest polypores. Murrill in North American Flora, Vol. 9, says, "known only from type locality," but a few other specimens have been reported since then. *Armstrong County:* along Big Buffalo Creek across from West Winfield, 8/12/39, M.B.K., checked by L. O. Overholts.

Polyporus arcularius (Batsch.) Fr.

On dead wood of deciduous trees, chiefly in spring and early summer. Common. *Allegheny County:* Frick Park, Pittsburgh, 6/14/07, D.R.S.; Darlington Hollow, Sharpsburg, 6/10/08, D.R.S.; Mayview Road, 3 miles S. of Bridgeville, 5/19/37, L.K.H., 413; 1 mile N. of Lisbon, 5/19/37, H. S. Wieand; Fallen Timber Hollow, opposite Sutersville, 8/22/39, H. Roslund; Sandy Creek, 5/23/40, R. Little; along Pine Creek, one half-mile S.E. of Wildwood, 5/29/40, L.K.H., 3061; 1-2 miles N.E. of Mt. Nebo, 6/5/40, L.K.H., 3067. *Armstrong County:* Kittanning, May 1901, D.R.S. *Beaver County:* Rock Point, 7/18/07, D.R.S.; 2 miles above mouth of Raccoon Creek, 3/17/24, O.E.J.; Temple Hollow, 1 mile N.W. of Aliquippa, 6/30/38, L.K.H., 1866. *Butler County:* Marwood, 1926, Mima R. Milliron; uplands, 4 miles N.E. of Harmony, May 1931, L.K.H., 47. *Cambria County:* Cresson, 8/24/09, D.R.S. *Crawford County:* Conneaut Park, 7/19/06,

D.R.S.; near Linesville, 6/29/35, L.K.H., 342. *Erie County:* Presque Isle, 5/8/06, O.E.J.; Corry, 7/1/08, D.R.S. *Fayette County:* Ohio Pyle, 5/30/08, O.E.J. *Lawrence County:* New Castle, 1906, Miss Suzan Gageby; E. of Volant along Route 278, 6/9/40, O.E.J. *Mercer County:* near Swamp Root, 6/8/35, L.K.H., 339. *Washington County:* Washington, 5/30/04, O.E.J.; vicinity of Hanlin Station, 5/21/40, L.K.H, 3052; along Buffalo Creek above junction with Buck Run, 5/23/40, L.K.H., 3059. *Westmoreland County:* Hillside, 5/19/06, D.R.S.; Idlewild Park, 5/7/21, D.R.S.; Shades Ravine, 2 miles E. of Trafford, 5/8/40, E. P. Kelley; along Loyalhanna Creek, 3 miles above junction with Conemaugh River, 5/16/40, L.K.H., 3050; near Saltsburg, 5/21/40, D.R.S.; along Loyalhanna Creek above the Dam, 6/12/40, L.K.H., 3126.

Polyporus Berkeleyi Fr. (Plate XXVIII, figs. 5, 6)

Around trees and stumps, especially oaks. Frequent. *Allegheny County:* Frick Park, Pittsburgh, 7/23/06, D.R.S.; near Wilkinsburg, 1930, H. S. Smith; Guyasuta Hollow, Sharpsburg, 7/21/37, W. L. Black. *Armstrong County:* Kittanning, 1901, D.R.S. *Butler County:* near Saxonburg, 8/24/39, D.R.S. *Fayette County:* Ohio Pyle, 9/1/07, O.E.J. *Forest County:* Cook Forest, 10/5/38, L.K.H., 2764. *Westmoreland County:* Idlewild Park, June 1904, D.R.S.; Speedwell, 7/28/08, D.R.S.; Kiski Campus, near Saltsburg, July 1939, D.R.S.

Polyporus betulinus (Bull.) Fr.

On living or dead birch trees. Frequent in the non-mountainous sections of Western Pennsylvania. *Armstrong County:* Kittanning, 11/7/26, Amy Neale. *Clarion County:* on dead *Betula lutea;* Cook Forest, 10/17/26, O.E.J.; near New Bethlehem, 9/19/40, D.R.S. *Erie County:* woods at Mercyhurst College, S. of Erie, 10/8/31, M. P. Wilbert. *Lawrence County:* Muddy Creek Falls, 10/7/37, L.K.H., 1733. *McKean County:* on *Betula* log, Tionesta Tract, near Brookston, 7/25/40, L.K.H., 3704. *Venango County:* on *Betula*, along Allegheny River, 1 mile N. of Perry Run, 6/7/33, L.K.H., 563. Scrubgrass Creek, 1 mile N. of Lisbon, 11/3/35, M.B.K.; Scrubgrass Creek N.E. of Suttons Mills, 11/8/36, M.B.K. *Westmoreland County:* 2½ miles N. of Bolivar, 1933, H. S. Wieand.

Polyporus biformis (Kl.) Berk. (Plate XXVI, figs. 5, 6)

On dead wood of deciduous trees. Infrequent. *Armstrong County:* Kittanning, August, 1905, D.R.S. *Erie County:* Presque Isle, 7/31/30,

C. K. Henlen. *Lawrence County:* Kennedy's Mills, Slippery Rock Creek, 1/30/26, E. H. Graham. *Westmoreland County:* Youngstown, 6/21/08, D.R.S.

Polyporus borealis Fr.

On stumps and logs of coniferous trees, also on living conifers. Frequent. *Allegheny County:* on log in Phipps Conservatory, Pittsburgh, 11/6/36, M.B.K. *Armstrong County:* near Leechburg, 10/8/38, D.R.S. *Bedford County:* Sulphur Springs, 8/7/40, D.R.S. *Blair County:* Yellow Springs, 7/11/40, D.R.S. *Centre County:* on *Tsuga*, Shaffer's Creek, 10 miles S. of State College, 7/22/36, M.B.K. *Lawrence County:* Muddy Creek Falls, 10/7/37, L.K.H., 1727. *McKean County:* on *Tsuga*, Tionesta Tract, near Brookston, 7/25/40, L.K.H., 3703. *Somerset County:* 3 miles W. of Bakersville, 1933, C. M. Hepner. *Westmoreland County:* New Florence, Mellon's Estate, 9/7/07, O.E.J.

Polyporus brumalis (Pers.) Fr.

On dead wood of deciduous trees, chiefly in fall and winter. Common. *Allegheny County:* Darlington Hollow, Sharpsburg, 10/27/01, J. A. Shafer; Narrows Run, Moon Twp., 2/23/03, J. A. Shafer; Power's Run opposite Verona, 5/25/04, O.E.J.; Frick Park, Pittsburgh, 1905, D.R.S.; Tom's Run Ravine, Dixmont, 10/14/16, O.E.J.; along Pine Creek, one half-mile S.E. of Wildwood, 10/14/28, C. K. Henlen; Sandy Creek, 10/31/36, D.R.S.; Monongahela City, 5/8/37, H. McCullough; near Allison Park, 10/17/37, D.R.S.; Fallen Timber Hollow, opposite Sutersville, 10/10/39, H. Roslund. *Armstrong County:* Kittanning, November 1901, D.R.S.; near Leechburg, 10/22/38, D.R.S. *Beaver County:* near Ambridge, 1921, H. W. Graham. *Butler County:* Marwood, 1926, Mima R. Milliron; uplands, 4 miles N.E. of Harmony, Dec. 1932, L.K.H., 48; near Saxonburg, 10/19/35, D.R.S.; near Butler, 11/10/39, D.R.S. *Cambria County:* near Armagh, 11/12/38, D.R.S. *Fayette County:* Dunbar Creek, 2½ miles S.E. of Dunbar, 4/18/37, L.K.H., 218. *Lawrence County:* Muddy Creek Falls, 10/16/40, L.K.H., 4541. *Somerset County:* Ursina, 5/12/05, O.E.J. *Westmoreland County:* W. of Export towards Logan's Ferry, 10/15/17, W. H. Emig; Hillside, Bear's Cave, 10/29/27, O.E.J.; Rock Run, 3 miles S.E. of Rector, 12/2/29, O.E.J.; 2½ miles N. of Bolivar, 1933, H. S. Wieand; Shades Ravine, 2 miles E. of Trafford, 10/18/36, H. S. Wieand.

Polyporus caeruloporus Pk.

On soil in woods. Rare, but readily determined by the bluish color of pileus, tubes and stipe. *Butler County:* on soil adhering to underside of overhanging rock, Little Buffalo Creek near Monroe Station, 10/13/40, M.B.K.

Polyporus caesius (Schrad.) Fr.

On dead wood of both deciduous and coniferous trees. Although this species is rather common in the mountainous sections, our collections show its frequency in the non-mountainous parts of the state. *Allegheny County:* Fallen Timber Hollow, opposite Sutersville, 10/9/39, H. Roslund. *Armstrong County:* Kittanning, October 1904, D.R.S. *Butler County:* near Saxonburg, 10/19/35, D.R.S.; along Route 528, one quarter-mile S.E. of junction with Route 8, 9/16/40, L.K.H., 4230; along tributary of Crab Run, 4 miles N.E. of Harmony, 9/18/40, L.K.H., 4348. *Clarion County:* Cook Forest, 10/7/38, L.K.H., 2682. *Forest County:* Cook Forest, 10/5/38, L.K.H., 2774. *Mercer County:* Mercer Bog, 1 mile W. of Mercer, 9/16/36, L.K.H., 977. *Venango County:* Little Scrubgrass Creek, 1 mile N.E. of Lisbon, 9/19/36, L.K.H., 807.

Polyporus cinnabarinus (Jacq.) Fr.

On dead wood of deciduous trees, rarely on conifers. Common. *Allegheny County:* near Carnot, 2/22/01, J. A. Shafer; Narrows Run, Moon Twp., 2/23/03, J. A. Shafer; Coraopolis, 9/4/05, O.E.J.; Frick Park, Pittsburgh, June 1906, D.R.S.; Pittsburgh, 11/10/15, F. R. Alker; Carnegie, 9/1/26, Dorothy Rome; Sewickley Hts., 2/21/30, C. K. Henlen; Rennerdale, 4/1/31, Thomas Millward; near Aspinwall, 9/13/35, M.B.K.; near Dorseyville, 6/15/39, M.B.K.; Warden Mine region, opposite Sutersville, 7/19/39, H. Roslund. *Armstrong County:* Kittanning, Sept. 1901, D.R.S.; across river from Jonetta, 10/23/21, O.E.J.; near Leechburg, 10/29/38, D.R.S. *Beaver County:* Camp Konokwee, 1 mile S. of Fombell, 4/5/36, L.K.H., 239; near Independence, 5/8/38, O.E.J. *Butler County:* near Nixon Station, Butler Short Line, 2/4/16, Wm. Millward; uplands, 4 miles N.E. of Harmony, 3/16/30, L.K.H., 51; near Saxonburg, 9/20/36, D.R.S.; near Butler, 11/7/36, D.R.S.; Watson's Run, 2 miles S. of Leasuresville, 9/15/37, L.K.H., 1658; near Slippery Rock, 7/3/40, D.R.S.; Crolls Mills, Slippery Rock Creek, 11/2/40, Mrs. Leslie Lanfear. *Centre County:* Millheim, 7/14/35, D.R.S.; Alan Seeger Monument, 7/6/36, M.B.K.; State College, 7/22/37, D.R.S.; near Boalsburg, 9/22/37, D.R.S.; State Game Lands, S.E. of Philipsburg, 7/11/40, L.K.H., 3631. *Clarion County:* near Clarion,

10/14/38, D.R.S. *Crawford County:* Hartstown, Pymatuning Swamp, 5/18/08, O.E.J.; on *Betula lutea*, S.E. of Hartstown, 5/31/27, O.E.J.; Cambridge Springs, 7/9/29, B. M. Ogden; Linesville, Pymatuning Swamp, 6/2/35, L.K.H., 331. *Elk County:* Bordentown Swamp, top of plateau S. of Medix Run, 9/30/34, O.E.J.; Route 555, 2 miles E. of Medix Run, 8/15/37, L.K.H., 1522; near Kane, 7/4/39, D.R.S. *Erie County:* Presque Isle, 5/8/06, O.E.J.; Hummell Farm, 1½ miles E. of Wattsburg, 7/31/28, O.E.J.; DeWitt Farm, 8 miles S.E. of Erie, 8/8/33, O.E.J. *Fayette County:* Ohio Pyle, 8/3/07, O.E.J.; Laurel Run Valley, S.E. of Haydentown, 8/24/40, O.E.J. *Forest County:* 1 mile N.W. of Brookston, 7/24/40, L.K.H., 3786. *Indiana County:* near Glen Campbell, 8/4/38, L.K.H., 2107. *Jefferson County:* along Clarion River, Cook Forest, 8/12/32, C. K. Henlen. *Lawrence County:* near Portersville, 11/26/26, H. M. Raup. *Potter County:* near Odin, 8/18/35, O.E.J. *Somerset County:* Haines, Laurel Hill, 7/8/06, D.R.S.; Wagner's Woods, near Buckstown, 10/3/36, M.B.K.; Laurel Ridge, 10 miles E. of Indian Creek Reservoir, 4/14/35, L.K.H., 332; Summit on Route 30, 8/9/40, D.R.S. *Venango County:* along Allegheny River, 1 mile N. of Perry Run, 6/7/33, L.K.H., 174; Little Scrubgrass Creek, 1 mile N.E. of Lisbon, 9/19/36, L.K.H., 854; Little Scrubgrass Creek, N.E. of Suttons Mills, 11/8/36, M.B.K. *Washington County:* vicinity of Hanlin Station, 5/21/40, L.K.H., 3054. *Westmoreland County:* near New Florence, Mellon Estate, 9/10/07, O.E.J.; near Millbank, Chestnut Ridge, 12/3/16, O.E.J.; on *Betula lutea*, Lynn Run, 3 miles S.E. of Rector, 7/1/22, O.E.J.; Hillside, 5/24/23, O.E.J.; Bog at Laurel Summit, S.E. of Rector, June 1930, O.E.J.; 2½ miles N. of Bolivar, 1933, H. S. Wieand; Congruity, 4 miles E. of Delmont, 9/27/34, L.K.H., 138; Laurel Ridge, 1 mile E. of Kregar, 10/14/34, L.K.H., 184; Jones's Mills, 8/17/35, D.R.S.; Pike Run, N.E. of Hopewell, 9/5/36, D.R.S.; 1½ miles E. of New Alexandria, off Route 22, 7/29/37, L.K.H., 1288; Chestnut Ridge, above Youngstown, 10/22/39, M.B.K.; near Ligonier, 5/28/40, D.R.S.; 1 mile E. of Mt. Pleasant, 6/13/40, I. H. Horner; Loyalhanna Creek above the Dam, 6/12/40, L.K.H., 3105.

Polyporus cinnamomeus (Jacq.) Sacc.

On ground in woods. Frequent. *Allegheny County:* North Park, 8/24/35, L.K.H., 401; Warden Mine region opposite Sutersville, 7/9/39, H. Roslund. *Armstrong County:* Kittanning, 1904, D.R.S. *Beaver County:* Temple Hollow, 1 mile N.W. of Aliquippa, 6/30/38, L.K.H., 1858. *Butler County:* near Frasier's Mill, 7/31/35, A. M. Barker; uplands, 4 miles N.E.

of Harmony, 8/18/35, L.K.H., 374; Little Buffalo Creek at Monroe Station, 7/11/39, L.K.H., 2862. *Centre County:* Millheim, 7/14/35, D.R.S.; Alan Seeger Region, 7/7/36, M.B.K.; Woodward, 7/21/38, D.R.S. *Crawford County:* French Creek, near Cochranton, 8/19/35, H. S. Wieand. *Elk County:* Ridgeway, 8/28/25, O.E.J. *Erie County:* Presque Isle, 7/7/27, C. K. Henlen. *Fayette County:* Ohio Pyle, July 1905, D.R.S. *Potter County:* near Odin, 8/18/35, O.E.J. *Westmoreland County:* near Dairy, 8/15/07, D.R.S.; Idlewild Park, 9/21/07, D.R.S.; Latrobe, 7/19/10, D.R.S.; Lynn Run, 3 miles S.E. of Rector, 8/28/27, O.E.J.

Polyporus circinatus Fr. (Plate XXVI, figs. 3, 4)

On dead or living wood of coniferous trees. Rare. *Centre County:* near Scotia, 6/22/09, O.E.J. Det. L. O. Overholts.

Polyporus conchifer (Schw.) Fr.

On dead wood of elm. Common. *Allegheny County:* Frick Park, Pittsburgh, October 1905, D.R.S.; Power's Run, opposite Verona, 7/4/20, D.R.S.; 2½ miles E. of Ambridge, 9/16/23, E. H. Graham; Dixmont Hollow, Tom's Run, 10/31/31, O.E.J.; Riverview Park, N.S., Pittsburgh, 9/17/36, M.B.K.; South Branch Little Sewickley Creek, N.E. of Sewickley, 9/17/38, L.K.H., 2226; 1 mile W. of Mt. Nebo, 8/1/39, L.K.H., 2972; Glenshaw, 8/15/39, L.K.H., 3013; near Aspinwall, September 1939, D.R.S. *Armstrong County:* Leechburg, 10/22/38, D.R.S. *Beaver County:* near Ambridge, 1921, H. W. Graham; Temple Hollow, 1 mile N.W. of Aliquippa, 6/30/38, L.K.H., 1870. *Butler County:* Harmony, 7/21/04, R. J. Pflaum; Nixon Station, Butler Short Line, 2/17/17, Wm. Millward; uplands, 4 miles N.E. of Harmony, 3/16/30, L.K.H., 56; near Zelienople, 8/18/34, D.R.S.; near Saxonburg, 9/26/36, D.R.S.; near Slippery Rock, 9/24/38, D.R.S.; along Route 528, one quarter-mile S.E. of junction with Route 8, 9/16/40, L.K.H., 4231; along tributary of Crab Run, 4 miles N.E. of Harmony, 9/18/40, L.K.H., 4349; along Little Buffalo Creek, near Monroe Station, 10/9/40, L.K.H., 4476. *Centre County:* near Woodward, 9/8/39, D.R.S. *Clinton County:* Route 220, at Lamar, 8/13/37, L.K.H., 1391. *Crawford County:* vicinity of Hartstown, 11/18/29, O.E.J. *Lawrence County:* New Wilmington, Westminster College Campus, 9/25/32, C. K. Henlen. *Mercer County:* 2 miles S.W. of Mercer, 9/11/35, L.K.H., 469. *Washington County:* vicinity of Hanlin Station, 9/13/40, L.K.H., 4196; vicinity of Houston, 9/21/40, L.K.H., 4420; along Buffalo Creek near junction with Buck Run, 9/26/40, L.K.H., 4442. *Westmoreland County:* Kissell's Spring, 4/30/10, D.R.S.

Polyporus cristatus (Pers.) Fr. (Plate XXIX, figs. 5, 6)

On ground in woods. Frequent. *Allegheny County:* North Park, 8/24/35, L.K.H., 391. *Armstrong County:* Kittanning, 1901, D.R.S.; Meredith's Woods, September 1903, D.R.S. *Centre County:* Woodward, 8/18/38, D.R.S. *Clarion County:* near Clarion, 9/6/37, D.R.S. *Crawford County:* French Creek, near Cochranton, 8/29/35, H. S. Wieand. *Fayette County:* near Somerfield, 8/31/35, D.R.S. *Venango County:* 1 mile N. of Lisbon, 9/19/37, H. S. Wieand. *Westmoreland County:* Chestnut Ridge, S.E. of Hillside, 9/17/09, O.E.J.

Polyporus croceus (Pers.) Fr.

On living or dead wood of oak and chestnut. A rather rare or infrequent species. *Armstrong County:* near Kittanning, September 1902, D.R.S. *Westmoreland County:* Idlewild Park, 9/21/07, D.R.S.

Polyporus cuticularis (Bull.) Fr. (Plate XXVIII, figs. 1, 2)

On dead wood of deciduous trees and from wounds in living hardwood trees. Infrequent. *Allegheny County:* Sandy Creek, 11/3/06, D.R.S.; on *Fagus grandifolia*, Frick Park, 9/5/37, M.B.K. *Butler County:* in hollow part of old *Tsuga*, along Little Buffalo Creek, near Monroe Station, 10/9/40, L.K.H., 4477. *Erie County:* Presque Isle, 7/15/33, O.E.J. *Westmoreland County:* across river from Saltsburg, 10/10/36, L.K.H., 923.

Polyporus cutifractus Murr.

On dead wood of both coniferous and deciduous trees. Infrequent in Pennsylvania, coming here from the West. Determinations by L. O. Overholts. *Allegheny County:* 1 mile N.E. of Ben Avon Hts., 8/1/39, L.K.H., 2984. *Butler County:* near Saxonburg, 8/24/39, D.R.S.; near Butler, 8/21/39, D.R.S.; near Slippery Rock, 8/29/39, D.R.S. *Venango County:* along Little Scrubgrass Creek, 1 mile N. of Lisbon, 9/23/39, H. S. Wieand.

Polyporus dichrous Fr.

On dead wood of deciduous trees, rarely on conifers. Frequent. *Allegheny County:* Sandy Creek, September 1905, D.R.S.; Frick Park, Pittsburgh, 10/13/06, D.R.S.; near Ingomar, 10/2/37, D.R.S.; near Allison Park, 10/17/37, D.R.S.; near Sewickley, 10/30/38. D.R.S.; Fallen Timber Hollow, opposite Sutersville, 8/5/39, H. Roslund; 1-2 miles N.E. of Mt. Nebo, 8/3/40, L.K.H., 3449. *Armstrong County:* Kittanning, 1903, D.R.S. *Beaver County:* Baden, 1/2/22, H. W. Graham. *Butler County:* uplands, 4 miles N.E. of Harmony, 9/12/35, L.K.H., 511. *Cambria County:* Cresson,

8/24/09, D.R.S. *Centre County:* Pine Hall, 7/2/36, M.B.K. *Crawford County:* Conneaut Park, 7/17/06, D.R.S. *Fayette County:* Kilarney Park, July 1919, D.R.S. *Forest County:* 1 mile N.W. of Brookston, 7/24/40, L.K.H., 3787. *Greene County:* Holbrook, 11/11/25, Sarah Marley. *Lawrence County:* Muddy Creek Falls, 10/7/37, L.K.H., 1763. *McKean County:* Tionesta Tract, near Brookston, 7/25/40, L.K.H., 3705. *Westmoreland County:* Idlewild Park, 7/21/07, D.R.S.

Polyporus distortus (Schw.) Fr.

On stumps and trunks of deciduous trees. This collection is the normal form of a very variable species, which is rare in our region. Determination checked by L. O. Overholts. *Allegheny County:* at base of stump, Frick Park, Pittsburgh, 8/31/37, D.R.S.

Polyporus dryadeus Fr.

On trunks of living deciduous trees, usually oak. Frequent. *Allegheny County:* on base of *Quercus*, West End Park, 9/14/20, Neil McCallum; North Park, 1/9/33, J. K. Doutt. *Armstrong County:* on *Quercus*, Kittanning, August 1902, D.R.S. *Butler County:* on base of *Quercus alba* stump, Plains Church, 9/17/24, O.E.J. *Centre County:* on *Quercus alba*, State College Campus, 7/27/36, M.B.K. *Westmoreland County:* on *Quercus*, Idlewild Park, 8/10/06, D.R.S.

Polyporus dryophilus Berk. (Plate XXIX, figs. 7, 8)

On living oak trees. Infrequent. Although we have only two collections, Dr. Overholts states that it is rather common in Pennsylvania. Perhaps future collecting will bring new records. *Armstrong County:* on *Quercus* stump, Kittanning, August 1904, D.R.S. *Beaver County:* Rock Point, 7/18/07, D.R.S.

Polyporus durescens Ovlts.

On logs. Rare. This is a species described by Dr. Overholts, in Mycologia Vol. XXXIII Jan.-Feb. 1941, No. 1. These two collections are the first records for Pennsylvania. *Allegheny County:* 2 miles E. of Ambridge, 9/16/23, E. H. Graham. *Beaver County:* 1 mile N.W. of Aliquippa, 8/15/38, S. Ristich.

Polyporus elegans (Bull.) Fr.

Usually on dead wood of deciduous trees. Frequent. *Allegheny County:* Sandy Creek, 6/29/07, D.R.S.; Warden Mine region, opposite Sutersville, 7/23/39, H. Roslund. *Armstrong County:* along Big Buffalo Creek across

from West Winfield, 8/12/39, M.B.K. *Beaver County:* Rock Point, 7/18/07, D.R.S. *Centre County:* Millheim, 7/14/35, D.R.S.; Rag Hollow, 25 miles S. of State College, 7/7/36, M.B.K.; Alan Seeger region, 7/12/36, M.B.K.; Woodward, 9/6/39, D.R.S.; State Game Lands, near Port Matilda, 7/14/40, L.K.H., 3675. *Crawford County:* Conneaut Park, 7/16/06, D.R.S.; near Exposition Park, 7/15/08, D.R.S. *Elk County:* Allegheny National Forest at Junction of Millstone Creek and Clarion River, 7/14/35, H. S. Wieand. *Erie County:* Presque Isle, 8/26/05, O.E.J.; Corry, 7/1/08, D.R.S. *Fayette County:* Ohio Pyle, July 1905, D.R.S.; Kilarney Park, 7/19/19, D.R.S. *McKean County:* Tionesta Tract, near Brookston, 7/25/40, L.K.H., 3706. *Venango County:* along Allegheny River, 1 mile N. of Perry Run, 6/7/33, L.K.H., 528. *Westmoreland County:* New Florence, 7/8/07, D.R.S.; Dairy, 7/30/08, D.R.S.; near Rector, 8/21/39, M.B.K.; Lynn Run, 3 miles S.E. of Rector, 7/22/40, M.B.K.; Waterford, 9/1/40, D.R.S.

Polyporus fagicolus Murr.

On dead wood of deciduous trees. Infrequent. Our first record, marked Type, was described by Dr. D. R. Sumstine as *Polyporus pennsylvanicus* which was antedated by *Polyporus fagicolus* Murr. *Allegheny County:* Frick Park, Pittsburgh, 6/12/06, D.R.S. (Type); Sandy Creek, 6/29/06, D.R.S.; Darlington Hollow, Sharpsburg, 6/10/08, D.R.S.; Fox Chapel Woods above Cable Bridge, 5/29/36, M.B.K.; Warden Mine region, opposite Sutersville, 8/18/39, H. Roslund.

Polyporus fissilis Berk.

In wounds on living deciduous trees. Rare. Determined by L. O. Overholts. *Armstong County:* Kittanning, July 1902, D.R.S.

Polyporus frondosus (Dicks.) Fr.

On stumps or trunks of deciduous trees. Frequent. *Allegheny County:* Frick Park, Pittsburgh, September 1906, D.R.S.; along Little Deer Creek, October 1926, Helen Blair; on *Ligustrum vulgare* in yard, Wilkinsburg, 7/15/40, M.B.K. *Armstrong County:* Kittanning, September, 1901, D.R.S. *Beaver County:* on roots of *Quercus rubra*, Pattons Point, 3 miles N. of Murdochville, 10/9/21, O.E.J. *Butler County:* uplands, 4 miles N.E. of Harmony, September 1931, L.K.H., 50. *Erie County:* on dying *Quercus rubra*, Presque Isle, 10/25/31, O.E.J. *Fayette County:* Ohio Pyle, 8/31/07, O.E.J. *Indiana County:* Chambersville, 10/16/37, O.E.J. *McKean County:* Mt. Jewett, 9/17/22, O.E.J. *Somerset County:* 3 miles W. of Bakersville, 10/20/33, C. M. Hepner. *Washington County:* at base of *Quercus* stump

near Charleroi, 10/15/35, G. Kosika. *Westmoreland County:* Forbes Forest, 3 miles S.E. of Rector, 10/7/34, M.B.K.; Kiski Campus, near Saltsburg, 7/13/40, D.R.S.

Polyporus fumosus (Pers.) Fr.

On dead wood of deciduous trees. Frequent here, although it is usually considered common in Pennsylvania. *Allegheny County:* Darlington Hollow, Sharpsburg, 11/2/01, J. A. Shafer; Frick Park, Pittsburgh, 10/3/06, D.R.S.; on *Ulmus* log, near Elizabeth, January 1933, C. M. Hepner; Schenley Park, Pittsburgh, 10/6/40, D.R.S. *Armstrong County:* Kittanning, July 1903, D.R.S. *Butler County:* near Butler, 10/26/40, D.R.S.; near Zelienople, 11/2/40, D.R.S. *Erie County:* Corry, 7/1/08, D.R.S.

Polyporus galactinus Berk.

On dead wood of deciduous trees. Rare here, but supposed to be common in Pennsylvania. Future collections may add new records. *Allegheny County:* Nine-mile Run, Frick Park, Pittsburgh, 10/26/35, H. S. Wieand.

Polyporus giganteus (Pers.) Fr.

On ground around stumps of deciduous trees. Frequent. The collection from Kittanning is the co-type of *Grifolia Sumsteinei* Murr., but antedated by *Polyporus giganteus* (Pers.) Fr. *Allegheny County:* West End Park, Pittsburgh, October 1916, Neil McCallum. *Armstrong County:* Kittanning, August 1904, D.R.S. *Centre County:* Pine Hall, 8/2/38, M.B.K. *Crawford County:* Conneaut Park, 7/18/06, D.R.S. *Fayette County:* near New Geneva, 8/21/40, D.R.S. *Mercer County:* Transfer, 8/9/12, D.R.S. *Westmoreland County:* Idlewild Park, 7/7/06, D.R.S.; Seward, 7/24/08, D.R.S.

Polyporus gilvus (Schw.) Fr.

On dead wood of deciduous trees. Common. *Allegheny County:* Allegheny Park, October 1903, J. A. Shafer; Frick Park, Pittsburgh, 6/12/06, D.R.S.; Sandy Creek, 7/26/06, D.R.S.; Darlington Hollow, Sharpsburg, 8/20/07, D.R.S.; Douthett, along Brush Creek, 10/25/12, O.E.J.; Power's Run, opposite Verona, 10/12/16, O.E.J. Allison Park, 10/2/20, O.E.J.; ravine, N.W. of Saunder's Station, 10/2/21, M. L. Bomhard; 2 miles E. of Ambridge, 8/16/23, E. H. Graham; Dream City Park, 6/23/26, D.R.S.; Carnegie, 9/11/26, Dorothy Rome; North Park, 8/24/35, L.K.H., 409; Sewickley Water Works Park, 10/11/36, M.B.K.; 1 mile N.E. of Ben Avon Hts., 7/19/37, L.K.H., 1182; 2 miles N.E. of Mt.

Nebo, 10/31/37, L.K.H., 1773; South Br. Little Sewickley Creek, N.E. of Sewickley, 9/17/38, L.K.H., 2229; Glenshaw, 8/15/39, L.K.H., 3019; one half-mile S. of Smithdale, 6/27/40, L.K.H., 3346; near Sewickley, 8/2/40, D.R.S. *Armstrong County:* Kittanning, 11/7/26, Amy Neale. *Beaver County:* Rock Point, 7/18/07, D.R.S.; Saw Mill Hollow, 12/28/21, H. W. Graham; Camp Konokwee, 1 mile S. of Fombell, 4/5/36, L.K.H., 418; Temple Hollow, 1 mile N.W. of Aliquippa, 6/30/38, L.K.H., 1904. *Butler County:* uplands, 4 miles N.E. of Harmony, 3/17/29, L.K.H., 43; Little Buffalo Creek, near Monroe Station, 9/9/37, L.K.H., 1550; near Saxonburg, 10/26/40, D.R.S.; near Zelienople, 11/2/40, D.R.S.. *Cambria County:* Cresson, 8/24/09, D.R.S.; Ebensburg, August 1916, D.R.S. *Centre County:* Bald Eagle Creek, 7 miles W. of Bellefonte, November 1935, Mrs. Paul Wible. *Crawford County:* Exposition Park, 7/15/08, D.R.S.; Linesville, Pymatuning Swamp, 8/3/09, O.E.J.; Hartstown, 11/18/29, O.E.J. *Erie County:* Presque Isle, 7/26/28, C. K. Henlen. *Fayette County:* Ohio Pyle, 8/7/07, D.R.S. *Indiana County:* Homer, September 1909, D.R.S.; Chambersville, 10/16/37, D.R.S. *Lawrence County:* Muddy Creek Falls, 10/7/37, L.K.H., 1732. *McKean County:* Mt. Jewett, 7/16/22, O.E.J.; on *Fagus*, Tionesta Tract, near Brookston, 7/27/40, L.K.H., 3707. *Venango County:* Scrubgrass Creek, 1 mile N. of Lisbon, 11/3/35, M.B.K. *Washington County:* Riverview, mouth of Mingo Creek, 5/1/20, O.E.J.; vicinity of Hanlin Station, 9/13/40, L.K.H., 4195. *Warren County:* Tionesta Tract, near Brookston, 7/25/40, L.K.H., 3859. *Westmoreland County:* Latrobe, June 1906, D.R.S.; Dairy, 8/6/06, D.R.S.; Idlewild Park, 7/21/07, D.R.S.; Ligonier, 7/24/07, D.R.S.; Seward, 7/23/08, D.R.S.; Laurel Hill Mt., 3 miles S.E. of Rector, 6/25/22, O.E.J.; along Lyons Run, E. of Trafford, 9/24/22, O.E.J.; Jones's Mills, 8/17/35, D.R.S.; across river from Saltsburg, 10/10/36, L.K.H., 944; 1½ miles E. of New Alexandria, off Route 22, 7/29/37, L.K.H., 1287; near South Greensburg's Swimming Pool, 7/29/37, L.K.H., 1296; near Waterford, 9/1/40, D.R.S.; Loyalhanna Creek above the Dam, 6/12/40, L.K.H., 3108.

Polyporus glomeratus Pk. (Plate XXVII, figs. 3, 4)

On dead wood of deciduous trees. Usually considered infrequent, our collections indicate its frequency in Western Pennsylvania. *Armstrong County:* Whiskey Hollow, Kittanning, August 1905, D.R.S. *Beaver County:* Temple Hollow, 1 mile N.W. of Aliquippa, 8/15/38, S. Ristich. *Butler County:* Little Buffalo Creek, near Monroe Station, 9/9/37, L.K.H., 1592. *Cambria County:* Cresson, 8/24/09, D.R.S. *Crawford County:* near Ex-

position Park, 7/15/08, D.R.S. *Westmoreland County:* Idlewild Park, August 1923, D.R.S.; Jones's Mills, 8/17/35, D.R.S.

Polyporus graveolens (Schw.) Fr. (Plate XXVIII, figs. 3, 4)

On dead or living wood of deciduous trees. A rather infrequent species of which we have four collections. *Blair County:* Tyrone, 8/15/09, D.R.S. *Indiana County:* Canoe Ridge, 3/20/1900, L. O. Gastin. Det: D.R.S. *Westmoreland County:* 3 miles E. of Smithton, 1915, A. S. Rowe; Eastern part, July 1937, Elsie McClure.

Polyporus guttulatus Pk.

On dead wood of coniferous trees. Rare here, although considered frequent in Pennsylvania. Future collecting may add to our records. *Centre County:* near Woodward, 9/7/39, D.R.S.

Polyporus hirsutus (Wulf.) Fr.

On dead wood of deciduous trees, rarely on conifers. Common. *Allegheny County:* Darlington Hollow, Sharpsburg, 10/27/01, J. A. Shafer; Lachelle's Hollow, Moon Twp., May 1902, J. A. Shafer; Narrow's Run, Moon Twp., 2/23/03, J. A. Shafer; Coraopolis, 9/4/05, O.E.J. Frick Park, Pittsburgh, October 1905, D.R.S.; Sandy Creek, 11/3/06, D.R.S.; Douthett, Brush Creek, 10/8/11, O.E.J.; Montrose, 1915, O.E.J.; Pittsburgh, 11/10/15, F. R. Alker; Schenley Park, Pittsburgh, 11/21/15, O.E.J.; Black's Run, N. of Oakmont, 11/3/16, O.E.J.; Tom's Run, Dixmont, 11/11/16, O.E.J.; Power's Run, opposite Verona, 9/4/20, D.R.S.; Carnegie, 10/2/26, Dorothy Rome; Wildwood, 9/30/28, C. K. Henlen; Sewickley Hts., 2/21/30, C. K. Henlen; Mayview Road, 3 miles S. of Bridgeville, 5/19/37, L.K.H., 291; 1 mile N.E. of Ben Avon Hts., 4/2/38, L.K.H., 1609; Warden Mine region, opposite Sutersville, 7/13/39, H. Roslund; Glenshaw, 8/15/39, L.K.H., 3017. *Armstrong County:* Kittanning, 1901, D.R.S.; across river from Jonetta, 10/23/21, O.E.J.; near Kittanning, 7/19/25, Amy Neale; Roaring Run, near Apollo, 4/6/30, L.K.H., 35; Leechburg, 10/22/38, D.R.S. *Beaver County:* Rock Point, 7/18/07, D.R.S.; Mudlick, 10/26/22, J. A. M. Stewart; Camp Konokwee, 1 mile S. of Fombell, 4/5/36, L.K.H., 234; Raccoon Creek, 2 miles W. of Aliquippa, 7/13/37, L.K.H., 1140; Temple Hollow, 1 mile N.W. of Aliquippa, 6/30/38, L.K.H., 1891. *Bedford County:* Morrison Cove Region, 7 miles N.E. of Everett, 11/24/34, L.K.H., 203; Sulphur Springs, 8/7/40, D.R.S. *Butler County:* Nixon Station, 12/4/16, Wm. Millward; Marwood,

1926, Mima R. Milliron; uplands, 4 miles N.E. of Harmony, September 1930, L.K.H., 34; tributary of Crab Run, 4 miles N.E. of Harmony, 9/11/36, L.K.H., 747; Watson's Run, 2 miles S. of Leasuresville, 9/15/37, L.K.H., 1630; Crolls Mills, Slippery Rock Creek, 11/2/40, Mrs. Leslie Lanfear. *Cambria County:* 1½ miles E. of Patton, 10/13/40, R. Little. *Centre County:* near Woodward, 9/8/39, D.R.S.; State Game Lands, S.E. of Philipsburg, 7/11/40, L.K.H., 3630; Pine Grove, 6 miles S.W. of Boalsburg, 7/11/40, D.R.S. *Clarion County:* near Clarion, 9/3/21, W. H. Emig; 4 miles N.E. of Parker's Landing, 7/27/35, L.K.H., 362. *Crawford County:* Conneaut Park, 7/17/06, D.R.S.; Pymatuning Swamp between Linesville and Hartstown, 5/30/24, O.E.J. *Erie County:* Corry, 7/1/08, D.R.S.; Girard, December 1911, R. H. Daily; Presque Isle, 7/12/28, O.E.J.; woods at Mercyhurst College, S. of Erie, 10/8/31, M. P. Wilbert; Hummell's farm, 2½ miles E. of Wattsburg, 7/21/28, O.E.J. *Fayette County:* Ohio Pyle, 7/9/05, Grace E. Kinzer; near Normalville, 8/20/40, D.R.S.; near New Geneva, 8/21/40, D.R.S. *Forest County:* Cook Forest, 10/5/38, L.K.H., 2714; 1 mile N.W. of Brookston, 7/24/40., L.K.H., 3788. *Greene County:* Holbrook, 11/20/24, Sarah Marley. *Indiana County:* near Glen Campbell, 8/4/38, L.K.H., 2112. *Lawrence County:* Slippery Rock Creek, 10/16/10, O.E.J.; Muddy Creek Falls, 10/7/37, L.K.H., 1706. *McKean County:* Kane, 7/2/33, D.R.S.; on *Fagus*, Tionesta Tract, near Brookston, 7/28/40, L.K.H., 3708. *Mercer County:* near Swamp Root, 6/8/35, L.K.H., 341. *Somerset County:* Ursina, 6/12/05, O.E.J.; Pickings, Laurel Hill, 7/8/06, D.R.S.; 3 miles W. of Bakersville, 1933, C. M. Hepner; summit on Route 30, 8/9/40, D.R.S. *Venango County:* Allegheny River, 1 mile N. of Perry Run, 6/7/33, L.K.H., 2487. *Washington County:* vicinity of Hanlin Station, 9/13/40, L.K.H., 4201. *Warren County:* Tionesta Tract, near Brookston, 7/25/40, L.K.H., 3860. *Westmoreland County:* Latrobe, June 1902, D.R.S.; Jacob's Creek above Laurelville, 5/31/03, J. A. Shafer; Dairy, 11/10/06, D.R.S.; Idlewild Park, 8/21/07, D.R.S.; New Florence, August 1907, D.R.S.; Hillside, near Bear's Cave, 10/29/27, O.E.J.; Rock Run, Forbes Forest, 3 miles S.E. of Rector, August 1925, O.E.J.; Shades Ravine, E. of Trafford, 9/8/34, O.E.J.; Laurel Ridge, 1 mile S.E. of Kregar, 8/1/36, L.K.H., 590; Pike's Run, N.E. of Hopewell, 9/25/36, D.R.S.; 2½ miles N. of Bolivar, October 1934, H. S. Wieand; across river from Saltsburg, 10/10/36, L.K.H., 913; 1½ miles E. of New Alexandria, off Route 22, 7/29/37, L.K.H., 1275; Kiski Campus, 9/18/38, D.R.S.; Ligonier, 5/28/40, D.R.S.; 1 mile E. of Mt. Pleasant, 6/13/40, I. H. Horner; Loyalhanna Creek above the Dam, 6/12/40, L.K.H., 3107.

Polyporus lucidus (Curt.) Fr.

On dead or living wood of deciduous trees. Frequent. *Allegheny County:* Allegheny Cemetery, Pittsburgh, September 1905, D.R.S.; on *Acer*, Wilkinsburg, September 1905, D.R.S.; on *Acer*, Pittsburgh, 1911, D.R.S.; Herron Hill, Pittsburgh, 10/5/34, H. S. Wieand; in wound at base of live *Ulmus americana*, Cathedral Lawn, University of Pittsburgh, 9/26/38, L.K.H., 2286. *Armstrong County:* Kittanning, 1901, D.R.S. *Clarion County:* Cook Forest, 10/15/38, D.R.S. *Crawford County:* on *Betula lutea*, Linesville, 6/4/38, O.E.J. *McKean County:* Kane, 9/5/37, D.R.S.

Polyporus nidulans Fr.

On dead wood of deciduous trees. Frequent. *Allegheny County:* Frick Park, Pittsburgh, 7/11/06, D.R.S.; 1 mile N.E. of Ben Avon Hts., 7/19/37, L.K.H., 1221; Warden Mine region, opposite Sutersville, 7/30/39, H. Roslund. *Armstrong County:* Kittanning, August 1904, D.R.S. *Bedford County:* Sulphur Springs, 8/7/40, D.R.S. *Butler County:* tributary of Crab Run, 4 miles N.E. of Harmony, 9/11/36, L.K.H., 773; uplands, 4 miles N.E. of Harmony, 7/3/39, L.K.H., 2809. *Centre County:* Woodward, 9/6/39, D.R.S. *Cambria County:* Ebensburg, August 1916, D.R.S. *Clarion County:* near Clarion, 6/20/40, D.R.S. *Crawford County:* Dollar Lake, Hartstown, 9/10/38, L.K.H., 2209. *Fayette County:* near Normalville, 8/20/40, D.R.S. *Forest County:* Cook Forest, 8/19/32, C. K. Henlen; 1 mile N.W. of Brookston, 7/24/40, L.K.H., 3823. *Indiana County:* near Glen Campbell, 8/4/38, L.K.H., 2104. *McKean County:* Tionesta Tract, near Brookston, 7/25/40, L.K.H., 3709. *Somerset County:* Haines, Laurel Hill, 7/8/06, D.R.S. *Venango County:* Little Scrubgrass Creek, 1 mile N.E. of Lisbon, 6/26/37, L.K.H., 1086. *Warren County:* Tionesta Tract, near Brookston, 7/25/40, L.K.H., 3861. *Westmoreland County:* Latrobe, June 1905, D.R.S.; Idlewild Park, 7/16/08, D.R.S.; Lynn Run, 3 miles S.E. of Rector, 7/22/23, O.E.J.; Jones's Mills, 8/7/35, D.R.S.; Kiski Campus, near Saltsburg, 8/29/37, D.R.S.; Shades Ravine, E. of Trafford, 8/10/39, M.B.K.

Polyporus osseus (Schaeff.) Fr.

On dead wood of coniferous trees. Rare. Determined by L. O. Overholts. *Centre County:* Woodward 9/8/39. D.R.S. *Jefferson County:* Cook Forest, 8/4/32, C. K. Henlen.

Polyporus pargamenus Fr.

On dead wood of deciduous trees, occasionally on conifers. Common. *Allegheny County:* Moon Twp. near Tom's Run, 8/12/01, J. A. Shafer; near Carnot, 10/27/01, J. A. Shafer; Frick Park, Pittsburgh, 9/17/05, O.E.J.; Power's Run, opposite Verona, August 1905, O.E.J.; valley of Little Sewickley Creek, above Edgeworth, 10/21/16, O.E.J.; Carnegie, 9/11/26, Dorothy Rome; along Pine Creek, one half-mile S.E. of Wildwood, 10/14/28, C. K. Henlen; on base of *Fagus grandifolia*, Sandy Creek, May 1930, L.K.H., 93; Bellevue, October 1932, Cornelia Ecke; North Park, 8/24/35, L.K.H., 387; 1 mile N.E. of Ben Avon Hts., 7/19/37, L.K.H., 1199; 2 miles N.E. of Mt. Nebo, 10/31/37, L.K.H., 1770; Union Avenue between Bellevue and West View, 4/2/38, L.K.H., 1738; South Branch, Little Sewickley Creek, N.E. of Sewickley, 9/17/38, L.K.H., 2232; 1 mile N.E. of Leetsdale, 9/17/38, L.K.H., 2215; near Harmarville, 7/6/39, D.R.S.; Warden Mine region, opposite Sutersville, 7/17/39, H. Roslund; 1 mile W. of Mt. Nebo, 8/1/39, L.K.H., 2975; Glenshaw, 8/15/39, L.K.H., 3026; 1 mile out Audubon Road from Magee Road, 9/9/40, L.K.H., 4086; Bellevue Reservoir, 9/15/40, J. A. Schatz. *Armstrong Co.:* Kittanning, Oct. 1901, D.R.S. *Beaver Co.:* Rock Point, 7/18/07, D.R.S.; Beaver's Hollow, 11/2/22, J. A. M. Stewart; Camp Konokwee, 1 mile S. of Fombell, 4/5/36, L.K.H., 235; Temple Hollow, 1 mile N.W. of Aliquippa, 6/30/38, L.K.H., 1893, *Bedford Co.:* Morrison Cove region, 7 miles N.E. of Everett, 11/24/34, L.K.H., 199; on *Betula lenta*, Sulphur Springs, 8/7/40, D.R.S. *Blair Co.:* Yellow Springs, 7/11/40, D.R.S. *Butler Co.:* Marwood, 1926, Mima R. Milliron; uplands, 4 miles N.E. of Harmony, 3/17/29, L.K.H., 53; Camp Bucoco, Slippery Rock Creek, October 1932, L.K.H., 54; tributary of Crab Run, 4 miles N.E. of Harmony, 9/11/36, L.K.H., 741; Little Buffalo Creek, near Monroe Station, 9/26/36, L.K.H., 877; Watson's Run, 2 miles S. of Leasuresville, 9/15/37, L.K.H., 1643; near Slippery Rock, 7/3/40, D.R.S.; along Route 528, one quarter-mile S.E. of junction with Route 8, 9/16/40, L.K.H., 4232. *Cambria Co.:* Cresson, 8/24/09, D.R.S.; 1½ miles E. of Patton, 10/13/40, R. Little. *Centre Co.:* Bald Eagle Creek, 7 miles W. of Bellefonte, November 1935, Mrs. Paul Wible; Pine Hall, 7/2/36, M.B.K.; Alan Seeger Forest, 8/2/36, M.B.K. *Clarion County:* on *Prunus serotina*, 4 miles N.E. of Parker's Landing, 7/27/35, L.K.H., 359; Cook Forest, 10/7/38, L.K.H., 2632; near Clarion, 10/12/39, D.R.S.; near New Bethlehem, 9/19/40, D.R.S. *Crawford County:* Conneaut Lake Park, 7/17/06, D.R.S.; Exposition Park, 7/15/08, D.R.S.; Hartstown, Pymatuning Swamp, 11/18/29, O.E.J.; near Linesville, 6/30/35, L.K.H., 293. *Elk County:* Route

555, 2 miles E. of Medix Run, 8/15/37, L.K.H., 1526. *Erie County:* Presque Isle, 7/19/27, C. K. Henlen; near Wessleyville, 7/25/29, C. K. Henlen. *Fayette County:* Ohio Pyle, 7/20/02, J. A. Shafer. *Forest County:* on dead *Populus grandidentata*, 1 mile N.W. of Brookston, 7/24/40, L.K.H., 3789, on *Betula lutea*, Ibid, 3790. *Indiana County:* Homer City, September 1909, D.R.S.; near Glen Campbell, 8/4/38, L.K.H., 2114. *Lawrence County:* Elliot's Mills, 5 miles S.W. of Slippery Rock, 8/19/22, O.E.J.; New Wilmington near Westminster College, 4/10/30, C. K. Henlen; Muddy Creek Falls, 10/7/37, L.K.H., 1709. *McKean County:* on *Betula lutea*, Mt. Jewett, 9/16/22, O.E.J.; Kane, 9/5/37, D.R.S.; on *Betula lutea*, Tionesta Tract, near Brookston, 7/23/40, L.K.H., 3710. *Mercer County:* 1 mile S. of Swamp Root, 6/8/35, L.K.H., 312; 2 miles S.W. of Mercer, 9/11/35, L.K.H., 462. *Potter County:* Route 872, 7 miles N.E. of Austin, 8/15/37, L.K.H., 1461. *Somerset County:* Keystone, 10/9/04, O.E.J.; St. Claris, Laurel Hill, 7/8/06, D.R.S.; 10 miles E. of Indian Creek Reservoir, 10/14/34, L.K.H., 345; near Jennerstown, 9/5/40, D.R.S. *Venango County:* Allegheny River, 1 mile N. of Perry Run, 6/7/33, L.K.H., 2495; Scrubgrass Creek, 1 mile N. of Lisbon, 11/3/35, M.B.K.; Scrubgrass Creek, N.E. of Sutton's Mills, 11/8/36, M.B.K. *Warren County:* Possum Pond, S.E. edge of Tamarack Swamp, 2 miles N.W. of Pine Valley, 10/15/36, L.K.H., 960; 3 miles W. of Tidioute, 7/16/40, A. G. Shields; Tionesta Tract, near Brookston, 7/25/40, L.K.H., 3862. *Washington County:* Raccoon Creek, 2 miles N.E. of Burgettstown, 10/21/17, O.E.J. *Westmoreland County:* Jacob's Creek above Laurelville, 5/31/03, J. A. Shafer; Latrobe, 8/10/06, D.R.S.; New Florence, 9/8/07, D.R.S.; Idlewild Park, 9/21/07, D.R.S.; Shades Ravine, E. of Trafford, 7/9/08, D.R.S.; Seward, 7/23/08, D.R.S.; 1 mile W. of Laughlintown, 12/3/16, O.E.J.; near Delmont, 11/13/29, L.K.H., 91; on *Prunus pennsylvanica*, Lynn Run, 3 miles S.E. of Rector, 11/4/33, O.E.J.; Congruity, 4 miles E. of Delmont on Route 22, 9/27/34, L.K.H., 138; 1 mile S.E. of Kregar, 10/14/34, L.K.H., 176; Jones's Mills, 8/17/35, D.R.S.; 2½ miles N. of Bolivar, 9/15/35, H. S. Wieand; Wildlife Lodge, New Kensington, 9/21/35, M.B.K.; Pike Run, near Hopewell, 9/5/36, D.R.S.; across river from Saltsburg, 10/10/36, L.K.H., 908; Kiski Campus, 9/18/38, D.R.S.

Polyporus perennis (L.) Fr.

On ground in woods, especially burned-over soil. Frequent. *Centre County:* Scotia, 6/20/09, O.E.J.; Millheim, 7/14/35, D.R.S.; State Game Lands, S.E. of Philipsburg, 7/11/40, L.K.H., 3628. *Clarion County:* 2

miles N. of Clarion, 10/5/35, O.E.J.; Cook Forest, 9/18/40, D.R.S. *Elk County:* Ridgway, 8/28/25, O.E.J. *Erie County:* Presque Isle, 7/31/30, C. K. Henlen. *McKean County:* Mt. Jewett, 9/16/22, O.E.J. *Venango County:* 1 mile N. of Lisbon, 7/11/37, H. S. Wieand.

Polyporus picipes Fr.

On dead wood of deciduous trees, rarely on conifers. Common. *Allegheny County:* Coraopolis, 9/4/05, O.E.J.; Frick Park, Pittsburgh, September 1905, D.R.S.; Thorn Hill, 8/28/21, W. H. Emig; Fallen Timber Hollow, opposite Sutersville, 7/12/39, H. Roslund; vicinity of Warden Mine, opposite Sutersville, 6/27/40, L.K.H., 3300; 1 mile out Audubon Road from the Magee Road, 9/9/40, L.K.H., 4087. *Armstrong County:* Kittanning, 1901, D.R.S.; along Big Buffalo Creek, across from West Winfield, 9/9/39, M.B.K. *Beaver County:* Red Ash Hollow, near Ambridge, 12/26/22, H. W. Graham; 2 miles E. of Baden, 2/12/27, H. M. Raup; near Georgetown, 7/14/40, O.E.J. *Butler County:* Marwood, 1926, Mima R. Milliron; uplands, 4 miles N.E. of Harmony, September 1931, L.K.H., 49; near Slippery Rock, 8/24/39, D.R.S.; near Saxonburg, 9/18/39, D.R.S.; near Slippery Rock, 7/3/40, D.R.S.; along tributary of Crab Run, 4 miles N.E. of Harmony, 9/18/40, L.K.H., 4367; near Zelienople, 11/31/40, D.R.S. *Clarion County:* Cook Forest, 10/16/26, O.E.J.; near New Bethlehem, 7/18/40, D.R.S. *Crawford County:* Linesville, Pymatuning Swamp, 6/1/04, O.E.J.; Conneaut Park, 7/19/06, D.R.S.; near Exposition Park, 7/15/08, D.R.S.; Cambridge Springs, 7/9/29, B. M. Ogden. *Elk County:* South of Kane, 7/4/39, D.R.S. *Fayette County:* Kilarney Park, July 1919, D.R.S.; Ohio Pyle, 9/21/37, O.E.J. *Venango County:* Little Scrubgrass Creek, 1 mile N. of Lisbon, 8/2/37, H. S. Wieand. *Warren County:* on *Tsuga* stump, Tionesta Tract, near Brookston, 7/25/40, L.K.H., 3863. *Washington County:* vicinity of Houston, 9/21/40, L.K.H., 4421; along branch of Wheeling Creek, 3 miles S. of Burnsville, 9/22/40, L.K.H., 4437. *Westmoreland County:* Latrobe, June 1902, D.R.S.; Hillside, 5/19/06, D.R.S.; Kingston, 7/3/07, D.R.S.; Rock Run, 3 miles S.E. of Rector, 9/15/34, O.E.J.; 2½ miles N. of Bolivar, October 1934, H. S. Wieand; Shades Ravine, E. of Trafford, 10/8/36, H. S. Wieand; Loyalhanna Creek above the Dam, 9/11/40, L.K.H., 4117.

Polyporus poculus (Schw.) B. & C.

On dead wood of deciduous trees, especially oak. Rare here, although this species is considered frequent in Pennsylvania. *Butler County:* Nixon Station, 2/17/17, Wm. Millward.

Polyporus pubescens (Schum.) Fr.

On dead wood of deciduous trees. Frequent. *Armstrong County:* Kittanning, 11/7/26, Amy Neale; *Butler County:* Little Buffalo Creek, near Monroe Station, 9/26/36, L.K.H., 882. *Clarion County:* near New Bethlehem, 7/19/40, D.R.S. *Fayette County:* Ohio Pyle, 6/19/37, H. S. Wieand; near Normalville, 8/20/40, D.R.S. *Lawrence County:* Muddy Creek Falls, 4/20/38, L.K.H., 1235. *Warren County:* Possum Pond, S.E. edge of Tamarack Swamp, 2 miles N.W. of Pine Valley, 10/15/36, L.K.H., 967. *Westmoreland County:* Trafford, Shades Ravine, 10/27/34, H. S. Wieand; Bethel Church, 10/23/39, M.B.K.

Polyporus radiatus (Sow.) Fr. (Plate XXVII, figs. 1, 2)

On dead wood of deciduous trees. Frequent. Usually on birch and alder in the mountainous regions, but occasionally on same hosts in other regions as indicated by our records. *Butler County:* on *Ulmus* branches, along tributary of Crab Run, 4 miles N.E. of Harmony, 7/18/40, L.K.H., 4351. *Erie County:* Presque Isle, 7/17/28, C. K. Henlen. *Forest County:* Cook Forest, 8/5/32, C. K. Henlen. *McKean County:* Kane, 9/5/37, D.R.S. *Mercer County:* 2 miles S.W. of Mercer, 9/11/35, L.K.H., 815. *Venango County:* 3 miles N. of Emlenton, 9/14/40, M.B.K. *Westmoreland County:* Rock Run, 3 miles S.E. of Rector, 9/6/25, O.E.J.

Polyporus radicatus Schw.

On ground attached to buried roots. Infrequent. In Bulletin 298 of Pennsylvania State College, Dr. Overholts says that this species has not yet been collected in the state. Our three collections indicate that it has a wide North-South distribution and careful collecting should bring other records. *Allegheny County:* Warden Mine region, opposite Sutersville, 8/2/39, H. Roslund. *Erie County:* Corry, 7/1/08, D.R.S. *Westmoreland County:* Latrobe, July 1903, D.R.S. Checked by L. O. Overholts.

Polyporus resinosus (Schrad.) Fr.

On dead wood of deciduous trees, occasionally on conifers. Common. *Allegheny County:* Frick Park, Pittsburgh, 10/13/06, D.R.S.; Tom's Run, Dixmont, 10/14/16, O.E.J.; Black's Run, Flood Plain, N. of Oakmont, 11/2/16, O.E.J.; on living *Acer saccharum* one-eighth mile below Wildwood, 3/30/20, O.E.J.; ravine N.W. of Saunder's Station, 10/2/21, M. L. Bomhard; near Groveton, about 1 mile up from Montour Run, 10/22/27, O.E.J.; North Park, 11/6/37, O.E.J.; Fallen Timber Hollow, opposite

Sutersville, 10/9/39, H. Roslund. *Armstrong County:* Kittanning, October 1902, D.R.S.; Buffalo Creek, W. of Slate Lick, October 1920, O.E.J. *Beaver County:* Legionville Hollow, 10/17/17, O.E.J. *Butler County:* Wolf Creek, 3/20/35, Keller Shelar. *Cambria County:* Cresson, 8/24/09, D.R.S.; 1½ miles E. of Patton, 10/18/40, R. Little. *Clarion County:* Cook Forest, 9/18/40, D.R.S. *Erie County:* Corry, 7/1/08, D.R.S. *Fayette County:* Ohio Pyle, 10/18/36, O.E.J. *Indiana County:* Chambersville, 10/16/37, O.E.J. *Lawrence County:* Rock Point near Ellwood City, 2/22/16, O.E.J.; Muddy Creek Falls, 10/16/40, L.K.H., 4521. *Somerset County:* Windber, 1924, O.E.J. *Venango County:* Little Scrubgrass Creek, 1 mile N. of Lisbon, 10/6/40, H. S. Wieand. *Warren County:* Sulphur Spring, Tamarack Swamp, 2 miles N.W. of Pine Valley, 10/15/36, L.K.H., 955. *Westmoreland County:* Dairy, 11/10/06, D.R.S.; Ligonier, December 1916, D.R.S.; Rock Run, 3 miles S.E. of Rector, 12/2/29, O.E.J.; across river from Saltsburg, 10/10/36, L.K.H., 946.

Polyporus robinophilus (Murr.) Lloyd

On living trunks of deciduous trees, especially black locust. Frequent here, although usually considered infrequent in Pennsylvania. Our collections suggest that it may be common locally, especially where its host, *Robinia pseudoacacia*, is plentiful. *Allegheny County:* Sandy Creek, 7/26/06, D.R.S.; Schenley Park, Pittsburgh, August 1906, D.R.S.; Pittsburgh, October 1912, D.R.S.; Wilkinsburg, August 1916, D.R.S.; on *Robinia pseudoacacia*, Mt. Lebanon, 9/15/37, H. McCullough; on *Robinia*, 1 mile out Audubon Road from Magee Road, 9/9/40, L.K.H., 4088. *Armstrong County:* Kittanning, August 1905, D.R.S. *Westmoreland County:* New Florence, 9/8/07, D.R.S.

Polyporus Schweinitzii Fr.

Around stumps or trunks of coniferous trees. Frequent. *Allegheny County:* 1-2 miles N.E. of Mt. Nebo, 6/5/40, L.K.H., 3064. *Armstrong County:* Kittanning, 1901, D.R.S. *Cambria County:* Cresson, 1916, D.R.S. *Clarion County:* Cook Forest, 9/18/31, C. K. Henlen. *Crawford County:* Conneaut Lake, 7/18/06, D.R.S.; near Exposition Park, 7/15/08, D.R.S.; Linesville, Pymatuning Swamp, 8/8/09, O.E.J.; French Creek near Cochranton, 8/25/35, H. S. Wieand. *Erie County:* Presque Isle, 8/11/33, O.E.J.; Wintergreen Gulch, 8/5/35, O.E.J. *Forest County:* Cook Forest, 10/5/38, L.K.H., 2691. *Somerset County:* 3 miles W. of Bakersville, 1933, C. M. Hepner.

Polyporus semipileatus Pk. (Plate XXVII, fig. 7)

On dead wood of deciduous trees. Infrequent here, although considered common in Pennsylvania. Perhaps future collecting will increase our records. *Allegheny County:* Frick Park, Pittsburgh, 8/21/08, D.R.S.; along Beaver Grade Road, near Montour Run, 7/3/40, L.K.H., 3414. *Bedford County:* Sulphur Springs, 8/7/40, D.R.S. *Fayette County:* Kilarney Park, 7/31/19, D.R.S. *Lawrence County:* Muddy Creek Falls, 10/7/37, L.K.H., 1760. *McKean County:* Kane, 9/5/37, D.R.S. *Westmoreland County:* Kiski Campus, near Saltsburg, 7/12/39, D.R.S.

Polyporus semisupinus Berk. & Curt. (Plate XXVII, fig. 8)

On dead wood of deciduous trees, especially birch. Infrequent here. *Armstrong County:* on *Betula*, near Kittanning, August 1905, D.R.S. *Bedford County:* Sulphur Springs, 8/7/40, D.R.S. *Cambria County:* near Cresson, 9/15/39, D.R.S. *Cameron County:* Route 872, 10 miles N.E. of Sinnemahoning, 8/15/37, L.K.H., 1495. *Clarion County:* Cook Forest, 10/13/39, D.R.S. *Somerset County:* near Jennerstown, 9/5/40, D.R.S. *Westmoreland County:* Idlewild, 8/10/06, D.R.S.; New Florence, 7/23/08, D.R.S.; Forbes Forest, 3 miles S.E. of Rector, 7/21/40, M.B.K.

Polyporus Spraguei Berk. & Curt.

On dead wood of deciduous trees, especially oak and beech. Common. *Allegheny County:* Sandy Creek, on *Quercus* stump, 7/26/06, D.R.S.; near Verona, 8/2/06, D.R.S.; Frick Park, Pittsburgh, September 1911, D.R.S.; Flood Plain, Black's Run, N. of Oakmont, 11/3/16, O.E.J.; ravine at Service Bridge, 10/26/34, O.E.J.; near Harmarville, 7/6/39, D.R.S.; Warden Mine region, opposite Sutersville, 8/1/39, H. Roslund; near Culmerville, 9/18/39, D.R.S.; along Beaver Grade Road, near Montour Run, 7/3/40, L.K.H., 3391. *Armstrong County:* Kittanning, July 1905, D.R.S.; along Big Buffalo Creek across from West Winfield, 8/12/39, M.B.K. *Bedford County:* Sulphur Springs, 8/7/40, D.R.S. *Butler County:* on old stump of *Malus*, uplands, 4 miles N.E. of Harmony, 8/18/35, L.K.H., 383; Wolf Creek near Slippery Rock, October 1935, Keller Shelar. *Centre County:* Woodward, 8/18/38, D.R.S. *Erie County:* Presque Isle, July 1929, C. K. Henlen. *Fayette County:* Ohio Pyle, 8/7/07, D.R.S.; Kilarney Park, July 1919, D.R.S.; near New Geneva, 8/21/40, D.R.S. *Huntingdon County:* near Mill Creek, 9/4/36, L.K.H., 658. *Indiana County:* near Chambersville, 10/16/37, O.E.J. *Lawrence County:* Muddy Creek Falls, 9/3/37, M.B.K. *Mercer County:* Transfer, 8/9/12, D.R.S. *Somerset County:* summit, Route 30, 8/9/40, D.R.S.; near Jennerstown,

9/5/40, D.R.S. *Westmoreland County:* on *Castanea dentata*, Dairy, 7/8/06, D.R.S.; Idlewild Park, 8/11/06, D.R.S.; Seward, 7/23/08, D.R.S.; Lynn Run, 3 miles S.E. of Rector, 8/9/25, O.E.J.; Congruity, 4 miles E. of Delmont on Route 22, 9/27/34, L.K.H., 145; Jones's Mills, 8/17/35, D.R.S.; Shades Ravine, 2 miles E. of Trafford, 8/11/37, L.K.H., 1353; Kiski Campus, near Saltsburg, 8/17/39, D.R.S.

Polyporus spumeus (Sow.) Horne

On old logs of deciduous trees, occasionally on wounds of living trees. Rare here, although said to be common in Pennsylvania. *Greene County:* on *Acer*, Holbrook, 11/22/25, Sarah Marley.

Polyporus spumeus var. **malicolus** Lloyd

On wood of apple trees, occasionally on other deciduous trees. Rare here, although considered common in Pennsylvania. *Crawford County:* on old log in woods (unusual host), Dollar Lake, Hartstown, 9/10/38, L.K.H., 2202.

Polyporus squamosus (Huds.) Fr.

On living or dead wood of deciduous trees. Rare. *Allegheny County:* Guyasuta Hollow, Sharpsburg, 6/10/08, D.R.S. *Lawrence County:* Heinz House Camps, Slippery Rock Creek, 10 miles E. of Ellwood, 7/22/36, H. S. Wieand.

Polyporus sulphureus (Bull.) Fr.

On living or dead wood of deciduous or coniferous trees. Common. *Allegheny County:* Power's Run, 9/15/05, O.E.J.; Elfenwild, 1909, Dr. Willett; Logan's Ferry, 10/30/26, O.E.J.; Tom's Run, Dixmont, 10/31/31, O.E.J.; Jack's Run Road, Ross Twp., July 1933, L.K.H., 45; Frick Park, Pittsburgh, 9/17/34, L.K.H., 123; Brooklyn, 10/5/35, H. McCullough; Pine Creek, one-half mile S.E. of Wildwood, 9/28/38, L.K.H., 2577; Warden Mine region, opposite Sutersville, 8/9/39, H. Roslund. *Armstrong County:* Kittanning, 1901, D.R.S. *Butler County:* uplands, 4 miles N.E. of Harmony, September 1931, L.K.H., 46; Buffalo Creek, 9/28/35, H. S. Wieand; Little Buffalo Creek, near Monroe Station, 9/26/36, L.K.H., 876. *Clarion County:* Cook Forest, 10/7/38, L.K.H., 2627. *Crawford County:* Linesville, Pymatuning Swamp, 6/7/04, O.E.J. *Erie County:* Presque Isle, 5/27/16, O.E.J.; Erie, 9/8/27, Agnes Hartman; woods at Mercyhurst College, S. of Erie, 10/8/31, M. P. Wilbert; Wintergreen Gulch, 8/5/35, O.E.J. *Fayette County:* near Uniontown, 8/28/36, D.R.S.; near Normalville, 8/20/40, D.R.S. *Lawrence County:* Elliot's Mills, 5

miles S.W. of Slippery Rock, 8/19/22, O.E.J. *Venango County:* Little Scrubgrass Creek, 1 mile N. of Lisbon, 10/3/36, H. S. Wieand. *Washington County:* near Amity, 9/19/39, D.R.S. *Westmoreland County:* near Blairsville, 8/8/01, J. A. Shafer; Idlewild Park, 9/21/01, D.R.S.; Jacob's Creek, E. of Mt. Pleasant, 5/30/03, J. A. Shafer; Kingston, 9/21/07, D.R.S.; Smithton, 9/2/19, A. L. Rowe; Laurel Mt. near Rector, 7/20/23, E. H. Graham; on old railroad tie between Ligonier and Rector, 8/26/23, O.E.J.; Lynn Run, 3 miles S.E. of Rector, 9/3/27, O.E.J.; 2½ miles N. of Bolivar, October 1934, H. S. Wieand; Buttermilk Falls, near Ligonier, 9/20/35, H. S. Wieand; Loyalhanna Creek above the Dam, 9/11/40, L.K.H., 4118.

Polyporus tephroleucus Fr.

On dead wood of deciduous trees. Frequent. *Allegheny County:* Allegheny Cemetery, September 1905, D.R.S.; Guyasuta Hollow, Sharpsburg, 10/1/10, D.R.S.; Frick Park, Pittsburgh, 10/5/34, L.K.H., 109. *Armstrong County:* Kittanning, 1902, D.R.S. *Beaver County:* near Ambridge, 1922, H. W. Graham. *Butler County:* Nixon Station, Butler Short Line, 12/4/16, Wm. Millward; Little Buffalo Creek, near Monroe Station, 9/9/37, L.K.H., 1600; near Butler, 10/26/40, D.R.S.; Crolls Mills, Slippery Rock Creek, 11/2/40, Mrs. Leslie Lanfear. *Venango County:* Little Scrubgrass Creek, 1 mile N.E. of Lisbon, 9/19/36, L.K.H., 852; Little Scrubgrass Creek, N.E. of Sutton's Mills, 11/8/36, M.B.K. *Warren County:* on *Betula lutea* log, Possum Pond, S.E. edge of Tamarack Swamp, 2 miles N.W. of Pine Valley, 10/15/36, L.K.H., 961. *Westmoreland County:* Kissell's Spring, 4/30/10, D.R.S.; Loyalhanna Creek, above the Dam, 6/12/40, L.K.H., 3112.

Polyporus Tsugae (Murr.) Ovlts.

On stumps and logs of coniferous trees. Common. *Allegheny County:* Hollow near Allison Park, 1902, J. A. Shafer; Power's Run opposite Verona, 7/5/04, D.R.S.; Frick Park, Pittsburgh, 10/17/22, Mrs. Telessio Lucci; 2½ miles E. of Ambridge, 9/16/23, E. H. Graham; Pine Creek, one-half mile S.E. of Wildwood, 6/25/38, L.K.H., 1854. *Armstrong County:* Kittanning, 1902, D.R.S.; near Mosgrove, May 1903, D.R.S. *Beaver County:* Rock Point, 7/18/07, D.R.S.; near Ambridge, 1921, H. W. Graham; Temple Hollow, 1 mile N.W. of Aliquippa, 6/30/38, L.K.H., 1906. *Bedford County:* Sulphur Springs, 8/7/40, D.R.S. *Butler County:* Petersville, 9/22/24, H. W. Graham; near Zelienople, 8/18/34, D.R.S.; Little Buffalo Creek, near Monroe Station, 9/26/36, L.K.H., 875. *Cambria County:* Cresson,

8/24/09, D.R.S.; Ebensburg, August 1916, D.R.S. *Centre County:* Millheim, 7/5/35, D.R.S.; Bear Meadows, 6/13/37, M.B.K.; near State College, 7/23/37, D.R.S.; near Woodward, 7/6/39, D.R.S.; State Game Lands, near Port Matilda, 7/11/40, L.K.H., 3676. *Clarion County:* Cook Forest, 6/26/26, H. W. Graham. *Crawford County:* Linesville, Pymatuning Swamp, 6/7/04, O.E.J.; Conneaut Lake, 7/18/06, D.R.S. *Erie County:* Corry, 7/1/08, D.R.S.; near Girard, December 1911, R. H. Daily; Presque Isle, July 1928, O.E.J.; Strong's Woods, 6 miles W. of Erie, 7/26/32, O.E.J.; Hummell's Farm, 1½ miles E. of Wattsburg, 7/31/38, O.E.J. *Fayette County:* Ohio Pyle, June 1905, D.R.S. *Jefferson County:* near Brookville, 3/7/17, A. R. Hilliard. *Lawrence County:* on *Tsuga*, Muddy Creek Falls, 10/16/40, L.K.H., 4520. *McKean County:* on *Tsuga*, Tionesta Tract, near Brookston, 7/25/40, L.K.H., 3711. *Mercer County:* near Houston Junction, 7/7/02, J. A. Shafer. *Somerset County:* 3 miles W. of Bakersville, 1933, C. M. Hepner; Wagner's Woods 1 mile E. of Buckstown, 8/14/36, O.E.J. *Venango County:* S. of Polk, 6/14/16, A. R. Hilliard; Allegheny River, 1 mile N. of Perry Run, 6/7/33, L.K.H., 2501; Little Scrubgrass Creek, 1 mile N.E. of Lisbon, 9/19/36, L.K.H., 786. *Warren County:* Edge of Tamarack Swamp, N. of Sulphur Spring, 6/10/34, Mildred E. Mathias. *Washington County:* Raccoon Creek near Burgettstown, 6/29/20, M. K. Bomhard. *Westmoreland County:* New Florence, 9/7/07, O.E.J.; near Blackburn, 6/13/08, O.E.J.; on *Carya* log, Forbes Forest, 3 miles S.E. of Rector, 6/25/22, O.E.J.; Shades Ravine, 2 miles E. of Trafford, 8/14/35, H. S. Wieand.

Polyporus Tulipiferus (Schw.) Ovlts.

On dead wood of deciduous trees. Common. *Allegheny County:* on cultivated *Prunus*, Narrows Run, Moon Twp., 2/23/03, J. A. Shafer; on *Prunus serotina*, near Carnot, Moon Twp., 1/22/07, J. A. Shafer; 4 miles E. of Monongahela City, November 1932, C. M. Hepner; Bayard St., Pittsburgh, 9/21/35, D.R.S.; Water Works Park, Sewickley, 10/11/36, M.B.K.; 1 mile N.E. of Ben Avon Hts., 7/19/37, L.K.H., 1180; near Allison Park, September 1937, D.R.S.; Warden Mine region, opposite Sutersville, 7/23/39, H. Roslund; on *Acer*, 1-2 miles N.E. of Mt. Nebo, 5/6/40, L.K.H., 3074; and on *Betula lenta*, Ibid, 3077; on *Ailanthus*, Keown Station, 9/8/40, D.R.S.; 1 mile out Audubon Road from Magee Road, 9/9/40, L.K.H., 4089. *Armstrong County:* on *Liriodendron tulipifera*, Kittanning, 1905, D.R.S.; valley of Buffalo Creek, west of Slate Lick, 10/17/20, O.E.J. *Beaver County:* Legionville Hollow, 1/2/22, H. W. Graham; Mudlick,

10/26/22, J. A. M. Stewart. *Bedford County:* Sulphur Springs, 8/7/40, D.R.S. *Butler County:* Nixon Station, 2/3/17, Wm. Millward; uplands, 4 miles N.E. of Harmony, 11/10/29, L.K.H., 52; tributary of Crab Run, 4 miles N.E. of Harmony, 9/11/36, L.K.H., 759; Little Buffalo Creek, near Monroe Station, 10/25/36, L.K.H., 988; Watson's Run, 2 miles S. of Leasuresville, 9/15/37, L.K.H., 1641; near Saxonburg, 8/24/39, D.R.S.; along Route 528, one-quarter mile S.E. of junction with Route 8, 9/16/40, L.K.H., 4233; near Zelienople, 11/2/40, D.R.S.; Crolls Mills, Slippery Rock Creek, 11/2/40, Mrs. Leslie Lanfear. *Cambria County:* near Cresson, 9/5/39, D.R.S. *Cameron County:* on *Betula papyrifera*, one-half mile N. of Driftwood, 8/29/25, O.E.J. *Centre County:* State Game Lands, S.E. of Philipsburg, 7/11/40, L.K.H., 3627. *Clarion County:* on *Sorbus americana*, Cook Forest, 10/16/16, O.E.J.; on *Prunus serotina*, 4 miles N.E. of Parker's Landing, 7/27/35, L.K.H., 363; on *Salix*, Ibid, 350; on *Quercus*, Ibid, 364; near Clarion, 10/14/38, D.R.S. *Crawford County:* Conneaut Park, 7/17/06, D.R.S. on *Alnus*, Hartstown, Pymatuning Swamp, 7/19/06, D.R.S. *Erie County:* Presque Isle, 5/27/16, O.E.J. *Fayette County:* Indian Creek Reservoir region, 4/13/35, L.K.H., 335; Ohio Pyle, 6/18/40, L.K.H., 3147. *Forest County:* Cook Forest, 11/17/34, C. K. Henlen; 1 mile N.W. of Brookston, 7/24/40, L.K.H., 3791. *Lawrence County:* New Wilmington, Westminster College Campus, 9/25/32, C. K. Henlen. *McKean County:* Tionesta Tract, near Brookston, 7/25/40, L.K.H., 3712. *Mercer County:* 2 miles S.W. of Mercer, 9/11/35, L.K.H., 465. *Venango County:* Little Scrubgrass Creek, N.E. of Sutton's Mills, 11/8/36, M.B.K. *Washington County:* vicinity of Hanlin Station, 9/13/40, L.K.H., 4190. *Westmoreland County:* Seward, 7/23/08, D.R.S.; on branch of *Prunus serotina*, near Delmont, 11/3/29, L.K.H., 90; Laurel Ridge, 1 mile E. of Kregar, 10/14/34, L.K.H., 190; on dead *Prunus serotina*, Rock Run, 3 miles S.E. of Rector, 7/6/35, L.K.H., 320; across river from Saltsburg, 10/10/36, L.K.H., 931; Shades Ravine, 2 miles E. of Trafford, 8/11/37, L.K.H., 1138; Kiski Campus, 11/7/37, D.R.S.; near Waterford, 10/17/39, D.R.S.; Loyalhanna Creek above the Dam, 6/12/40, L.K.H. 3101.

Polyporus versicolor (L.) Fr.

On dead wood of deciduous and coniferous trees. Common. *Allegheny County:* Darlington Hollow, Sharpsburg, 10/27/01, J. D. Shafer; Riverview Park, Pittsburgh, 9/18/05, O.E.J.; Frick Park, Pittsburgh, 9/22/06, D.R.S.; Sandy Creek, 11/3/06, D.R.S.; Power's Run opposite Verona, 5/27/15, O.E.J.; Coraopolis, 10/23/15, O.E.J.; Wildwood, on rail-

road ties, 10/2/16, O.E.J.; Lowlands at Logan's Ferry, 11/8/17, O.E.J.; near Aspinwall, September 1919, D.R.S.; Carnegie, 9/11/26, Dorothy Rome; Black's Run, N. of Oakmont, 10/30/26, O.E.J.; on base of old *Ligustrum* stump, Pittsburgh, 3/2/35, O.E.J.; 1 mile N.E. of Ben Avon Hts., 7/19/37, L.K.H., 1187; South Br. of Little Sewickley Creek, N.E. of Sewickley, 9/17/38, L.K.H., 2231; Glenshaw, 8/15/39, L.K.H., 3016; Schenley Park, Pittsburgh, 6/7/39, D.R.S.; 1 mile W. of Mt. Nebo, 8/1/39, L.K.H., 2976; 1½ miles S. of Smithdale, 6/27/40, L.K.H., 3344; vicinity of Warden Mine, 6/27/40, L.K.H., 3282; 1 mile out Audubon Road from Magee Road, 9/9/40, L.K.H., 4090; Bellevue Reservoir, 9/15/40, J. A. Schatz. *Armstrong County:* Kittanning, 1901, D.R.S.; Whiskey Hollow near Kittanning, August 1903, D.R.S.; Roaring Run, near Apollo, 4/6/30, L.K.H., 39. *Beaver County:* Rock Point, 7/18/07, D.R.S.; Mudlick, 10/24/22, J. A. M. Stewart; Raccoon Creek, 2 miles W. of Aliquippa, 7/13/37, L.K.H., 1156; Temple Hollow, 1 mile N.W. of Aliquippa, 6/30/38, L.K.H., 1887; woods 1½ miles E. of Raccoon Creek Bridge on Route 30, 8/7/39, A. Miclaucic; Raccoon Creek Park, 5/4/40, O.E.J. *Bedford County:* Hyndman, Will's Mt., 10/9/04, O.E.J.; Morrison Cove Region, 7 miles N.E. of Everett, 11/24/34, L.K.H., 202; Felton's Mill, along Raystown Branch of Juniata River, 11/25/34, L.K.H., 211. *Blair County:* Yellow Springs, 7/11/40, D.R.S. *Butler County:* Marwood, 1926, Mima R. Milliron; Winfield Junction, 1926, Millie Turner; uplands, 4 miles N.E. of Harmony, September 1931, L.K.H., 37; near Zelienople, 8/18/34, D.R.S.; tributary of Crab Run, 4 miles N.E. of Harmony, 9/11/36, L.K.H., 742; Little Buffalo Creek, near Monroe Station, 9/26/36, L.K.H., 883; Watson's Run, 2 miles S. of Leasuresville, 9/15/37, L.K.H., 1637; near Saxonburg, 7/11/40, D.R.S.; near Zelienople, 11/2/40, D.R.S.; along Route 528 one-quarter mile S.E. of junction with Route 8, 9/16/40, L.K.H., 4237; 1 mile S.E. of Whitestown, 9/17/40, L.K.H., 4289. *Cambria County:* Cresson, 8/24/09, D.R.S.; 1½ miles E. of Patton, 10/13/40, R. Little. *Centre County:* Alan Seeger region, 8/2/36, M.B.K.; near Woodward, 9/6/39, D.R.S.; State Game Lands, S.E. of Phillipsburg, 7/11/40, L.K.H., 3629. *Clarion County:* Cooksburg, 7/28/26, C. K. Henlen; Tom's Run Valley, Cook Forest, 10/16/26, O.E.J. *Crawford County:* Pymatuning Swamp, 6/12/05, O.E.J.; Conneaut Park, 7/16/06, D.R.S.; near Exposition Park, 7/15/08, D.R.S.; Linesville, Pymatuning Swamp, 6/30/35, L.K.H., 344; Hartstown, Mud Lake, 8/26/36, L.K.H., 610. *Erie County:* on dead *Quercus rubra*, Presque Isle, 8/26/05, O.E.J.; Corry, 7/1/08, D.R.S.; Girard, December 1911, R. H. Daily; near Wattsburg, 7/31/28, C. K. Henlen;

near Wessleyville, 7/24/30, C. K. Henlen; woods near Mercyhurst College S. of Erie, 10/8/31, M. P. Wilbert. *Fayette County:* Ohio Pyle, 1904, D.R.S.; Indian Creek Reservoir region, 4/13/35, L.K.H., 337; near Normalville, 8/20/40, D.R.S.; near New Geneva, 8/21/40, D.R.S.; Laurel Run Valley, S.E. of Haydentown, 8/24/40, O.E.J. *Forest County:* Cook Forest, 9/11/31, C. K. Henlen; 1 mile N.W. of Brookston, 7/24/40, L.K.H., 3792. *Greene County:* Holbrook, 11/22/25, Sarah Marley. *Indiana County:* Homer City, September 1909, D.R.S.; near Armagh, 6/27/39, D.R.S. *Lawrence County:* Slippery Rock Creek above Wurtemburg, 10/16/10, O.E.J.; Kennedy's Mills, Slippery Rock Creek, 1/30/26, E. H. Graham; near New Wilmington, 4/18/30, C. K. Henlen; Muddy Creek Falls, 10/7/37, L.K.H., 1703. *McKean County:* Kane, 9/5/37, D.R.S.; Tionesta Tract, near Brookston, 7/25/40, L.K.H., 3713. *Mercer County:* 1 mile S. of Swamp Root, 6/8/35, L.K.H., 326; 2 miles S.W. of Mercer, 9/11/35, L.K.H., 461. *Potter County:* Route 872, 7 miles N.E. of Austin, 8/15/37, L.K.H., 1457. *Somerset County:* Laurel Hill, Haines, 7/8/06, D.R.S. *Venango County:* Little Scrubgrass Creek, 1 mile N.E. of Lisbon, 9/19/36, L.K.H., 804; Little Scrubgrass Creek, N.E. of Sutton's Mills, 11/8/36, M.B.K. *Warren County:* Tionesta Tract, near Brookston, 7/25/40, L.K.H., 3864. *Washington County:* vicinity of Hanlin Station, 9/13/40, L.K.H., 4193; along branch of Wheeling Creek, 3 miles S. of Burnsville, 9/22/40, L.K.H., 4438; along Buffalo Creek near junction with Buck Run, 9/26/40, L.K.H., 4443. *Westmoreland County:* Jacobs Creek, near Laurelville, 5/31/03, J. A. Shafer; Latrobe, June 1905, D.R.S.; Idlewild Park, 8/10/06, D.R.S.; Dairy, 11/10/06, D.R.S.; near Youngstown, 7/3/07, D.R.S.; near Millbank, Chestnut Ridge, 12/3/16, O.E.J.; 1 mile W. of Laughlintown, 12/3/16, O.E.J.; on *Betula lutea*, Forbes Forest 3 miles S.E. of Rector, 7/29/25; and on *Prunus pennsylvanica*, Ibid, 9/7/31, O.E.J.; Hillside, Bears Cave, 10/29/27, O.E.J.; near Delmont, 11/3/29, L.K.H., 38; Congruity, 4 miles E. of Delmont on Route 22, 9/27/34, L.K.H., 140; Laurel Ridge, 1 mile S.E. of Kregar, 10/14/34, L.K.H., 177; Wild Life Lodge, New Kensington, 9/21/25, M.B.K.; 2½ miles N. of Bolivar, 9/27/36, H. S. Wieand; across river from Saltsburg, 10/10/36, L.K.H., 911; Shades Ravine, 2 miles E. of Trafford, 8/11/37, L.K.H., 1336; 1 mile E. of Mt. Pleasant, 6/13/40, I. H. Horner; near Waterford, 9/1/40, D.R.S.; Loyalhanna Creek above the Dam, 6/12/40, L.K.H., 3129.

Solenia anomala (Pers.) Fckl.

On rotted wood. Infrequent. *Allegheny County:* Guyasuta Hollow, Sharpsburg, 6/10/08, D.R.S. *Washington County:* near Amity, 9/19/39, D.R.S. *Westmoreland County:* Kingston, 8/2/10, D.R.S.

Solenia endophila (Ces.) Fr.

On rotted wood. Rare. *Westmoreland County:* mountain above Laughlintown, 5/9/36, D.R.S.

Solenia fasciculata Pers.

On rotted wood. Common. *Allegheny County:* Frick Park, Pittsburgh, 1/1/07, D.R.S.; Sardis, 11/6/38, D.R.S. *Armstrong County:* Kittanning, 1905, D.R.S. *Cambria County:* Cresson, August 1916, D.R.S.; Ebensburg, August 1916, D.R.S. *Westmoreland County:* Idlewild Park, 8/5/10, D.R.S.; Latrobe, January 1915, D.R.S.; near Saltsburg, 9/27/37, D.R.S.; Pikes Run, 9/6/36, D.R.S.

Trametes americana Ovlts.

On dead wood of coniferous trees, and on structural timbers. Rare. *Allegheny County:* on *Pinus* log, Sandy Creek, September 1905, D.R.S., Det: L. O. Overholts.

Trametes hispida Bagl.

On dead wood of willow and occasionally aspen. Rare. *Erie County:* Weiss Library woods, 8 miles S.W. of Erie, 8/18/31, O.E.J., Det: L. O. Overholts.

Trametes malicola Berk. & Curt.

On dead wood of deciduous trees, especially maple and hickory. Frequent. *Allegheny County:* Allegheny Cemetery, 8/3/06, D.R.S.; Frick Park, Pittsburgh, 10/13/06, D.R.S.; Guyasuta Hollow, Sharpsburg, 8/20/07, D.R.S., Det: L. O. Overholts. *Armstrong County:* Kittanning, September 1904, D.R.S. *Beaver County:* near Ambridge, 1929, H. W. Graham. *Cambria County:* Ebensburg, August 1916, D.R.S. *Fayette County:* Ohio Pyle, 8/12/08, D.R.S. *Mercer County:* Transfer, 8/9/12, D.R.S.

Trametes mollis (Sommerf.) Fr.

On wood of deciduous trees. Rare. *Erie County:* Presque Isle, July 1928, O.E.J.

Trametes sepium Berk.

On dead wood of deciduous trees, rarely of coniferous trees. Frequent. *Allegheny County:* Frick Park, Pittsburgh, 8/16/06, D.R.S.; Sandy Creek, 11/3/06, D.R.S., Det: L. O. Overholts. *Armstrong County:* resupinate form, Kittanning, 1905, D.R.S. *Washington County:* vicinity of Hanlin Station, 9/13/40, L.K.H., 4194. *Westmoreland County:* 1 mile S.E. of Kregar, 10/14/34, L.K.H., 242, Det: L. O. Overholts.

Trametes serialis Fr.

On wood of coniferous or rarely of deciduous trees. Rare. *Armstrong County:* Kittanning, 1903, D.R.S., Det: L. O. Overholts.

CONCLUSION

Out of a total of thirty-two counties in western Pennsylvania, the majority of our polypores have been collected in fifteen counties. Several collections, some rather large, have been obtained from a few localities in Bedford, Cambria, Clearfield, Forest, Indiana, McKean, Mercer, Somerset, Warren, and Washington Counties, but otherwise these regions have been unexplored. From Blair, Cameron, Elk, Greene, Jefferson, and Potter Counties few specimens are recorded. We have made one collection each in Clinton and Huntingdon Counties, but none from Fulton County.

According to our collection data, twenty-eight out of the ninety-six species listed are rare here, twenty-four of which are represented by one collection only, and two of which, *Polyporus durescens* and *Polyporus radicatus*, are recorded for the first time from Pennsylvania.

In order to obtain a more complete record of the distribution of the Polyporaceæ in western Pennsylvania, we need to do more collecting in the above mentioned counties.

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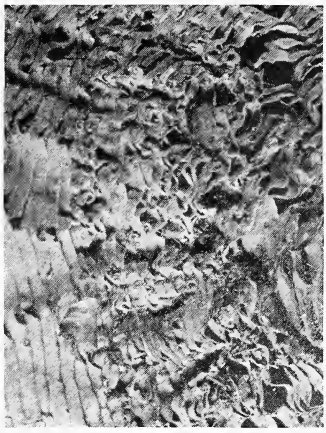
EXPLANATION OF PLATE XXVI

FIG. 1. *Cyclomyces greenei* Berk. Surface of pileus. × 0.75
FIG. 2. *Cyclomyces greenei* Berk. Lamellated hymenium. × 2.
FIG. 3. *Polyporus circinatus* Fr. Surface of pileus. × 1.25.
FIG. 4. *Polyporus circinatus* Fr. Pores. × 2.
FIG. 5. *Polyporus biformis* (Kl.) Berk. Surface of pileus. × 0.81.
FIG. 6. *Polyporus biformis* (Kl.) Berk. Pores. × 2.

1



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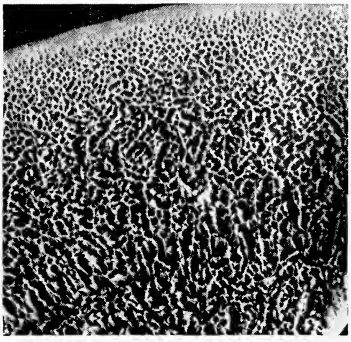

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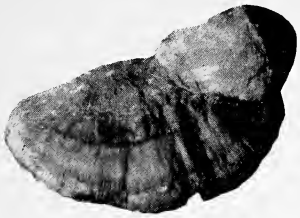
EXPLANATION OF PLATE XXVII

FIG. 1. *Polyporus radicatus* Schw. Surface of pilei. × 1.07.
FIG. 2. *Polyporus radicatus* Schw. Pores. × 1.5.
FIG. 3. *Polyporus glomeratus* Pk. Surface of pilei. × 1.37.
FIG. 4. *Polyporus glomeratus* Pk. Pores. × 2.
FIG. 5. *Merulius rubellus* Pk. Surface of pilei. × 1.07.
FIG. 6. *Merulius rubellus* Pk. Porose hymenium. × 2.
FIG. 7. *Polyporus semipileatus* Pk. Sub-resupinate pilei showing pores. × 0.07.
FIG. 8. *Polyporus semisupinus* B. & C. Surface of pilei. × 1.29.



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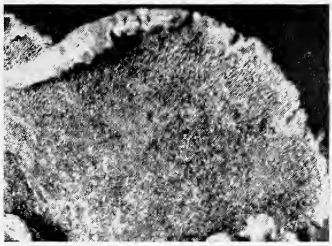

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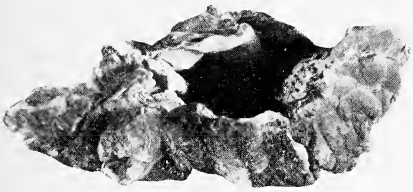

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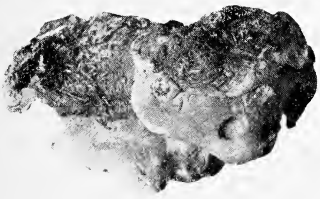

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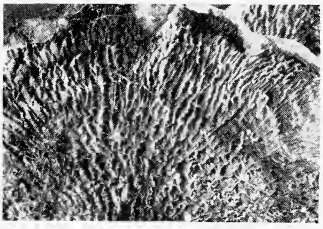

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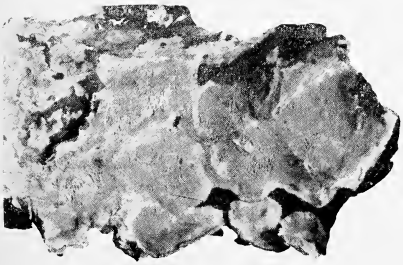

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EXPLANATION OF PLATE XXVIII

FIG. 1. *Polyporus cuticularis* (Bull.) Fr. Surface of pileus. × 0.6.
FIG. 2. *Polyporus cuticularis* (Bull). Fr. Pores. × 2.
FIG. 3. *Polyporus graveolens* (Schw.) Fr. Surface of pilei. × 0.5.
FIG. 4. *Polyporus graveolens* (Schw.) Fr. Pores. × 2.
FIG. 5. *Polyporus Berkeleyi* Fr. Surface of pilei. × 0.34.
FIG. 6. *Polyporus Berkeleyi* Fr. Pores. × 1.

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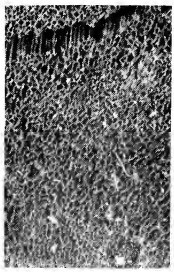

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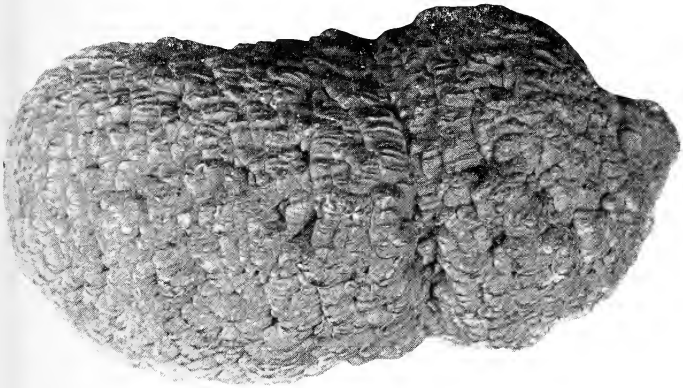

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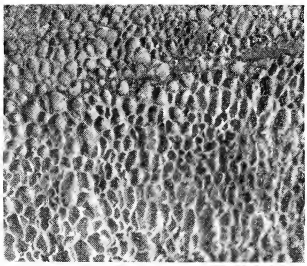

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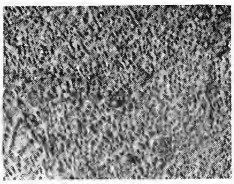
EXPLANATION OF PLATE XXIX

FIG. 1. *Fomes pini* (Thore) Lloyd. Surface of pileus. × 0.52.
FIG. 2. *Fomes pini* (Thore) Lloyd. Pores. × 2.
FIG. 3. *Fomes connatus* (Weinm.) Gill. Surface of pilei. × 0.5.
FIG. 4. *Fomes connatus* (Weinm.) Gill. Pores. × 2.
FIG. 5. *Polyporus cristatus* (Pers.) Fr. Surface of pileus. × 0.41.
FIG. 6. *Polyporus cristatus* (Pers.) Fr. Pores. × 2.
FIG. 7. *Polyporus dryophilus* Berk. Surface of pilei. × 0.6.
FIG. 8. *Polyporus dryophilus* Berk. Pores. × 2.

1



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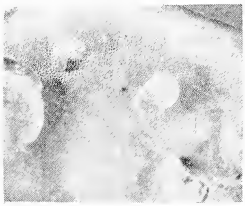

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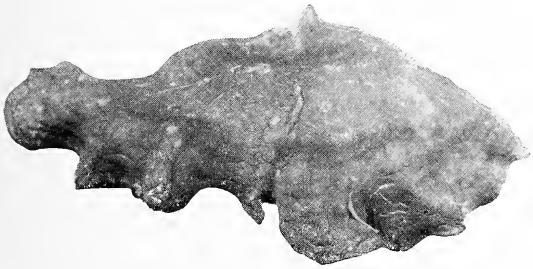

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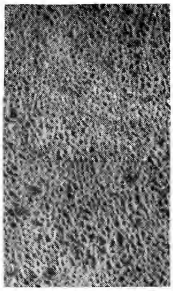

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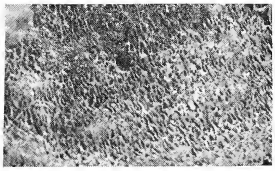

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ART. XIV. THE PALEOGEOGRAPHY OF THE EASTERN PART OF THE UINTA BASIN DURING UINTA B (EOCENE) TIME

BY WILBUR LOWELL STAGNER

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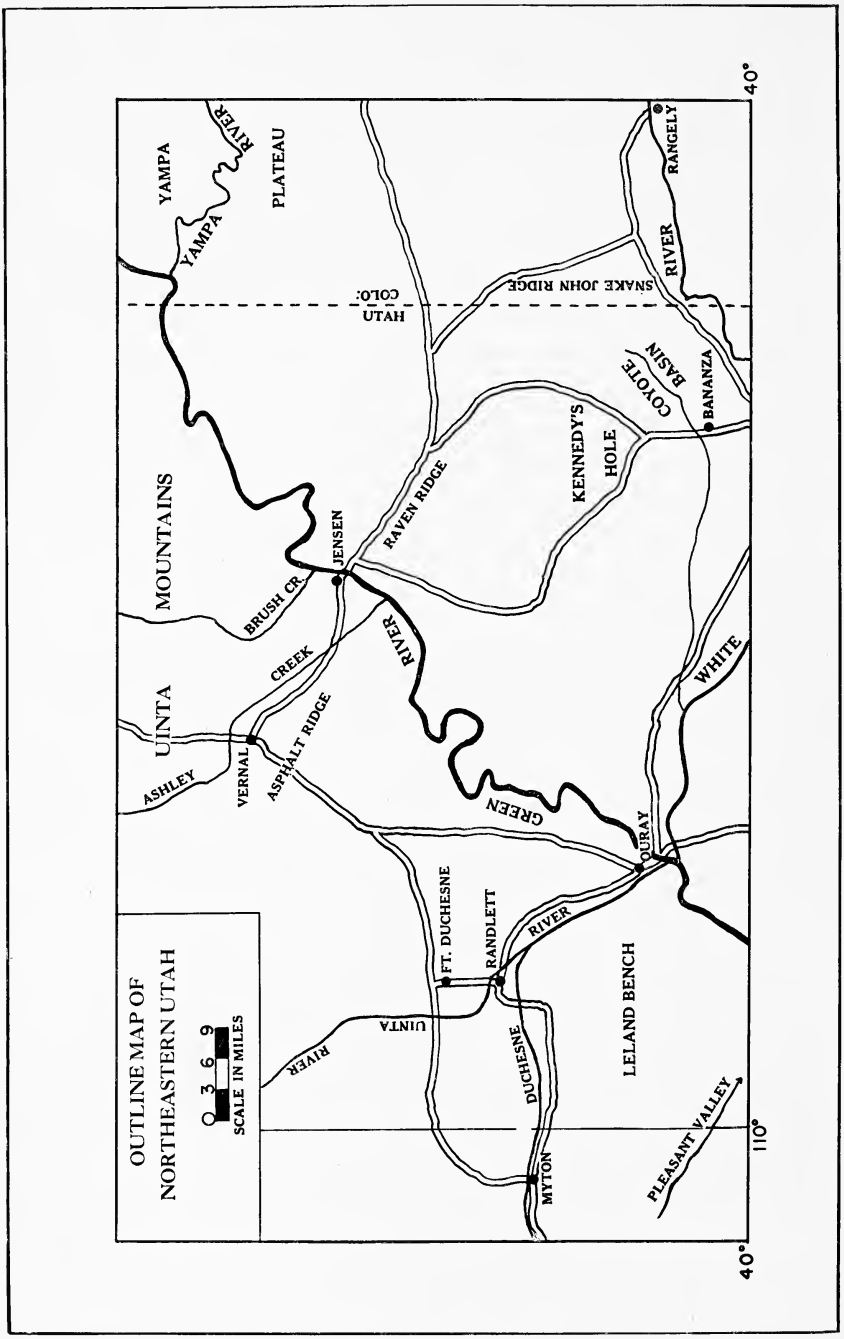

(To face page 273)

ART. XIV. THE PALEOGEOGRAPHY OF THE EASTERN PART OF THE UINTA BASIN DURING UINTA B (EOCENE) TIME

By Wilbur Lowell Stagner
Wentworth Military Academy
Lexington, Missouri

(Plates XXX-XXXV)

Purpose and Scope of this Report

The Eocene deposits of northeastern Utah and northwestern Colorado have been the object of much attention by stratigraphers and paleontologists since the early geologic expeditions of Hayden, King, Powell, Hatcher, Emmons, and White. This interest has been perpetuated in more recent years by the discovery of oil-shale deposits in the Green River formation, by the rich accumulation of vertebrate fossils in the Eocene beds, and by the presence of mammalian and reptilian remains found in the Bridger and Uinta formations. Many writers have had opportunity to observe the characteristics of, and collect fossils from the Uinta formation, but none has made a detailed study of the lithology.

The purpose of this report is threefold: first, to present a brief summary of some geologic studies pertaining to the upper Eocene formations in the Uinta Basin; second, to describe the lithology and areal distribution of the Uinta B formation exposed to the east of Green River in Uinta Basin, Utah; and, finally, to suggest certain new theories pertaining to the paleogeography of northeastern Utah during Uinta B time.

Location and Extent of the Area

The Uinta Basin is located in northeastern Utah, immediately south of the east-west trending Uinta Mountains (see map, plate XXX). This asymmetric basin is nearly 200 miles in length from east to west, and about 80 miles wide. A saucer shaped basin, it is limited on the west by the Wasatch Range, on the east by the gently rising Yampa Plateau,

Issued March 31, 1941.

on the south by the precipitous Roan or Book Cliffs, and on the north by the anticlinal Uinta Mountains.

The area included in this paper lies in Uinta County, Utah, immediately north of White River, and extends from the Colorado state line west to Green River. Detailed study of the Uinta B member was made over an area of about 135 square miles, bounded on the east by Snake John Ridge and on the west by Green River. General reconnaissance studies were made in the surrounding area from Snake John Ridge on the east to Myton on the west, and from the area immediately south of White River to the crest of the Uinta Mountains on the north.

FIELD WORK

The data for this paper were obtained during the summer of 1938 when the writer was an assistant to Dr. John Clark, then of the University of Colorado. An expedition was made into the Uinta Basin for the purpose of collecting fossils and interpreting the geology of the post-Green River formations. The writer was assigned the problem of studying the geology and paleogeography of the Uinta B member, and his findings constitute the material of this paper.

The position of the river-channel zone and flood-plain deposits in Coyote Basin and Kennedy's Hole was carefully mapped by means of the Brunton compass, triangulation-pace traverse method. The triangulation was tied into the Federal land survey. Because of the rough topography which characterizes the area, the limited time available for mapping, and the large area to be covered, it was found inadvisable to use the alidade and plane-table except for measuring detailed sections.

Plate XXXV, the map showing the area included in this paper, is a compilation from three sets of maps. The western third of the map is taken from the United States Geologic Survey topographic map, 1917, and the eastern two-thirds is taken from the King and Powell survey maps. Superimposed upon this map are cultural and geological phenomena obtained from the map of J. LeRoy Kay.[1]

Rock samples were taken from several horizons within the Uinta B member, from every formation above the Green River formation, and from each formation in the Uinta Mountains. Key samples from this collection were later microscopically analyzed in the laboratory.

[1] Kay, J. L., The Tertiary Formations of the Uinta Basin: Annals of the Carnegie Museum, vol. 23, 1934.

ACKNOWLEDGMENTS

This study was made possible through the financial support of the University of Colorado Museum and of Mr. Childs Frick, New York paleontologist.

The writer wishes to express his gratitude to the following men who have contributed to the completion of this paper: to Dr. John Clark and J. LeRoy Kay of the Carnegie Museum for their numerous suggestions and criticisms in the field and in the writing of the paper; to Dr. P. G. Worcester and Dr. L. O. Quam of the University of Colorado for checking the field work, and critically reading the paper; and to Dr. Lincoln Page of the University of Colorado, for his aid in the microscopic identification of certain mineral grains.

EARLY TERTIARY GEOLOGIC HISTORY OF NORTHEASTERN UTAH

The Mesozoic geologic history of northeastern Utah was terminated by orogenic movements that formed the Uinta Mountains. Field evidence verifies that the first post-Paleozoic orogenic movement in the Uinta Mountain area occurred near the close of the Cretaceous period. Sears and Bradley[2] have presented several lines of evidence in support of their belief that most of the sediments which formed the Eocene Wasatch formation in northeastern Utah, northwestern Colorado, and southwestern Wyoming came from the Uinta Mountains. Forrester[3] has reported that the Wasatch formation rests unconformably upon the youngest Mesozoic deposits. It has been stated by Bradley[4] that in places the Wasatch rests upon Cretaceous rocks with distinct unconformity, while in other places there is a transitional change in deposition between the two groups of rocks of different ages. Bradley presented several logical explanations of the unconformity between the Mesozoic and Cenozoic formations along the southern flank of the range. Field evidence in this area shows that the Wasatch and Green River formations do not outcrop along the northern

[2] Sears, J. D. and Bradley, W. H., Relation of the Wasatch and Green River Formations in Northwestern Colorado and Southwestern Wyoming, with Notes on Oil Shale in the Green River Formation: U. S. Geol. Survey, Prof. Paper 132, p. 96, 1923.

[3] Forrester, J. D., Structure of the Uinta Mountains: Bull. Geol. Soc. Amer., vol. 48, pp. 654-655, 1937.

[4] Bradley, W. H., Origin and Microfossils of the Oil Shale of the Green River Formation of Colorado and Utah: U. S. Geol. Survey, Prof. Paper 168, p. 22, 1932.

edge of the Uinta Basin west of Asphalt Ridge. In this area, the Oligocene Duchesne River formation overlaps, not only all the younger Tertiary deposits, but in places it overlaps the Mesozoic and upper Paleozoic formations as well. In Asphalt Ridge southwest of Vernal, there is apparent uniform dip between the upper Cretaceous and the Duchesne River formations. It is logical that these two formations appear conformable a few miles south of the mountain front, yet are definitely unconformable along the flanks of the Uinta Mountains. The unconformity along the edge of the range would result from the overlapping of the Tertiary formations upon the steeply-dipping Cretaceous sediments. A few miles south of the Uinta Mountains at Asphalt Ridge, where the dip of the Cretaceous sediments is greatly reduced, the two groups of sediments would naturally lie more nearly conformably. The unconformity between the Mesozoic and Cenozoic formations, and the knowledge that the Wasatch sediments were derived from the Uinta Mountains substantiates the theory that the uplift of the Uinta Range began after the deposition of the latest Cretaceous sediments and prior to the deposition of the Wasatch.

Erosion occurred contemporaneously with the growth of the Uinta Mountains. Sediment derived from this highland was deposited along the flanks of the range to form the Wasatch formation. Wasatch deposition was terminated by the gradual spreading of a broad, shallow lake over this continental deposit. Thick deposits which accumulated in this shallow lake form the marlstone, shale, and oil shale of the Green River formation. This lake condition continued until Upper Middle Eocene.

By the close of Middle Eocene the Uinta Mountains had been eroded to hills of minor relief. Probably, most of the Mesozoic sediments had been removed from the crest of the anticlinal mountain range, and in places streams had cut into the Paleozoic formations.

Green River Lake was drained or filled by Upper Eocene time, and upon the horizontally-bedded Green River shales was deposited the Uinta formation. Unlike the underlying lacustrine deposits, the Uinta formation was predominantly of fluviatile origin. The Duchesne River formation of basal Oligocene age was the next and last deposit to be laid down during Tertiary time in the Uinta Basin.

In most structural mountain ranges there are usually two or more periods of orogenic movements: the first is frequently expressed by folding of the sediments, and the latter by broad, vertical uplifts of the positive area. The Cretaceous and older sediments in northeastern Utah and northwestern Colorado were folded during the Laramide Revolution to form the

Uinta Mountains. However, the size of the original structures was probably smaller than that of the present ones. Later movements occurred during late Eocene and early Oligocene time. The evidence used for dating these uplifts will be discussed in a later portion of the paper.

Summary of Principal Earlier Studies

The members of the earliest geologic expeditions in northeastern Utah concentrated their attention essentially upon the structure and stratigraphy of the Uinta Mountains. Occasionally, minor parties were authorized to investigate the Tertiary formations that lie to the south. Because of its inaccessibility, the Uinta Basin was not explored until after concentrated attention was devoted to the Eocene basins north of the mountain range. Of the earlier works done in this area, only those which have an important bearing upon the present problem are mentioned.

In 1878 King[5] assigned the term "Uinta Group" to include all the Tertiary deposits south of the Uinta Mountains. On the basis of vertebrate remains found in the White River area, it was noted by King that these beds belonged to a period younger than the true Bridger series. These sediments were supposedly of lacustrine origin deposited in a post-Bridger lake, which was the last of a long, almost continuous series of Eocene lakes. King (*op. cit.*, vol. 2, pp. 313-315, 1878) also stated that the Tertiary rocks extended as far west as the Wasatch Range, and that there was a progressive increase of gravel and conglomerate in the upper part of the group extending from east to west. The source of sediments that formed the Wasatch and Green River formations was the Uinta Mountains, which were uplifted at the close of the Cretaceous period. The source of the upper Eocene sediments was not stated, but it appears from the description in his report that King believed they, too, were derived from the nearby highlands to the north.

Although Powell's[6] Tertiary geologic study was confined primarily to the Wyoming basins, he did note the presence of vast Tertiary deposits on the south slope of the Uinta Mountains. He made no attempt to describe or to correlate them with other known Tertiary deposits. In addition, he made it known that immediately following the uplift of the Uinta Mountains, sedimentation took place in the surrounding area and that the ma-

[5] King, Clarence, United States Geological Exploration of Fortieth Parallel: vol. 1, p. 407, 1878.

[6] Powell, J. W., Geology of the Eastern Portion of the Uinta Mountains, pp. 168-169, U. S. Geol. and Geol. Survey Terr., 2d div., 1876.

terial came from the nearby uplifted range, probably mixed with some material carried into the basin from distant sources.

According to the reports of White,[7] the upper Tertiary beds designated by King as the Uinta Group, occupy not only the southern flank of the Uinta Mountains, but completely encircle their eastern extremity as well. White observed that this expanded series of sediments, which he named the Brown's Park formation, was not everywhere uniform in appearance. He attributed this condition to the fact that not all the sediments came one common source. He believed that the light-colored sediments, found east and north of the range, were derived from the local Green River and Bridger formations; and that the sediments of the Uinta Basin, which are characteristically red in color, came from the Uinta Mountains. However, White did not deviate from King's supposition that these sediments were of lacustrine origin.

Peterson and the American Museum Expeditions of 1893 and 1894[8] were the first to recognize the true Uinta Group of King. Peterson named the lower portion of the formation "Uinta A and Uinta B." The upper member was termed both "Uinta C" and the "Brown's Park." The subdivisions of the former Uinta Group were based upon lithological and faunal changes between the horizons.

In the summer of 1903, Berkey[9] studied in considerable detail the Duchesne River region. Although he was primarily interested in the stratigraphy of the Uinta Mountains, he did mention the enormous Tertiary deposits to the south of this range. He believed that erosion had removed from 15,000 to 20,000 feet of sediment from the range after it was uplifted at the close of the Cretaceous period and that the sediment was deposited "along the flanks and in adjacent basins forming all the later rocks."

Emmons,[10] in his study of the Uinta Mountains, made no attempt to subdivide the post-Cretaceous deposits that now surround and, in places, overlap the older Mesozoic and Paleozoic formations. He recognized only three Eocene formations: the Wasatch, the Green River, and the

[7] White, C. A., U. S. Geol. Survey, 9th Ann. Rept., pp. 692-697, 1887-1888.

[8] Osborn, H. F., Fossil Mammals of the Uinta Basin: Bull. Am. Mus. Nat. Hist., vol. 7, pp. 72-76, 1895.

[9] Berkey, C. P., Stratigraphy of the Uinta Mountains: Bull. Geol. Soc. Amer., vol. 16, pp. 523-524, 1904.

[10] Emmons, S. F., Uinta Mountains: Bull. Geol. Soc. Amer., vol. 18, p. 302, 1907.

Bridger. From this statement the writer assumes that the Bridger deposits mentioned by Emmons are the correlative of all the post-Green River deposits in the Uinta Basin. These deposits include not only the upper Bridger (?), but also the Uinta and the Oligocene Duchesne River formations.

According to Weeks,[11] orogenic movements occurred in post-Cretaceous time which gave rise to the Uinta Mountains. Vast deposits of sediment accumulated, not only on the flanks and in the structural depressions of the range, but also upon the outlying uneven floor of the major basin south of the Uinta Mountains.

Riggs,[12] in 1912, published very complete notes on the stratigraphy of Uinta A and Uinta B, but he did not mention the overlying beds. He was the first to mention the presence of former stream channels in the Uinta Basin and to emphasize that the Uinta A and Uinta B were definitely of fluviatile origin.

In 1922, Sears[13] stated that vigorous erosion following the post-Cretaceous uplift had "supplied the material for the extensive Eocene deposits which filled the Green River and Uinta Basins." Sears, like Berkey, Weeks, and others, emphasized that the Uinta Mountains were the chief source of the Eocene deposits.

The Uinta C was further sub-divided by Peterson[14] in 1928. He acknowledged that, according to his former division, the Brown's Park formation included too much of the Uinta formation. He then restricted the term Uinta C to include only the shales, clays, and sandstones in which "*Diplacodon*, *Protitanotherium*, *Eotitanotherium*, and most of the microfauna of the Uinta sediments were found by the earlier and later collectors." The material overlying the Uinta C still retained the name Brown's Park.

The term Brown's Park was excluded from the Uinta Basin terminology in 1931 by Peterson and Kay.[15] In the sediments overlying Peterson's

[11] Weeks, F. S., Stratigraphy of the Uinta Mountains: Bull. Geol. Soc. Amer., vol. 18, pp. 446-447, 1907.

[12] Riggs, E. S., Field Mus. Nat. History, Geol. Ser., vol. 4, pp. 17-41, 1912.

[13] Sears, J. D., Relations of the Brown's Park Formation and the Bishop Conglomerate, and Their Role in the Origin of the Green and Yampa Rivers: Bull. Geol. Soc. Amer., vol. 35, p. 301, 1924.

[14] Peterson, O. A., The Brown's Park Formation; Memoirs Carnegie Museum, vol. 11, pp. 94-96, 1928.

[15] Peterson, O. A., and Kay, J. L., The Upper Uinta Formation of Northeastern Utah: Annals Carnegie Museum, vol. 20, pp. 295-6, 1931.

latest Uinta C level, they found *Teleodus*, *Poabromylus*, remains of hyaenodonts, and other faunal evidence that definitely differentiated this formation from the true Brown's Park formation of northwestern Colorado first recognized by White. On the basis of faunal evidence, the age of this youngest red formation in the Uinta Basin is basal Oligocene, and at Scott's suggestion it was named Duchesne River formation by Kay (*loc. cit.*, pp. 357-359) in 1934.

The foregoing statements convey the impression that before 1912 very little detailed study was made of the Upper Tertiary formations in the Uinta Basin. Before that date, no one had suggested that the sediments were of fluviatile origin. Only during the past ten years have the names and ages of the formations been correctly designated. Nowhere in the reports of this area was it suggested that the sediments came from distant areas. Instead, it was implied that the paleogeography of the Uinta Basin was favorable for the continuous accumulation of Uinta Mountain derived sediments during Upper Eocene time.

Stratigraphy of the Post-Green River Formations

Immediately overlying the Green River fresh-water lake deposits in Wagon Hound Canyon are 170 feet of sandstone and shale whose exact correlation has not been determined. These deposits of questionable age are composed of light-grey, friable sandy shales, interrupted by light-brown, massive ledges. In places these sediments have the appearance of the Green River shales, and according to Douglass,[16] there is one thin layer of "shale that contains fossil leaves and insects, which implies a temporary return of the Green River lake conditions." He stated, however, that they might belong to the Uinta formation or might represent a transitional formation. These same deposits, including the Uinta A and Uinta B of Peterson, have been correlated with the Bridger by the United States Geological Survey. On the other hand, Peterson and Kay (*loc. cit.*, pp. 293-300) favor placing these beds of questionable age at the base of the Uinta A. Riggs (*loc. cit.*,) favored placing these beds in the Uinta formation, and they are the lowest member of his Lower Metarhinus Zone. The finding of *Metarhinus* and *Sphenacocoelus* remains in this horizon favors assigning these beds to a period younger than the Bridger.[17] They are at least no older than the uppermost member of the true Bridger.

[16] Douglass, E., Geology of the Uinta Formation: Bull. Geol. Soc. Amer., vol. 25, pp. 417-420, 1914.

[17] Clark, J., in a personal communication, 1939.

The Uinta formation, composed of varicolored clays, shales, and sands, overlies this group of sediments of questionable age. This Upper-Eocene formation is subdivided into the Uinta A, Uinta B, and Uinta C, which are respectively the lower, middle, and upper members.

The lower member contains nearly 700 feet of massive sandstone, alternating with shales and clays. The most conspicuous features of this member are isolated, massive, sandstone ledges of limited lateral extent that vary in thickness from ten to forty feet. Each of the sandstone ledges, which contain light-colored, fine-grained calcareous sands, can be traced for only a short distance. These deposits are true Uinta A, the upper member of the Lower Metarhinus Zone and the entire Upper Metarhinus Zone of Riggs.

Conformably above this lower member which is characterized by massive sandstone, is the Uinta B, which according to Peterson and Kay (*loc. cit.*, pp. 293-300) is about 405 feet thick. The Uinta B member outcrops in an east-west belt extending from the eastern extremity of Coyote Basin near the Colorado state line, west beyond the town of Ouray, Utah. The westernmost extent of this member is not known, as the region west of Ouray lies outside the area covered in this report. However, the Uinta B was observed in Pleasant Valley south of Myton, although it was not traced continuously west from Ouray. The width of the outcrop varies from about three to six miles, the widest expanse being in the Ouray region.

The Uinta B contains a smaller proportion of massive sandstone but more shales and clays than the Uinta A. Massive sandstone ledges, extending from station 3 to station 6, a distance of 23 miles, characterize the upper portion of this member (see map, Plate XXXV). Riggs referred to this massive ledge as the Amynodon Sandstone. In fact, this is not a single sandstone ledge, but consists of a series of river-channel fills, each varying in thickness from four to forty feet. These sandstone ledges are not continuous. The characteristic brown color of these massive sandstones prevails throughout the entire area. To the south, or stratigraphically beneath these massive sandstones, and alternating to a certain extent with them, are clays, shales, and sandy shales. Unlike the sandstones, the color of these softer deposits is not consistent throughout the area. In Coyote Basin, the shales and clays in the lower part of the Uinta B are chiefly grey and green in color, inter-stratified occasionally with a band of red clay. In the upper part of the Uinta B especially east of station 3, red clays predominate, and only occasionally do the green

shales occur. However, west of station 4, no distinct bands of orange-red clays are present. In the western part of the area, especially in White River Pocket, the clays have lost their brilliant color. Instead of brilliant, well-marked layers of red, green, and grey shales, there are only dull-purple, pale-green, and purplish-green shales which blend with each other.

The Uinta B is conformably overlain by the Uinta C, which, according to Peterson and Kay (*loc. cit.*, pp. 293-300), is about 700 feet thick. This upper member of the Uinta formation contains a still smaller proportion of brown sandstone and a much greater percentage of shales and clays than does the Uinta B. However, in this upper member the increased percentage of red-colored shales and clays is very conspicuous.

The Uinta B and Uinta C and possibly the upper portion of Uinta A are chiefly of fluviatile origin, consequently no continuous datum plane could be traced for any considerable distance. Hence, the writer has accepted the original division of the three members of the Uinta formation made by Peterson[18] based upon minor changes of lithology within the formation. The division has been verified and strengthened in recent years by the discovery of a distinct fauna within each of the three horizons. Peterson used the lowest band of red clay to divide the lower members. Evidently the deposition of these red clays marked a change in conditions under which the Uinta A (which contains chiefly massive sandstone) and the Uinta B (which contains a smaller proportion of sandstone but more clays and shales) were laid down. This band of red clay is very conspicuous east of Bonanza well in the southern part of Coyote Basin, but it is not traceable to the west.

The change in lithology between the two upper members is conspicuous in the eastern part of the area studied. Peterson's division of the Uinta B and Uinta C coincides with the previously mentioned division of these members made at a later date by Riggs. It was observed that the known stream-channel characteristics of upper Uinta B time continued on into Uinta C time. The main lithological difference observed in the field between the Uinta B and the Uinta C was an increased amount of red clays and shales in the latter. In Kennedy's Hole the sudden influx of large quantities of red sediments in the Uinta C, overlying the pale-grey Uinta B, is very striking. Near Ouray both the Uinta B and Uinta C are purplish-red and green. However, it is the determination of the contact

[18] Osborn, H. F., Fossil Mammals of the Uinta Basin: Bull. Amer. Mus. Nat. Hist., vol. 7, pp. 72-76, 1895.

between the two lowest members in this area that offers the greatest difficulty. Peterson and Kay (*loc. cit.*, pp. 293-300) assigned a series of sandstones twenty feet thick to limit the top of the Uinta A. This stratum of sandstone is found near the head of Happy Canyon on a plateau south of White River, east of Willow Creek road. In a small depression, about 250 yards north of this stratum of sandstone, occur innumerable small badland knolls with copper-stained summits that have weathered from the original sandstone.

Above the Uinta formation occurs the Oligocene Duchesne River formation. According to Kay (*loc. cit.*, pp. 357-359) whose measurements were made west of Green River, this basal Oligocene deposit is 1372 feet thick, and is composed chiefly of coarse conglomerates at the base, followed by "alternating bands of sandstones and red, brown, and variegated clays, the sandstone often enclosing lenses of arenaceous clays."

STRUCTURE OF THE UINTA B MEMBER AND CONTROL OF RECENT DRAINAGE

From station 3 to Ouray, the Uinta B member dips north to northwestward from 2 to 4 degrees. This dip is rather uniform for all the post-Green River sediments lying immediately north of White River. Along the southern flank of the Uinta Mountains the sediments have a steeper southward dip, thus forming a synclinal basin whose axis is about ten or twelve miles south of Vernal. The structure in eastern Coyote Basin has been affected by the orogenic movements that gave rise to the Raven Park anticline. There is a progressive increase in the westward dip of these sediments extending from station 3 east to Snake John Ridge. All along the western slope of this ridge the Eocene beds dip steeply to the southwest. At station 2, Uinta B member strikes N. 52° W. (see Plate XXXI).

Where the entire Uinta formation is exposed, a very striking feature of the drainage pattern is the development of the major intermittent and main streams along the contacts of the various horizons. White River closely parallels the contact of the Green River formation and Uinta A (?) through part of its upper course in Utah. Coyote Draw roughly follows the contact betwen the Uinta A and Uinta B members in its westward course before emptying into the White River. Northwest of station 3, Kennedy's Hole has been gouged out of the soft shales and clays to form a minor drainage system, the south side of which lies along the contact of the Uinta B and Uinta C members. Thus, in the eastern and central part of the region studied, the outcrop of upper Uinta B sandstones

forms a ridge higher topographically than the immediate areas to the northwest and south. In the western part of the region, White River swings to the north to carve its valley in the middle and upper Uinta B sediments. Here the top of the Uinta B is lower topographically than the base, which is exposed on the plateau south of the White River.

The Source of the Uinta B Sediments

The writer wishes to emphasize that he does not intend to deal with the entire Uinta B member. Detailed study was made of the filled river-channels near the top of the Uinta B. From the interpretation of these channel deposits, certain conclusions were reached which may aid in understanding the paleogeography of northeastern Utah during Upper Eocene time. Hence, the total thickness of the Uinta B or the exact contacts of the lower and upper members were not of significance except when a closer study of some portions of the adjacent horizons aided in interpreting the problem.

It seems apparent that most of the Uinta B sediments at present exposed were derived from an eastern source, and that only a small percentage of the material came from the Uinta Mountains. The sediments brought in from the east extend as far west as Ouray, and perhaps to the western margin of the Uinta Basin. The sediments derived from the Uinta Mountains are confined to the northeastern corner of Coyote Basin. This means that the paleogeography of the area during most of the Uinta B time was not favorable for the accumulation of sediments from the north. Furthermore, this entire area was so flat that the velocity of the streams coming in from the east was suddenly checked when the streams debouched upon this area. As a result, the carrying power of the streams was reduced and the material was dropped. Thus the streams, which changed from degrading to aggrading types, built up the thick fluviatile deposits. If the Uinta Mountains were present at all during early Uinta B time, they were so low in relief that they did not act as a main source of material. By the close of Uinta B time, uplifts of the Uinta Mountains rejuvenated the streams so that the Uinta Basin received an increased amount of detritus from the northern mountain range.

These conditions have been determined from the interpretation of the Uinta B stream-channel deposits, the reconnaissance study of other post-Green River formations, and the comparison of the sediments that composed the Uinta Mountains with the Tertiary deposits. Six contributory

lines of evidence have been used to develop this theory of the paleogeographic conditions of the area at that time:

1. The east-west orientation of the ridges capped by massive sandstones, that are the Eocene stream-channel deposits.
2. The presence of flood-plain deposits all along the northern margin of the channel zone.
3. The decrease in grain size of the coarsest sediment from east to west.
4. The presence in the channel-sands of feldspars that could not have come from the Uinta Mountains.
5. The higher percentage of heavy minerals in the eastern derived sediments than in the northern derived sediments.
6. The presence of small fragments of igneous rock in the eastern derived sediments.

Evidence Based on the Orientation of Stream Channel Deposits

The first line of evidence used to determine the source of the sediments is the actual east-west orientation of the zone of river-channel deposits. These old channel-fills, which today are represented by long, relatively narrow ridges, usually capped by massive sandstones, were traced from Coyote Basin to Ouray (see map, Plate XXXV). They should be considered as a zone or group of sandstone ledges, rather than as one individual massive ledge. Although this zone of massive sandstone ridges was traced from near the Colorado state line to Green River, no individual ledge was traced more than one mile. This condition may be explained by one or two causes. Braided and meandering streams probably occurred in this flat region where continental deposition was taking place. The lateral shifting of the stream bed accompanying aggradation resulted in the development of a maze of channel-deposits at slightly different elevations. This condition, together with the complete removal of the deposits in certain places by later erosion, makes it impossible to trace an individual channel-fill for any great distance.

Usually each east-west trending ridge is produced by a single, highly cross-bedded, massive sandstone ledge, which is often the cap rock. The thickness and width of the river-channel fills vary from place to place. The width of most channel deposits is from forty to 150 feet. The characteristic feature of the heavy ledges is the lateral thinning or pinching out of the sandstone ledges to the north and south (see Plate XXXII). The thickest portion represents the center of the old river bed, while the pinching out of the sands would normally be expected along the banks of the stream.

The average channel-fill, which is about twenty feet thick, is composed of poorly-sorted, fine and coarse material that has been transported a great distance. Well rounded quartz grains and small, smooth pebbles suggest that the sediment had been long subjected to the destructive forces of running water. Many of the massive sandstones are made up of fine-grained sands firmly cemented by calcareous material, and in nearly every ledge, cross-bedding is very conspicuous. The color of the channel sands is brown to reddish brown. This color is probably due to recent weathering of the sands, for when a fresh surface is exposed, the color of the rock is usually light grey.

Lying beneath the sandstone ledges are variously-colored shales and clays. Interstratified with these shales are occasional thin bands of sandy shales that have weathered into small, well-rounded nodules. These clays and sandy shales probably represent the flood-plain deposits of the stream when it meandered either to the north or south. A few of the east-west trending ridges contain two and sometimes three channel ledges. These ledges are always separated by the flood-plain clays and sandy shales previously mentioned.

Although the orientation of the entire channel zone is east-west, there are a few places where the strike of individual ridges deviates from this direction. This deviation is rare, but when it does occur, the strike of the ridge is never more than thirty degrees from east-west. It is only natural that this variation should occur, for the deviation of the ridges from east-west is analogous to broad meandering of streams so characteristic of old age topography. The most conspicuous place where this condition was observed is at station 8 (see Plate XXXII). Here there are four narrow, elongated ridges that were formerly one continuous sand-filled channel before recent erosion disjointed it. The stream course was curved convexly northward, giving it the appearance of a major northward meander. It was actually an oxbow lake that had been cut off from the stream. A thin, four-inch seam of limestone that caps the ridge indicates that still water occupied the oxbow lake for a considerable time to allow this calcareous accumulation. The water in the lake was probably replenished intermittently by flooding from the major streams. Immediately below the limestone cap rock are shales and clays that settled to the bottom of the shallow lake. The ledge of massive sandstone, which was deposited when the main stream followed this course, lies below the shales and clays.

There are three relatively flat areas where Upper Uinta B stream-

channel deposits are absent. In the western part of the area studied there are no conspicuous upper Uinta B sandstone ledges west of station 6. West of Ouray, at the base of an east-facing escarpment cut by Green River, these river-channel deposits are again present. However, river-channel deposits in the lower Uinta B were observed on the north-facing escarpment along White River. The absence of upper Uinta B sandstone ledges west of station 6 may be explained by recent erosion of these sediments by Green River and White River. Northwest of station 9, recent, rather well-stratified clays cover most of a north-south trending valley and the adjacent highlands. It is possible that Green River formerly followed Wonsits Valley south from Leota, then cut across the lower Uinta C ridge in section 24 to join White River four miles east of its present junction.

Four miles west of Chipeta Crossing is a small, flat area where the upper Uinta B sandstones are absent. The absence of the massive sandstone ledges here may be explained by the southward shifting of the entire Uinta B river zone. The southward shifting of this group of channel deposits, which at the present time is up dip, has led to their complete removal by recent, vigorously-cutting, badland tributary streams of White River. As previously mentioned, the entire area to the south of the channel zone is the lowest both topographically and statigraphically. Thus, the evidence of all former streams that meandered into the area now occupied by lower Chipeta Draw has been completely removed. In the area west of Chipeta Crossing, where the channel deposits are absent, the composition of the surface rock is chiefly fine-grained sand which in places has weathered to form well-rounded nodules.

In the eastern part of Coyote Basin, no river-channel fills are present east of station 3. The total absence of all sandstone ledges here is explained by the stripping away of the sediments by ephemeral streams following the uplift of Raven Park anticline, which strongly affected the sediments in eastern Coyote Basin. By the time the bad-land streams that had been cutting vigorously into these uplifted sediments had reduced the eastern part of Coyote Basin to the level of station 3, the upper channel deposits had been completely removed. The streams draining the southwestern slope of Snake John Ridge continued to flow across the area to carve Coyote Basin from the clays, shales, and softer sandstones that characterize the middle and lower Uinta B.

From the foregoing statements it is evident that the direction of the major drainage system in the central part of the Uinta Basin during Uinta

B time was east-west. This condition favors the hypothesis that the Uinta B sediments were derived from an eastern or possibly a western source.

Evidence Based on Flood-Plain Deposits

Evidence of the Upper Eocene streams is represented today, not only by the massive sandstone ledges, but also by fine-grained sands, shales, and clays representing the flood-plain deposits of these streams. The material of the flood-plain deposits changes in texture from coarse-grained sands near the former channels to very fine-grained shales farther north. Nowhere to the south of the channel-zone are the former flood-plain deposits now exposed, for they have been stripped away by erosion. However, to the north, which is down dip, the flood-plain deposits are well preserved, especially in Kennedy's Hole. These fine-grained sands and shales that are light-grey, almost white in color, weather into the form of nodules varying in size from six to ten inches in diameter. In Kennedy's Hole there is a series of nodular layers at slightly different elevations, each of which can be associated with a stream-channel deposit that lies to the south (see Plate XXXIII, upper figure). In fact, this entire zone of nodules is on the same stratigraphic level as the channel zone, and it was formerly immediately overlain by the Uinta C (see Plate XXXIII, lower figure). This overlying member was later removed by the agencies of erosion that produced Kennedy's Hole. Thus at the present time this zone of nodules forms the floor of the depression. At the base of a south-west-facing escarpment within Kennedy's Hole, this nodular zone dips beneath the overlying red shales of the Uinta C. The first layer of red shales above the white flood-plain deposits was conveniently used as the base of the Uinta C since it extends for a considerable distance to the west. This zone of nodules is well exposed wherever erosion has been vigorous enough to remove the overlying Uinta C clays. Wherever this condition does not occur, or where the Uinta C outcrops farther south against the upper Uinta B channel deposits, the zone of nodules is not so conspicuous. Nevertheless, even here an occasional nodular layer dips beneath the younger member. This condition rarely occurs since the Uinta C usually outcrops a considerable distance north of the channel zone.

This zone of nodules occupies the area west of Chipeta Crossing where the expected channel zone was absent. The presence of the flood-plain deposits here further supports the belief that the channel zone shifted to the south, which explains this discontinuity of the east-west trending

channel zone. No flood-plain deposits are present east of station 3, for they too were removed following the uplift of the eastern portion of Coyote Basin.

Paralleling the importance of the presence of flood-plain deposits north of the channel zone in determining the source of the Uinta B sediments, is the total absence of any north-south stream-channel fills cutting across the muds and clays. If any major stream had entered this basin from the north, some evidence of its channel deposits would be expected where it cut across the flood-plains of the east-west stream.

Evidence Based on Change in Texture

Thus far the direction of flow of east-west streams of Uinta B time has not been considered. The solution of this problem is based upon the change in texture of the sediments from east to west. Since no one sandstone ledge could be traced continuously across this area, difficulty was experienced in determining the exact decrease in the grain size of material. This would naturally be expected in a region where continental deposition from braided, meandering streams was taking place. However, it was observed that the coarsest material in the eastern part of the area consisted of larger individual pebbles than the coarsest material in the Ouray region (see Plate XXXIV). This would indicate that the streams flowed from east to west, and that the coarsest material in the east resulted from the sudden deposition of the larger particles due to decrease in the velocity of the water. A less likely explanation is that the materials were ground finer as they were carried farther to the west.

Evidence Based on Feldspathic Content of Rock

The Uinta Mountains are a very unusual range in that there are no igneous materials exposed except in the extreme western part where extrusive andesites and agglomerates cover Lower Eocene sediments. The age of the flows has been placed as late Eocene and early Oligocene, and according to Forrester (*loc. cit.*, pp. 641-642), intrusive rocks may or may not be found there. In Eocene time there was no igneous mass to the north that could have supplied large crystals of pure feldspars, an abundance of heavy minerals, and small igneous pebbles to the Uinta Basin. The presence of these igneous materials in the sediments, with the other evidence of direction of stream flow, indicates a source in the igneous mountains of western Colorado.

Microscopic study of Uinta B rock samples taken from stations 1 to 7, inclusive, reveals that there is a marked contrast in the percentage of feldspars in the samples taken from stations 1 and 2 as compared with those taken from stations 3 through 7. From the feldspathic content of the rocks, it is obvious that these two groups of sediments did not come from the same source.

Samples 3, 5, and 6 are from the highest channel-fills in the upper channel zone; sample 4, from a middle Uinta B channel-deposit near Bananza Well; and sample 7, from a coarse deposit near the base of the Uinta B White River Pocket. Samples 1 and 2 are from eastern Coyote Basin, number 1 from the northeastern corner and number 2 from the west slope of Snake John Ridge. The portion of the Uinta B member embracing the area from which samples 3 through 7 were derived will henceforth be regarded as eastern-derived sediments, while the northeastern Coyote Basin sediments will be designated as northern or Uinta Mountain derived sediments.

Each of these samples was broken down, cleaned, and sifted to obtain individual grains of ten, twenty, forty, sixty, and eighty-mesh size. Each sieve was thoroughly mixed and mechanically divided by a microsplit to obtain one hundred grains of each size. The percentage of feldspar was then determined for each of the five sieves from the seven samples (see Table, p. 291).

The eastern-derived sediments contain an abundance of feldspars that could not have been derived from the Uinta Mountains. Although there is no igneous material in the Uinta Mountains which could have been the direct source of the feldspars, one might reasonably assume that the feldspars in the Uinta B could represent reworked material derived from the sedimentary rocks of the Uinta Mountains. However, this is improbable for three reasons:

First: feldspars decompose and disintegrate more rapidly than most minerals, therefore, it is very doubtful if feldspars could withstand two complete cycles of erosion, transportation, and deposition and still retain the size of many of the crystals that were observed in the Uinta Basin. However, too much emphasis must not be placed on this reasoning, because under favorable conditions it might be possible for feldspars to withstand destruction even though they were exposed to the agencies of erosion for a long period of time.

Second: the samples that contained the feldspars were taken from the east-west trending river-channel fills.

TABLE

STATISTICS REPRESENTING PERCENTAGES OF FELDSPARS, IGNEOUS PEBBLES, AND HEAVY MINERALS

Sample No.	Mesh Size	Percentage Of: Feldspars (w)	Igneous pebbles (x)	Heavy minerals (y)
1	10, 20 40, 60, 80	0	0	.079
	10	(z) -	(z) -	
	20	-	-	
2	40	1	0	.037
	60	1	0	
	80	0	0	
	10	32	28	
	20	24	10	
3	40	38	10	11.800
	60	7	0	
	80	8	0	
	10	40	2	
	20	27	2	
4	40	29	3	4.040
	60	6	0	
	80	17	0	
	10	38	2	
	20	29	3	
5	40	22	3	1.240
	60	7	0	
	80	16	0	
	10	34	6	
	20	27	2	
6	40	32	0	.340
	60	2	0	
	80	6	0	
	10	30	3	
	20	29	7	
7	40	34	3	.510
	60	5	0	
	80	6	0	
	115	0	0	.198
Triassic	250	1	0	

(w) and (x)—Determined by numerical count;
(y)—Determined by weight.
(z)—No. of grains found in no. 10 & 20 sieve.

Third: the third line of evidence used to explain why most of the Uinta B deposits do not represent reworked Uinta Mountain sediments arises from a study of the Uinta Mountain formations. Although thousands of feet of sediment have been eroded from the Uinta Mountains, partial remains of all the formations that formerly comprised the crest of the arch are still preserved along the flanks of the range. Samples were taken from every formation of the Uinta Mountains, except the Uinta quartzite, and only the coarsest material was considered. These formations range in age from pre-Cambrian through upper Cretaceous. As there were no visible feldspars found in the Mesozoic or Paleozoic sediments, it does not seem probable that the Uinta Mountains could have been the source of the abundant and large feldspars found in the Tertiary rocks. From field observations, the only formation that seemed likely to contain the necessary constituents to classify it as a possible source rock for the feldspar was the red Triassic Chugwater. A microscopic analysis of the sample taken from this formation did not reveal any feldspars in the grains that were larger than the one hundred fifty mesh. Only one feldspar was in the two hundred fifty mesh size, and two feldspars were present in the grains that were smaller than the two hundred fifty mesh. The almost total absence of feldspars in the Chugwater, which seemed to be the most plausible source rock, further supports the theory that the Uinta Mountains were not the principal source of the Upper Eocene sediments.

An abundance of large visible crystalline grains of pure feldspar were observed in the Uinta B and C far to the west beyond Green River. Uinta B river sands in Pleasant Valley south of Myton, and Uinta C channel-fills west of Duchesne River, southwest of Myton, and on Leland Bench east of Myton, revealed an abundance of feldspars. This condition strengthens the theory that streams flowed to the western margin of the basin, thus eliminating the possibility of the presence of Green River in Eocene time. If a southward flowing stream as large as modern Green River had been present, it would have intercepted the smaller, westward-flowing streams that entered the basin, as it does to-day. However, under ideal conditions, the presence of feldspars west of present Green River could be explained even though an Eocene stream did follow the upper course of modern Green River in the Uinta Basin. This condition would necessitate a major east-west drainage pattern with only tributary streams flowing from the north. Thus the feldspars in the Upper Eocene deposits northwest of Ouray and New Leota would result from the deposition of major westward-flowing rivers that meandered northward after intercep-

ting ancestral Green River. However, field evidence does not uphold this condition. No evidence of former southward-flowing streams represented by north-south trending channel-fills are present. In fact modern Green River cut its course through east-west trending Eocene channel-deposits. In addition there is an east-west orientation of Uinta B and Uinta C channel-zones west and northwest of Ouray and New Loeta. There is no indication of a major northward meander of the westward-flowing streams. in the area northwest of Ouray.

The almost total absence of feldspars in samples 1 and 2 supports the previously mentioned statement that the exposed sediments in northeastern Coyote Basin were derived from the Uinta Mountains. No feldspars were identified in sample 1, while in sample 2, two feldspar grains were found, one of 40-mesh and the other of 60-mesh size.

Evidence Based on Percentage of Heavy Minerals

Closely paralleling the preceding contributory line of evidence is the comparison of the heavy mineral content of the Triassic formation with the two groups of Uinta B sediments. About five grams of sand taken from the eighty-mesh size of each sample were carefully cleaned, and weighed. The heavy minerals of each sample were concentrated by means of the bromoform separation method. The percentage of heavy minerals by weight was determined for each sample.

The heavy mineral content of each sample of the eastern-derived sediment was greater than that of the Triassic formation, which in turn was greater than the heavy mineral content of the samples taken from eastern Coyote Basin. There was a difference, not only between the quantitative analysis of the two groups of Uinta B sediments, but also between the kinds of heavy minerals present in each. The prevalent kinds of heavy minerals in the eastern-derived sediment were magnetite, hornblende, augite, apatite, and epidote. In samples 1 and 2, only nine individual grains of heavy minerals were present in ten grams of sand. There were three magnetite, two garnet, and one each of the following: leucoxene, pyrite, tourmaline, and hornblende. The heavy minerals from the Triassic formation sample were chiefly pyrite and some magnetite. The highest percentage of heavy minerals in the sediments that came from the east was in sample 3. The concentration of heavy minerals in channel fills in the eastern third of the area was very striking. The abundance of heavy minerals decreases rather consistently towards the west.

In addition to the findings revealed in the laboratory, field evidence pertaining to heavy minerals sustantiates the belief that the two groups of Uinta B sediments were of different origin. Throughout the entire area where the Uinta B stream-channel fills are exposed, a concentration of heavy minerals has accumulated in most of the small ravines between badland hills and knolls. In some places the heavy minerals constitute thirty percent of the total amount of sand. This high concentration of heavy minerals implies that their immediate source was a rock derived from an igneous mass. The extreme scarcity of heavy minerals in recent detrital sands of eastern Coyote Basin verifies the belief that the Eocene sediments present here were from the northern source.

Evidence Based Upon Igneous Pebbles

The sixth and probably the most striking characteristic of the stream-channel gravels is the occurrence of small, rounded, water-worn igneous pebbles that are thoroughly mixed with the other constituents of the Uinta B. Interlocked crystals of quartz, orthoclase, hornblende, and biotite were exposed on a freshly broken surface of a small fragment of igneous rock from sample 3. The fragments of igneous rock were most abundant in the ten and twenty mesh size, but a liberal scattering of the pebbles was found in every sample of the eastern derived sediments. In the western part of the area, the granite fragments were not as abundant as are the lighter-colored, fine-grained types of igneous material.

Paralleling the scarcity of feldspars and heavy minerals in northeastern Coyote Basin is the complete absence of igneous pebbles in the samples taken from that area. It is the writer's opinion that this evidence, more than any other, indicates that the two groups of sediments were derived from different sources.

Summary of Post-Green River Paleogeographic History of Northeastern Utah

At the close of Green River time, Green River lake was receiving only fine-textured sediments. These fine-textured sediments are indicative of only low, almost completely subdued encircling land masses. By this time the Uinta Mountains, which had first been uplifted at the close of Cretaceous, probably were reduced in size to ridges and hills of small relief. Part of the sediment removed from the Uinta Mountains, following their initial uplift, was deposited along the eastern flanks of the range to form the Paleocene and Lower Eocene (Wasatch) Formations. Coarse

sediment present in the basal Wasatch is very conspicuous close to the Uinta Mountains, and there is a gradual reduction in grain size of the sediment outward from the range.[19] As the mountains were degraded, finer sediment was carried south and deposited into Green River lake to form the Green River Formation.

Following the drainage or filling of Green River lake, the topography of northeastern Utah was not favorable for the continued accumulation of Uinta Mountain derived sediment into the area now occupied by White River. Instead, the direction of the main drainage system in this area was probably from east to west. The earliest streams were poorly developed and were often interrupted by a temporary return of Green River lake conditions. As a result, about 170 feet of sediment of alternating lacustrine and fluviatile origin were deposited upon the Green River shales.

This writer accepts Bradley's (*loc. cit.*, pp. 19-22) explanations of the origin of the massive sandstone layers that characterize the lower Uinta A. Apparently, streams cut into this newly accumulated sediment. "These streams later filled their own channels with relatively clean, medium to coarse grained and crossbedded sand. Locally the streams cut down close to the Green River formation." Throughout the remainder of Uinta A time, the Uinta Mountains remained low and incapable of serving as a source of Uinta Basin Tertiary sediments.

By the beginning of Uinta B time, well developed streams were entering this area from the east. These streams flowed west across the Uinta Basin for considerable distance beyond Myton. These sediment-laden streams deposited their load, which resulted in the aggradation of the area. Although the exact source of the streams is not known, the presence of large crystals of pure feldspar, an abundance of heavy minerals, and small granite pebbles in the channel-sands implies that the source may have been as far east as the Park Range. There are exposures of igneous material west of the Park Range, but to this writer's knowledge, these are chiefly of extrusive origin, and granites are totally lacking.

Certain phases of the climate during Uinta B time are interpreted from the greenish sands and clays. The streams that came into this area from Colorado probably dissolved a considerable amount of sulphates while flowing over Cretaceous outcrops. The presence of plant and animal

[19] Sears, J. D. and Bradley, W. H., Relation of the Wasatch and Green River Formations in Northwestern Colorado and Southwestern Wyoming, with Notes on Oil Shale in the Green River Formation: U. S. Geol. Survey, Prof. Paper 132, p. 96, 1923.

remains found in the river-channel sands indicates that the water was highly charged with natural organic remains. Clark[20] has observed that water high in sulphates tends to dissolve iron from ferruginous clays and shales. In addition, Thiel[21] has proven that "the presence of natural organic matter in water is very effective in reducing ferrous sulphates to sulphides." Hence the abundance of green clays and shales in the eastern derived sediments is probably the result of the reducing action of organic-charged water upon ferrous sulphates. This interpretation of the west-flowing streams implies that the climate at that time was either humid or sub-humid. This assumption is further strengthened by the study of the types of animal remains found in the channel sands. The presence of large turtles and crocodiles in these beds favors the belief that the climate of this area during the upper Eocene was relatively warm, equable, and moist.

At the beginning of Uinta B time, a minor uplift of the eastern portion of the Uinta Mountains slightly rejuvenated the small streams flowing from that area. The increased carrying power of the streams made it possible for fine-grained sediment to be carried south into the present White River area. As a result of pre-Uinta B erosion of the Uinta Mountains, some red formations had been exposed. The streams that carried this red sediment into the Uinta Basin emptied into the main west-flowing stream at the vicinity of Coyote Basin. Hence, it is only natural that a rich accumulation of red sediment should now occupy this region. In addition, in the area where two streams joined, it is also natural that there was an interfingering of the sediments derived from different sources. The increased amount of red sediment near the top of Uinta B is indicative of the continued uplift of the Uinta Mountains. Some of the red clays were carried downstream and mixed with the eastern derived material. Thus the syngenetic coloring of the clays and shales in White River Pocket was probably a result of the blending of sediments derived from different sources.

In Uinta C time the Uinta Mountains were probably further uplifted to allow a greater accumulation of red sediment into the present Kennedy's Hole region.

[20] Clark, J., The Stratigraphy and Paleontology of the Chadron Formation in the Big Badlands of South Dakota: Annals Carnegie Museum, vol. 25, pp. 275-276, 1937.

[21] Thiel, G. A., Experiments Bearing on the Biochemical Reduction of Sulphate Waters: Econ. Geology, vol. 25, No. 3, p. 242, 1930.

The Eocene period was terminated by an uplift of the Uinta Mountains. The effects of this uplift were reflected far to the east and south of the mountains, causing a change in the drainage system of northeastern Utah. As a result of this orographic movement, minor streams flowing from the Uinta Mountains were greatly rejuvenated; they now had the power, not only to cut deeply into the rising range, but also to transport coarse detritus far south into the Uinta Basin to form the Duchesne River formation. This detritus was stripped from the mountains and deposited by the innumerable small, swift-flowing streams that issued from the Uinta Mountains. The former westward-flowing streams were probably deflected and pushed to the south as a result of the vertical movements in northeastern Utah.

Following the deposition of the basal Oligocene deposits and possibly preceding the deposition of the Brown's Park formation, occurred another orogenic disturbance that gave rise to the many anticlines that radiate outward from the eastern end of the Uinta Mountains. The age given to this orogenic movement is verified by the effect of the disturbance upon the Duchesne River formation. The reflection of the Raven Park anticline was felt in Coyote Basin as far west as station 3. The steep dip of the beds in eastern Coyote Basin has increased the cutting power of the intermittent streams which drain the west limb of the structure. After the minor streams had stripped away the channel-zone of the Uinta B (and all the overlying sediment), they continued their downward cutting to produce the present depression.

The basis for dating the age of the post-lower Oligocene movements that gave rise to Split Mountain, Blue Mountain, Raven Park, and other anticlines, is confined entirely to the sedimentation of the Uinta Basin and to the effect of the major orogenic movements upon these sediments.

The climatic conditions of northeastern Utah changed to greater aridity since basal Oligocene time. Bradley's[22] opinion that the Gilbert Peak surface is a pediment further substantiates this belief. At the present time the climate of this region is very arid. This aridity is directly reflected in the type of relief features in the interior of the Uinta Basin, where typical badland topography prevails. This desert basin is now drained by the southward-flowing Green River, which entered the Uinta Basin in post-basal Oligocene time.

[22] Bradley, W. H., Geomorphology of the North Flank of the Uinta Mountains: U. S. Geol. Survey, Prof. Paper 185, I, pp. 174-179, 1936.

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EXPLANATION OF PLATE XXXI

View of the westward-dipping Uinta B member at station 2.

EXPLANATION OF PLATE XXXII

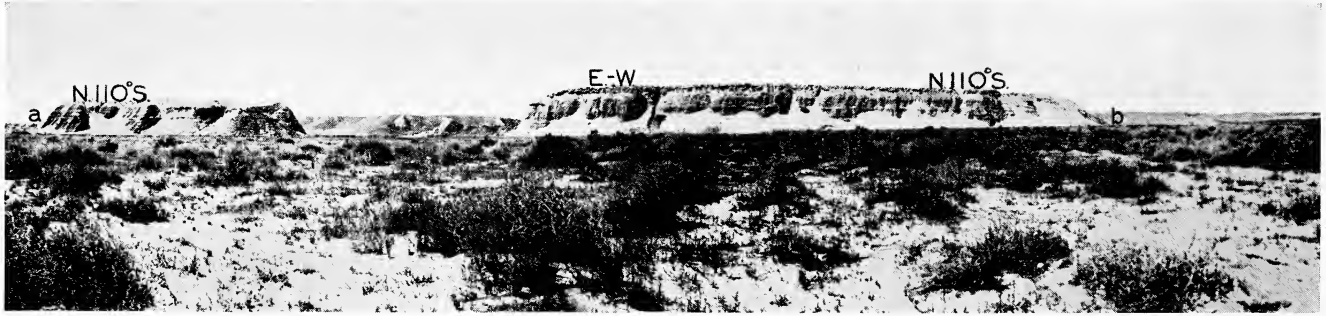
LEFT FIGURE

Northern margin of the Uinta B stream-channel deposit at station 3. Note the thinning or pinching out of the massive sandstone ledge from left to right (towards the north).

RIGHT FIGURE

Spliced panorama of the meander-channel deposit at station 8. The dissected channel fill curves convexly towards the observer (north). The horizontal distance between the meander-channel fill in the foreground and the main east-west trending channel zone in the background is about one-fourth mile, and the distance between "a" and "b" is one mile.

In the figure below, direction at **a** is N.110° E.; at **b** the direction is N.110° W.



EXPLANATION OF PLATE XXXIII

UPPER FIGURE

Nodules forming the floor of the southern portion of Kennedy's Hole. In the background the elevated ridge is composed of east-west trending stream-channel deposits. The nodular layers in the foreground are on the same stratigraphic horizon as the channel zone.

LOWER FIGURE

View northward of the same zone of nodules dipping beneath the overlying Uinta C red shales and clays.

EXPLANATION OF PLATE XXXIV

Photographs illustrating the texture of Uinta B rock samples.

UPPER FIGURE

Sample of the fine-textured, northern-derived sediment from Station 2.

MIDDLE FIGURE

Sample of the coarsest-textured, eastern-derived sediment in the Ouray area from station 7.

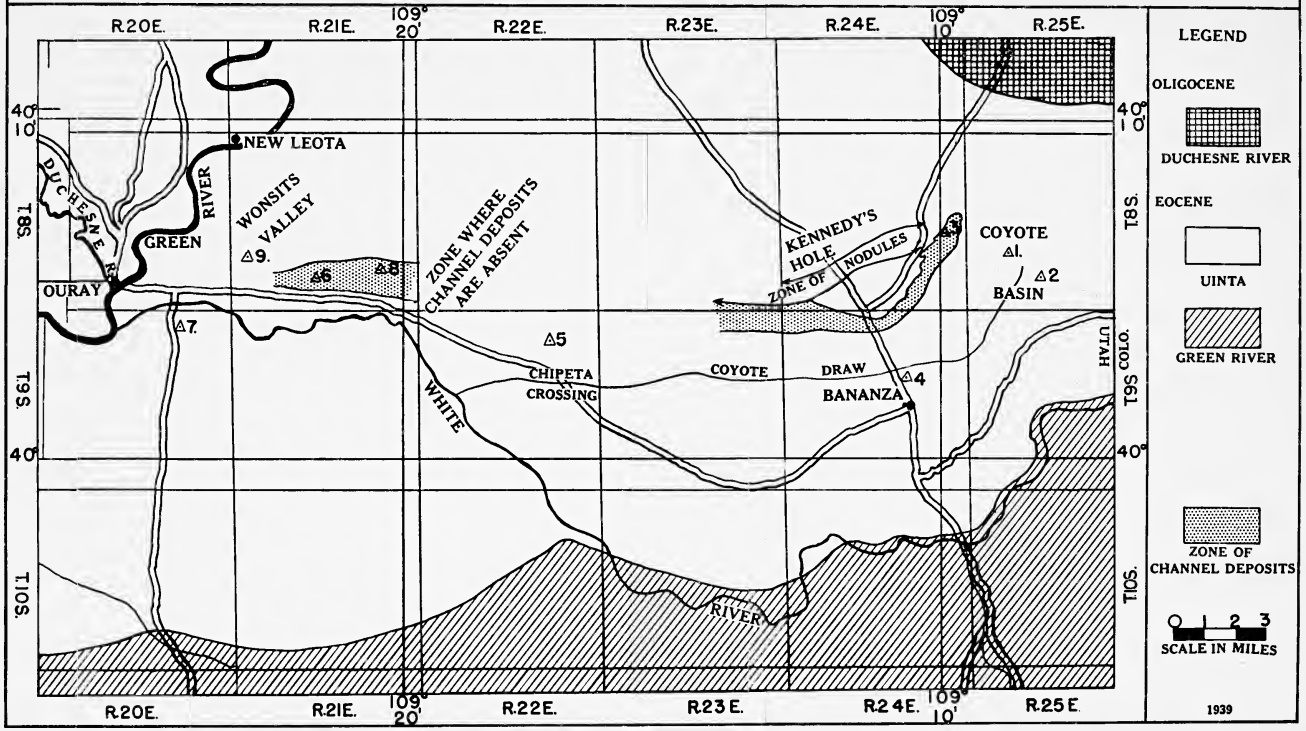
LOWER FIGURE

Sample of the coarsest-textured, eastern-derived sediment from station 3. Note the size of the fragmentary crystal of pure feldspar in the center of the picture.

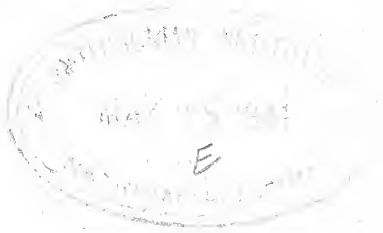
EXPLANATION OF PLATE XXXV

Geological map of the White River Area.

GEOLOGIC MAP OF THE WHITE RIVER AREA



ART. XV. SOME NEW AND UNDESCRIBED JAMAICAN BUTTERFLIES



By A. Avinoff and Nicholas Shoumatoff

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ART. XV. SOME NEW AND UNDESCRIBED JAMAICAN BUTTERFLIES

By A. Avinoff and Nicholas Shoumatoff

(Plate XXXVI)

The present paper contains descriptions of some of the new forms of butterflies found on Jamaica during the five visits we made to this island in the summer seasons between 1931 and 1940. It constitutes a preliminary note which will eventually be succeeded by a complete list of the Rhopalocera recorded by us from this island. Our studies have amplified to a rather considerable degree the present knowledge of the Jamaican fauna. The Cockpit Country, which was but slightly investigated heretofore and left almost a virgin field for lepidopterists, yielded the major portion of these novelties as well as several additions to the fauna as it will be discussed in a subsequent publication. While all of our investigations were carried on during the periods between June and August, one new species of the Hesperiidæ was discovered by Mr. Chester Roys in the course of a brief visit he made to Jamaica in the spring season. The present descriptions record not only new forms but also outline the characteristics of the females of three species which were heretofore known only from the males. The type specimens, together with the rest of the material collected on Jamaica, are the property of the Carnegie Museum since all the material assembled on this island was turned over by us to that institution.

Nathalis iole Bsd. ab. **albida** nov. (Pl. XXXVI, figs. 1, ♂; 2, ♀)

On an isolated elevation of over 3,000 feet called Low River, or All Sides, in Trelawney, a peculiar aberration of *Nathalis iole* was found to be predominant in July of the year 1933, as compared with the normal kind. The majority were decidedly light in color, of a varying degree of whitish lemon. The extremely light individuals may be called white with a very slight yellow tinge. This yellowish tint is scarcely more expressed than in the female of *Terias messalina* F. One extreme specimen of the male is an exaggerated example of such an albinic form. Two females

Issued May 22, 1941.

also show this same white tint from both sides. One of them approximates the lightest specimen among the males whereas the other has a peculiar admixture of the orange tint which, added to the white portions of the wings, produces a cream color similar to that of some albinic females of *Colias* with orange males (*Colias edusa* F., *myrmidone* Esp., *aurora* Esp., *diva* Gr.-Gr.). The absence of the lemon yellow color is noticeable also on the reverse sides of both males and females and produces some peculiar effects of a dull gray tint on the hind wings which do not show the greenish hue of the normal *iole*. Although one might feel a legitimate reluctance to describe any aberration, yet in this case nomenclatorial designation seems to be desirable in order to signalize a certain regional phenomenon which is not duplicated anywhere in the species. Nowhere throughout the wide range of the distribution of *iole* in North and South America and the Antilles was such a light aberration recorded. In all other localities of Jamaica where *iole* is found it appears in the typical form, never showing any tendency toward a lighter ground color. It is only on this isolated open grassy top of Low River, which forms a peculiar ecological station as compared with the surrounding country, that this whitish form was decidedly predominant, although a certain percentage of normal specimens also flew together with this striking light form. It is worth noting that all these specimens were collected in 1933. In subsequent years *Nathalis iole* was not seen at all in this region although it was thoroughly searched for further material of this aberrant form. In the collection there are altogether six normal specimens of *iole* from that locality. A set of six individuals is distinctly lighter and readily distinguishable from *iole* from other parts of Jamaica and from anywhere else. There are seven specimens having the exceptionally whitish background which constitutes the typical form of the new aberration named here as *albida*. Systematically, the problem of similar local aberrations has a definite interest. It seems as if conditions of a certain ecological setting produce a distinct mutational effect. Such forms could not be called races since it is not a case of an exclusive local isolation. Instances of this order reflect a predominant regional alteration of an otherwise stable type. It may be a race in the making. It is unquestionably something other than an accidental aberration, as it has a certain territorial base. Similar phenomena should stimulate further studies in order to ascertain other analogous fluctuations of the regular types.

All these considerations seem to justify a special designation of this predominant local aberration as *N. iole* ab. *albida* nov.

Chlosyne pantoni Kaye, ♀ (Pl. XXXVI, figs. 7, ♀ ; 8, ♀ ; 9, ♂)

Chlosyne pantoni Kaye, The Entomologist, 1906, vol. 39, p. 52, pl. 2, fig. 6, ♂.

The heretofore unknown female of this species found in the Cockpit Country near Troy, Warsop, and Belmore Castle, in the months of June and July, differs considerably from the male in the following respects. The abdomen has whitish yellow edges of the segments instead of russet edges as in the male. The size of the female is considerably larger than the male, the length of the front wings being 1.25 inches as compared with the one inch wing of the male.

Upper side: The wings are brownish black; all the markings on the front wings are light yellow instead of brick-red, as in the male. The extent of the light maculation is more restricted, especially the basal part. There are seven light yellow antemarginal spots smaller than in the male. The costal extramesial band is divided by veins into four distinct maculæ which are confluent in the male. The transverse light band in the middle of the cell is divided from the two oblique light spots in the discus of the wing. In the male this portion of the pattern forms a continuous area. At the base the light spots in the median cell and near the inner edge are much reduced. In two of the twelve females caught they almost disappear altogether. The hind wings have a light yellow basal spot occupying the major part of the median cell and extending beyond it to vein 1. A mesial band of seven uneven spots, of a light yellow color similar to that of the basal maculation in all the light patterns of the front wings, occupies the intraneural region. A band of brick-red spots shows these maculations coalescent in the front portion and divided into triangular patches in the lower part. There is an antemarginal row of crescents of light yellow color occupying the intraneural spaces. The aspect of the hind wings is in close analogy with the reverse of the hind wing in both sexes, with the exceptions, (1) that the inner part between the edge and first vein is entirely fuscous brown, and does not show the light spots, (2) that the mesial band is not divided into two rows of light spots, and (3) that there is only a single row of antemarginal lunulæ while on the reverse they are in a double formation.

Under side: Upper wings dark brown with a somewhat lighter yellow pattern than on the upper side, with some additional maculation, namely three light yellow lunulæ at the apex continued by faintly indicated antemarginal crescents and a small yellow spot divided by three veins at the close of the median cell. There are traces of brick-red color at the

base of the wing in the inner edge of the two antemarginal yellow spots between veins 2 and 4 and in the intraneural portion at the outer edge.

Hind wing: Light basal pattern as in male but of a lighter yellow tinge since in the male these portions are of a deeper straw-yellow color; the brick-red antemarginal spots are smaller and form a band of divided maculæ.

Discussion: There are certain characteristics in regard to the female of *pantoni* which have to do with the systematic and distributional peculiarities of the genus. It is the outstanding example of sexual dimorphism in the genus. *Chlosyne narva* F. and *saundersi* Dbl.-Hew. show a slight dimorphism, in the latter case the female being lighter than the male. The light coloration of the maculæ of the front wings is typical for a whole group in the genus *Chlosyne*. Another group of the genus, to which *marina* Hbn., *fasciata* Röb., and *poecile* Fld. belong, although not dimorphic, shows however in both sexes a general type of coloration similar to the female of *pantoni*, namely light spots with the exception of an antemarginal band of reddish spots on the hind wings. If this kind of coloration may be taken for the more primitive, the female of *pantoni* would show such archaic traits, whereas the male differentiates in the direction of the uniform brick-red or russet color of the pattern of the upper side. The close similarity of the upper side of the female of *pantoni* with the reverse of both sexes is another indication that it is the upper side of the male that is undergoing the change in comparison with the presumably more ancient type. It is interesting to note that the females of the two representatives of *Chlosyne* from Porto Rico and Cuba do not display any dimorphism, since they show the same russet red pattern as their corresponding males.

The questions of the relationships of *pantoni* on one side, and *perezi* H.-Sch. of Cuba and *tulita* Dev. from Porto Rico on the other side, should be settled in the sense of ascribing to the Jamaican butterfly the systematic position of specific independence. The difference of the Cuban species, bearing wide antemarginal spots, is readily apparent as are also the considerable differences of the under side when compared with *pantoni*. The Jamaican representative is closer to the Porto Rican *tulita*. In the male the most important characteristic is the complete double row of antemarginal spots in *tulita* which is reduced to one row in *pantoni*. Furthermore on the hind wings the black portions of the pattern are considerably reduced so that the russet tint forms the predominant background beyond the fourth vein. Also there is a difference in the under

side in the separation of the intraneural maculation in *tulita* and the russet color of the spot in the median cell. The dimorphic character of the female adds a further ground for a specific separation of *pantoni* from *tulita*.

It is also of interest to observe that the species of *Chlosyne* with a light maculation in both sexes happen to occur in Mexico and Central America. The existence on Jamaica of a *Chlosyne* with a light yellow pattern in the female may be an indication that this insular form has preserved to a closer degree, than the species of *Chlosyne* of the islands of Cuba and Porto Rico, a certain phylogenetic relationship with the Central American representative of the genus. Such a picture of systematic and phylogenetic relationships may find an explanation in the geological past of the Antilles and possibly points toward a former connection of Yucatan with Jamaica. It would seem plausible to expect that further explorations on the island of Haiti will record a form from that island related to *pantoni* and *tulita*. This hypothetical butterfly might help to settle the question of the specific relationships of the Jamaican and Porto Rican representatives of the genus.

A figure of the male of *pantoni*, under the name of *seitzi*, is shown in the "Macrolepidoptera" of Seitz on plate 91h. The under side is not figured, either by the describer or by Seitz, so that it was found desirable to reproduce, in the present paper, both sides of the male for comparison with the corresponding parts of the female.

Anaea johnsoni sp. nov. (Pl. XXXVI, figs. 3, ♂; 4, ♂; 5, ♀; 6, ♀)

Anaea johnsoni is named in honor of Mr. Frank Johnson who has been particularly interested in studies of *Anaea* in addition to his interest in the other groups of Rhopalocera which have attracted his attention during his distinguished career of assembling and investigating the butterflies of the Western Hemisphere.

The new *Anaea* was found in the Cockpit Country of Jamaica and was recorded from two places, Coleyville, near Christiana, and Cave River. In these regions the Jamaican form of *troglodyta* F. is not found since this butterfly occurs in the lower regions of the island.

Male: The coloration is vivid russet as in *Anaea glycerium* and *cratais* Hew. The shape of the wings is falcate as in both of these species. The exterior outline indicates a slight protrusion on the second and fifth vein which is not so marked by far as in *glycerium*. On the other hand the slight outward curve on the fifth vein is different from the even concave shape

of this part of the vein in *cratais*. The hind wings have a slightly undulating outline similar to those of *cratais* but do not produce the distinctly scalloped effect of *glycerium*. The tails on the fourth vein are elongated and narrow somewhat like in *glycerium* and not so short as in *cratais*. On the front wings the dark pattern on the bright russet background consists of a brownish black apical portion extending through the discocellular toward the exterior part of the wing, where the dark color gradually merges with the russet tint of the background. The band of russet runs transversely in this apical portion and is divided by a brownish black band in the intraneural space 3-4 from the russet ground color below. This is a character which is different from the majority of the specimens of *glycerium* Dbl.-Hew., and from some of the specimens of *cratais* Hew., where the light apical band merges with the background because of an interruption of the dividing dark band. The hind wings show on the russet background a transverse dark mesial shade which forms a curved line and is far from being as straight as in *glycerium* and *cratais*. Altogether, the male of the new species is best compared with *cratais* from which it is differentiated by the position of the mesial dark maculæ and by the greater development of the dark pattern in the apex. The apical black portion is running deeper inwardly along the front edge than in that species. Also, the russet subapical transverse band is narrower than in *glycerium* and in *cratais*. The under side is very much like the reverse of *glycerium*. It is of a purple reddish brown tinged with a lighter silvery striation; it shows a transverse band through the middle of the wings outlining the darker basal area and another curved darker band in the exterior half of the hind wing. The character of the coloration is less motley than in *glycerium* but of a brighter red brown hue and marked by darker striation than in the somewhat satin-like reverse of *cratais*.

Female: The russet coloration is lighter than in the male with a yellowish russet color, still slightly lighter, in the transverse apical band, and in the band of maculation in the outward part of the wing below the dark apical area. The dark pattern, outlining inwardly this latter band, is particularly characteristic and perhaps may best be described as a dark crescent with points directed inwardly, in the 2-3 inter-space, and an arrow point directed outwardly, in the 1-2 intraneural section, shifted considerably to the exterior border without any contact with the crescent. This pattern can be compared with the corresponding portion in the female of *Anaea titan* Feld., which shows much similarity in general distribution of the pattern having, however, a much straighter outline of the sharply

falcate wings. In *titan*, besides, the dark marking in the 1-2 interspace in the left wing has the shape of a figure three, and is not drawn into a point in the middle to suggest the shape of an arrow point, as it is in the new *Anaea johnsoni*.

On the hind wings the coloration of the lighter band is clearly seen in the front part between the more shaded brownish areas which form inwardly a more irregular outline than in either *glycerium* or *cratais*, again not unlike the pattern of *titan*. It should be kept in mind that the general coloration of the female of the new *Anaea*, as compared with *titan* Feld., is of a distinct russet color and not of the ochre yellow tinge predominant on the front wings of the latter. The tails on the fourth vein are as long or even longer than in *glycerium*.

The under side of the wing in the female is like that in the male but lighter; the arcuate shadows of a motley purple-brown are more clearly indicated. It may be described as occupying an intermediate position between *glycerium* and *cratais* with regard to this reticulation, or, to be more specific, intermediate between *glycerium* and that particular form of *cratais* which is not characterized by the presence of silvery white spots. In one of the three females, a suffusion of dark specks is concentrated into scattered spots as in some individuals of *cratais*.

Discussion: This new *Anaea*, which should be placed close to *cratais* and suggests a few traits of *ryphaea* Cr. and *eurypyle* Fld. in the general characteristics of the dark apical part, has a facies distinct from *glycerium* for which it apparently was taken by former investigators who recorded the latter species from Jamaica. The initial mistake was made by Godman and Salvin in the "Biologia Centrali-Americana" and perpetuated in later writings like those by Kaye and other authors. Through the courtesy of Mr. Johnson, photographic prints showing two specimens from Jamaica in the Godman and Salvin collection and in the Hewitson collection of the British Museum were made available to us for examination. Both male and female are typical *Anaea johnsoni* although they are erroneously labeled *Anaea glycerium*. The under side of the male bears a silvery white spot near the front edge of the hind wings, similar to an analogous maculation found occasionally in *cratais*. The apices of the front wings in these specimens seem not to be so strongly falcate as in those taken by us in Jamaica. It may be a case of seasonal variation which happens to be manifest in some instances in other species of the genus.

Anaea "*glycerium*" was recorded by Kaye from the Blue Mountain region, a different part of the island from the habitat of our new *Anaea*. A

painting in water color by Miss Lilly Perkins of a Jamaican *Anaea* looks, in the outline of the front wings, suspiciously like a true *glycerium*. Could it be possible that the true *glycerium* is also existing on the island after all? Incidentally, attention should be drawn to the fact that Seitz, in the volume on American Butterflies (Pl. 118, in line c), figures what is apparently a *cratais*, or another related form, which closely resembles the new *Anaea*. The apical portion in that figure is closer to that in *johnsoni* than it is in the other figure of *glycerium* on Seitz' plate, which is correctly identified as to the species but is erroneously labeled "female" when it actually is a male. Mr. Wm. P. Comstock has kindly drawn my attention to these facts.

Altogether six specimens of this new *Anaea* were collected by us. Paratypes of both sexes of this species are preserved in the collection of Mr. Frank Johnson, a specimen of the male having been taken previously.

Telegonus roysi sp. nov. (Pl. XXXVI, fig. 12, ♂)

Related to *Telegonus cubana* Mabille-Boullet, described in Ann. Sci. Nat. (zool.) Paris (ser. 9), vol. XVI, p. 77, 1912. Size smaller than *cubana*. Body dark brown, scales at tip of body only faintly lighter. Wings somewhat elongated and narrow; upper side dark brown, of a darker tint than *cubana*. The two dark bands on the front wing are narrower and less perceptible than those in *cubana*. The external band runs in a straight line from the second to the fourth vein and is very faintly indicated in the apical part. The band in the discus crosses the discocellular. The hind wings are uniformly dark brown without any indication of the band. The bases of the wings and the thorax do not show the ochre brown hair covering which is typical for *cubana*. The fringes on both wings are dark, without any trace of ochre color at the lower angles of the hind wings. On the reverse side the ground color is dark brown with a faint indication of the pattern on the front wings. The hind wings show two dark brown bands, discal and antemarginal, indicated by a slight suffusion of dull ochreous scales on the rest of the surface of the wing. The antemarginal dark bands are not accentuated outwardly by the ochreous outline typical for *cubana*. One specimen, a male, was caught by Chester Roys at Bath in the month of March. This new species is described in his honor.

Discussion: Roswell C. Williams, Jr., figures a female of *cubana* from Jamaica on pl. 34, fig. 5, in "Transactions of the American Entomological Society," vol. 53, 1927. It shows a distinct yellowish fringe on the hind

wings, a light tip of the body and a well marked yellowish outline of the dark antemarginal base on the reverse of the hind wings, with a special accentuation of this light pattern in the portion of the wing near the hind angle. These characters are absent in the insect described here as *Telegonus roysi* and distinguish specimens of *cubana* found not only on the island of Cuba, but also on the island of Haiti, as it is represented by a specimen from the latter island in the Holland collection of the Carnegie Museum. This individual, collected by Chipman, is practically identical in every respect with the one figured by Williams, including the characteristic reverse of the hind wings and the light fringes. The new Jamaican insect shows some resemblance to *Telegonus anausis* Godman and Salvin, described (Proc. Zool. Soc. London, 1896, p. 519) from St. Vincent, Grenada, Dominica, and Hispaniola. There is an authentic specimen of *anausis* in the Carnegie Museum in a collection acquired from Sir Frederick Ducane Godman. It was taken by H. H. Smith on St. Vincent in the Lesser Antilles.

This form, *Telegonus anausis*, it may be said is in a way related both to the present new species from Jamaica and to *cubana* with which it has more affinity. It differs from *roysi* in having a light tuft at the end of the body, a touch of ochre in the fringe, and an ochreous spot at the lower outside edge of the dark antemarginal band of the reverse side of the hind wings. On the upper side it shows the ochre-brownish covering of the basal portion of both wings, typical for *cubana*. On the other hand it differs from *cubana* by a restriction of the ochre scales in the fringes and on the reverse of the hind wings. This *Telegonus anausis* compares closely with another specimen in the collection of W. J. Holland, from "Venezuela," without further designation of locality. The upper side is very similar to the specimen from St. Vincents, but the reverse shows the dark bands on both wings projecting on a lighter background. The dark bands on the hind wings are accentuated by the lighter scalloped marking, but the fringes are dark. This Venezuelan form agrees well in characteristics with *Telegonus alpistus* Mabille, described in "Genera Insectorum," Fasc. 17, p. 25, Hesperidæ, 1903, from Santa Catharina, Brazil. The description calls for the yellowish scalloped outline of the band and seems to be of a form not unlike a larger form called *ampyx* Godman in Seitz, p. 167, b. This latter insect shows, however, less of the ochreous suffusion on the reverse and is entirely unlike the true *ampyx*, as figured, from the only specimen then known to the authors, in "Biologia Centrali-Americana," pl. 77, figs. 11, 12. The true *ampyx* has a distinct light

marginal patch at the lower angle of the reverse of the hind wings which are much rounder in shape.

The describer of *alpistus* compares this species with *Telegonus anaphus* Cramer which shows, in this latter group of forms, the maximum in the spread of the ochreous tint on the hind wings. Mr. Marston Bates in his "Butterflies of Cuba," published in 1935, refers to *cubanus* as a subspecies of *anaphus* and not of *alpistus* as was done by the joint describers of the Cuban insect. Roswell Williams shared the view of Bates, in a tentative way, by treating *Telegonus cubana* as a good species, but advancing the opinion that it is "probably an insular race of *anaphus*."

It was deemed proper to review all these references to related forms. According to this grouping, *alpistus*, *cubana*, *anausis*, and the form figured as *ampyx* by Seitz, belong to one close cycle. *T. anaphus* seems to be somewhat on the periphery of the cycle with an extreme development of the yellow. On the opposite periphery of the cycle stands the new *roysi*, as the smallest and darkest of all, with an absence of ochreous markings on the reverse of the hind wings and with a peculiar absence of hairlike shiny ochre-brown scales on the base of both pairs of wings on the upper side.

A problem which remains unsolved at the present is the relationship of this new *Telegonus* to the insect from Jamaica figured by Williams as *cubana*. The form reproduced on the plate by Williams seems to be sufficiently well fitted into the conception of *cubana*, so that it appears improbable that it could be correlated specifically with *Telegonus roysi*. If *cubana* is to be considered not as an independent systematic entity but merely as a race of *anaphus*, we shall have to apply the same criterion to *roysi* and thus come to the misleading conclusion of accepting two local races of the same species in Jamaica. It seems justifiable to consider this group as being composed of a set of closely related but distinct specific entities with two species found on Jamaica, namely the true *cubana*, which is practically indistinguishable from this insect from the other Greater Antilles, and another divergent dark member of this group, *Telegonus roysi*. Further investigations and more abundant material will be necessary to settle this question with certitude, but meanwhile the best possible course is to assign to *roysi*, at least provisionally, the taxonomic position of a valid species. It deserves this position better than the rest of the group which are characterized by a peculiar suffusion of hairy scales with a glossy golden sheen which do not show on the uniformly dark background of *roysi*.

A comparative study of the armature of the male in related forms supports these considerations. *T. roysi* shows the greatest development of the sculptured points covering the internal process of the harpa. This feature may be considered a distinguishing character in the various forms. In *anausis*, *jaira* Butler, *galesus* Mabille, and *anaphus*, the points are relatively less developed. The points on the process are particularly well developed in *roysi* and *cubana* and in the more remotely affiliated species *chiriquensis* Staudinger. Only *T. roysi* shows an occasional double formation of these points and the whole process is altogether heavier than in any other form of *Telegonus*. There is another character which is diagnostic for *roysi;* namely, the extremely obtuse points of the harpæ approximate a right angle closer than in any other form of *Telegonus*. Although the armatures in *roysi* and *cubana* closely resemble each other with respect to this angle, nevertheless the size, heaviness, and exaggerated sculpture of the process in *roysi* is sufficent to distinguish it from *cubana*.

Grateful acknowledgement is due Mr. Ernest L. Bell and Mr. William P. Comstock for their helpful suggestions and their courtesies in pointing out the affinities of this form to *anausis* and *cubana*.

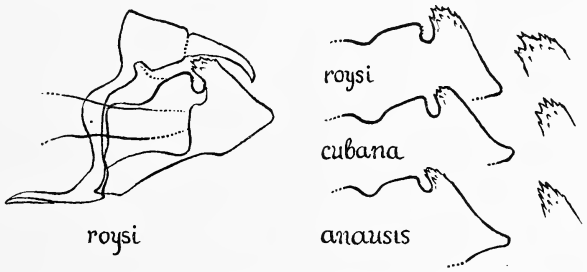


FIG. 1. Genital armature of male of *Telegonus roysi* sp. nov., compared with related forms.

Choranthus lilliae Bell, ♀ (Pl. XXXVI, figs. 10, ♂; 11, ♀)

Choranthus lilliae Bell, Entomological News, vol. 42, Oct., 1931, pp. 220-222, fig. of male genitalia.

The female is distinctly different in aspect from the male. Upper wings are dark brown without any trace of the russet coloration in the discocellular observed in the male. The pattern is reduced to three russet maculæ of a somewhat lighter tinge than in the male. They are arranged in the following fashion: between the second and third veins there is a triangular marking, and a smaller one above it between the third and

fourth veins. There is a faint indication of russet streaks between the fifth and seventh veins. These two units of marking, mesial and apical, do not constitute a continuous band as in the male, but are distinctly interrupted by the dark coloration of the background of the wings. The hind wings are more or less uniformly dark brown with a slight tinge of a reddish coloration in the center part of the wing.

On the under side, both sexes are more closely alike. The band of spots in the mesial part of the front wings is lighter and composed of more clearly separated patches. The tint of these spots is much lighter than in the male. The discocellular shows a touch of the russet coloration. A characteristic of the female, as compared with the male, is the uniform tone of the dark cilia of both wings which are marked by a russet tinge in the male in the hind corners of the wings. The unique specimen is unfortunately in a poor state of preservation, the wings being partly torn on one side. The female of this rare species was captured, with a few males, in the Blue Mountains at Cornpuss Gap, near Bath. In addition, *lilliae* was found also in the Cockpit Country at Warsop and Belmore Castle. This species is extremely difficult to catch, being shy and apparently having excellent vision. It may occasionally be found sitting on some isolated leaf or branch and at the slightest sign of danger it flies straight upward to some inaccessible part of the crown of a neighboring tree.

Rhinthon thermae Kaye, ♂ (Pl. XXXVI, fig. 13, ♂)

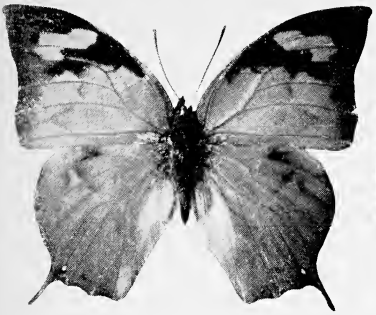
The female was described by Kaye in "Transactions of the Entomological Society of London," 1925, p. 495, on the basis of one female specimen in his collection. Mr. Kaye refers to another specimen in the collection of the Institute of Jamaica. The male is figured in "Transactions of the Entomological Society," vol. 79, 1931, plate 39, fig. 14. The male, of which we secured a few specimens, differs from the female as follows: both pairs of wings are narrow and elongated, especially the front wings. The pattern of the transparent spots is similar to the one in the female. These spots are smaller. The patch between the second and third vein is somewhat rhomboid. The transparent patches in the median cell are reduced to two elongated maculæ divided by a black streak, instead of the three confluent marks in the female having an E shape as noted by the describer. Besides Bath, where this species was originally discovered, and later on found by us, *Rhinthon thermae* also occurs in other parts of the island, namely at High Gate and Cave River, in the vicinity of the Cockpit Country.

EXPLANATION OF PLATE XXXVI

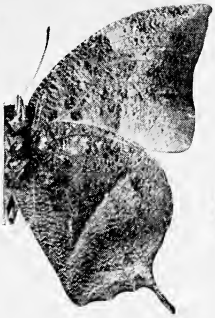
New and undescribed Jamaican butterflies.

All figures are of natural size.

FIG.	1.	*Nathalis iole* ab. *albida* nov. ♂	
"	2.	" " " " " ♀	
"	3.	*Anaea johnsoni* sp. nov. ♂	Upper side.
"	4.	" " " " ♂	Under side.
"	5.	" " " " ♀	Upper side.
"	6.	" " " " ♀	Under side.
"	7.	*Chlosyne pantoni* Kaye ♀	Upper side.
"	8.	" " " ♀	Under side.
"	9.	" " " ♂	
"	10.	*Choranthus lilliae* Bell ♂	
"	11.	" " " ♀	
"	12.	*Telegonus roysi* sp. nov. ♂	
"	13.	*Rhinthon thermae* Kaye ♂	



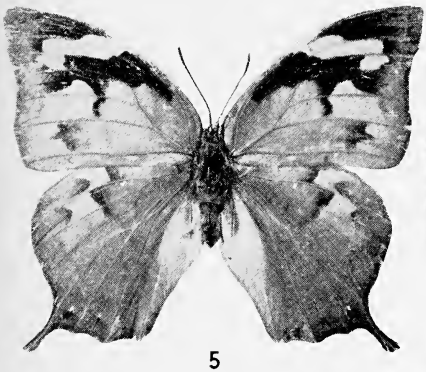
3



4

10

11



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ART. XVI. SCOLECODONTS FROM THE WINDOM, MIDDLE DEVONIAN, OF WESTERN NEW YORK

By E. R. Eller

(Plates XXXVII-XXXVIII)

While pursuing his studies of the geology and paleontology of western New York, Dr. Irving G. Reimann of the Buffalo Museum of Science found a single specimen of a scolecodont or fossil polychaete jaw. He found the jaw on the surface of a piece of concretionary material from near the base of the Windom Member, Moscow Formation, Hamilton Group of the Devonian on White Creek near East Bethany, New York. He called my attention to this discovery and together we examined the locality thoroughly for additional jaws. No other specimens, however, were detected in the field or on the surface of the several hundred pounds of material collected. The impure limestone layer, in which the scolecodont was found, is of a concretionary structure with phosphatic nodules. It dissolves very slowly in weak acid, resulting in a residue of muddy, silicious material with some pyrite crystals. An occasional jaw was found in this residue. The thin distinctive layer was traced to Bowen Brook, two and one-half miles northwest of Alexander, to Murder Creek near Darien, and to several other localities. Farther east, on Little Beard Creek at Leicester, and on Fall Brook near Geneseo, and at many other outcrops of the Windom through and east of the Finger Lake district, it was not possible to find this particular layer. Several concretionary layers were found near the base of the Windom but none had the phosphatic nodules. However, a large amount of material was collected from each of the localities visited and jaws were recovered from White Creek, Bowen Brook, Murder Creek, Little Beard Creek, and Tichenor Gully on Canandaigua Lake. The jaws were secured by dissolving the matrix in a five percent solution of hydrochloric acid. More than thirty gallons of concentrated acid were diluted to dissolve the several hundred pounds of rock. This procedure was mostly accomplished in the laboratory by Mr. David Seaman and the writer is most appreciative of his help. The

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residue was carefully searched and about one complete or broken specimen was recovered in a day's work. In all, eighty-eight good specimens and perhaps an equal number of broken ones were found.

The specimens are distributed among fourteen new species, four known forms and two which are identifiable only generically. Several other questionable forms were neither figured nor described. The jaws, in general, are very small, measuring from .13 to .87 mm. in length. As in other scolecodont faunas, the writer (1934, 1938, 1940) has found one dominant species (in the present collection it is *Nereidavus harbisonæ* m.), which seems to be represented by twice as many as any other. The scolecodont fauna from the Windom of New York has four species that are found in both the Widder beds and the Olentangy shale of Ontario, and two in the Silica Shale of Ohio. Perhaps when more is known of these faunas, correlations of the beds may be made. One species is found also in the Potter Farm Formation of Michigan.

A large number of ostracod valves were found in the residue, especially in that from the Bowen Brook locality. Long, soft, fibrous structures with horizontal lines are common in some of the residue. These are found in single strands or in closely bound bundles. A single strand measures less than .05 mm. in diameter and is often transparent, with thickened margins. There are also suggestions of pores on some of the strands. Very interesting, soft, rubbery, black, hollow, spherical objects, less than .2 mm. in diameter, are common in much of the limestone. Often they are found as flattened discs. The writer will not attempt to determine their nature. Hinde (1879) mentioned that his Middle Devonian jaws of Canada were found associated with the spores of Lycopods. It is possible that they may be egg-cases. Acid does not affect them. On first examination it was thought that the objects were some sort of a fungus growth on the surface of the rocks, but since they are also found imbedded, it is probable that they are not of recent origin. Other microscopic forms recovered, which have passed through a twenty mesh sieve, are gastropods, bryozoans, two species of pteropods, and some sponge spicules.

The author makes grateful acknowledgment of financial aid received from the Academy of Natural Sciences of Philadelphia and the Department of Geology of Princeton University which enabled him to carry on the field work upon which this paper is based.

The holotypes of the species described in this paper are at the Carnegie Museum; the paratypes have been divided between the Academy of Natural Sciences of Philadelphia and Princeton University.

DESCRIPTION OF SPECIES

Genus NEREIDAVUS, Grinnell, 1877

Nereidavus harbisonæ sp. nov.

Maxilla I, plate XXXVII, figs. 1, 2, 4, 5.

The asymmetrical right and left jaws are long and narrow, and measure from .23 to .8 mm. in length, with the average about .5 mm. From ten to fifteen small, sharp, triangular-shaped denticles extend along about one-half the length of the inner margin. The denticles begin about one-third the distance from the anterior end and gradually increase in size posteriorly. A large fang is curved backward, oblique to the plane of the lower surface. The inner margin is nearly straight but incurves abruptly to the fang. The outer margin curves irregularly but is generally parallel to the inner margin. The left and right jaws differ fundamentally at the posterior end. The posterior end of the right jaw is irregularly truncate, while the left jaw is indented by a small, shallow bight. This difference in the posterior end of the left jaw radically changes the shape of the fossa from a wide, deep cavity at the anterior end to a narrow but fairly deep cavity at the posterior end. The fossa of the right jaw is wide and deep anteriorly but becomes slightly convex or flattened posteriorly. This shallowness is reflected on the lower surface of the right jaw. A wide, well rounded margin surrounds the fossa of both left and right jaws. The upper and lower surfaces of both left and right jaws are generally convex but have many irregular concave areas. One of the concave areas often begins close to the fang and continues along the outer margin giving it the appearance of a ridge.

Two species, *Nereidavus invisibilis* Eller (1940) and *Nereidavus perlongus* Eller (1934), similar to *Nereidavus harbisonæ*, were described by the writer from the Silurian at Niagara Gorge, New York, and from the Upper Devonian near Alfred Station, New York. In both these species the left and right jaws were described. In the present collection, and in the two mentioned above, the majority of the specimens are jaws of this type and there is about an equal number of right and left jaws in all three. *Œnonites aspersus* Hinde (1882) is similar to *Nereidavus harbisonæ*, in a general way but differs in the character and arrangement of the denticles and in the size of the fang. Zebera (1935) described two species, *Arabellites perneri* Zebera and *Arabellites kittneri* Zebera, which are probably related to *Nereidavus harbisonæ*, but since the posterior ends are missing, no comparison can definitely be made. The forms most closely related to *Nereidavus harbisonæ* were described by Stauffer from the Hamilton group of Ohio and Ontario. *Nereidavus ontarioensis* Stauffer (1939) is similar to the left jaw of *Nereidavus harbisonæ* and

Nereidavus planus Stauffer (1939) to the right jaw. There are, however, several principal differences between these forms. In *Nereidavus harbisonæ* the jaw is more narrow, the denticles are less in number and begin more posteriorly, the fang much longer, thinner and more hooked, and the bight on the posterior end of the left jaw is not so deep.

The specific name is given to this new species in honor of Miss Helen D. Harbison in appreciation of her interest in paleontological research.

Nereidavus hamulus sp. nov.

Maxilla I, plate XXXVII, fig. 3.

The jaw is long, widens centrally, and narrows to an acute posterior extremity. A typical jaw measures .6 mm. in length. Along the straight inner margin six denticles extend only to the mid-point of the jaw. The first two denticles begin close to the fang and are sharp, conical, and point in a forward direction. The remaining four are rounded, perpendicular to the margin, and decrease in size posteriorly. The fang is small and only slightly hooked. The outer margin curves gently from the fang to the posterior. A wide, deep, triangular-shaped fossa is limited to the posterior third of the jaw. The margin of the fossa is thickened and well rounded. The upper and lower surfaces of the jaw are convex but may be slightly concave at various places, especially on the lower side.

Jaws of this type have been described, by the writer and others, under the following genera: *Arabellites*, *Œnonites*, and *Nereidavus*. This is probably due to the very broad definitions of the various genera. For the present, this species will be placed under the genus *Nereidavus*. No other forms correspond very closely to this species. *Nereidavus antiquus* Hinde (1880) has an anterior end similar to *Nereidavus hamulus*. The posterior extremity, including the fossa, of the right jaw of *Nereidavus invisibilis* Eller (1940) resembles *Nereidavus hamulus*. The fang, the denticles and their arrangement suggest a similarity between *Nereidavus perlongus* Eller (1939) and *Nereidavus hamulus*. The outline of the jaw and fossa of *Œnonites peraculus* Eller (1940) and *Arabellites plenidens* Eller (1940) are somewhat like *Nereidavus hamulus*.

GENUS ŒNONITES, Hinde, 1879

Œnonites excavatus sp. nov.

Maxilla II, plate XXXVII, figs. 6, 7.

The jaw is small, wide anteriorly, and tapers to an acute posterior extremity. On the convex lower surface a series of nine, very sharp, thin,

conical, backward directed denticles extend the full length of the jaw. The first denticle is of medium size, the second very large, followed by one or two small ones. The remaining denticles are large and at the posterior end suddenly decrease in size. The inner margin is nearly straight, while the outer margin is straight or slightly curved from the anterior and then forms an abrupt angle about midway and becomes nearly straight to the posterior end. The upper surface is taken up completely by the fossa which is wide at the anterior but becomes very narrow posteriorly. The fossa is deep but becomes shallow along the outer margin. The thickened margin of the fossa is wide and well rounded. Each specimen measured .36 mm. in length.

This form does not resemble any other very closely. *Œnonites levis* (Eller, 1940) is, perhaps, the nearest species, but it has the suggestion of a shank on the outer margin and the fossa is not similar at all.

Œnonites tenuis sp. nov.

Maxilla II, plate XXXVII, fig. 8.

The jaw is narrowly elongate and measures .35 mm. in length. A series of seven, large, conical, slightly hooked, backward directed denticles extend along the straight inner margin to the acute posterior end. The fang is very thick, short, and not particularly hooked. The outer margin is straight and parallel to the inner margin. A long, narrow fossa extends nearly the full length of the jaw. The margin of the fossa is thickened and rounded. Both the upper and lower surfaces are convex.

Except for the number and size of the denticles, *Œnonites parvulus* Hinde (1882) resembles *Œnonites tenuis* in a general way. *Œnonites grandidentatus* Eller (1934) is similar to *Œnonites tenuis* in its length, narrowness, and the type of denticles, and fossa.

Œnonites cadwaladeri sp. nov.

Maxilla II, plate XXXVII, figs. 9, 10.

The jaw is elongate, narrow, and tapers to an acute posterior extremity. In length the jaw measures .6 mm. On the inner margin twelve, large, sharp, conical, backward directed denticles extend to the posterior end. The first denticle is large and is followed by two very small ones. The following denticles are large but decrease in size posteriorly. The outer margins are straight and parallel. On the upper surface a narrow, deep fossa extends the full length of the jaw. Its margins are thickened and rounded. The upper surface is slightly concave between the fossa and the denticles while the lower surface is convex.

The interesting feature of this beautiful and unique species is the large

size of the denticles in proportion to the narrowness of the jaw. There are no particularly close relationships with this form except, perhaps, *Œnonites grandidentatus* Eller (1934) and in this case only in a general way.

At the suggestion of Professor B. F. Howell, it gives me pleasure to name this species in honor of Dr. Charles M. B. Cadwalader, President of The Academy of Natural Sciences of Philadelphia, in appreciation of his encouragement and his support of this research.

Genus ILDRAITES, Eller, 1936

Ildraites bowenensis sp. nov.

Maxilla I, plate XXXVII, figs. 19, 20.

The jaw is wide anteriorly and tapers to a narrow posterior extremity. The length of an average specimen is .65 mm. On the gently curved inner margin a series of ten, rather large, conical, backward directed denticles extend nearly to the posterior end. There is very little or no space between the denticles. The first denticle, or fang, is short, heavy, and slightly oblique to the lower surface of the jaw. There is only a small space between the fang and the series of denticles. The outer margin incurves slightly to form a short, heavy shank. A wide, shallow bight emphasizes the width and shortness of the shank. The fossa is wide, not deep, of medium size, and extends from the end of the shank to the posterior extremity. The margin surrounding the fossa is heavy and its edges are well rounded. The upper surface of the jaw is convex, while the lower one is slightly concave or flattened.

Arabellites anglicus Hinde (1880) is somewhat like *Ildraites bowenensis* except that the denticles are of a different character and the shank is not similar. *Arabellites dauphinensis* Stauffer (1939) appears to resemble, in a general way, *Ildraites bowenensis* except that the denticles, position of the hook in relation to the surface of the jaw, and the shape and position of the shank do not correspond.

Ildraites howelli sp. nov.

Maxilla I, plate XXXVII, figs. 11, 12, 15, 16.

The jaw is small and narrowly sub-triangular in shape. Measurements of the length range between .25 and .58 mm., with an average of about .44 mm. The inner margin is gently curved from the short, heavy fang. Along the inner margin is a series of twelve to fourteen, small, conical, backward directed denticles which begin just adjacent to the fang and which extend to the posterior end. The first five or six denticles are very

small while the remaining seven or eight are larger. The outer margin incurves abruptly to a medium sized shank. A shallow, crescent-shaped bight on the outer margin emphasizes the width of the shank. Only two-thirds the length of the jaw is occupied by the rather small fossa. The outer margins of the fossa are thickened and well rounded. The upper and lower surfaces are mostly convex, but there are some small, slightly concave areas near the margins and denticles.

Hinde (1882) described a species, *Arabellites anglicus* Hinde, from the Silurian of Gotland, in which the size and number of denticles remarkably resemble *Ildraites howelli*. They differ mostly in the width of the jaw and in the position and size of the shank and fossa. *Arabellites priscus* Stauffer (1939) resembles *Ildraites howelli* in a general way, but Stauffer's species differs in that it has more denticles, a greater width of jaw, a larger fang set at a different angle, and a shank that is oblique to the surface of the jaw. *Arabellites howelli* is somewhat like *Arabellites bowenensis* m. but the number and character of the denticles, and the shape and position of the shank are not the same.

Ildraites anatinus (Stauffer)

Maxilla I, plate XXXVII, figs. 17, 18.

Arabellites anatinus Stauffer, 1939, Jour. of Paleon., vol. 13, no. 5, p. 501, pl. 58, figs. 40-42, 50.

The jaw is large, wide at the mid-area, and tapers to an acute posterior extremity. The largest specimen measured .87 mm. in length. On the nearly straight inner margin a series of conical, closely set, backward directed denticles extend to the end of the jaw. They are not large and do not decrease very much in size posteriorly. The series of denticles is set usually in a uniform row, but the angle of incline may change from horizontal through nearly a complete arc in relation to the lower surface of the jaw. The fang is large, distinctly hooked, and may be in an oblique position to the lower side of the jaw. The outer margin is broadly curved from the fang to about two-thirds the length of the jaw where it is notched by a shallow, angular bight. A short, wide fossa beginning opposite the denticles extends to the posterior extremity. The fossa is deep near the margins but quite shallow in the central area. The margin of the fossa is narrow and rounded, and on the inner margin it forms a distinct ridge. The upper and lower surfaces of the jaw are convex except at the posterior end of the lower side where they are concave.

In his description of this species, Stauffer (1939), remarked that "This type of jaw falls under Hinde's genus *Arabellites*, and the species here described is very similar to one of his from the Silurian of Gotland. If,

however, they are maxillae I, as they appear to be, they are so different from the more normal form of the genus that they should be separated from it." In 1936 the writer did separate forms of this type under a new genus, *Ildraites*, and therefore feels justified in placing this species under that genus. The specimens figured by Stauffer from the Hamilton of Ontario seem to be precisely like the New York forms except that the fang of the latter is longer and thinner.

Ildraites anomalus sp. nov.

Maxilla I, plate XXXVII, figs. 13, 14.

The jaw is long, angular, and wide at the central area but tapers to an acute posterior end. The inner and outer margins are irregular. In length the jaws measure from .5 to .6 mm. On the straight part of the inner margin is a series of five to seven, irregular, medium sized, backward directed denticles that extend to the posterior extremity. A large, slightly hooked fang is curved obliquely to the lower surface of the jaw. The outer margin curves irregularly to a small shank which is notched by a shallow, crescent-shaped bight. A wide fossa begins at about the midpoint of the jaw and extends into the narrow posterior end. The fossa is deep near the margins but shallow in the center due to the reflection of a concave area on the lower side. The wide, heavy margins of the fossa are well rounded. The upper and lower surfaces are irregularly convex with many concave areas.

Since this species resembles *Ildraites anatinus* (Stauffer 1939) in most respects, on first examination the writer considered these jaws to belong to that form but believed they had been distorted in some way, thus giving them their rather abnormal appearance. However, after examining several specimens it was decided that they are somewhat different in several respects. In *Ildraites anomalus* the jaw is uniformly smaller and narrower, the number of teeth is less, and the bight is crescent-shaped rather than angular as in *Ildraites anatinus* (Stauffer 1939). Hinde (1882) described a species, *Arabellites spicatus* Hinde, that resembles this form in a general way. *Arabellites marcellusensis* Eller (1934) from the Hamilton Group near Canandaigua, New York, resembles *Ildraites anomalus* except for the number of denticles, size of the shank, depth of the bight, and character of the margins. *Ildraites anatinus* (Stauffer 1939) is somewhat like *Ildraites anomalus* except for the difference in the width of the jaw (including the shank) and the character of the fang and margins. *Ildraites peramplus* Eller (1940) is similar only in a general way to *Ildraites anomalus*.

Genus LUMBRICONEREITES, Ehlers, 1868

Lumbriconereites clavatus sp. nov.

Maxilla II, plate XXXVIII, figs. 1, 2.

The jaw is sub-triangular in outline and tapers to an acute posterior extremity. In length the jaw measures .38 mm. A series of ten, conical, backward directed denticles is located on the lower surface and extends to the posterior end. The denticle line is curved anteriorly but becomes straight posteriorly. The inner margin is straight from the anterior to a shank, the acuteness of which is accentuated by a deep crescent-shaped bight. The outer margin is gently curved to a small, angular shank and straight to the posterior end. A narrow, deep fossa extends about three-quarters the length of the jaw. The margin of the fossa is thickened and rounded. The lower surface of the jaw is concave, except for the ridge on which the denticles are situated and the thickened margins. The upper surface is convex.

Some of the varieties of *Lumbriconereites falciformis* Hinde (1882) are similar to *Lumbriconereites clavatus* in some ways. The inner margin and the arrangement of the denticles may be considered as corresponding. The outer margins are not at all alike.

Genus EUNICITES, Ehlers, 1868

Eunicites seamani sp. nov.

Maxilla III or IV, plate XXXVIII, figs. 3-5.

The jaws are small, irregularly oblong and rounded in outline. Measurements of the length range from .13 to .26 mm. From five to six, conical or blunt, usually closely set denticles are present on the inner margin. The first, and often the last, denticle is much sharper than the others. A large, wide fossa takes up almost the complete upper surface, leaving only a small concave area near the denticles. The margins of the fossa are slightly thickened and rounded. The lower surface is irregularly convex with a curved ridge in the central area. In all specimens examined no two outer margins were the same.

These jaws have many individual differences but they resemble each other in most respects. They do not resemble any other form of *Eunicites* except in a general way.

Eunicites sp. indet.

Plate XXXVIII, fig. 6

Only one specimen of this form of jaw or forceps was found in this collection and, since it may not be complete, the writer hesitates to describe it at this time.

Eunicites turgidus sp. nov.

Maxilla II or III, plate XXXVIII, figs. 8, 9.

The jaw is triangular in outline, wide anteriorly, and tapers to a blunt posterior end. On the straight inner margin, a series of ten or eleven, small, blunt, conical denticles extend about three-quarters the length of the jaw. The first denticle may be either a straight continuation of the anterior margin or slightly hooked. In length, the jaws measure from .25 to .37 mm. The anterior margin is straight and wide, while the outer margins are curved. A deep, large, wide fossa extends from the anterior to the posterior end. The margin of the fossa is thickened and rounded, if present. The upper surface of the jaw is highly convex while the lower one is slightly concave or flattened.

Most of the outer margins of the specimens were found in a broken condition, but a few nearly complete ones made a description possible. Except for a general likeness, there is not enough similarity between these jaws and those of other species of the genus to make comparisons necessary.

Genus LEODICITES, Eller, 1940

Leodicites scitulus sp. nov.

Maxilla II, plate XXXVIII, figs. 14, 15

The shape of the jaw is triangular; the length is .35 mm. Along the slightly curved inner margin a series of six, sharply pointed, conical denticles extend nearly to the blunt posterior extremity. The denticles, with the exception of the first two, are uniform in size. A small, curved first denticle is followed by a large, straight second denticle. All but the first denticle usually point in a backward direction. Toward the posterior end the denticles may decrease slightly in size. The anterior margin is fully rounded from the first denticle to the pointed shank. A deep, crescent-shaped bight on the outer margin emphasizes the curvature and acuteness of the shank. The fossa is shallow and very wide. It extends from a point opposite and close to the second denticle and from nearly the end of the shank to the posterior extremity of the jaw. A margin with rounded edges, especially thick at the anterior and inner sides, surrounds the fossa. The lower surface is concave at the anterior end and flattened or slightly convex at the posterior end. The upper surface is highly convex at the anterior end but becomes less so posteriorly.

Leodicites scitulus does not resemble closely any other species. *Arabellites ferox* Hinde (1882) is similar in some respects, but the position and shape of the fossa are different and the curvature of the shank is dissimilar. Except for the shank, there is a resemblance between the lower

surface of the species, *Arabellites magnificus*, described by Stauffer (1939) from the Widder Beds of Ontario. Stauffer's figures show only the lower side so a complete study cannot be made. The fossa, and in some specimens the shank of *Leodicites variedentatus* Eller (1940), resembles *Leodicites scitulus*. They differ greatly, however, in the number and character of the denticles and in the length of the jaw.

Leodicites magnificus (Stauffer)

Maxilla II, plate XXXVIII, fig. 7.

Arabellites magnificus Stauffer, 1939. Jour. of Paleon., vol. 13, no. 5, p. 503, pl. 57, fig. 7, pl. 58, figs. 1, 14.

In outline the jaw is triangular; the anterior and outer margins are almost at right angles. Measurements of the length range between .28 and .37 mm. Along the straight inner margin a series of seven or eight, sharply pointed, conical denticles extend practically to the posterior extremity. The denticles usually point in a backward direction, and are of various sizes. The first denticle is usually quite small, the second large, thin, and hooked. These first two are followed by denticles of various sizes which decrease toward the posterior end. The anterior margin is nearly straight and terminates in a long narrow shank which is almost at right angles with the jaw. The outer margin is slightly incurved. The fossa is wide and deep and extends almost the full length of the jaw. A thin margin with rounded edges is present around the fossa. The upper surface is highly convex while the lower one is slightly concave.

The forms described by Stauffer (1939) from the Devonian of Ohio and Ontario seem to resemble the New York specimens in all respects. Stauffer figures, however, only the lower sides of the jaws, but from the descriptions it is probable that the upper side is the same.

Leodicites reimanni sp. nov.

Maxilla II, plate XXXVIII, figs. 10-13.

The jaw is triangular in shape and measures .32 to .56 mm. in length. A series of ten to thirteen conical to triangular, often blunt, denticles extend almost the full length of the slightly curved inner margin. The denticles are not uniform in size and do not point backward or always in the same direction. The first denticle or the first and second denticles are small and point forward. They are followed by a large, powerful denticle that usually curves backward. One or two smaller denticles follow the third one. The remaining denticles are large and decrease in size to the posterior end. The anterior margin is nearly straight from the first

denticle and then is slightly incurved to form a wide but pointed shank. A shallow, crescent-shaped bight on the outer margin emphasizes the width of the shank. The fossa is narrow and deep, and extends from about the end of the shank to the posterior extremity. A thickened margin with well rounded edges is present on all sides of the fossa. The upper surface is highly convex but irregular. The lower surface is concave along the inner margin and slightly convex at the outer margin.

There are a number of species described under the genera *Arabellites*, *Leodicites*, and *Eunicites*, that may be compared with this form. *Arabellites similis* Hinde (1879) is not as wide as *Leodicites reimanni*, but has a similar arrangement of the denticles. The anterior margin of *Eunicites cristatus* Hinde (1882) is quite different from that of *Leodicites reimanni*, but otherwise the two species have a general likeness. *Arabellites contritus* Stauffer (1933) resembles *Leodicites reimanni* in many respects, especially in the character and arrangement of the denticles. *Leodicites reimanni* is almost identical with *Leodicites variedentatus* Eller (1940) except for the width and length of the jaw. Only a general likeness is discernible between *Leodicites scitulus* m. and *Leodicites reimanni*.

Genus STAUROCEPHALITES, Hinde, 1879

Staurocephalites truncatus sp. nov.

Maxilla I or II, plate XXXVIII, fig. 18.

The jaw is elongate and measures from .68 to .85 mm. in length. On the convex lower surface a series of eighteen, small, sharp, conical, backward directed denticles extend nearly to the posterior end. The first denticle is slightly larger with a long straight upper edge. The next two or three denticles may be small. The remaining denticles are quite uniform in size but may decrease slightly at the posterior end. The anterior end is irregularly broad and obliquely truncate. The posterior extremity is rounded. Both inner and outer margins are thin and are broken. The lower surface is slightly concave on each side of the denticles and convex at the anterior and posterior ends. The fossa occupies the complete upper surface of the jaw and is deep in the center toward the denticles but shallow at the margins.

Hinde (1879) described a genus, *Staurocephalites*, based on "Jaws of more or less elongated, compressed, denticulate plates, resembling those of the existing genus *Staurocephalus*, Grube." Stauffer (1933) added that the "Anterior tooth is slightly larger, and is followed by a series of gradually diminishing teeth, all directed backwards." After reviewing the various species described under the genus, the writer feels that one of the most important characters is that region at the anterior part of the jaw

where the margin is obliquely truncate to the first denticle. The inner and outer margins of most of these species seem to be thin and are usually broken. The genotype, *Staurocephalites niagarensis* Hinde (1879), is similar to *Staurocephalites truncatus* in a general way. In 1880 Hinde described *Staurocephalites serrula*, based on three variable specimens, but later, (1882), he placed this species in the genus *Eunicites*. One of these specimens, Hinde (1880), plate XIV, fig. 20, possesses the characters of the genus *Staurocephalites* and has a slight resemblance to *Staurocephalites truncatus*. Stauffer (1933) described two species, *Staurocephalites acutidentatus* Stauffer and *Staurocephalites dentatus* Stauffer which resemble *Staurocephalites truncatus*, since the obliquely truncate anterior denticle arrangement and the uneven inner and outer margins are somewhat similar.

Genus ARABELLITES, Hinde, 1879

Arabellites hamiltonensis (Stauffer)

Maxilla I, plate XXXVIII, figs. 19, 20.

Protarabellites hamiltonensis Stauffer, 1939. Jour. of Paleon., vol. 13, no. 5, p. 509, pl. 57, figs. 22, 23; pl. 50, figs. 35, 36.

The jaw is irregularly oblong in shape. A series of seven to nine, conical, backward directed denticles is located on a narrow, elevated area nearly parallel to the inner margin. The space between the denticles and the inner margin is concave. The first denticle, which is small, is followed by larger ones which gradually decrease in size to the wide, obtuse, posterior extremity. The denticles incline toward the inner margin. The elongate fang, the tip of which often points toward the posterior, is oblique to the lower surface. The inner margin is nearly straight and has a heavy, rounded edge. The outer margin is nearly straight from the sharp hook of the fang to the posterior end. A large, wide fossa occupies nearly two-thirds of the area on the upper surface. It is deep along the inner margin and anterior part but rather shallow centrally and posteriorly. The upper and lower surfaces are convex with irregular concave areas. Typical specimens average .6 mm. in length, but one specimen measured 1.26 mm. and supported eleven denticles.

For the present, this species is being removed from the genus *Protarabellites* and placed in the genus *Arabellites*. In the writer's opinion, the form described above does not conform entirely with Stauffer's definition of the genus *Protarabellites*. The various species described by Stauffer (1933) under *Protarabellites* are not similar to *Arabellites hamiltonensis* (Stauffer) (1939) except for a flange on the inner margin. The

number and arrangement of the denticles, the anterior part, and the fang do not correspond at all. There are some slight differences between Stauffer's specimens from Ohio and Ontario and the New York forms. In the specimens described in this paper the positions of the fang and the denticles are not quite so oblique to the lower surface and the jaw is wider, especially at the posterior end. *Arabellites hamiltonensis* (Stauffer, 1939) is similar to *Arabellites spicatus* var. *contractus* Hinde (1880) from the Wenlock of England, later changed to *Arabellites contractus* Hinde (1882), in the description of the forms from the Silurian of Gotland. *Arabellites hamiltonensis* (Stauffer, 1939) has a straighter margin, a wider fossa, and a longer and thinner fang. If the flange on the inner margin of *Arabellites robustus* Stauffer (1939) is broken, then it somewhat resembles *Arabellites hamiltonensis* (Stauffer, 1939). Except for the greater width of the jaw and fossa, and the more hooked fang of *Arabellites hamiltonensis* (Stauffer, 1939), it resembles in many ways *Arabellites rectidens* Eller (1940).

Arabellites comis Eller

Maxilla I, plate XXXVIII, figs. 16, 17.

Arabellites comis Eller, 1938. Annals, Carnegie Museum, vol. 27, p. 227. pl. 28, fig. 9.

Arabellites comis Stauffer, 1940. Jour. of Paleon., vol. 13, no. 5, pp. 501-502, pl. 58, figs. 21, 22, 28.

The fang and the denticles of *Arabellites comis* Eller (1938) from the Potter Farm Formation of Michigan differ slightly from those of the forms figured in this paper and those described by Stauffer (1939) from Ontario. The New York forms measure .6 mm. in length and the inner margin bears from nine to eleven denticles, the posterior ones being very small.

Arabellites (?) sp. indet.

Maxilla I, plate XXXVIII, fig. 21.

This fragment of the anterior end of a jaw is that of the only large sized form found in the fauna. The very unusual wide thin keel situated on the fang makes this specimen extremely interesting. The writer heretofore has not met with a jaw having a structure of this kind. Placing the form under the genus *Arabellites*, is purely a guess and is a temporary arrangement. The fragment measures .65 mm. in length and if complete would probably be more than 4 mm. in length.

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EXPLANATION OF PLATE XXXVII

Figures magnified about 53 times.

Numbers in parentheses at the right indicate the Carnegie Museum catalogue numbers of the respective specimens.

FIGS. 1, 2. *Nereidavus harbisonæ* sp. nov.
Maxilla I, right jaw (22590).
Fig. 1. Under side.
Fig. 2. Upper side.

FIG. 3. *Nereidavus hamulus* sp. nov.
Maxilla I, right jaw, upper side (22642).

FIGS. 4, 5. *Nereidavus harbisonæ* sp. nov.
Maxilla I, left jaw (22589).
Fig. 4. Upper side.
Fig. 5. Under side.

FIGS. 6, 7. *Œnonites excavatus* sp. nov.
Maxilla II, left jaw (22612).
Fig. 6. Upper side.
Fig. 7. Under side.

FIG. 8. *Œnonites tenuis* sp. nov.
Maxilla II, right jaw, under side (22608).

FIGS. 9, 10. *Œnonites cadwaladeri* sp. nov.
Maxilla II, left jaw (22620).
Fig. 9. Under side.
Fig. 10. Upper side.

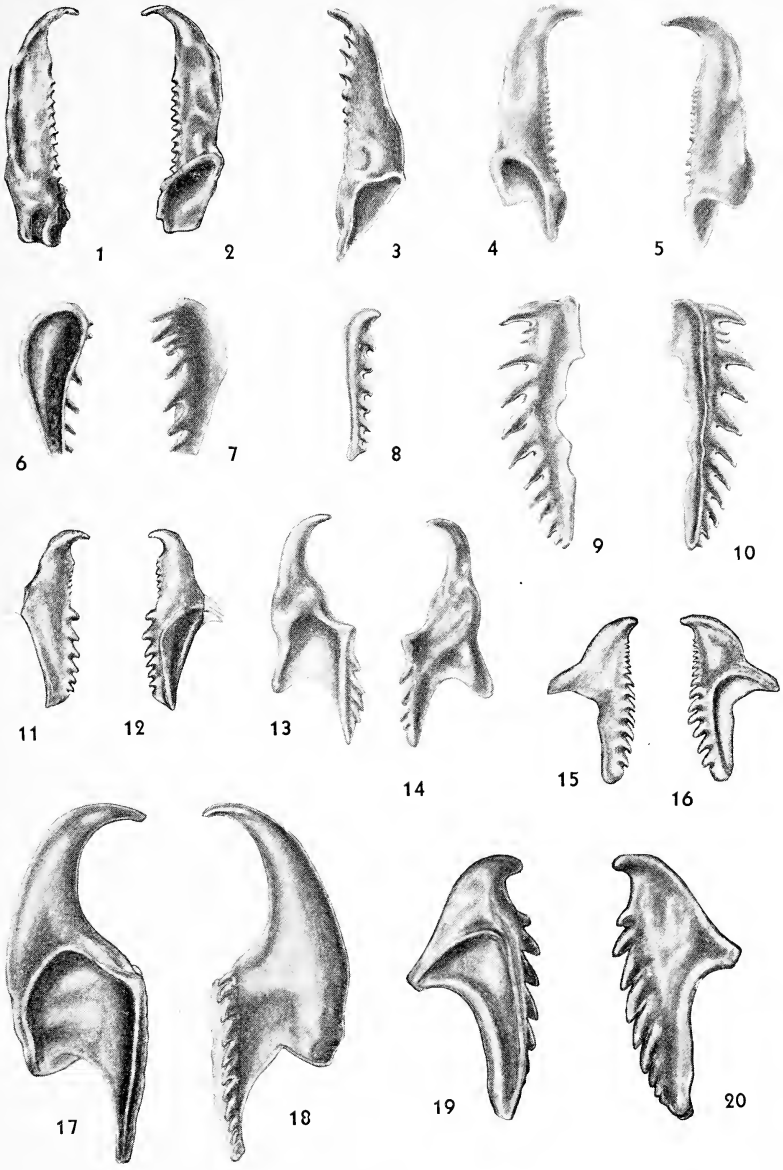
FIGS. 11, 12. *Ildraites howelli* sp. nov.
Maxilla I, right jaw (22646).
Fig. 11. Under side.
Fig. 12. Upper side.

FIGS. 13, 14. *Ildraites anomalus* sp. nov.
Maxilla I, left jaw (22629).
Fig. 13. Upper side.
Fig. 14. Under side.

FIGS. 15, 16. *Ildraites howelli* sp. nov.
Maxilla I, right jaw (22645).
Fig. 15. Under side.
Fig. 16. Upper side.

FIGS. 17, 18. *Ildraites anatinus* (Stauffer)
Maxilla I, left jaw (22616).
Fig. 17. Upper side.
Fig. 18. Under side.

FIGS. 19, 20. *Ildraites bowenensis* sp. nov.
Maxilla I, left jaw (22606).
Fig. 19. Upper side.
Fig. 20. Under side.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EXPLANATION OF PLATE XXXVIII

Figures magnified about 53 times.

Numbers in parentheses at the right indicate the Carnegie Museum catalogue numbers of the respective specimens.

FIGS. 1, 2. *Lumbriconereites clavatus* sp. nov.
Maxilla II, left jaw (22641).
Fig. 1. Upper side.
Fig. 2. Under side.

FIGS. 3, 4. *Eunicites seamani* sp. nov.
Maxilla III or IV, right jaw (22609).
Fig. 3. Under side.
Fig. 4. Upper side.

FIG. 5. *Eunicites seamani* sp. nov.
Maxilla III or IV, left jaw, under side (22610).

FIG. 6. *Eunicites* sp. (22652).

FIG. 7. *Leodicites magnificus* (Stauffer)
Maxilla II, left jaw, under side (22631).

FIGS. 8, 9. *Eunicites turgidus* sp. nov.
Maxilla II or III, right jaw (22643).
Fig. 8. Under side.
Fig. 9. Upper side.

FIGS. 10, 11. *Leodicites reimanni* sp. nov.
Maxilla II, left jaw (22622).
Fig. 10. Upper side.
Fig. 11. Under side.

FIGS. 12, 13. *Leodicites reimanni* sp. nov.
Maxilla II, left jaw (22621).
Fig. 12. Upper side.
Fig. 13. Under side.

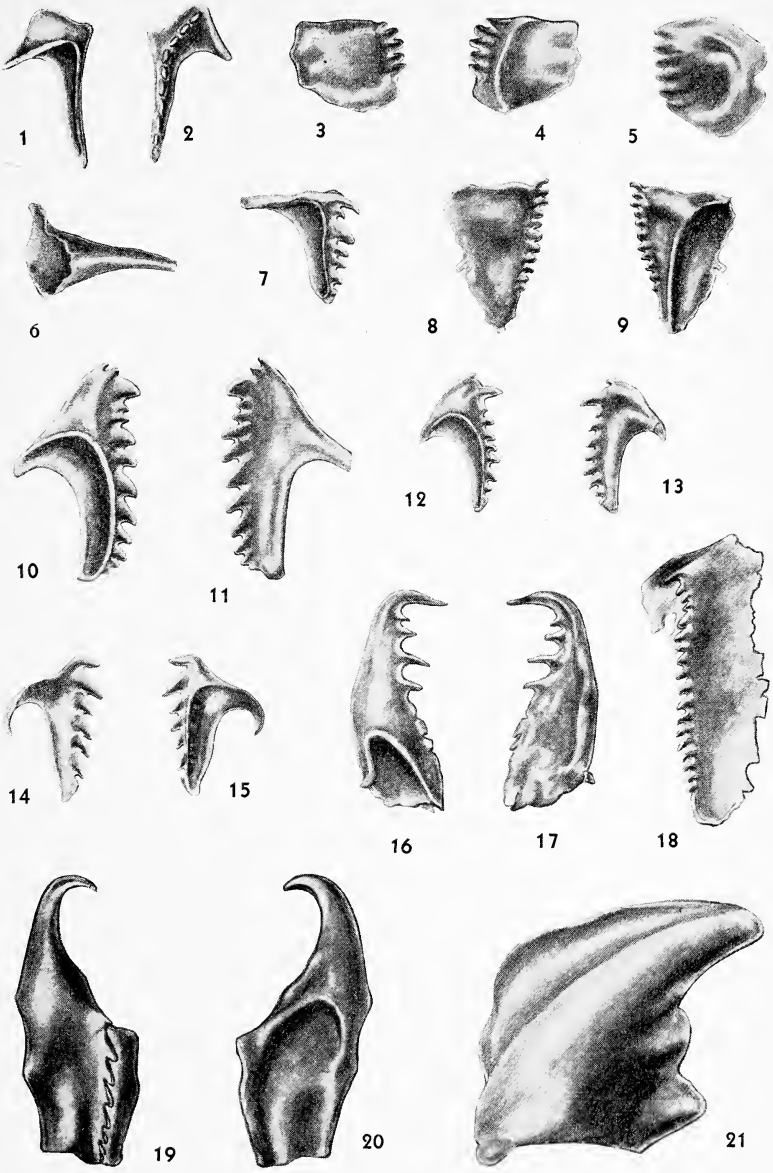
FIGS. 14, 15. *Leodicites scitulus* sp. nov.
Maxilla II, right jaw (22607).
Fig. 14. Under side.
Fig. 15. Upper side.

FIGS. 16, 17. *Arabellites comis* Eller
Maxilla I, left jaw (22614).
Fig. 16. Upper side.
Fig. 17. Under side.

FIG. 18. *Staurocephalites truncatus* sp. nov.
Maxilla I or II, left jaw, under side (22618).

FIGS. 19, 20. *Arabellites hamiltonensis* (Stauffer)
Maxilla I, right jaw (22633).
Fig. 19. Under side.
Fig. 20. Upper side.

FIG. 21. *Arabellites* (?)
Maxilla I, (22644).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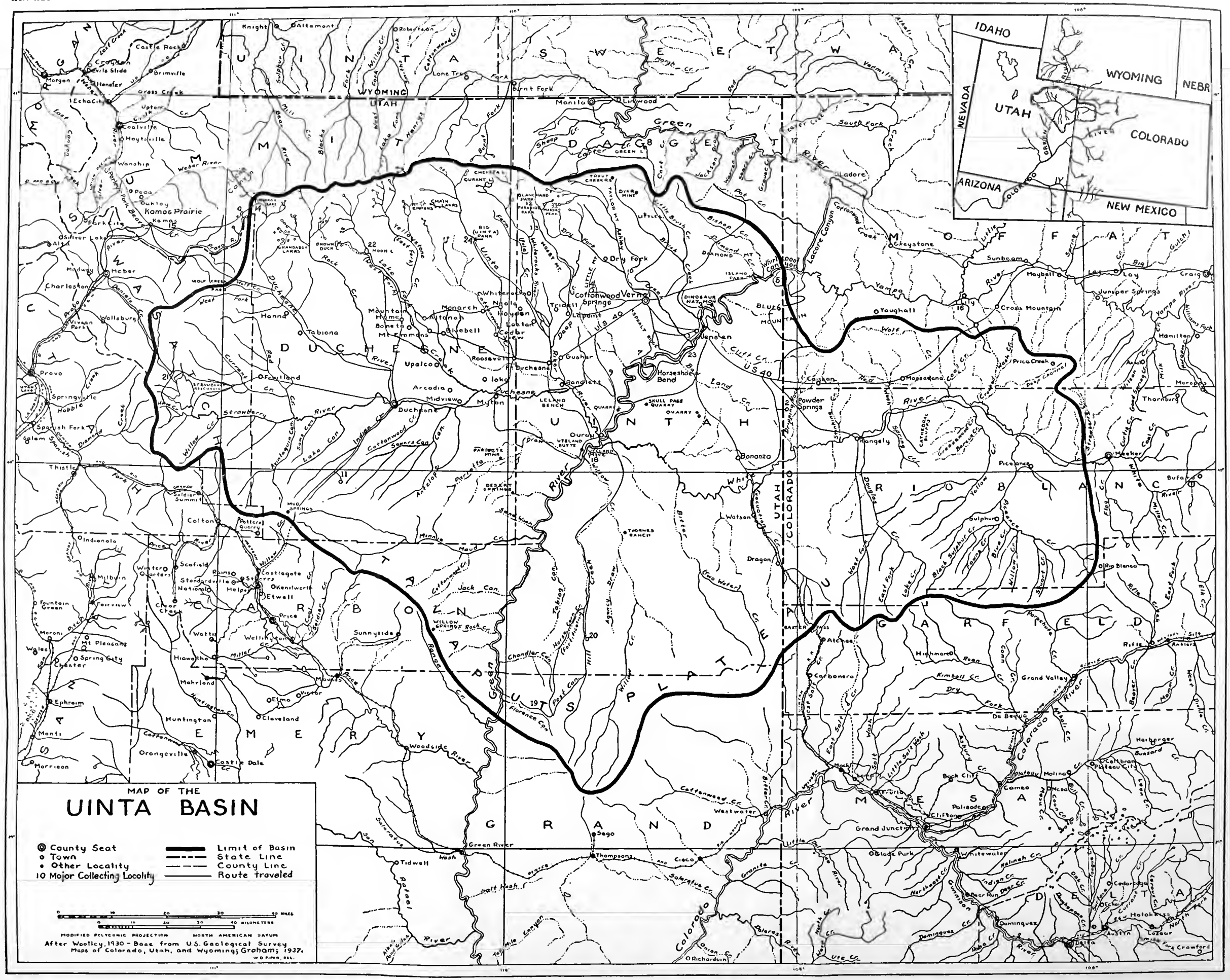

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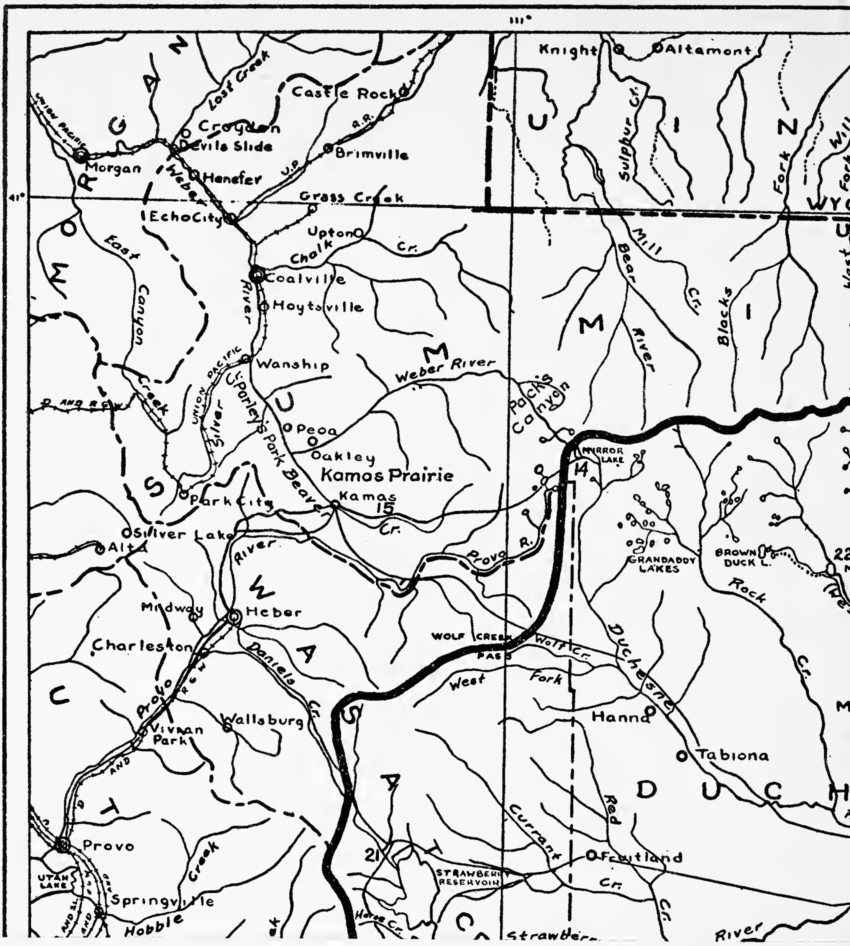
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Wanship
Weber River
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Park City
Silver Lake
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Midway
Heber
Charleston
Wallsburg
Vivian Park
Provo
Springville
Utah Lake
Hobble Creek
Wolf Creek Pass
West Fork
Duchesne
Hanna
Tabiona
Fruitland
Currant Cr.
Strawberry Reservoir
Mirror Lake
Grandaddy Lakes
Brown Duck L.
Rock Cr.
Provo R.
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ART. XVII. THE BIRDS OF THE UINTA BASIN, UTAH

By Arthur C. Twomey

(Plates XXXIX-XLIX)

Introduction

The limitations and apparent isolation of the Uinta Basin, and its position as the focal point of a large number of species of birds from the east, west, north, and south, made this area a most desirable point for intensive and systematic field work in ornithology. The present paper is based on the Carnegie Museum Expedition to the Uinta Basin in the summer of 1937, although the one season spent in the Basin cannot be considered as a complete and exhaustive study.

The study of the birds of the region was undertaken partly because of the wide interests of the various sections of the Carnegie Museum in the Basin. For many years extensive paleontological investigations have been carried out, as well as studies in the fields of botany, mammalogy, entomology, herpetology, and conchology. In 1937, Dr. Edward H. Graham published a report of his botanical studies. The remaining studies will appear as separate publications in the "Annals of the Carnegie Museum" and will constitute a biological survey of a restricted area set off by natural physiographic features that make of the Uinta Basin a unit in the intermontane area of the United States.

The expedition of 1937 was the first ornithological survey of the area as a unit. Previous to this, Mr. A. C. Lloyd collected intensively around the vicinity of Jensen, concentrating his efforts on the Ashley Creek marshes two miles south of Jensen. He also made a few trips south and north of Vernal. This work was conducted between May 18 and May 30 and from July 20 to August 11 in 1934, and April 23 to August 24 in 1935.

During the expedition made by the author in 1937, as many of the plant communities as possible were visited. The area, as had been suspected, proved to be a zone of intergradation between many western races of birds. The extensive work of Graham (1937) on the botany of the region has greatly helped the present author in his evaluation of the communities.

Issued January 19, 1942.

ITINERARY

The writer arrived in the Uinta Basin on April 30, 1937, and established a base camp at the Ashley Creek marshes, two miles south of Jensen. During the period from April 30 to June 14, trips were made to Powder Springs, Diamond Mountain, Dinosaur National Monument, Blue Mountain, Cottonwood Springs, Horseshoe Bend, Green Lake, and Ashley Canyon.

Mrs. Twomey joined the expedition on June 12. On June 16 we broke camp at Ashley Creek and started for Indian Canyon, twenty miles southwest of Duchesne. From June 17 to 20 we camped at Indian Canyon. From June 20 to 28 we worked out from Vernal to Jensen, Ashley Canyon, Powder Springs, Blue Mountain, and Cottonwood Springs. From June 29 to July 5 we established a camp at Green Lake and worked over the immediate vicinity. Here Miss Ruth Trimble joined us, remaining until July 10. We returned to Vernal on July 6 for supplies, and from July 7 to 10 we camped at Paradise Park. July 11 to 15 was spent in Vernal. From July 16 to 21 we camped at Bald Mountain northeast of Kamas. From July 22 to 27 we traveled from Vernal to the Yampa River north of Elk Springs, Colorado, and Beaver Creek, northwest of Ladore, Colorado. From July 28 to August 9 we worked at Ouray, Florence Canyon, Hill Creek, and Ashley Creek marshes. Between August 10 and September 9 trips were made to Brigham City, Strawberry Reservoir, Moon Lake, Powder Springs, Bonanza, Rangely, Uinta Canyon (Big Uinta Park), Utah Lake, and Heber. From September 11 to 15 we worked from our camp at Green Lake. We set up a base camp again at the mouth of Ashley Creek between September 16 and 30. We left the Basin on October 3, and from October 4 to 25 we collected further in central and southern Utah at Fish Lake, Cedar City, St. George, Pine Valley Mountains, Santa Clara, Beaver Dam Mountains, Kanab, and north of New Harmony. On October 26 we started back for Pittsburgh, Pennsylvania.

GEOLOGY OF THE UINTA BASIN

The Uinta Basin is an area of great interest to geologists and paleontologists. Consequently, its delimitations have been defined many times and on a whole, these definitions have been fairly consistent. For the purposes of this paper the following discussion covers the existing ideas and delimits the Basin as a unit in the intermontane area of the United States. On the north the Basin is bounded by the main east-and-west

range of the Uinta Mountains. The western spur of the Uintas merges with the divide at the headwaters of the Duchesne and the Strawberry river drainage on the west. The whole southern boundary is sharply marked by the southern escarpment of the Tavaputs Plateau which breaks off into the Brown Cliffs. This includes the whole drainage system of streams running north into the Strawberry, Duchesne, and White rivers east as far as Piceance Creek. The eastern limits of the Basin are not so distinct. Graham (1937, p. 25), in speaking of the floristic composition and physiographic considerations, says: "The extreme eastern end of the Basin is the only place in which the boundary is not strictly defined by drainage . . . In the east we arbitrarily consider the Basin to be limited by the ridge west of Government and Sheep creeks, Colorado and, northward, by the Gray Hills west of Strawberry Creek, Colorado. While this limitation excludes the upper White River and its tributaries, such a limit seems topographically justified. By certain floristic distinctions also, this boundary is the apparent transition area between the desert conditions of the Basin to the west and the more mesophytic conditions of the Rocky Mountain foothills to the east. From this eastern limit, including the westward drainage of the Citadel Plateau, the boundary of the Basin swings westward into the divide at the head of the south-flowing tributaries of the White River."

The Green River transects the entire Basin from north to south, cutting through the Uinta range on the north and the Tavaputs Plateau to the south. The river runs in a south-southwesterly direction and is the master stream for the entire drainage system of the Basin.

As a basis for the existing communities in the Basin, the geological formation of the area and the present exposed surface is of significance. Graham (p. 31) found no correlation of the vegetation with the underlying geological formation. Rather the altitudinal communities conform with altitudinal limits despite the parallel series of both formations and vegetation along the south slopes of the Uinta Mountains. He states: "Where environmental factors, such as rainfall, temperature, length of growing season, etc., begin to vary with difference in elevation, the geological formation, even though composed of a homogeneous soil, has still less influence upon the vegetative cover." There were, however, numerous local edaphic factors within their altitudinal limitations that affected directly the vegetative cover, such as the preference of *Juniperus utahensis* for gravel, and *Kochia vestita* (Gray Molly) for highly alkaline soil.

Geologically speaking, the Uinta Range was formed by an immense up-

lift during the late Cretaceous period. The movement that produced this great fold was accompanied by little fracturing and by no intrusion of igneous rocks. During the Tertiary and in recent times erosion has been a most active agent in breaking down the structure. At the eastern end of the comparatively uniform fold preexisting Archaean rocks have tended to complicate the geology at this point (Emmons, 1878). To the south the Basin is limited by the uplifts of the La Sal Mountains and San Rafael Swell, which were active in late Tertiary or early Quaternary times. On the east it is confined by the Rocky Mountains and their foothills; on the west, by the Wasatch Mountains, which were thrown up during the general uplift that elevated the high plateaus of Utah, Wyoming, and Colorado, at about the time of the La Sal and San Rafael swell uplifts.

The establishment of Green River as the master stream of the region has been a point of conjecture. Forrester (1937, p. 660) states "that a major uplift of the Uinta Range took place in late Eocene or early Oligocene time." This was accompanied by large scale faulting and in late Tertiary or early Quaternary time there was another uplift, which was "shown by a marked entrenchment of the meandering Green, Yampa, and other master rivers of the region. It is now generally accepted that the Green River and its tributaries are later in their development than the first Uinta Mountain uplift . . . . that is, the Green and the Yampa rivers, in order to maintain their courses, must have been established before this last major uplift began; and this, as has been brought out, had been done at the close of Browns Park (Pliocene) time." Later investigations place Browns Park in Miocene time. Recent fault slips in the area show tectonic action still to be in progress (Peterson and Kay, 1931, p. 298).

There was extensive glaciation in the Uinta Mountains in the Pleistocene that greatly modified the topography, but other parts of the Basin were not affected. Atwood (1909) brings out the fact that there were at least two periods of glaciation. The earlier one was the longer and extended down the canyons of the south slopes of the Uintas to 7000 and 8000 feet. This investigator (1909, p. 65) states: "At the period of the maximum extension of ice, glaciers covered by far the greater portions of the Uinta Mountains west of longitude 109° 40′ and a few extended beyond the mountains into the lower country north and south . . . The total area covered by ice was somewhat over 1000 square miles. The portions of the range that rose above the ice near the crest line were lofty peaks and narrow, rugged divides. On the flanks of the range the areas not covered

by ice lay between the great canyons . . . The longest glacier was 27.5 miles long, the shortest independent glacier was 1.5 miles long." Glacial lakes are very numerous in the Uintas. Many occur in chains because of the blocking of recessional moraines.

For the convenience of comparison with the vegetational map of the Basin, Pl. XLIX, the Geological map, Pl. XLVIII by Kay (1934), indicates the main geological formations and the approximate present surface cover, although it does not cover the entire Basin.

DISTRIBUTION AND COMMUNITIES

The Uinta Basin, constituting a wide range of community relationships, is made complex by the presence of altitudinal variations that result in complete climatic changes as far reaching in their component biotic relationships as major biomes. The present study covered only a portion of one year with emphasis upon the avian population and its relationship and distribution to the plant communities of the Basin. Studies at the Carnegie Museum in other taxonomic groups are progressing which, when completed, will give evidence to evaluate the biotic communities under existing bio-ecological concepts.

Ecologists recognize in the tundra, coniferous forest, deciduous forest, etc., a landscape aspect that represents a natural unit. The value of these units, called biomes, cannot be overemphasized by the ecologist. This concept is also worthy of application by the ornithologist.

In a consideration of these terrestrial biomes, vegetation is the dominant or controlling element of the community, whereas animals, in general, are constituents which exert an influence on the community, in varying degree, depending mainly on their abundance, habits, and size. Within these natural units there are developmental or subordinate communities that occur in a definite order of succession which is known as a "sere." In the later development of this succession, sub-climax communities are formed. The last community of such a succession is the climax, which is characterized by the life form of the dominants and is self-perpetuating.

The use of the life-zone concept of Merriam (1898) is used by ornithologists in discussing the general distribution of birds. Grinnell (1914) made an attempt to bring the life-zone concept into harmony with the modern ecological viewpoint. His work, however, was conducted in a mountain dominated region where the life-zones and biotic communities are generally in agreement.

An actual analysis and a discussion of life-zones is not within the scope

of this paper, but it will suffice to say that they have been criticized from the experimental side by Kendeigh (1932), Shelford (1932), and Daubenmire (1938). The final conclusion of Kendeigh (1932, p. 142) states rather precisely the general criticism of this concept: "The life-zone concept, in order to survive, must be based upon the actual distribution of important and significant animals and plants in nature and not upon climatic factors of uncertain preconceived importance." Pitelka (1941) discusses the distribution of birds in their relation to the major biotic communities. Certain species conform fairly well with the limits of biotic communities—for example, the ptarmigan in the tundra biome and the spruce grouse in the coniferous forest biome. On the other hand, many species are not confined to the climax, but rather are sub-climax in position, or as in the cases of the Gray Ruffed Grouse and Sharp-tailed Grouse, are characteristic of seral stages and spread over several biomes.

The ecological niche[1] that a species requires is identifiable with some life form of plant which it will not occupy outside of its normal range if other physical factors exceed the limits of the species' tolerance. Pitelka remarks: "In addition to niche requirements, agreements in distribution with climax communities may represent approximately similar ranges of tolerance to climatic factors." In his summary (p. 135) he brings out several important facts that should be considered critically by the ornithologist:

"Correlation of birds with vegetation reveals no relation to specific dominants or groups of dominants of a single biome; consistent correlation, however, occurs between species and life forms of plants.

"In species ranging over several biomes variation tends to show correlation with climatic factors; among species confined to one major community variation appears to be effected by geographic and biotic factors."

Merriam (1898), Clements (1920), Tidestrom (1925), Cottam (1929, 1933), Dixon (1935), and Graham (1937), have studied the plant components of the altitudinal zones of western North America and of local areas therein, with results that on the whole are fairly consistent; although in many instances where differences occur, they are due to local variations in the areas studied. Graham (1937) evaluated the plant communities of the Basin; he did not attempt to distinguish between climax and seral stages and treated them both as associations.

[1]The term *niche*, in referring to a species, entails an intensive study of environmental relations. It is understood to mean simply the environment characteristically frequented by the species.

The following table compares the plant components of the altitudinal zones as used by these men with the present treatment.

	TWOMEY (Present treatment)	GRAHAM, 1937	DIXON, 1935	MERRIAM, 1898
13,500′				
11,000′	Sieversia-Carex Community	Alpine	Alpine Meadow Alpine Scrub	Arctic-Alpine
10,000′	Picea-Abies Community	Spruce-Fir	Sub-Alpine Forest	Hudsonian
8700′	Pinus-Vaccinium Community	Lodgepole Pine	Montane	Canadian
8000′	Populus-Rosa Community	Aspen	Pinus ponderosa	
7000′	Artemisia-Cercocarpus Community	Sub-montane Shrub		Transition
5500′	Juniperus-Pinus Community	Juniper-Pinyon	Pinyon	Upper Sonoran
4500′	Mixed Desert Shrub Community	Mixed Desert Shrub	Northern Semi-Desert Northern Desert Alkali Association	
3000′				Lower Sonoran

For uniformity and lack of sufficient seasonal and qualitative studies of the sere, the term community will be used in the evaluation of avian-plant components of the climax and sere in this paper.

Birds usually are considered to be minor influents in the community, but for the purposes of this paper some will be considered as influents because of their abundance, habits, and size. Migrations, fluctuations in abundance, territorial selection, survival, food relations, etc., all make the evaluation of a bird in its community a difficult problem, at least for the present.

Situated in northeastern Utah, bordering southwestern Wyoming and northwestern Colorado, the Uinta Basin is surrounded on all sides by high

mountain rims or high plateaus. Yet these barriers do not exert any appreciable influence on the general migration or distribution of the avian fauna of the area. The Basin really affords several avenues of migration which under certain conditions may form invasion points of range extensions.

From the south the main migration routes follow up from the Colorado River by way of the Green River, which cuts a deep valley across the Book Cliff Mountains, through the Basin and finally through the Uinta Mountains. The whole drainage system of the Basin proper is into the Green River, and during migrations such forms as *Zonotrichia leucophrys leucophrys*, *Zonotrichia leucophrys gambeli*, *Melospiza lincolni lincolni*, and *Melospiza lincolni alticola*, appear in mixed flocks. Many of the *Zonotrichia l. leucophrys* and *Melospiza l. alticola* pass up the drainage systems of the Basin to the high altitude communities to nest, while *Zonotrichia l. gambeli* and *Melospiza l. lincolni* follow the Green River migration route north, on out of the Basin. Likewise, during the autumnal migration, many of the local nesting migrants follow the drainage system down to the Green River and meet the main body of the northern migrants returning to the south.

In the west, the Provo River opens a migration route through the Wasatch Mountains to the western extremity of the Basin and the western extension of the Uinta Mountains.

During the early spring migration there is a surprising influx of such birds as the Black-necked Stilt, Avocet, and White-faced Glossy Ibis into the Green River floodplain. Just what route they take into the Basin is not clear. They remain in the Basin proper only during May, and by the first week of June they disappear. The nearest nesting concentrations of these species are at Great Salt Lake (Great Bear marshes) and Utah Lake. In their flight out of the Basin they probably move west up the valley of the Duchesne River to Strawberry Reservoir, and then over one of the lower passes into the Great Salt Lake drainage system, where they nest. Another route is from the regions of Strawberry Reservoir west over a low pass into the central Provo valley. From here they can move north and northwest down the valleys of the Weber and Bear rivers into the Great Salt Lake drainage system. The watercourses of the Uinta Basin afford avenues of migration and penetration into or through the Basin which conform with existing migration lanes and distributional boundaries.

The Basin has a wide range of communities, mostly altitudinal, and as a result, a large number of avian forms. Because of its geographic position

the Basin is an area where the ranges of western, eastern, and Rocky Mountain forms meet. There has resulted considerable overlapping of adjacent ranges and a consequent hybridization of such birds as *Junco caniceps* < *J. mearnsi*, *Pipilo maculatus montanus* < *P. m. arcticus*, *Loxia curvirostra benti* < *L. c. grinnelli*, and *Lanius ludovicianus excubitorides*, which shows an influence from *nevadensis* and *gambeli*.

Western birds whose ranges cross the Basin as far east as Colorado are the Gray Flycatcher, Gray Titmouse, Audubon Hermit Thrush, and the Black-throated Gray Warbler. Western birds that reach the eastern extremity of the Rocky Mountains are the Treganza Heron, White-faced Glossy Ibis, Western Red-tailed Hawk, Black-chinned Hummingbird, Batchelder Woodpecker, Ash-throated Flycatcher, Hammond Flycatcher, Wright Flycatcher, Desert Horned Lark, and Townsend Solitaire.

Rocky Mountain forms that reach their western limits at the Wasatch Mountains are the Dusky Grouse, Howell Nighthawk, Natalie Sapsucker, Rocky Mountain Hairy Woodpecker, Rocky Mountain Jay, Rocky Mountain Creeper, Rocky Mountain Pine Grosbeak, and Alpine Three-toed Woodpecker. Eastern birds that reach as far west as the Wasatch are the Eastern Belted Kingfisher, Red-headed Woodpecker, and American Redstart. Southern birds whose range limits extend as far north or into the Uinta Basin are the Western Nighthawk, Western Mockingbird, Western Gnatcatcher, Scott Oriole, Arkansas Goldfinch, and Spurred Towhee. Birds whose distribution is primarily north of the Basin, but whose ranges, in their southern extremities, reach into the Basin, are the Sennett Nighthawk, Black Rosy Finch, Pale Goldfinch, and the Pink-sided Junco. The Basin may then be considered to be situated in an intergradational zone where the breeding ranges of a large number of geographical forms meet. Although the mountains act as barriers for some, the low passes through the mountains tend to eliminate any altitudinal barrier. The barrier to the west beyond the Wasatch is principally the low hot desert stretch of the Great Basin, which extends from the Wasatch to the Sierra Nevada mountains. To the north, east, and south the comparative uniformity of the mountain ranges, their long, low valleys that approximately parallel the direction of migration (north and south), and the cleaving by large drainage systems of the east and west mountain ranges, such as the Uinta and the Book Cliffs, permit the passage of avian forms (and further invasion) under favorable circumstances. An example of an invasion resulting in extension of a breeding range is that of the Scott Oriole. This is a bird of the hot semi-arid country, where it is most

abundant in the lower oak forests of the mountain foothills in southwestern New Mexico and Arizona. The Scott Oriole probably follows the low valleys between the mountains from southwestern Utah (where it has been reported in the Beaver Dam Mountains) to the hot, dry arid region south of the Book Cliffs. Then following the Green River valley, it has made its way into the Basin where, at Powder Springs, it has found a near equivalent of climate and community relationships in the Juniperus-Pinus Community.

The Western Mockingbird also has extended its range north into the Basin, probably following the Green River valley. Inside the Basin this bird has found favorable environmental conditions at the lower edge of the Juniperus-Pinus Community. Tanner (1936) reports that the Western Mockingbird has moved north from the valley of the Virgin River. It has been found nesting west of the Wasatch Mountains just north of Utah Lake. The present records from the Uinta Basin extend its range to the northeastern corner of the state.

In the Uinta Basin the distribution of avian species conforms with the plant communities, showing very little variation throughout the area. There are some instances, however, of discontinuous altitudinal variations in habitat preference. But when these occur, there is a wide physiological adaptability of certain forms to comparatively wide altitudinal ranges. Even so, the preference for certain vegetational forms and the presence of invasion avenues make the discontinuous ranges possible. The Meadowlark and the Sage Thrasher are particularly abundant over the lower Atriplex-Tetradymia and Artemisia communities at from 4500 to 5500 feet. In numerous places on the south slope of the Uinta Mountains and the Tavaputs Plateau, deep valleys enabled these birds to follow through a scattering of *Artemisia* to the Sub-montane Shrub Community. At 8000 feet on the Artemisia flats of the Blue Mountain Plateau, they were found nesting in large numbers. On the Tavaputs Plateau sage thrashers were encountered with immature birds in the Artemisia communities at 9000 feet.

1. Mixed Desert Shrub Community

This is a complex community with an altitude of from 4500 to 5500 feet. The annual rainfall is between 6.7 and 9.5 inches and the average annual temperature is 44 degrees F. It is composed of a large number of developmental communities that form a sere converging from the floodplains and the "bad lands" of the Basin. Ever since the settlement of the Basin in

1873, stock grazing has been the major industry. As a result of this constant over-grazing the winter range which comprises the Mixed Desert Shrub Community is in an advanced state of erosion. Stoddart (1938) says: "More than 95 per cent of the spring-fall and winter range land is subject to varying degrees of accelerated sheet erosion, while three-fourths of the area is in an advanced stage of gully erosion. About one-half of it is being further damaged by wind erosion." This has had a drastic effect on the various communities, and has accelerated the sere in a retrogressive direction rather than the natural advance of succession. Not only the dominant plants have felt this destructive agency but also the influent animals. Over the entire Mixed Desert Shrub Community most of the predators and rodents have been largely extirpated by human agencies.

The following discussions of the community components, from early vernal to late serotinal periods (May 1 to September 1), follow as closely as possible the seral stages of the Mixed Desert Shrub Community and include the dominant plants and influent birds in order of effect.

(a) *Populus-Salix Community:* The floodplains of the lower drainage systems of the Basin are built up by alluvial soils brought down by spring floods. The sand-bar islands and banks frequently are dominated by *Salix exigua*, which in addition to *Salix amygdaloides* form the dense willow thickets of the cottonwood floodplains. The shrub-layer society of the floodplain is dominated by *Rosa puberulenta*, *Rhus triolobata*, and *Lepargyrea argentea*.

In the pure stands of cottonwood, *Populus Sargentii*, the Bullock Oriole and Arkansas Kingbird nest and feed in the upper canopy, the food consisting principally of adult and larval insect forms. The minor influents are the Western House Wren, Long-tailed Chat, and Macgillivray Warbler. The wide-ranging influents of the floodplain and adjoining Mixed Desert Shrub communities are the Eastern Sparrow Hawk and American Magpie.

(b) *Scirpus-Typha Community:* This is best developed at the mouth of Ashley Creek and around the shores of Ashley Creek lake. The community also exists on the Duchesne River between Myton and Duchesne, but not so extensively as at the mouth of Ashley Creek. The swamps are developed by springs or overflows from the rivers and creeks. The damming of Ashley Creek marshes has resulted in a small lake, but the shores, except for the eastern side, form a large Scirpus-Typha Community. Here there is a considerable development in community activities, particularly since the carp (*Carpoides* sp.) has invaded the lake in large numbers from the

backing up of Ashley Creek during the spring floods. Just what will be the status of this community in a few years is not yet clear. But for the present, the American Coot, Yellow-headed Blackbird, and Treganza Heron are the principal avian influents, and the Marsh Hawk is a wide-ranging influent. The minor avian influents include the Thick-billed Redwing Blackbird, Sora Rail, Long-billed Marsh Wren, and the Northern Yellow-throat.

(c) *Distichlis stricta Community:* This community is best developed in the region of the Ashley Creek marshes. In the spring of the year these meadows of salt grass are often flooded and, because of their impervious subsoil, act as catch-basins. The resulting ponds are temporary but afford excellent feeding grounds for large numbers of migrating ducks, plovers, sandpipers, willets, dowitchers, phalaropes, ibis, herons, and egrets. The Nevada Savannah Sparrow and Western Meadowlark remain to nest in the dense salt grass that grows back from the edges of the ponds. Throughout the summer, as long as water remains in the meadows, the Treganza Heron returns each day to feed on frogs or small fish that have been carried in from the Green River by the spring floods.

(d) *Bare-ground Community:* This comprises the "bad lands" of the Basin, which are extensive along the east side of the Green River from the Dinosaur National Monument south. This type of community usually flanks the lowlands of the major streams. The soil is very poor and, by constant erosion of its shales, sandstones, and clays, the whole community is cut up into gullies. The vegetation is limited to a few greasewoods along drainage ways, or in spring to a few dwarfed species that have invaded from adjoining communities. Bird life is scarce, but the precipitous clay, sandstone, and shale cliffs afford excellent nesting sites for the Prairie Falcon; and the rounded gravel knolls are suitable nesting sites for the Nighthawk. Both of these birds range out over the surrounding Mixed Desert Shrub Community in search of food.

(e) *Sarcobatus vermiculatus Community:* There is a noticeable distribution of this community along the banks of some of the larger rivers in the central and eastern parts of the Basin. Plate XLIX shows that this community forms a belt between the cottonwoods and the bad-land bluffs of the larger rivers. In this lowland the greasewood flourishes on a compact soil with a high alkali content and a high water table. *Atriplex* sp. is often the important secondary species, but in many cases this community merges into the more extensive Atriplex-Tetrodymia Community. Few birds nest in the greasewoods; the Sage Thrasher is the most common. The

greater number of avian forms found here are from the surrounding communities and invade the greasewood for food or shelter from wide-ranging predators.

(f) *Atriplex-Tetradymia Community:* This is the major community of the Mixed Desert Shrub. Such developmental communities as the Chrysothamnus and Sarcobatus (Graham, 1937) merge into it. Other minor communities, such as the Mat Atriplex and Kochia-Hilaria, which develop under local edaphic conditions, move in the line of succession toward the dominant Atriplex-Tetradymia Community. Graham points out that in many places in this community *Artemisia spinescens* ranks as an equally important species. Sheep, by their close grazing of the *Atriplex*, have permitted the spiny *Tetradymia* to become equally abundant, and with continued over-grazing the *Atriplex* may be completely eliminated as a dominant plant of the community. Wherever sandy soil permits the Prairie Dog (*Cynomys leucurus*) to form mounds, the Western Burrowing Owl occupies the vacated burrows to raise its young. These owls are wide-ranging minor influents in the Mixed Desert Shrub Community. They are primarily nocturnal and feed chiefly on the Kangaroo Rat (*Dipodomys ordii*) and the Spade-footed Toad (*Scaphiopus intermontanus*), which are important mammal and reptile components of the community. Over this community the Western Lark Sparrow is a minor avian influent from early vernal to late serotinal periods. Other minor avian forms found here are the Common Rock Wren, Sage Thrasher, and Say Phoebe. The wide ranging minor influent species are the Western Red-tailed Hawk, Prairie Falcon, Turkey Vulture, and Nighthawk.

2. Juniperus-Pinus Community

This community is consistent within its altitudinal limits of 5500 to 7000 feet. The average annual rainfall is twelve inches and the mean annual temperature is 44 degrees F. The dominant plants are the Utah Juniper, *Juniperus utahensis*, and the Pinyon Pine, *Pinus edulis*. The influent avian species is the Pinyon Jay, while the minor influents are the Black-throated Gray Warbler, Mexican House Finch, Gray Titmouse, and Western Mourning Dove.

The lower edge of this community is transitional with the low altitude communities of the Mixed Desert Shrub. At practically all points in the Basin it was noticed that the sagebrush usually follows up dry washes and reaches, in many cases, the Artemisia-Cercocarpus Community. At other places the junipers follow narrow ridges that have extensive growths of

Artemisia sp. growing between them. Wherever there is a gravel ridge, the junipers follow closely; while on the more extensive shale or clay, intervening strips of *Atriplex* sp. form the dominant ground cover. This plant invader from the Mixed Desert Shrub is important in the Juniperus-Pinus Community, because it affords an insect-food supply and a dense shrubby growth as protection from predators for the avian components. The Sage Thrasher, White-rumped Shrike, and Western Mockingbird reach the Juniperus-Pinus Community through the Artemisia Community. During the winter the Sage Grouse comes down to low altitudes in the Artemisia Community and so becomes a hiemal resident of the Mixed Desert Shrub.

3. Artemisia-Cercocarpus Community

This rather uniform community occurs at an altitude of 7000 to 8000 feet. Graham (1937, p. 71) states "While Artemisia is almost everywhere a conspicuous shrub, it seems to represent a life-form rather than a specific element." As far as present observations are concerned the life-forms of this complex community are more important to the avian components than the specific composition of the dominant plants. The dominant plant, *Artemisia tridentata*, is associated with the sub-dominant shrubs, such as *Amelanchier* sp., *Cercocarpus montanus*, and *Purshia tridentata*. In this community at the south rim of the Basin, *Quercus utahensis* becomes an important sub-dominant. There is considerable variation of the altitudinal limits of this community on the Tavaputs Plateau, where it invades areas up into the firs at 9500 feet. The Sage Hen is an avian influent, depending upon the Artemisia for food, shelter, and nesting sites. The wide-ranging minor influents are the Swainson and Red-tailed hawks; the minor influents are the Green-tailed and Spurred towhees, the Vesper and Brewer sparrows, Western Meadowlark, and Brewer Blackbird, all nesting and feeding within the community.

4. An irregular ecotone between the Artemisia and Populus aurea communities

This transition is composed of a series of local edaphic communities. Graham refers to them as the mid-altitude valleys which occur at elevations from 6000 to 8000 feet; they are mesophytic and not extensive. The Douglas Fir, *Pseudotsuga mucronata*, is the dominant tree where the valleys are narrow, and the sides precipitous and rocky. The shrub and herbaceous cover is generally rather luxuriant in spots where the Spurred

Towhee, Green-tailed Towhee, and Broad-tailed Hummingbird are the minor avian influents. Where the valleys are dry and open, with gravelled old glacial floors, the Rocky Mountain Yellow Pine, *Pinus scopulorum*, is the dominant tree. In the openings Artemisia invades, and often stands of pine are mixed by scattered aspen groves. The yellow pine is practically non-existent on the Tavaputs Plateau, but in the Uinta Mountains, particularly at Green Lake, large stands of this tree grow.

In this Pinus scopulorum Community, the Aves form a large number of influent and minor influent components. A most interesting feature is that this community is invaded by a large number of birds from the higher altitudes, many coming with their young in July and remaining in the community until September. Avian influents are the Western Tanager, Townsend Solitaire, and Natalie Sapsucker. Invading avian influents are the Bent Crossbill, Clark Crow, Cassin Purple Finch, Long-crested Jay, and Northern Pine Siskin. The minor avian influents are the Rocky Mountain Audubon Warbler, Rocky Mountain Hairy Woodpecker, Uinta Nuthatch, Western Warbling Vireo, Western House Wren, Mountain Bluebird, Western Chipping Sparrow, and Western Evening Grosbeak.

In moist valleys of the Uinta Mountains and Tavaputs Plateau, scattered stands of Blue Spruce, *Picea pungens*, are found. At the collecting locality in Indian Canyon there is an extensive growth of Blue Spruce, the dominant tree; it is interspersed with Lodgepole Pine, Douglas Fir, Aspen, and on the open hillsides by the Artemisia-Cercocarpus Community. The avian population, consisting principally of minor influent forms from the adjacent communities, is made up of the Gray-headed Junco, Rocky Mountain Pine Grosbeak, Long-crested Jay, Western Warbling Vireo, Rocky Mountain Hairy Woodpecker, Red-naped Sapsucker, Rocky Mountain Chickadee, Western Robin, Western House Wren, Spurred Towhee, Green-tailed Towhee, Western Tanager, and Audubon Hermit Thrush.

5. Populus-Rosa Community

This community has a wide transitional infringement into the lodgepole pines and the mixed communities of the transitional valleys. Between altitudes of 8000 and 8700 feet, *Populus aurea* is found in pure stands, often broken by grassy meadows of varying extent. The aspens flourish in a mesophytic environment where the annual rainfall is thirty or more inches, most of which occurs as snow in the winter months. The herbaceous component of the community is very luxuriant and is

comprised of a large number of plant species, of which the following are almost universally associated with the aspens (Graham, 1937): *Juniperus sibirica*, *Aquilegia coerulea*, *Clematis hirsutissima*, *Prunus melanocarpa*, *Rosa chrysocarpa*, *Rosa manca*, *Rosa puberulenta*, *Lupinus parviflorus*, *Geranium Richardsonii*, and *Frasera speciosa*. The number of secondary species listed by Graham (p. 75-76) is very large.

In this community the avian components are few compared to its transitional elements. The avian influents are the Red-naped Sapsucker and Gray Ruffed Grouse; the minor avian influents, the Western House Wren, Western Warbling Vireo, Wright Flycatcher, Western Wood Pewee, and Broad-tailed Hummingbird.

6. Pinus-Vaccinium Community

The lodgepole pines are extensive in the Uinta Mountains between 8700 and 10,000 feet but do not occur on the Tavaputs Plateau (Graham, 1937). In pure stands of this pine, *Pinus Murrayana*, the trees grow so close to each other that there is little herbaceous vegetation; however, in the more open stands considerable numbers of plant species, especially *Vaccinium scoparium*, are found.

Birds are not overly abundant in the forest, but in its developmental stages, running from the creeks and small bog lakes, a number of species nest. The avian influents are the Long-crested Jay and Sharp-shinned Hawk. Both of these forms are wide ranging but confine their nesting activities to this community. The minor avian influents are the Northern Pileolated Warbler, Mountain Lincoln Sparrow, Uinta Nuthatch, Western Tanager, Bent Crossbill, Audubon Hermit Thrush, and Western Chipping Sparrow.

7. Picea-Abies Community

This community is distinct and extensive in the Uinta Mountains from 10,000 to 11,000 feet. The Engelmann Spruce, *Picea Engelmanni*, and the Alpine Fir, *Abies lasiocarpa*, are the two dominant trees; at the upper extremity of their altitudinal range, the alpine fir is the commoner, although here they both have become dwarfed. While the ground cover in the spruce-fir forest proper is not luxuriant, a large number of secondary plants constitute a rank cover in moist open areas in the forest.

The birds of this community are numerous but carry on the greater part of their activities throughout the developmental stages of the forest. The avian influent is the White-crowned Sparrow, which nests on the

ground under the edges of fallen logs, protecting shrubs, or bunches of grass. It feeds principally at the edge of the forest or in the more mesophytic clearings. The Rocky Mountain Jay ranges throughout the community and over its developmental stages, Minor avian influents are the Alpine Three-toed Woodpecker, Olive-sided Flycatcher, Rocky Mountain Pine Grosbeak, Audubon Hermit Thrush, Gray-headed Junco, Rocky Mountain Chickadee, Rocky Mountain Creeper, and Northern Pine Siskin.

Associated with both the Lodgepole Pine and the Spruce-Fir Communities are two developmental communities that Graham calls the "upper altitude lake" and "upper altitude meadow." In the Uinta Mountains there are numerous glacial lakes, some almost devoid of vegetation, others in various successional stages of becoming so choked with vegetation that they are merely wet Carex meadows. Still other meadows of a more xerophytic nature are the result of edaphic factors in the community, or are due to wind action, or to other natural agencies. In both communities there is a large number of plant forms. These developmental communities, being immediately adjacent, are of particular interest, because they afford the principal food territories for many of the avian components of the Lodgepole Pine and Picea-Abies communities (White-crowned Sparrow, Rocky Mountain Pine Grosbeak, Clark Crow, Long-crested Jay, Western Chipping Sparrow, and Northern Pine Siskin). The meadows have a minor avian influent in the Rocky Mountain Pipit, which nests in the grass or in dry sedges, usually under the protection of a rock or mound, and always close to one of the numerous small lakes or streams of the high meadows. The birds feed on the abundance of invertebrate life found along the margins of lakes or streams.

8. Sieversia-Carex Community

This community is above timberline, which starts at about 11,000 feet, and occurs in scattered islands among the lichen-covered rocks. *Sieversia turbinata* with *Carex* sp. dominates where enough soil has accumulated. In these meadows small lakes occur, and it is here that the Rocky Mountain Pipit nests in largest numbers. Above this community, on the sheer rock faces or along bare rock ridges, the Black Leucosticte nests and comes to the meadows and small lakes for food. The Southern White-tailed Ptarmigan nests over these high alpine communities and down to the edges of the dwarf alpine firs. Today this once important avian influent is almost extinct in the Uinta Mountains. The Sharp-shinned Hawk is the only wide-ranging avian influent above timberline.

Under the discussion of communities, the local distribution of the bird population of the Basin is clearly seen to be one of community preference. A great many of these birds exert an important force over a number of communities by their food, shelter, and reproductive coactions. The early autumnal movement before actual migration from the higher altitudes to the lower drainage systems of the Basin, the sudden influx of migrants, and the movement to lower altitudes of alticoline forms emphasize, even more effectively, the importance of the avian population to community phenomena.

DESCRIPTION OF MAJOR COLLECTING LOCALITIES

1. Near Jensen, including a considerable area from the mouth of Ashley Creek; two miles south of Jensen to eight miles north of the Dinosaur National Monument on the west side of Green River. Elevation 4700 ft. Uintah County. Four hundred and nine specimens: May 1-7, 10-24, 26, 28-31; June 1-5, 7-8, 21, 24; July 12; August 9; September 20-30. This area covers a strip along the west side of Green River ten miles long with an average width of two miles. The major collecting locality was at the Ashley Creek marshes, at the mouth of Ashley Creek where it empties into Green River. A large part of this strip is under cultivation and the remainder is used principally for pasture. Here, there is an extensive mixture of communities ranging from the cottonwood floodplain and Scirpus-Typha swamp to the very xerophytic greasewood desert. In the early developmental stages of the floodplains, dense growths of *Salix* sp., *Rosa puberulenta*, and Sour Buffalo Berry, *Lepargyrea argentea*, are the dominants. In the mature floodplains the dominant tree is the Western Cottonwood, *Populus Sargentii*. The Scirpus-Typha swamp has been dammed to form Ashley Lake, a government waterfowl refuge. However, the west and north sides of the lake still remain an extensive Scirpus-Typha swamp. Between the swamp and the greasewood and sagebrush flats, which in many places come to the edge of the swamp by following high ground, there are meadows of salt grass, *Distichlis stricta*. These complex developmental communities afford a great diversity of habitats for various species. The Long-tailed Chat, Western House Wren, and Yellow Warbler nest in the Salix and Rosa communities; the Red-shafted Flicker, Arkansas Kingbird, and Bullock Oriole, in the mature Cottonwood Community; the American Coot, Long-billed Marsh Wren, Yellow-headed Blackbird, and Red-winged Blackbird, in the Scirpus-Typha Community; the Savannah Sparrow and Western Meadowlark in the Distichlis stricta

Community; and the Lark Sparrow, Sage Thrasher, Brewer Sparrow, and Baird Wren nest in the Greasewood-Sagebrush Community. The Green River valley is used as the principal migration lane. The swamp and floodplain at the mouth of Ashley Creek afford an abundance of food and protection for the migrants.

2. Powder Springs, sixteen miles southeast of Jensen and one and one-half miles south of U. S. Highway 40. Elevation 5100 ft. Uintah County. Eighteen specimens: May 6, 8, and 10; June 25; and August 23. Here the country is rolling and greatly cut by washes. It belongs to the Mixed Desert Shrub Community with Shadscale, *Atriplex confertifolia*, the dominant shrub. The lower slopes are sparsely covered by juniper, but on the upper slopes and hilltops to the south and east, there is a well-developed Juniperus-Pinus Community. The Pinyon Jay, Mexican House Finch, Western Mourning Dove, and Black-throated Gray Warbler are the common nesting birds of the community.

3. Five miles north of Jensen between the Dinosaur Quarry and the Green River. Elevation 4800 ft. Uintah County. Two specimens: May 6. A Greasewood (*Sarcobatus vermiculatus*) Community.

4. Cottonwood Springs, Little Mountain, eight miles due west of Vernal. Elevation 6600 ft. Uintah County. Thirty-four specimens: May 28, June 14, and June 28. The spring is surrounded by a well-developed stand of large cottonwoods, which make it appear as a cottonwood island in the middle of a Juniperus-Pinus Community. This spring is the main watering hole for the birds of the entire mountain slope. The surrounding Pinyon-Juniper forest is the nesting locality of the Black-throated Gray Warbler, Mexican House Finch, and the Mourning Dove.

5. Blue Mountain, twenty-five miles east of Vernal. Elevation 7500-8000 ft. Uintah County, Utah; Moffat County, Colorado. Thirty-two specimens: May 15, May 25, and June 26. This locality is approached from the southeast slope by a road that turns north off U. S. Highway 40, sixteen miles southeast of Jensen. The southeast mountain slope is covered by a well-developed Juniperus-Pinus Community to an altitude of 7500 feet. Here the slope breaks off at about 8000 feet into a high, rolling mountain plateau that is dominated by an Artemisia Community. Other plants such as *Amelanchier*, *Cercocarpus*, and *Symphoricarpos*, are found, especially along the south-facing slopes and in the shelter of small valleys. The Sage Hen, Green-tailed Towhee, Lark Sparrow, and Sage Thrasher are the abundant nesting species.

6. Along U. S. Highway 40 from Jensen to a point sixteen miles south-

east, where it follows north by east for seven miles, then joins the Blue Mountain trail, which in turn goes due north to the foot of the mountain and winds up the southeast slope to an altitude of 8000 ft. Uintah County, Utah; Moffat County, Colorado. Six specimens: May 25. This route passes through strips of "bad lands" and a Mixed Desert Shrub Community at the foot of the mountain and through a Juniperus-Pinus Community on some of the higher hills. The Burrowing Owl, Lark Sparrow, Desert Horned Lark, and the White-rumped Shrike were frequently seen along the road.

7. Horseshoe Bend, twelve miles south of Vernal. Elevation 5000 ft. Uintah County. Five specimens: June 9 and June 20. This locality is on the west side of Green River, about eight miles from the Ashley Creek marshes along the old Vernal-Dragon road. Here the Atriplex-Tetradymia Community breaks off rapidly to the Green River, where it gives way to a fringe of Western Cottonwood, *Populus Sargentii*, and Sandbar Willow, *Salix exigua*. Such birds as the Bullock Oriole and Flicker frequent the cottonwoods; whereas in the xerophytic Atriplex-Tetradymia Community, the Lark Sparrow, Sage Thrasher, and Meadowlark are numerous.

8. Green Lake, Uinta Mountains, forty miles north of Vernal on the Vernal-Manila road. Elevation 8000 ft. Uintah County. One hundred and fifty-nine specimens: June 10, June 29, July 5, and September 11-15. This locality is just over the crest of the Basin, a little north of the height of land between Carter and Cart creeks, which drain north into the Green River. The community is somewhat complex and transitional. It is a plateau between the Green River Canyon to the north and the crest of the Uinta Mountains on the south. The Yellow Pine is dominant over a greater part of the locality in which we collected, although high altitude sagebrush flats cover extensive areas between the stands of Yellow Pine. In the more mesophytic localities lodgepole pines and aspens dominate. The Spruce-Fir forests of the higher altitudes meet the lodgepole pines at approximately 8500 feet. The Mixed Yellow Pine, Lodgepole, Aspen, and Sub-montane Shrub Community is the nesting locality of a large number of birds, including the Cassin Purple Finch, Pine Siskin, Western Tanager, Uinta Nuthatch, Williamson Sapsucker, and Townsend Solitaire.

9. Fifteen-seventeen miles southwest of Vernal and five miles south of U. S. Highway 40, along the road to Ouray. Uintah County. Thirty-nine specimens: June 12, 23, and July 12. This country is fairly level with rolling hills cut by soil erosion. The desert is composed chiefly of an Atriplex-Tetradymia Community. Burrowing owls nest in the more sandy

portions, while the Say Phoebe and Rock Wren are the more abundant birds.

10. Ashley Canyon, ten miles north of Vernal. Elevation 6000 ft. Uintah County. Ten specimens: June 15 and 22. This locality extends from the junction of Ashley Creek and Dry Fork to a mile above the junction along each side of Ashley Creek. A mature floodplain of large cottonwoods is distributed along the creek bed, but not extensively, for at this point it is cut by a deep gorge. The mesophytic and sheltered condition of the floodplain makes possible a luxuriant shrubby growth of *Rosa puberulenta*, *Rhus triolobata*, *Lepargyrea argentea*, and a dense herbaceous vegetation. Along the banks and in many places for a distance of two hundred feet or more, willows (*Salix lutea* and *Salix* sp.) form an extremely dense shrubby tangle. In this Populus-Salix Community the Spurred Towhee, Macgillivray Warbler, Virginia Warbler, Mountain Bluebird, and the Broad-tailed Hummingbird are the abundant nesting species. Along the swift streams the Dipper is seen frequently.

11. Indian Canyon, twenty miles southwest of Duchesne, and a mile east of the Duchesne-Castlegate road on the east side of the east fork of Indian Creek. Elevation 7500-8000 ft. Thirty-eight specimens: June 17-20. A mixed forest of Blue Spruce, Lodgepole Pine, Aspen, and Alpine Fir make up the mixed community. Deep valleys, well-wooded over their banks and narrow bottoms, make a mesophytic environment. There are several large stands of aspens in which the trees average ten to eighteen inches in diameter just above the bases. The more open slopes are dominated by a Sub-montane Shrub Community. In these dense secondary growths birds are numerous, particularly the Spurred Towhee, Green-tailed Towhee, and Gray-headed Junco. In the dense coniferous and aspen forests the Long-crested Jay, Hairy Woodpecker, Western Robin, Western House Wren, and Western Tanager are abundant.

12. Paradise Park, Uinta Mountains. Elevation 10,000 ft. Uintah County. Fifty-eight specimens: July 7-10. A large reservoir-lake is surrounded by alpine meadows and a Mixed Lodgepole Pine, Picea-Abies Community. From the basin formed by the lake the ground slopes rather abruptly on the east and west sides to rocky ridges, where there are dense stands of spruce and fir, interspersed by numerous small glacial lakes. To the north, the ground steadily rises to an elevation of 10,000 feet to the crest of the Uinta Basin. Birds such as the Rocky Mountain Jay, Rocky Mountain Pine Grosbeak, and the Gray-headed Junco are numerous.

13. Paradise Park, Uinta Mountains. Elevation 8500 ft. Uintah County. Three specimens: July 8. This locality is on the southeast slope of Mosby Mountain along the Paradise Park-Lapoint road. A Mixed Aspen and Sub-montane Shrub Community dominates the slope from 8000 to 8500 feet. The Gray Ruffed Grouse, Spurred Towhee, Green-tailed Towhee, and Broad-tailed Hummingbird nest here in considerable numbers.

14. Bald Mountain, Uinta Mountains, twenty-five miles northeast of Kamas. Elevation 10,000-10,500 ft. Wasatch County. Sixty-three specimens: July 16-20. This locality extends from Mirror Lake, which is surrounded by a lodgepole pine-spruce woods through the upper Alpine Fir-Spruce Community to the extensive alpine meadows at the foot of Bald Mountain. In the Engelmann Spruce-Alpine Fir Community, the White-crowned Sparrow, Gray-headed Junco, Western Chipping Sparrow, and Rocky Mountain Jay are plentiful, nesting throughout the forest. Above timberline the alpine meadows are dotted by numerous small glacial lakes in various successional stages, from lakes nearly free of vegetation to wet meadows that formerly were lakes but now are completely filled in by vegetation. In this community the Rocky Mountain Pipit nests in large numbers; other birds, such as the White-crowned Sparrow, Western Chipping Sparrow, Rock Wren, and Rocky Mountain Jay, frequent these meadows.

15. Four miles east of Kamas on the Kamas-Mirror Lake road that runs along the west side of Beaver Creek. Elevation 6500 ft. Wasatch County. Three specimens: July 21. West of the road there is a very abrupt mountain slope completely covered with a shrubby growth of *Quercus* sp. This cover is so dense that one can hardly walk through it. The Dusky Grouse, Green-tailed Towhee, and Woodhouse Jay are the common birds of the community.

16. On the south bank of the Yampa River, just east of the junction of the Little Snake and Yampa rivers, eight miles north of Elk Springs, Colorado. Elevation 5600 ft. Moffat County, Colorado. Twelve specimens: July 24. At this point the Yampa River is broad and carries a great deal of silt, resulting in sand bars which have been rapidly built up in the middle of the river and along its banks. On several of these midstream sand bars *Salix* sp. has been able to invade. A small colony of black terns was seen feeding young here. The plateau just south of the locality is in the bad-land formation and is in an advance stage of gully erosion. Plant growth is extremely sparse, although sagebrush and grease-

wood appear between the river and the plateau. Some abandoned farms of the river "bottoms" are overgrown with weeds, but wherever the natural floodplain exists, it is dominated by a mature stand of cottonwoods and dense secondary growths of *Salix*. In this mature floodplain the Nighthawk, Long-tailed Chickadee, and Arkansas Kingbird are abundant. The Kingbird nests in the cottonwoods. The Nighthawk spends its days in these trees, hunting over the floodplain in early morning and evening, and nesting on the nearby "bad-land" plateaus.

17. Beaver Creek, seven miles northwest of Ladore. Elevation 6000 ft. Moffat County. Seventeen specimens: June 25 and 27. This locality is on the west side of the creek three miles from its junction with the Yampa River. Beaver Creek is a small stream, but with flash floods in the spring and summer it becomes a sizable river, flooding a considerable area for short periods. Cottonwoods dominate the floodplain with an extremely luxuriant shrub and herbaceous growth. The valley through which the creek runs is narrow, but the greater part of it is cultivated land. The rocky slopes of the valley are very abrupt; a mature Juniperus-Pinus Community covers them and the promontories of the surrounding locality. In the Floodplain Community the Mountain Song Sparrow, Western Tanager, and Spurred Towhee are numerous, while in the Juniperus-Pinus Community the Pinyon Jay and Black-throated Gray Warbler are abundant forms.

18. Ouray, two miles west of the junction of the Green and White rivers. Elevation 4650 ft. Uintah County. Eight specimens: July 28. Along the river there is a well-developed Cottonwood-Floodplain Community, while a Greasewood-Shadscale Community occupies the flats back from the river. In the Floodplain Community numerous large dead cottonwoods afford nesting sites for the Lewis Woodpecker and Arkansas Kingbird.

19. Florence Canyon, seventy-five miles south of Ouray; head of Florence Canyon and along its north rim on the Tavaputs Plateau, which borders the southern rim of the Basin between the heads of Florence and Hill creeks. Elevation averages 8000 ft. over the greater part of the locality. Uintah County. Ten specimens: July 29-30, August 3-5. *Artemisia* forms the dominant plant growth and this, with scattered stands of aspen, oak (*Quercus utahensis* and *Quercus Gambellii*), and *Cercocarpus* make up a complex Sub-montane Shrub Community. The Sage Grouse, Green-tailed Towhee, Bridled Titmouse, and Western Vesper Sparrow are common over the sagebrush plateaus.

20. Hill Creek and immediate vicinity, forty miles south of Ouray on the Wild Brothers Ranch. Elevation 6800 ft. Uintah County. Thirty-one specimens: August 5-7. The river at this point cuts a deep gorge with towering cliffs two hundred to four hundred feet high on either side. The bottoms are from a half-mile to three quarters of a mile wide. On the tops of the high cliffs and part way down the less perpendicular slopes are scattered stands of the Juniperus-Pinus Community. In the floodplains a good portion is under cultivation or is used for hay fields. The greater part of the community is dominated by *Salix* sp., that is extremely dense on each bank of the river and in many places reaches to the foot of the cliffs. Scattered stands of cottonwoods dominate small areas of the Salix Community. At the base of the cliffs on the higher, more xerophytic ground, greasewood and sagebrush form a Desert Shrub Community that meets the lower extension of the Juniperus-Pinus Community. The Thick-billed Red-wing, Spurred Towhee, and Bullock Oriole nest abundantly in the Salix-Floodplain Community. At the edge of the floodplain in the Desert Shrub Community, the Sage Thrasher and Canyon Wren are numerous. The Pinyon Jay hunts through the Juniperus-Pinus Community in large flocks and invades the entire floodplain.

21. Strawberry Reservoir, twenty-five miles southeast of Heber. Elevation 7500 ft. Wasatch County. Seven specimens: August 17. The large reservoir-lake in the Strawberry River valley is fed principally by the Strawberry River and numerous creeks that drain the immediate surrounding mountain slopes. The Strawberry River has its outlet at the southeast corner of the reservoir, and from here it continues in an easterly direction to join the Red River about ten miles southeast of Fruitland. The Red River forms one of the main tributaries of the Duchesne River. The shores of the reservoir are extensive mud flats, and because of the shallow water line, there is an abundance of food for ducks, geese, shore birds, and other waterfowl. Extensive and comparatively level, the valley is three to six miles wide and runs some twenty-five to thirty miles in a northwest-southeast direction. The valley is covered with big, grassy meadows, sagebrush, and rabbitbrush flats. Along the Strawberry River and numerous creeks are extensive growths of *Salix* sp. and a luxuriant growth of herbaceous plants. This valley is surrounded by ridges and mountains that rise rapidly from 8000 to 9500 feet. From 9000 feet aspens trail down the slopes into the valley to about 7800 feet. At 9000 feet lodgepole pines form a transition between the Aspen and the Lodgepole Pine communities.

In the Basin, the largest number of migratory and nesting ducks as well as shore birds and other waterfowl may be found at Strawberry Reservoir. Sage Hens are numerous in the valley and nest on the sagebrush flats. Other birds, such as the Brewer Sparrow, Green-tailed Towhee, and Marsh Hawk, are plentiful.

22. Moon Lake, forty miles north of Duchesne. Elevation 8500 ft. Duchesne County. Sixteen specimens: August 20-21. This large lake is fed by the West Fork River, which continues out the southeast corner of the lake, and ultimately joins the Lake Fork River, a tributary of the Duchesne River. Moon Lake is approached from the south by a chain of broad-terraced valleys. The lake is surrounded on the east and west by steep mountain slopes which rise abruptly from 8500 to 10,000 feet. This locality is in a transitional community between the aspens and lodgepole pines. At the southwest side of the lake there is an extensive meadow cut by small creeks. The Gray-headed Junco, Pileolated Warbler, and Olive-sided Flycatcher are here abundant.

23. Five miles south of Jensen on the east side of the Green River. Elevation 4700 ft. Eleven specimens: May 22, June 3, 5. Along the bank of the river a margin of *Salix* sp. dominates, but on slightly higher ground a mature cottonwood floodplain exists. At the east edge of the cottonwood floodplain a dense growth of rose briers covers many of the openings. The floodplain gives way on higher ground to greasewood. The Arkansas Kingbird, Bullock Oriole, Nevada Cowbird, and Western House Wren are the common species.

24. Uinta Canyon, twenty miles north of Roosevelt, in the general vicinity of Big Uinta Park, eight miles above the mouth of Pole (Farm) Creek, Uinta Mountains. Elevation 7300 ft. Duchesne County. Thirty specimens: August 28, 29. The valley floor is flat and fairly narrow with high mountainous slopes on each side, running from 7300 to 10,000 ft. This valley belongs to a mixed community referred to by Graham as the Mid-Altitude valley. Along the river banks are dense secondary growths of *Salix* sp. Yellow pines with mixed stands of aspens dominate the higher ground, whereas sagebrush dominates the openings along the canyon. Birds are numerous over the Yellow Pine-Aspen and Willow communities. The Macgillivray Warbler, Mountain Song Sparrow, Uinta Nuthatch, Audubon Warbler, and the Western Robin are plentiful in the Yellow Pine-Aspen Community.

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ANNOTATED LIST OF SPECIES

The sequence of species and the nomenclature in the "Check-List" of the American Ornithologists' Union have been followed, except for such changes and additions that the author believed justifiable. The annotated list contains 217 species and subspecies, which includes one new subspecies, the Uinta Nuthatch, *Sitta carolinensis uintaensis* subsp. nov.

Gavia immer elasson Bishop. LESSER LOON.

Two birds were observed on Green River on May 5. Again on September 28 a loon was heard calling from the Green River, one-half mile south

of the base camp on Ashley Creek, although the bird was never seen. A. C. Lloyd saw a single bird at the same locality on May 19, 1935. Leo Thorne of Vernal has a mounted loon that was killed in the spring of 1920 on the Green River at Jensen. On geographical grounds these are *G. i. elasson.*

Colymbus nigricollis californicus (Heermann). EARED GREBE.

Two specimens: two miles south of Jensen. 121824, ad. ♂: postnuptial molt has just set in; a few white feathers are present on the neck and throat; yellowish brown ear-tufts are still conspicuous. 121825, im. ♂: head still shows signs of downy plumage; faint streaks of white are present. The bird, however, is nearly full grown; the first fall plumage is just appearing.

These grebes were found to be uncommon in the Basin. Two pairs were seen on the marshy lake two miles south of Jensen on May 3. One pair was seen on June 16, fifteen miles east of Duchesne in a large marsh that lies just south of the main highway. The two birds were together when collected on August 9; this circumstance established a breeding record for the Basin. On August 17 two pairs with five young were seen swimming in the mouth of a small creek which empties into Strawberry Reservoir.

Aechmophorus occidentalis (Lawrence). WESTERN GREBE.

One specimen: two miles south of Jensen. This grebe was observed only as a migrant. Five birds were seen in Ashley Creek lake on May 4, 5, and 6. During these three days their characteristic call, "*kreek, kreek,*" could be heard in the evening. Again, on September 3, two birds were seen at Strawberry Reservoir. A. C. Lloyd found this bird to be rare in 1934 and 1935. He collected one specimen, a female, on May 21, 1935.

Podilymbus podiceps podiceps (Linnaeus). PIED-BILLED GREBE.

One specimen: two miles south of Jensen. The Pied-billed Grebe is rare in the Basin. It appears only as a migrant in the spring and early fall. The only collected specimen for the Basin was taken by A. C. Lloyd on May 24, 1935. Lloyd reports that the bird was in an emaciated condition when collected at Ashley Creek marshes. A pair was observed by the author at the south end of Strawberry Reservoir on August 17, 1937.

Pelecanus erythrorhynchos Gmelin. WHITE PELICAN.

This is a rare visitor to the Uinta Basin. A single pelican was seen one-half mile below Jensen on May 12. Residents of the Basin say that they see one or two birds on the Green River almost every year. There is a large colony of these pelicans at Great Salt Lake, which may account for the occasional stragglers in the Basin during migration.

Phalacrocorax auritus auritus (Lesson). DOUBLE-CRESTED CORMORANT.

This species was rare in the Basin, although a flock of four was seen flying down Green River near the mouth of Ashley Creek on May 14. A. C. Lloyd saw three near this point on May 15, 1935.

Ardea herodias treganzai Court. TREGANZA HERON.

Two specimens: two miles south of Jensen. These adult specimens measure (in mm.); male: wing, 463; tail, 181.8; culmen, 133; depth of bill, 26; tarsus, 150; middle toe, 99. Female: wing, 478; tail, 171.5; culmen, 138.5; depth of bill, 26; tarsus, 165; middle toe, 101.5.

This heron nested commonly at the mouth of Ashley Creek, where it empties into Green River. The creek spreads out into several branches that become choked, forming rather extensive marshes or swamp land. Here a Scirpus-Typha swamp has developed, which is rare in the Basin (Graham, 1937). Over other portions of this extensive floodplain are found solid stands of cottonwood, *Populus Sargentii*. The herons here find suitable nesting sites and an abundance of food, such as small fish, frogs, etc. Birds were observed at several localities throughout the Basin: namely, Ashley Canyon, six miles north of Vernal on June 15; Brush Creek, twelve miles north of Vernal, June 29; Strawberry Reservoir, July 14; Yampa River, eight miles north of Elk Springs, Colorado, July 24; Hill Creek, forty miles south of Ouray, August 5, 6, and 7; Strawberry Reservoir, very numerous (thirty individuals), August 17. Each day from September 20 to 30, from twenty-five to thirty birds were seen feeding over the marsh two miles south of Jensen.

Casmerodius albus egretta (Gmelin). AMERICAN EGRET.

Three birds were seen in a flock of fifteen snowy egrets on May 3 at the Ashley Creek marshes. They were seen again on May 5 with a flock of six snowy egrets, but after that date no birds were observed.

Egretta thula thula (Molina). SNOWY EGRET.

Three specimens: near Jensen. At the mouth of Ashley Creek snowy egrets were found to be very common from May 3 until the end of the month. At that time flocks of from ten to twenty birds frequently were seen flying about the marsh or quietly feeding along some of the river banks. At least three pairs remained in the Ashley Creek marshes throughout the summer; but because of the flooded condition of the southwest end of the marshes it was not until late July that two nests were discovered. It was apparent that the nests had been used earlier in the season, for young in immature plumage were seen later with the adults. A. C. Lloyd saw birds in immature plumage in late August, 1935.

Three birds were seen on June 16 on the Duchesne River, seven miles west of Myton, and four at Strawberry Reservoir on July 14. While at the Ashley Creek marshes, September 20, twelve birds were seen flying about and feeding in the shallows of the marsh. By September 25 they had disappeared, and none was seen after that date.

Nycticorax nycticorax hoactli (Gmelin). BLACK-CROWNED NIGHT HERON.

Three specimens: near Jensen. A small colony of ten or twelve pairs of these birds nested in Ashley Creek marshes. Their nests were from ten to fifteen feet above the water level in the great tangle of willows and cottonwoods. At dusk they were a noisy lot—flying out of the marsh, circling high above the camp, and uttering their raucous "quawk." Throughout May and June this was a nightly performance and was repeated again in late August and September, when the young birds joined in the chorus. For the most part the herons fed in the shallows of the dense Scirpus-Typha swamp, and upon occasion single birds would fly from the shallows of the creek at points where the dense foliage nearly formed a canopy over the water. The colony left the marsh about the 28th of September, and by the 30th, not a bird could be found. A. C. Lloyd saw several birds in late May, 1935.

Botaurus lentiginosus (Montagu). AMERICAN BITTERN.

One specimen: two miles south of Jensen. This bird was not common in the Basin, although two pairs nested in the Ashley Creek marshes. One of the adults was seen whenever the marshes were visited. The birds were wary and flew up long before a close approach could be made. Often in

the quiet evenings their characteristic calls came booming out of the depths of the dense growth of rushes, or the birds were seen flying low across the marshes to new feeding places. The bitterns were present from May 1 until September 30. The only other localities in which bitterns were observed were at eight miles west of Myton on the Duchesne River, June 16, and at Strawberry Reservoir, August 17.

Plegadis guarauna (Linnaeus). WHITE-FACED GLOSSY IBIS.

Four specimens: near Jensen. Flocks of from twenty-five to fifty ibis were seen feeding in irrigated fields in the vicinity of Jensen from May 1 to June 2. Farmers of the district called them "angleworm birds" because they concentrated in freshly irrigated fields in the spring, wading about in the shallow water and picking up earthworms and various larvæ.

These large, dark reddish birds were common during the spring and for a short time gave evidence that they might nest in Ashley Creek marshes, although they did not do so. They had a well-regulated daily routine. They could be found in the marsh until 10:00 o'clock every morning. Then they flew into the air, circling high in the sky for half an hour or more, and finally the whole group wheeled off toward newly irrigated fields. There they continued feeding or resting until late afternoon. At dusk the birds could be seen flying slowly back to the protection of the Scirpus-Typha swamp of Ashley Creek. After June 2 the birds suddenly disappeared. They were not seen again until August 25, when a small group of eight was encountered on the Green River just south of Jensen. Although the writer spent the latter half of September in the vicinity of the Ashley Creek marshes, the birds were not observed again. These birds are apparently new arrivals in the Uinta Basin, appearing with the development of irrigation. The residents of the Basin showed considerable interest in these large wading birds. LeRoy Kay recalls that the first time he saw them was in May, 1927, when two fed at the edge of a grassy slough, one mile north of Leota Ranch.

Branta canadensis canadensis (Linnaeus). COMMON CANADA GOOSE.

Four specimens: two miles south of Jensen.

No.	Date	Tarsus	Culmen	Depth of Bill	Wing	Middle Toe and Claw
122073 ♂	Sept. 27	88	55	26	505	99.5
122076 ♂	" 28	88.5	52	26.1	501	100.5
122075 ♀	" 28	80	49.9	24	453	90.5
122074 ♂	" 27	79.9	49.8	25.9	470	97

On May 3 several large flocks of Canada geese were seen traveling northwest, flying high overhead, and following the general course of the Green River valley. Apparently these birds were migrants, for they were not seen again. However, a small flock of twenty geese fed along the sand bars of the Green River, just north of Jensen. Reports of farmers of the district that the birds nested in the Green River canyon were verified by Henry Millacum, reliable local resident of Vernal, who passed down the gorge in a specially constructed rowboat. He observed several pairs of Canada geese with good-sized young in late July, 1936.

The first small flock of eight geese came out of the canyon and began to feed in the Ashley Creek marshes on September 15. By September 20 it was not unusual to be awakened at daylight by the honking of two or three hundred geese flying out of the marsh lake and from the sand bars of the Green River into a grain field one mile south of my base camp. Flocks of from fifteen to thirty geese could be seen flying along the river throughout the day, or resting quietly out on the sand bars and the mud flats of the Ashley marsh lake.

A trip was made out to the grain field before daylight on the morning of September 27, and shallow pits were dug. At 5:30 A.M., with the first streaks of light in the east, a flock of twenty-five geese slipped quietly into the field from the southwest and dropped to the ground not more than twenty yards behind me. Then, from the direction of the marsh lake, came the clamor of geese. Twelve flocks of geese, averaging from eight to thirty individuals, arrived at five to ten-minute intervals. Before the main concentration had assembled, two birds were collected. The geese continued feeding until 10:00 A.M. En masse they returned to the marshes. The next morning, September 28, two more birds were collected. The geese made daily morning visits to the field until September 30; but with the opening of the duck season, the flocks soon dispersed to safer feeding grounds.

Fifty geese were observed on August 17 resting on a large mud flat on the west side of Strawberry Reservoir. From reports of the state game warden, Lee Kay, numbers of Canada geese are commonly seen at the reservoir in the spring and fall migrations. LeRoy Kay says that from 1915 to 1918 one or two pairs of geese nested on a sand bar of the Green River, just below the Dinosaur Monument. In 1919, a heavy flood covered the bar with driftwood so that no birds nested there in 1920. One nested on the bar in 1921, but no geese nested while Mr. Kay worked there in 1922 and 1923. However, these birds always nest in the Green

River canyon that swings to the east and north of the Dinosaur Monument. Mr. Kay saw two adults with six young swimming in Green River a short distance above Leota Ranch, which is about six or eight miles north and east of Ouray.

Anas platyrhynchos platyrhynchos Linnaeus. COMMON MALLARD.

This was the common nesting duck of the creeks, rivers, and lakes of the Basin and up to 6000 feet in the mountains. Mallards were found in considerable numbers about the Ashley Creek marshes.

Chaulelasmus streperus (Linnaeus). GADWALL.

Two specimens: two miles south of Jensen. This species was fairly common at the Ashley Creek marshes and also at Strawberry Reservoir. Six or eight pairs were seen in the vicinity of the marshes throughout the summer. A female and eight partly grown young were located out in the lake on July 12. Later in the fall, from September 21 until the end of the month, from thirty to forty birds could be seen at any time on the lake. At Strawberry Reservoir on July 14, two birds were seen; six on August 10; fifteen, August 17; ten, September 2; and four on October 3.

Mareca americana (Gmelin). BALDPATE.

One specimen: two miles south of Jensen. The Baldpate was not common in the Basin, although at least two pairs nested in the Ashley Creek marshes. One female and a family of seven young were seen on July 12. During May one or two pairs were seen feeding on the open, grassy sloughs almost every day. A large number of this species suddenly appeared after September 23, and they could be seen frequently in flocks of from six to fifteen birds. At Strawberry Reservoir four were seen on July 14; one, August 10; three, August 17; eight, September 2; and twenty on October 3. A. C. Lloyd reports that the Baldpate was rare at the marshes in the spring of 1935.

Dafila acuta tzitzihoa (Vieillot). AMERICAN PINTAIL.

Two specimens: two miles south of Jensen. The American Pintail was a common nesting duck along the Green River valley and occured in considerable numbers in the vicinity of the Ashley Creek marshes. By early July females with broods of young could be seen at numerous places in the marsh lake. The pintails with the mallards were the first to arrive in early May. The characteristic black and white marking on the necks of the males made them very conspicuous in the irrigated fields or out in the

marshes. In September there was evidence of a concentration of pintails; flocks of from twenty-five to forty birds were seen frequently. Local sportsmen report that this species is one of the last ducks to leave for the south, departing just before the freeze-up.

Pintails were seen in the following numbers at the listed localities: Strawberry Reservoir, July 14, thirty adults and two families of half-grown young; August 10, thirty-five birds; August 17, eight birds; September 2, fifty birds; October 3, twenty birds. At Ashley Canyon, ten miles north of Vernal, on June 15, two birds. At Moon Lake, altitude 9500, forty miles north of Duchesne, on August 20, six birds; and at Green Lake, Uinta Mountains, altitude 8000 feet, on September 11, two birds.

Nettion carolinense (Gmelin). GREEN-WINGED TEAL.

This teal is common in the Basin, and during May, pairs were seen frequently in the sloughs and small lakes that form the Ashley Creek marshes. A female with five half-grown young was observed in Ashley Marsh lake on July 12. In late September, small flocks of between six and fifteen birds were seen very often in the creeks and flooded bayous of Green River.

Querquedula discors (Linnaeus). BLUE-WINGED TEAL.

One specimen: two miles south of Jensen. In May these birds were seen in pairs nearly everywhere in the vicinity of the Ashley Creek marshes and the Green River. Families with six or eight young were observed on June 24 at the mouth of Ashley Creek. In late August, and throughout September, this species was very common along the Green River, at Strawberry Reservoir, and on the Provo River, five miles south of Heber.

Querquedula cyanoptera (Vieillot). CINNAMON TEAL.

Five specimens: near Jensen. 121129, ♂, May 11: plumage on lower breast and belly badly worn and new plumage beginning to appear. The remainder were all full-plumaged males.

Although this was not the most common duck in the Basin, it was the most conspicuous. During May each small slough or lake harbored a pair of these bright-colored ducks. Two males and one female often were seen together, but after the first of June, they were scattered about in pairs and had begun to nest. One nest was located on the northeast corner of Ashley Creek lake. There, forty yards back from the water, the bird had constructed its nest in a small depression in the tall grass. A few

feathers lined the nest, where eight eggs had been deposited. The female sat very close and refused to leave her half-incubated eggs until I approached within ten feet of the nest. Then the bird went flapping off the nest in an attempt to distract attention. After this period, through June and part of July, the teal just seemed to vanish. Immature birds were seen flying by the end of July, and were seen frequently in groups of between four and ten in the small pools and creeks of the marshes until the end of September. Cinnamon teal were observed at Strawberry Reservoir on August 17, September 2, and October 3.

Spatula clypeata (Linnaeus). SHOVELLER.

Three specimens: two miles south of Jensen. This duck was a common migrant; two or three pairs always were to be seen feeding in the shallow ponds of Ashley Creek marshes during May. Again, in September, they reappeared in flocks of from five to twenty individuals. The hunters of the region state that these ducks remain into October, disappearing just before the freeze-up. A few scattered individuals were seen at Strawberry Reservoir on August 14.

Nyroca americana (Eyton). REDHEAD.

Three specimens: two miles south of Jensen. Flocks of between three and ten birds frequently were seen as they stopped in the Ashley marshes during the May migration. In September two flocks of fifteen and twenty, respectively, were seen out in the marsh lake. A. C. Lloyd noticed numerous pairs at the marshes in the spring of 1935.

Nyroca valisineria (Wilson). CANVAS-BACK.

One flock of six birds was observed on Ashley Creek lake on May 14. No others were seen throughout my entire stay in the Basin.

Nyroca affinis (Eyton). LESSER SCAUP DUCK.

One specimen: two miles south of Jensen. This specimen was collected by A. C. Lloyd, who observed several of these ducks in the marshes during the early spring of 1935. Between May 2 and 17, 1937, small flocks of from five or ten scaups were seen on the marshes or along Green River.

Glaucionetta clangula americana (Bonaparte). AMERICAN GOLDEN-EYE.

This species was common in the spring and fall migrations. During May flocks of from three to seven frequently were seen along Green River

in the vicinity of Jensen or the Ashley Creek marshes. Likewise, in September, it was not unusual to see a flock of between twenty and forty golden-eyes as they flew along the Green River. A small flock of eight birds was seen at Strawberry Reservoir on August 17, and again on September 3, several were seen at the north end of the reservoir.

Charitonetta albeola (Linnaeus). BUFFLE-HEAD.

Three specimens: two miles south of Jensen. A. C. Lloyd collected the three specimens on May 9 and 21, 1935, but considered this duck to be a rare migrant. In 1937 a pair was seen at Ashley Creek marshes on May 5. From then until the end of the month one or two birds were encountered at the marshes or along Green River each day. Although none was observed as late as September, 1937, the hunters of the vicinity said that a number are killed each year in October.

Erismatura jamaicensis rubida (Wilson). RUDDY DUCK.

Two specimens: ten miles northeast of Vernal; near Jensen. This duck was not common in the Basin, although a few were observed at the following localities: ten miles northeast of Vernal, May 8; twelve miles east of Vernal, May 13; Green Lake, Uinta Mountains, altitude 8000 feet, three males, September 14. During the latter part of September one or two individuals were seen on Ashley Creek lake and along Green River. A. C. Lloyd saw a flock of four at the Ashley Creek marshes on May 16, 1935.

Mergus merganser americanus Cassin. AMERICAN MERGANSER.

A flock of fifteen birds was observed flying along the west shore of Strawberry Reservoir on September 10, but none was collected.

Mergus serrator Linnaeus. RED-BREASTED MERGANSER.

These birds frequented Green River during migration in early May and late September. Nearly every day during these periods from one to five individuals could be seen feeding in the river or on Ashley Creek lake.

Cathartes aura teter Friedmann. TURKEY VULTURE.

Turkey vultures were numerous along Green River in the vicinity of Jensen, where forty or fifty birds often were seen feeding on a carcass. The birds were seen at nearly every point in the Basin, particularly near the immediate vicinity of cattle and sheep ranches. The vultures seemed to prefer the more arid ranch and farm areas. They also spent much of

their time flying along the river courses and up and down the deep canyons. Even at 8000 feet on Blue Mountain they were observed to be very common; and along the Green River at daybreak, it was not unusual to see an occasional group of ten or fifteen turkey vultures sitting in a dead cottonwood tree, their wings outspread to catch the first warm rays of the sun. A nest of the vulture was found on June 3 at a point four miles south of Jensen on the east side of the river. The nest was nothing more than a rocky ledge fifty feet up on the perpendicular wall of a cliff sixty feet high. In the nest two eggs were just hatching. Upon returning to the nest on June 5, I found that some small boys from a nearby ranch had dropped stones on the young and had knocked them off the ledge, killing them. Ranchers report that the birds nest in the cliffs along Hill Creek, Uinta Canyon, Antelope Canyon, the upper part of Ashley Canyon, and at many other points in the Basin. According to A. C. Lloyd, a few vultures were seen about the marsh during the spring and summer, and large numbers after August 20 in 1934 and 1935.

Astur atricapillus striatulus Ridgway. WESTERN GOSHAWK.

Although the goshawk is not a common bird in the Basin, it was noted to range from the Aspen Community to timberline. Single individuals were observed at Green Lake on June 10 and September 11, and at Paradise Park on July 9. Neither ruffed nor dusky grouse were plentiful in 1937, and this may have been responsible for the scarcity of this species.

Accipiter velox velox (Wilson). SHARP-SHINNED HAWK.

Two specimens: Uinta Canyon, twenty miles north of Roosevelt; and two miles south of Jensen. Sharp-shinned hawks choose suitable nesting sites in the forests of Rocky Mountain Yellow Pine (*Pinus scopulorum*) and Lodgepole Pine (*Pinus murrayana*). During early May they were seen hunting along the edge of dense willows of the Green River and the Ashley Creek swamp. On June 10 at Green Lake, Uinta Mountains, four birds were seen. From their actions they appeared to be either nesting or in the process of building. While I was at Green Lake from June 29 to July 5, hunting birds were seen as they passed quickly through the forest but no nests were found. During September the birds passed along the Green River valley in considerable numbers, becoming most numerous at the height of the sparrow migration in late September. Scattered individuals, usually only one and never more than two, were seen at Blue Mountain, altitude 8000 feet on May 22; Indian Canyon, twenty miles

southwest of Duchesne, June 18; Ashley Canyon, twelve miles north of Vernal, June 22; Paradise Park, Uinta Mountains, altitude 10,050 feet, July 7, 9, and 10; Bald Mountain, twenty-five miles northeast of Kamas, Wasatch County, altitude 10,500 feet, July 16; Beaver Creek, seven miles northwest of Ladore, Moffat County, Colorado, July 25; Hill Creek, forty miles south of Ouray, August 5; Strawberry Reservoir, August 17; and Uinta Canyon, twenty miles north of Roosevelt on August 28.

Accipiter cooperi (Bonaparte). COOPER HAWK.

One specimen: Green Lake, Uinta Mountains. The Cooper Hawk was not abundant in the Uinta Basin even during migration. At the Ashley Creek marshes an occasional bird was to be seen throughout May and particularly at periods when a migration wave of other birds was under way. A single male was taken at Green Lake, Uinta Mountains, altitude 8000 feet. On later trips to this vicinity, June 29 to July 5, and September 11 to 15, pairs of hawks were seen on several occasions, indicating that the birds were nesting not far away. While driving to Green Lake on June 29, I recorded a pair in the Brush Creek valley at a point where the Vernal-Manila road crossed Brush Creek. Later in September a small migration of the Cooper Hawk was observed along the Green River valley between the Dinosaur Quarry and the junction of Ashley Creek and Green River. One or two birds could always be seen hunting along the cottonwoods and willows of the floodplain. There was never any indication of a concentration but it was evident that the hawks were following the migration waves of the smaller Passerine birds.

Buteo borealis calurus Cassin. WESTERN RED-TAILED HAWK.

Five specimens: (a). Strawberry Reservoir; (b). five miles south of Heber; (c). two miles south of Jensen.

	No.		Date	Wing	Tail	Tarsus	Culmen
Light phase							
(a).	121864	♂	Aug. 17	392	246	83	25
	121866	♂	Aug. 17	390	250	80	24
	121865	♀	Aug. 17	387	248.5	86.5	24
(b).	121962	♀	Sept. 9	411	261	86	26
Dark phase							
(c).	122072	♀	Sept. 27	415	250	79	26

The telephone poles between Vernal and Jensen were the favorite perches for fairly large numbers of migrating and resident hawks. Most numerous

was the light phase of *calurus* and only occasionally were melanistic individuals seen. Of five birds collected, specimen 122072, a female, is a dark bird but the remaining four specimens are of the light phase. On several occasions birds of the light-breasted *fuertesi* and light *calurus* types were seen circling together in the Strawberry Reservoir territory, and on August 17 a large concentration of hawks was noted. A continuous stream of red-tailed hawks could be seen wheeling about over the high ridges. Traveling a quarter- to a half-mile apart, they were hunting for ground squirrels, which at that time were dying in large numbers from a disease that was thought to be the sylvatic plague. Later on, in October, while passing through Strawberry Reservoir to Provo, we saw large numbers of red-tailed hawks periodically dotting the roadside posts. About ninety percent of these were of the typical light *calurus* phase, and the remainder melanistic or very rufous individuals of *calurus*.

Birds were noted during June and July at the following localities: Green Lake, Uinta Mountains, altitude 8000 feet, four miles south of Jensen; Indian Canyon, twenty miles southeast of Duchesne; Ashley Canyon, twelve miles north of Vernal; Blue Mountain, east slope, altitude 8000 feet, twenty-five miles east of Vernal; Paradise Park, Uinta Mountains, altitude 10,050; Bald Mountain, altitude 10,500 feet, twenty-five miles northeast of Kamas; Yampa River, eight miles north of Elk Springs, Colorado; Hill Creek, forty miles south of Ouray; Uinta Canyon, twenty miles north of Roosevelt; and Moon Lake, altitude 9500 feet, forty miles north of Duchesne.

Buteo borealis fuertesi Sutton and Van Tyne. FUERTES RED-TAILED HAWK.

Three specimens: (a). ten miles north of Vernal; (b). Blue Mountain; (c). nine miles east of Vernal.

	No.		Date	Wing	Tail	Tarsus	Culmen
Utah: Uinta Basin							
(a).	121376	♂	June 10	407	233	82	25
(b).	121511	♂	June 26	422	224.9	86	27
(c).	121252	♀	May 25	442	254	86	25.1
Texas: Marathon (a); Hot Springs (b). Collected by G. M. Sutton							
(a).	113883	♂	May 6, '33	395	212	79	26
(a).	113842	♂	May 4, '33	396	211	80.5	25.5
(a).	114049	♂	May 23, '33	398	212	77	27
(b).	114017	♂	May 18, '33	398	209	80	27

The three Uinta Basin birds were evidently breeding, for they had been seen on repeated occasions in the same localities. Two of the birds, 121376 and 121511, showed the characteristic lighter underparts, and the streaking of the lower breast and flanks was greatly reduced. The backs of both specimens were lighter on the whole than examples of *fuertesi* examined. The third bird, 121252, was darker. The throat, upper breast, and belly, were very rufous. There was a band of brown blotches on the lower breast; the belly and flags were barred with darker rufous. The upperparts were dark brown with considerable light tan and rufous; the tail, dark reddish with a faint black bar near end; and the tip of the tail had a light terminal band, somewhat worn.

Examination of the above table shows that the wings and tails of the Uinta Basin birds are a little longer than those of the Texas specimens. The lighter color of the backs of the Uinta Basin birds and the larger wings and tails would indicate an intermediate or a gradation between *fuertesi* and the light phase of *calurus*. Thus *fuertesi* and the light phase of *calurus* were nesting in the same locality. The region in question offers an excellent location for further study of these interesting races.

Several times while traveling between Vernal and Jensen during August and September I saw light-colored red-tailed hawks. But in nearly every case, these desirable individuals were able to keep their distance. Several light-breasted red-tailed hawks were seen along the road at Strawberry Reservoir on August 10.

Buteo swainsoni Bonaparte. SWAINSON HAWK.

One specimen: twelve miles northwest of Strawberry Reservoir. Not in fully adult plumage: under parts very dark; breast, dark brown; belly and flags, rich reddish brown.

This large hawk was not overly abundant in the Uinta Basin, although numbers were seen between Strawberry Reservoir and Heber in August. At Hill Creek, forty miles south of Ouray, several were observed between July 28 and August 7. Ranchers informed me that the birds frequently nest almost to the head of the canyons at the lower end of Hill Creek and in the more arid country about and south of Ouray. Single birds or pairs were noted at Indian Canyon twenty miles southwest of Duchesne; Cottonwood Springs, nine miles west of Vernal; on the Vernal-Lapoint road, near Lapoint; twenty miles southeast of Jensen; and between Fort Duchesne and Myton.

Ridgway (1877) states: "In Parley's Park, on the Wahsatch Mountains,

Swainson's Hawk was common, and many nests were found among the scrub-oaks on the slopes or on small aspens on the sides of the ravines. Their position was always low down, often merely a few feet from the ground, and easily reached without climbing. In one of these nests, found July 2d, was a single young one, which, although yet covered with snow-white cottony down, was savagely tearing at a dead weasel which had been carried to the nest by the old birds. . . . The food of this Hawk is by no means confined to small mammals and birds, but during the flights of the grasshoppers, which so often devastate the fields of Utah and other portions of the West, they keep continually gorged on these insects; and at one season we found them living chiefly on the large cricket so common in the Salt Lake Valley."

Buteo regalis (Gray). FERRUGINOUS ROUGH-LEG.

One specimen: two miles northwest of Strawberry Reservoir. Breast and flags, cream tan, lightly mottled with brown; belly white; back, head, and wing-coverts, show considerable rufous with some white; tail faintly barred with a little rufous; terminal base, nearly gray.

The Ferruginous Rough-leg occurred in the Basin only during migrations. At Ashley Creek marshes a number of these hawks were seen flying up Green River and traveling nearly due north. The birds, flying a half to a mile apart, were wheeling about over the east bank of the river as they passed along. On May 5, when this migration was noticed, forty birds passed during a two-hour period. The following day five more were seen passing along precisely the same route. On August 17, at Strawberry Reservoir, five rough-legs were seen hunting over the large sage-brush flats on the west shore of the lake. On one occasion, just like a bullet, a rough-leg dropped out of the sky and pursued for some distance a sage hen from a large flock that suddenly flew up. This did not seem to be in the manner of a direct attack but rather a playful performance. The big hawk swept over the fleeing sage hen, making it redouble its speed, but other than this no attempt was made to strike the grouse. While driving through Strawberry Reservoir on October 4 several Ferruginous rough-legs were seen along the road, flying or resting on nearby dead trees.

Aquila chrysaetos canadensis (Linnaeus). GOLDEN EAGLE.

This large majestic bird is surprisingly common throughout the Basin, despite the reprehensible campaigns that are often promoted by ranchers and farmers to destroy them. Fortunately the big birds spend the greater

part of their time in the less accessible parts of the high surrounding mountains. Pairs of birds that were seen consistently at certain localities during the spring and early summer were considered to be nesting individuals. Only two nests were observed. One was located, high in a crevice of a cliff that dropped off for a sheer thousand feet on the southwest slope of Blue Mountain, on June 26; the other was found on May 25 on a towering cliff one-fourth mile northwest of Dripping Rock Creek. At this second locality the birds were just finishing the construction of the nest. Large dead branches of sagebrush were scattered about the base of the cliff. It was impossible in either case to look into the nests, for they were placed well back into large crevices in the face of the cliff. The first nest probably contained young, because both adults kept flying overhead, screaming as long as anyone was near the vicinity of the nest.

Pairs were seen at the following localities: south entrance of the Green River Canyon; Green Lake, Uinta Mountains; Cottonwood Springs, nine miles west of Vernal; Ashley Canyon, twenty miles southwest of Duchesne; Paradise Park, Uinta Mountains, altitude 10,050 feet; Bald Mountains, twenty-five miles northeast of Kamas, Wasatch County, altitude 10,500 feet; Beaver Creek, seven miles northwest of Ladore, Moffat County, Colorado, 6000 feet; Hill Creek, forty miles south of Ouray; Florence Canyon, seventy-five miles south of Ouray; Strawberry Reservoir, Moon Lake, forty miles north of Duchesne, altitude 9500 feet; Uinta Canyon, twenty miles north of Roosevelt; and at Ashley Creek marshes, two miles south of Jensen. A. C. Lloyd frequently saw golden eagles flying about over the Ashley Creek marshes during the spring and summer of 1935.

Circus hudsonius (Linnaeus). MARSH HAWK.

This species was comparatively common in the Ashley Creek marshes and along the Green River valley. Two pairs nested in the marshes and were seen whenever the locality was visited between May and September. These hawks were found to be numerous at Strawberry Reservoir; and although they nested there, the large numbers that were seen in August and September probably included numerous migrants. A few individuals were seen at Yampa River, eight miles north of Elk Springs, Colorado, on July 24; Beaver Creek, seven miles northwest of Ladore, Moffat County, Colorado, on July 25, 26, 27; Ouray on July 28; Hill Creek, forty miles south of Ouray, on August 5; and Duchesne River, ten miles northwest of Ouray, on August 8. A. C. Lloyd found two nests in the marshes in 1935.

Pandion haliaetus carolinensis (Gmelin). OSPREY.

The Osprey was not widely distributed in the Uinta Basin. A single bird was observed in the vicinity of the Ashley Creek marshes during the early part of May. The next record of the Osprey was at Mirror Lake, Bald Mountain, altitude 10,500 feet, twenty-five miles northeast of Kamas, Wasatch County, between July 16 and 20. A pair had a nest at the north end of the lake in the top of a tall dead Engelmann spruce (*Picea Engelmanni*). The birds were feeding their young at the time. They could be seen resting on tall trees that overhung the lake shore, or flying out over the lake and suddenly plunging down to emerge with a good-sized fish clutched in their talons. They were unwelcome visitors about the well-stocked trout streams and lakes of the Basin, which might possibly account for their small numbers. A. C. Lloyd saw two on May 15 and one on May 19, 1935, at the marshes.

Falco mexicanus Schlegel. PRAIRIE FALCON.

One specimen: five miles south of Jensen. This species is comparatively numerous in the "bad-land" sections of the Basin, particularly between Jensen and Bonanza. The one specimen collected was a female taken from her nest, which contained two eggs. The nest was located by watching for white streaks on the face of the cliffs. Although there were many evidences of old nests, this one nest, five miles south of Jensen and three-fourths of a mile east of the Green River, was the only one that was occupied. Located on a deep rocky shelf extending for some distance back into the face of the cliff, it was in an almost inaccessible place, for the upper face of the cliff overhung the nest shelf by four or five feet. Since there was a drop of fifty feet from the nest to the base of the cliff, the nest was safe from prowling predators. Later in September several individuals were seen a short distance both below and above Jensen along Green River, and at Strawberry Reservoir.

Falco peregrinus anatum Bonaparte. DUCK HAWK.

Two specimens: twelve miles east of Vernal, and two miles south of Jensen. 121144, ♂: adult plumage beginning to show on breast, belly, head, back, and rump. 122031, ♀: adult in full plumage.

This large falcon was common in May and early June at the Ashley Creek marshes. In the evening, just at dusk, one or more of these birds would fly swiftly over camp, much to the alarm of the black-crowned

night herons that were preparing for their twilight flight. The presence of the falcons could always be detected a minute or so before their arrival, for the red-winged blackbirds would whistle a shrill warning. If there happened to be a crow in the neighborhood, his low, guttural growl would confirm the warning.

The hunting birds always came from the southeast, the direction of the bad-land cliffs east of Green River. There, one inaccessible nest was located about forty feet up the deep shelf of a cliff. The actions of the pair indicated young in the nest. Immature birds were noticed about the marsh early in August. There was always one, or more, of these birds in the general vicinity of Jensen from August until the end of September. Others were seen at Hill Creek, forty miles south of Ouray, on August 5, and at Strawberry Reservoir on August 17. A. C. Lloyd collected three males at Ashley Creek marshes respectively on April 23, August 5, and August 23, 1935.

Falco columbarius richardsoni Ridgway. RICHARDSON PIGEON HAWK.

These small falcons were in the Basin only during migrations. In May, and again in September, a few individuals were seen along the Green River near Jensen, and also at Strawberry Reservoir.

Falco sparverius sparverius Linnaeus. EASTERN SPARROW HAWK.

Nine specimens: two miles south of Jensen; near Jensen; Green Lake, Uinta Mountains. The range of measurements of the adult specimens in millimeters is as follows: Four males, wing, 190.2-177.0 (185.5); tail, 133-125.0 (128.3). Five females, wing, 212.0-198.0 (206.0); tail, 131.2-130.0 (130.4).

The Sparrow Hawk, a common bird in the Basin, ranges from the lowlands to timberline in the mountains. In the spring it appeared in largest numbers between May 15 and 30. After the first of June there was a dispersal of the population over the Basin. While there was a preference for the wooded river valleys, the birds were also seen feeding over the edge of the arid bench lands adjacent to the river valleys. Along the Green River valley pairs of sparrow hawks nested wherever suitable sites could be found. There was a very wide nesting distribution, for these birds were found nesting in all communities up to timberline. In the fall the sparrow hawks became numerous, especially from September 15 to the end of the month. At this time there was a gradual movement of the birds down the river and creek valleys of the territory studied. A. C. Lloyd says that

this hawk was among the common birds observed at the Ashley Creek marshes during the spring and summer of 1934 and 1935.

Dendragapus obscurus obscurus (Say). DUSKY GROUSE.

Two specimens: (a). seventy-five miles south of Ouray; (b). four miles east of Kamas, Wasatch Co.

	No.		Date	Wing	Tail	Tarsus	Culmen
(a).	121792	♀	August 5	222	167	29	23.5
(b).	121743	♀	July 21	225	159	38	22.0

These birds are undoubtedly *D. obscurus obscurus* but the saddle is dark with narrow light tan cross bars; the back mottlings lack the gray of *richardsoni* and the rusty of *fuliginosus*.

This large grouse is not so abundant as the early settlers of the Basin found it fifty years ago. The present status of the bird would indicate that it now has a very scattered distribution. Considerable time was spent looking for these birds and inquiring about their breeding grounds. On July 21, while returning from Mirror Lake in the Bald Mountains, Wasatch County, I made a sudden stop about seven miles north of Kamas at the base of a very steep slope where scrub oak (*Quercus* sp.) formed a dense cover. A female and four young were crossing the road. The birds immediately flew into the dense oak thickets. A juvenal bird that had been killed on the road by a motorist was found and identified. Later a female and several young were collected. Forest rangers at Mirror Lake informed me that several flocks of these grouse were known to nest about nine miles northwest of Kamas in the Beaver Creek Canyon. The next evidence of the birds in the Basin was at Florence Canyon, seventy-five miles south of Ouray. The birds nested here along the rim of the canyon; and according to the ranchers of that region, they were found along these canyon rims throughout the year. They were very wary, and when I approached, they would fly up and dart down into the depths of the canyon forest. One female was collected on August 5. On the same day five adults and ten immature birds were flushed, but they sought the shelter of the canyons.

According to the early settlers, these fine birds were once very plentiful in the Uinta and Book Cliff Mountains, but they have been extensively hunted for food. Consequently, there is left but a remnant of the original numbers. Ridgway (1877, p. 598) states: "but it did not occur in abundance until we arrived at the Wahsatch and Uintah Mountains, where it

literally abounded in certain localities, particularly on the latter range." He collected adults and juvenal birds at Parley's Park, also at Pack's Canyon, Uinta Mountains, between June 25 and July 23, 1869.

Bonasa umbellus umbelloides (Douglas). GRAY RUFFED GROUSE.

Three specimens: below Paradise Park, Uinta Mountains, altitude 8500 feet. On July 8 one female and two young birds were collected by J. K. Doutt, of the Carnegie Museum, at the upper edge of the aspens where they meet the lodgepole pines at an altitude of 8500 feet. The following day a second visit was made to the locality, but no further grouse were observed. The fire rangers at Paradise Park, Mirror Lake, Moon Lake, Uinta Canyon, and Indian Canyon, all reported that these grouse are fairly common along the stream courses in the Uinta and the Book Cliff mountains, especially above an altitude of six or eight thousand feet. During our visit to Blue Mountain on June 26, a single bird was flushed at the edge of a deep canyon but immediately vanished from sight. A similar incident occurred at Green Lake on September 14, when two grouse were flushed at the brink of the Green River Canyon.

Lagopus leucurus altipetens Osgood. SOUTHERN WHITE-TAILED PTARMIGAN.

The White-tailed Ptarmigan was once common in the high Uinta Mountains. Reports during recent years indicate that ptarmigan still are found in scattered flocks of from two to five birds in the vicinity of the Bald Mountains, north of Kamas. None of these reports has been verified.

Centrocercus urophasianus (Bonaparte). SAGE GROUSE.

Twelve specimens: fifteen miles northeast of Vernal, Blue Mountains, altitude 8000 feet; Florence Canyon, seventy-five miles south of Ouray. These large grouse were common in certain areas throughout the mountains of the Basin. The first birds observed were on the *Artemisia* and *Atriplex* plains where they had been dancing. Unfortunately by May 7 the dancing had stopped, and the birds had begun to move up into the higher foothills. The first nest of the sage hen was found on the high, rolling sagebrush plateaus (*Artemisia* spp.) of Blue Mountain on May 15. It was located high up on a slope and under the protection of a dense sagebrush bush. The female sat quietly on her eight eggs and allowed me to approach within two feet before she made any attempt to leave. The eggs were just on the point of hatching, and as little time as possible was

spent in the vicinity of the nest. She returned in less than an hour and continued her incubating. It was interesting to note that the nest was on a cattle range, and the cattle had been feeding almost to the edge of the nest. But the dense canopy of the sagebrush bush acted as a barrier, preventing the cattle from trampling the nest. The same thing was noticed at other ranches. Even sheep were observed browsing all around a nest, but the bird still sat on her eggs. However, a large herd of sheep or cattle moving across a country might possibly do some damage to nesting sage hens. The coyotes that abound in the district take a heavier toll. Rasmussen (1938, p. 863), in his study at the Strawberry Valley Federal Refuge during 1936-37, lists the destruction of forty-one nests of a total of 161 nests studied; the causes being as follows: (1) Carnivores (coyotes, skunks, and weasels), 23 nests; (2) Raven, 7 nests; (3) Undetermined, 7 nests; (4) Domestic livestock, 2 nests; and (5) Man, 2 nests.

From the evidence gathered, it seems that in the early morning, just before sunrise, the hens come to the springs and water-holes where they spend an hour or more. The females return to their nests as the morning progresses while the males walk off across the slopes, browsing on sagebrush leaves, grasses, a few grasshoppers, and other insects. Rasmussen (1938, p. 856, 857) studied the food of the Sage Grouse from May to October of 1936-37 at Strawberry Valley. The total average food of the adults consisted of 97.68 per cent vegetable matter of which 77.50 per cent was *Artemisia* (2 spp.); the animal material comprised 2.35 per cent which was made up mainly of the *Formicidæ* (6 genera). Fifty-four per cent of the food of the juvenal birds during June and July was plant material, which was made up principally of *Artemisia* and *Polemoniaceæ* (Gilia). The animal material at this time amounted to forty-six per cent, which in turn was made up largely of *Hymenoptera* and *Formicidæ*. During August, September, and October, the juvenal birds became 97 to 99 per cent vegetarians, eating principly *Artemisia* (2 spp.). The animal material averaged from 0.5 to 4.5 per cent, consisting largely of *Formicidæ* (6 genera).

The birds rest in the shade of dense growths of sagebrush during the day. About four in the afternoon, they again come out of their retreats and continue feeding, going to water at dusk.

Later, on June 25-26, the Blue Mountain plateaus were visited again. The young had hatched and were flying with the adults; they could fly very well when but a week or so old. Many of these young birds retained downy plumage on the head, breast, and back, although their wings, tail,

and feet were well developed. When the young were put up, they scattered in all directions, making it almost impossible to locate them again, for they would remain motionless under a sagebush until they received a call from the female. After quietly resting out of sight for a short time, the female would begin to whistle or coo softly to gather her scattered flock. The slightest movement would cause the birds to vanish again. Also at this time the males began to gather. In the early morning and again at about four in the evening, flocks of from twenty-five to fifty birds could be seen quietly walking along the little valleys, browsing as they moved.

One of the finest flocks of sage hens in Utah is at Strawberry Reservoir on the Strawberry Valley Federal Refuge. Here, it is most gratifying to find that their summer and winter range has been turned into a state and federal wildlife refuge. When driving along U. S. Highway 40 in the morning or late afternoon, one can see large flocks of these birds strutting along the side or nonchalantly crossing the road. Their utter disregard for the vehicles causes many casualties among the sage hen population by thoughtless or ruthless motorists. The roadside is well-posted concerning the crossing of the sage hens, and there is little need for the continued slaughter that occurs in this manner. The rare opportunity of observing and studying the sage hens at this reserve is being utilized by the Agricultural College at Logan, where graduate students are making life history studies of this grouse.

According to LeRoy Kay, there were thousands of sage grouse on the flats at Strawberry in November of 1905. He says also that in the early 1920's, while dry farming was being carried on, sage hens were more numerous on Diamond Mountain than at any other place. They were there in countless numbers. However, it seems that one of the main reasons for the sudden disappearance of the birds has been due to the operations of groups of men who would go up into these mountains and deliberately kill sage grouse by the hundreds at any season, particularly during the summer. One authenticated report is that on one Sunday afternoon four men with .22 rifles and small bore shotguns killed 150 sage hens and left all but a half dozen or so to rot on the mountain. This type of destruction still occurs in some sections of the Basin, but fortunately, the practice is gradually being stamped out through the efforts of the state game wardens.

Mr. Kay, who has lived in the Basin the greater part of his life, says that the sage hens come out of the mountains with the first heavy snows and spend the winter on the flats between Brush Creek and Ashley Creek,

where they are able to feed on the shadscale and sage. At times in the fall these birds will eat quantities of choke cherries (*Prunus melanocarpa*). During certain years, when there has been little snow on the mountains, the birds have been known to remain on the mountain slopes throughout the winter.

In April, when the snow is gone from the lower plains, the winter flocks gather on certain high knolls of their winter range and there, just as the first red streaks of an early spring dawn break across the sky, the big grouse begin their dance. Ranchers and farmers of the Basin all talk enthusiastically of this performance. When the sheep and cattle are being moved to the summer ranges, the grouse will sometimes refuse to move from the path of a moving wagon or car, so intent are they in their dance. The birds begin to move gradually toward the mountain slopes as May approaches and to cease their dancing. By the middle of May the grouse are on the upper sagebrush flats, and many of the females are already brooding under the protection of a sagebrush thicket.

Lophortyx californica californica (Shaw). CALIFORNIA QUAIL.

One specimen: two miles north of Jensen. This quail was introduced into the Basin about 1914. Since that time the birds have become numerous along the river bottoms. At the Ashley Creek marshes, several pairs of these birds nested during the early part of June. A. C. Lloyd saw numerous pairs and broods at the Ashley Creek marshes in 1934 and 1935. Local residents report that the severe winters with considerable snowfall are detrimental to the quail. The birds reach good numbers during a series of favorable years, and then experience severe reversals in times of stress.

Phasianus colchicus torquatus Gmelin. RING-NECKED PHEASANT.

These pheasants were introduced into the Basin in 1900, and since that period they have increased continuously. The largest concentrations of these birds were found in the irrigated farming districts of the Green River, Duchesne River, White River, Ashley Creek, Brush Creek, Strawberry River, Provo River, and along many of the smaller watercourses of the region. In a strip of land extending from Ramsey Stewart's ranch on the west side of Green River to a point two miles south along the river, thirty-two pairs of pheasants were known to nest. The cocks could be heard crowing in the morning and evening about my camp at the Ashley Creek marshes throughout May and June. By the middle of August it is

not uncommon to see coveys of pheasants in the meadows or the sagebrush and greasewood thickets.

Grus canadensis tabida (Peters). SANDHILL CRANE.

A large flock of fifty-four cranes was seen following the Green River valley northward on May 5. The birds were flying very high, but their loud trumpeting calls soon attracted attention. This was the only time that cranes were observed in the Basin. Older residents, however, recalled having seen these birds frequently during early spring and fall from twenty to twenty-five years ago. They said that in May migrating flocks would come to rest for the night on the large, flat sand bars in Green River just north of Jensen.

Rallus limicola limicola (Vieillot). VIRGINIA RAIL.

Five specimens: near Jensen. This bird was not abundant. The few that were observed and collected were found in the Ashley Creek marshes. Their presence in the vicinity was hardly perceptible unless a careful hunt was made along the west side of the marsh in the late afternoon. At that time one or two rails were always seen, but if even slightly disturbed, they would dart back into the protection of reeds. One bird was seen in July at the edge of the marsh. Although attempts were made to locate its nest, the efforts were always unsuccessful. During the last week of September a number of these rails were seen at the edge of the marsh. These were probably local birds in addition to migrants. In 1934 and 1935, A. C. Lloyd found this rail common about the marsh but remarked on the very retiring nature of the bird. He collected a juvenal male on August 9, 1934.

Porzana carolina (Linnaeus). SORA.

Five specimens: near Jensen. A number of sora rails were seen in company with a few Virginia rails during migration. At least four pairs of sora rails remained for the summer in the Ashley Creek marshes just east of our base camp. Although attempts were made to locate the nests, none was found. A. C. Lloyd had similar experiences during 1934 and 1935.

Fulica americana americana Gmelin. AMERICAN COOT.

This was the most common water bird found in the Ashley Creek marshes. In May the marshes were fairly alive with the birds. Many

were migrants merely stopping over. However, by June a considerable population had begun to nest. On June 7, while out in the marsh lake on an island of reeds that covered about two acres, forty-three nests were counted. The same conditions prevailed in most of the other sections of the marshes, which were about two and a half miles square. By the first of July young coots were everywhere, and by September, with the arrival of the first migrants, great flocks of between two hundred and five hundred coots were seen out in the lake. Coots were also noticed in numbers at Strawberry Reservoir, Duchesne River, and on some small marshes just south of Heber.

Charadrius semipalmatus Bonaparte. SEMIPALMATED PLOVER.

This plover was not an uncommon migrant during early May and September. At this time it was seen frequently in small flocks of from two to five birds along the sand bars of Green River, at Strawberry Reservoir, and at Ouray at the junction of the White and Green rivers.

Oxyechus vociferus vociferus (Linnaeus). KILLDEER.

This was a very common summer resident of the Basin and was found in large numbers along Green River, Strawberry Reservoir, Ashley Creek, White River, Hill Creek, Duchesne River, and other places where water and suitable nesting sites occurred. In all of these places the birds nested in considerable numbers. During May and September, while migration was under way, large flocks of from twenty to thirty birds frequently were seen feeding in the open fields.

Pluvialis dominica dominica (Müller). AMERICAN GOLDEN PLOVER.

This plover was a fairly common migrant along Green River during the first week of May. A flock of forty-six was seen in a plowed field south of Jensen on May 2. A second flock of forty-six was observed flying low over the Ashley Creek marshes on May 6. Again, on September 10, a flock of eight birds was seen feeding in a small grassy slough just north of the Reservoir lake.

Squatarola squatarola (Linnaeus). BLACK-BELLIED PLOVER.

This bird was not observed in large numbers in the Basin. On September 10, at Strawberry Reservoir, several birds were heard whistling far out over the lake. By imitating their call, we got them to fly directly to us,

where they wheeled about for a few minutes before flying off. Fourteen birds were observed at the time. They probably pass through the Basin in larger numbers in October. Hayward (1937) remarks that the only published record for the Black-bellied Plover in the State was by Bent (1929) from Provo, Utah County, May 11. Hayward lists a number of records for Utah Lake, the latest being May 5, 1937.

Capella delicata (Ord). WILSON SNIPE.

Five specimens: two miles south of Jensen. Three pairs of these birds nested in the vicinity of the Ashley Creek marshes. Single individuals were seen at Ouray, six miles west of Myton; Hill Creek, twenty-five miles south of Ouray; Strawberry Reservoir; and in the Provo River valley, five miles below Heber. A. C. Lloyd found these birds fairly common about the Ashley Creek marshes in 1934 and 1935. He collected a set of four eggs on May 29, 1935.

Numenius americanus americanus Bechstein. LONG-BILLED CURLEW.

These birds were rare in the Basin; one pair was observed on the Green River flats, two miles north of Jensen, on May 11. Four birds were seen at Strawberry Reservoir on August 17. There were no evidences of nesting. A. C. Lloyd observed a single bird on June 3 and again on June 5, when it flew over his camp at the Ashley Creek marshes.

Bartramia longicauda (Bechstein). UPLAND PLOVER.

Ridgway (1877) reports that this species was rather common in July at Kamas Prairie.

Actitis macularia (Linnaeus). SPOTTED SANDPIPER.

One specimen: near Jensen. These sandpipers were not numerous in the Basin, although several pairs were seen along the Green River in the vicinity of Jensen from early May until late September. Young birds that were just able to fly were seen at the mouth of Ashley Creek on July 12. Singles and pairs of these birds were seen at Brush Creek, ten miles southeast of Vernal; Duchesne River, six miles west of Myton; Hill Creek, twenty-five miles south of Ouray; Strawberry Reservoir; Green Lake, Uinta Mountains, altitude 8000 feet; Provo River, five miles south of Heber; and the Yampa River, eight miles north of Elk Springs, Colorado.

Tringa solitaria cinnamomea (Brewster). WESTERN SOLITARY SANDPIPER.

One specimen: two miles south of Jensen. This sandpiper was not abundant in the Basin. At Ashley Creek marshes at least two pairs remained as residents. Although their nests were not located, they were paired and no doubt nested. In 1934 and 1935, A. C. Lloyd, while at the Ashley Creek marshes, saw four or five solitary sandpipers almost every day.

Catoptrophorus semipalmatus inornatus (Brewster). WESTERN WILLET.

Two specimens: near Jensen. These birds were observed during migration. Until June 10 several birds were seen about the marshes of Ashley Creek and along the Green River. The birds were not noted after June 10 in the Basin until August 17, when twelve were seen at Strawberry Reservoir. Again, during the month of September, willets were numerous at Ashley Creek marshes. They were seen feeding in small flocks of from three to seven birds. Three birds were observed on October 4, feeding in a small pond near the highway six miles east of Duchesne. A. C. Lloyd collected two specimens, one on May 8, and the other on May 9, 1935, at the Ashley Creek marshes. He reports these birds to be fairly common during migrations.

Totanus melanoleucus (Gmelin). GREATER YELLOW-LEGS.

One specimen: two miles south of Jensen. The Greater Yellow-legs occurs as a migrant in the Basin. Three birds were observed in a flock of fifteen lesser yellow-legs on May 4 at the mouth of Ashley Creek. At the same locality on September 25 two birds again were seen in a flock of eight lesser yellow-legs. A. C. Lloyd saw them in 1935 in flocks of four or five, mixed with larger flocks of lesser yellow-legs.

Totanus flavipes (Gmelin). LESSER YELLOW-LEGS.

This species was common as a migrant during early May but became scarce by the last of the month. In the fall these birds were abundant and occurred in flocks of from ten to twenty birds, reaching the peak of their migration by the middle of September. They were very numerous in May and September at the mouth of Ashley Creek, and at Green River, Duchesne River, Strawberry Reservoir, and Provo River.

Pisobia bairdi (Coues). BAIRD SANDPIPER.

These sandpipers were not abundant but appeared in small scattered flocks of from three to ten birds during early May and September. They were first seen along the Green River on May 4. During September they were observed in company with least and semipalmated sandpipers at Strawberry Reservoir and at the Ashley Creek marshes.

Pisobia minutilla (Vieillot). LEAST SANDPIPER.

One specimen: two miles south of Jensen. Flocks of from ten to fifty least sandpipers were seen along the Green River and at the Ashley Creek marshes during the first two weeks of May. The first flock of the fall migration was observed at Strawberry Reservoir on August 17. At this time two mixed flocks of least and semipalmated sandpipers, numbering between twenty-five and thirty individuals, were seen shifting about and feeding on the mud flat at the northwest side of the reservoir. During September small flocks of between twenty and sixty birds were seen along Green River and at Green Lake.

Pelidna alpina sakhalina (Vieillot). RED-BACKED SANDPIPER.

A. C. Lloyd reports that on May 1, 1935, he saw a single red-backed sandpiper in a flock of least sandpipers.

Limnodromus griseus scolopaceus (Say). LONG-BILLED DOWITCHER.

Three specimens: twelve miles east of Vernal. Two females in full breeding plumage were collected from a flock of forty-two birds on May 4. The dowitchers fed along the shallow muddy shores or out on the grassy (*Distichlis stricta*) meadow (Graham, 1937) about the Ashley Creek marshes. This meadow became flooded during early May from the overflow of Ashley Creek, and the subsequent green, grassy meadow offered excellent feeding grounds for numerous migratory birds. Again, on May 13, a second flock of dowitchers dropped in and fed on the Distichlis meadow. This flock numbered only seven individuals and disappeared by May 15. During the fall migration a flock of thirty was observed at Strawberry Reservoir on September 10. On September 25, at the mouth of Ashley Creek, a flock of twenty-six was seen feeding on a sand bar. A. C. Lloyd did not see any birds of this species in 1934, but from April 30 to May 3, 1935, several flocks were recorded at the Ashley Creek marshes.

Ereunetes pusillus (Linnaeus). SEMIPALMATED SANDPIPER.

Three specimens: two miles south of Jensen. These birds were the most numerous of the sandpipers that passed through the Basin during the spring and fall migrations. By the first two weeks of May it was common to see flocks of between two and three hundred feeding about the Ashley Creek marshes and along Green River. Two early fall flocks of from twenty-five to thirty individuals were noted at Strawberry Reservoir on August 17, in company with some least sandpipers. During the month of September, at Green Lake in the Uinta Mountains, and at Green River, Ashley Creek marshes, and Strawberry Reservoir, these sandpipers appeared in flocks that often numbered five hundred.

Limosa fedoa (Linnaeus). MARBLED GODWIT.

One specimen: twelve miles east of Vernal. Flocks of from ten to thirty marbled godwits occurred in the Basin as migrants during May. A female with well-developed ovaries, indicating that she was in full breeding condition, was collected on May 6. On May 10 a pair of godwits was feeding in the Distichlis meadow when suddenly they began to call loudly and to fly about over the marsh, where they started their mating performance. Presumably, the male was the more aggressive. By the end of May most of the birds had moved on, although several were seen at Strawberry Reservoir on August 16. Reports from ranchers in the vicinity indicated that the birds were seen throughout the summer, although no one actually had found a nest. A. C. Lloyd says that large flocks occurred during the spring of 1935 at Ashley Creek marshes, but after the first week of June none was recorded.

Crocethia alba (Pallas). SANDERLING.

Two specimens: two miles south of Jensen. During the spring migration only a few birds, numbering from four to eight to the flock, were seen at the Ashley Creek marshes between May 4 and May 10. In the fall they were recorded first at Strawberry Reservoir, when a flock of six birds was observed feeding at the edge of a mud flat. During the last two weeks of September, small flocks of between five and twenty birds constantly were seen along Green River and on the mud flats of the Ashley Creek marshes. A. C. Lloyd collected a female on May 21, 1935, at the Ashley Creek marshes. He reported small flocks in the vicinity of the marsh and along Green River during the spring migration.

Recurvirostra americana Gmelin. AVOCET.

Two specimens: near Jensen. These graceful waders were not common in the Basin. Five were seen between May 15 and 17 at the Ashley Creek marshes. They seemed to be intent upon nesting, but this was probably because of the flooded Distichlis meadow, which afforded attractive feeding grounds for the short time before they continued their flight. One pair which remained until late May was driven out of the Distichlis meadow by an early flood. On August 16, at Strawberry Reservoir, three were seen, but other than these no further avocets were observed in the Basin. A. C. Lloyd saw no avocets in or around Ashley Creek in 1934, but in 1935, in early May, he recorded several flocks with as many as eleven in a flock.

Himantopus mexicanus (Muller). BLACK-NECKED STILT.

This stilt is a rare visitor to the Basin. It seems strange that the Black-necked Stilt nests in large numbers at Great Salt Lake and the Great Bear marshes just on the other side of the Wasatch, yet does not nest in the Basin. A. C. Lloyd saw a pair on June 25 at the Ashley Creek marshes. They remained the one day and vanished the next.

Steganopus tricolor Vieillot. WILSON PHALAROPE.

Four specimens: twelve miles east of Vernal. Four birds, two females and two males, were collected at Ashley Creek marshes on May 14. The females were in full nuptial plumage, showing no sign of their winter plumage. The males still retained a few white winter feathers on the head and back, which gave the birds a very light and mottled appearance. In the large flocks seen, it was evident that at least forty per cent had not attained full breeding plumage by May 14. Large flocks of phalaropes gathered in the flooded Distichlis meadow just south of the mouth of Ashley Creek. Flocks of from ten to one hundred and fifty were seen every day from May 12 to 19. It was remarkable how these meadows of salt grass (*Distichlis stricta*), when flooded, resembled the grassy marshes of the birds' nesting grounds. This aspect, as well as the abundance of food in the form of Cladocera, Copepoda, and numerous other invertebrates, was no doubt responsible for the extended visit which the birds made. On August 17 several flocks of Wilson phalaropes were seen on Strawberry Reservoir. Flocks of from twenty-five to fifty birds were observed almost every day at the Ashley Creek marshes during the last two weeks of September.

Lobipes lobatus (Linnaeus). NORTHERN PHALAROPE.

Two specimens: two miles south of Jensen. This phalarope is a common migrant in the Basin. A flock of two hundred was observed on May 4 at the Ashley Creek marshes. Numerous flocks of from two hundred to five hundred were seen at Strawberry Reservoir on September 10. A. C. Lloyd considered this species very common during the middle of May, 1935, at Ashley Creek marshes, where he saw flocks of several hundred almost daily.

Larus californicus Lawrence. CALIFORNIA GULL.

These gulls were irregular visitors to the Basin. One was seen on the Green River below Jensen on May 10, and two dark juvenal birds at Strawberry Reservoir on August 17. A. C. Lloyd saw a flock of fifty at Ashley Creek marshes about the middle of May, 1935.

Larus delawarensis Ord. RING-BILLED GULL.

One specimen: twelve miles east of Vernal. This specimen had not yet attained its full adult plumage; the rectrices still showed a slight dark band near their terminal end, and the remainder of the plumage was typically adult. The feathers throughout were badly worn. The Ring-billed Gull was never seen in numbers in the Basin. During May and September, particularly, several individuals always could be seen flying about over the Ashley Creek marshes, hunting along the shore line or above Green River. Two or three were seen throughout the summer on Green River, but there was no indication of nesting. However, some of the ranchers along the river, who were careful observers, said that during past years a pair or two of these gulls nested on the large sand bars of Green River, between Jensen and the mouth of the Green River Gorge. Ring-billed gulls were seen also at Strawberry Reservoir, August 11, 16, and 17; and at Duchesne River, five miles east of Duchesne on August 11.

Larus pipixcan Wagler. FRANKLIN GULL.

A flock of twenty-eight Franklin gulls was seen over the mouth of Ashley Creek on May 10, apparently following the Green River valley, for they were flying in a general northeasterly direction. The birds were exceptionally noisy, and they moved along quickly, showing no interest in the large marsh over which they were flying.

Sterna forsteri Nuttall. FORSTER TERN.

This tern was rare in the Basin; only two were observed. They were seen flying along the Green River valley on May 10.

Hydroprogne caspia imperator (Coues). CASPIAN TERN.

There is a paucity of records for the Caspian Tern in the Uinta Basin. None was observed in 1937, but on July 19, 1935, A. C. Lloyd saw a pair flying over the Ashley Creek marshes. The Caspian Tern is found in large numbers around the Great Bear marshes, north of Salt Lake City, which are separated from the Uinta Basin by the Wasatch Mountain range. The terns should find it comparatively easy to reach the Basin by way of the Green River, or by the Provo River, which latter cuts through the Wasatch Mountains, for along both of these rivers there is an abundance of food.

Chlidonias nigra surinamensis (Gmelin). BLACK TERN.

One specimen: two miles south of Jensen. This species was not abundant in the Basin, even during migrations. A small group of eleven was seen in the Ashley Creek marshes on May 10, but they soon moved on. Later, on July 23, at a point on the Yampa River eight miles north of Elk Springs, Colorado, three birds were seen flying low over the river. On July 24, 25, and 26, thirty birds were seen along the Yampa River. From their actions it was evident that they had nests on a sand bar in midstream that was grown over with rushes. This was the only colony seen and the only evidence of nesting terns in the Basin.

Zenaidura macroura marginella (Woodhouse). WESTERN MOURNING DOVE.

One specimen: Green Lake, Uinta Mountains. This dove was one of the commonest birds in the Basin, and was found from the "bad lands" of the shrub deserts to the slopes of the surrounding mountains up to an altitude of 8000 feet. A feature of the water-holes or springs of the desert was the large numbers of doves which came and went from the springs in a continuous stream throughout the day. When a bird came in from the desert and flew down to the edge of the pool to drink, it usually took a "siesta" in the cool shade of the bordering dense thickets. Often from fifty to a hundred doves would collect at these favorite water-holes during

the day. When frightened, they merely flew off a short distance and came to rest on the ground or in a low bush and waited until the intruder had gone.

The nests were scattered from the low desert shrub to the coniferous forest of the high mountains. Preferred sites were in dense thickets of willows and other shrubs that covered the floodplains of the Basin. Nesting was carried on during June and July; and by the end of July large numbers of young in immature plumage had joined the adults, making up flocks of between fifty and two hundred birds which would be found around a favorite spring. Other than these aggregations about the springs, the doves seldom flew in flocks of more than six to eight birds. Despite the fact that there were a great many doves in the Basin, they did not cause any noticeable damage to the grain fields along the river.

Tyto alba pratincola (Bonaparte). BARN OWL.

Reports of this owl at Vernal were authenticated by several residents. It seems that during certain years, these owls are found more frequently than at other times. Dale Stewart reported having seen one near Jensen in 1936. In 1937, on August 6 at Hill Creek, forty miles south of Ouray, a single bird was flushed from a hole in the face of a high cliff.

Otus asio inyoensis Grinnell. INYO SCREECH OWL.

Four specimens: two miles south of Jensen. These specimens, collected by A. C. Lloyd between July 25 and 30, 1935, are now in the collection of Dr. Max M. Peet. Three are in juvenal plumage. They are already beginning to show signs of the immature plumage over the breast and back. They are very pale throughout, as is true of the one adult female, which has a less brownish and a more ashy tone to its general coloration than that of *O. a. maxwelliæ*. They were identified by H. C. Oberholser as *O. a. inyoensis*. He writes, in a personal letter, that the range of this bird now extends from the Inyo Mountains of southeastern California through Nevada to northern Utah, and possibly to southeastern Oregon, and not improbably to southwestern Idaho.

During a conversation A. C. Lloyd said that these screech owls were found in the dense willows of the Populus Sargenti-Salix Community at the mouth of Ashley Creek. The birds had nested there, and the female was still feeding the juvenal birds when taken.

Bubo virginianus occidentalis Stone. MONTANA HORNED OWL.

One specimen: twenty-five miles northeast of Kamas, Wasatch County. This large owl was found only in the more inaccessible parts of the Basin. Hunted rather extensively as "vermin" by ranchers, farmers, and sportsmen alike, these birds have become greatly reduced and are very shy, making it difficult even to locate them. The specimen collected on July 16 was in juvenal plumage, having considerable down about the head, breast, belly, and flags. Although very dark, it has many light warm buff markings throughout its plumage.

Glaucidium gnoma pinicola Nelson. ROCKY MOUNTAIN PYGMY OWL.

A small owl was reported by Leo Wild, a rancher, from Hill Creek. He informed me that every summer several very small owls may be seen in the dense thickets of willows that enclose the creek in many places. He has seen the owls in the vicinity of his ranch throughout the year. In the winter the little owls become so tame that they are caught occasionally. There is no definite evidence as to whether or not these small owls are the Rocky Mountain Pygmy Owl, but the mere fact that owls of this size are seen in the Basin each year would indicate the possibility of the presence of this subspecies.

Speotyto cunicularia hypugaea (Bonaparte). WESTERN BURROWING OWL.

Ten specimens: twenty miles east of Vernal; seventeen miles south of Vernal; and two miles south of Jensen. Burrowing owls were not numerous in the Uinta Basin, although there were a few scattered colonies found in similar environments in the Mixed Shrub Desert Communities. They built their nests in deserted prairie-dog burrows. One colony, seventeen miles south of Vernal, was in a Chrysothamnus Community, where it was associated with and merged into an Atriplex-Tetradymia Community. Scattered clumps of cactus (*Opuntia rhodantha*) were prevalent throughout the two communities.

The first birds were seen along the main highway on May 6, twenty miles east of Vernal, where there was considerable shrub desert (Atriplex-Tetradymia Community). Later, on June 20, seventeen miles southwest of Vernal, I noticed an owl, sitting on a post close to the road. Frightened by my close approach, the bird flew on a short distance and alighted on a rocky knoll. A second visit was made to the same locality on June

23, and this time a second bird flew up from the ground, where it had been hidden by some scattered rabbitbrush. Further investigation revealed the burrow to their nest. The entrance clearly indicated that there were young, for the ground was strewn with half-eaten kangaroo rats (*Dipodomys ordii*) and spade-foot toads (*Scaphiopus intermontanus*). After digging for nearly two hours in the soft, sandy soil of the desert floor, we excavated a hole ten feet long and between two and four feet deep. The dead carcasses of rats and toads became more numerous, and the odor grew stronger as the nest came into sight. A few bits of grass were found, although these may have been used by the former occupant, a prairie dog. The nine young became frightened when the daylight was let in, and in unison they hissed and squawked, making a noise that sounded surprisingly like the susurration of a big rattlesnake. The nine young varied in age from one that had just hatched to birds that were nearly full-grown, with well-developed wings and tail-feathers. In the meantime, the adults kept flying about in wide circles, clicking their bills. When I examined the nest, eighteen half-eaten spade-foot toads and the remains of twenty-two kangaroo rats were found, revealing that the owls must be very busy during the early morning, evening, and at night, hunting for food.

While I was driving along the roads in August, it was common to see owls resting on fence-posts or on low mounds, where they would watch the car without any apparent alarm; but the moment I stopped near them, they would fly. There were three points in the Basin where they could always be seen, since these were close to nesting sites: one, four miles southwest of Jensen; another, twenty miles east of Vernal; and the last, seventeen miles southwest of Vernal. The birds all seemed to leave their favorite grounds by the first of September. After this date they would be found scattered about over the shrub-deserts; at first, in small family groups of from three to ten, and later as occasional individuals. By September 20, the burrowing owls had disappeared and none was observed in the Basin after this date.

Asio wilsonianus (Lesson). LONG-EARED OWL.

Four specimens: Jensen. A. C. Lloyd collected two males and two females near Jensen on April 24 and May 15, 1935. The stomach of the female taken on April 24 contained the remains of a kangaroo rat. This seems to indicate that these owls travel over the surrounding shrub desert, at least during the early morning and evening. None of these owls was observed in 1937. P. A. Taverner notes that specimen 1899 in the National

Museum of Canada is very pale, the ochers being largely replaced by ashy gray.

Asio flammeus flammeus (Pontoppidan). SHORT-EARED OWL.

This owl was seen only once, at the Ashley Creek marshes on September 21, 1937.

Phalaenoptilus nuttalli nuttalli (Audubon). NUTTALL POOR-WILL.

One specimen: two miles south of Jensen. A. C. Lloyd collected this bird, a male, on August 19, 1935. It is in the National Museum of Canada. P. A. Taverner remarks that the specimen is not distinguishable from gray birds taken at Osooyos, British Columbia. Ridgway (1876) records an adult male taken on July 7, 1869, in the Uinta Mountains. From the description of his route, this bird was collected at some point on the western spur of the Uinta Mountains.

Chordeiles minor howelli Oberholser. HOWELL NIGHTHAWK.

Eleven specimens: Jensen; two miles south of Jensen; forty miles north of Vernal; and eight miles north of Elk Springs, Colorado. Nighthawks were first seen in the Basin along Green River on May 14 at a spot near Jensen. A considerable flock in migration was flying high in widely diffused formation; each bird several hundred yards from the next. Several races may have been represented, but it was impossible to collect any specimens at the time. Since *howelli* later was found to be the nesting form in the Basin, probably many of these birds were of this variety.

Nighthawks were seen frequently in the evenings along Green River or out over the shrub deserts, where they seemed to be considerably concentrated. Several were collected and all proved to be *howelli*. On July 24, eight miles north of Elk Springs, Colorado, a nest was located high up on a clay and gravel hill which was bare of vegetation at its summit. Here the nighthawk had laid its eggs in a slight depression in the gravel. At the time there were two eggs in the nest. These proved to be two-thirds incubated. The nesting bird was identified as *howelli*. Later that evening, while collecting in this locality, but lower along the Yampa River, I observed a large number of nighthawks feeding on flying insects that had concentrated over the tall grassy meadows and weedy thickets. Upon collecting several specimens, I found that there were two subspecies present, *howelli* and *henryi*, but *howelli* was the more abundant form. This is substantiated on Oberholser's map (Oberholser, 1914).

The Howell Nighthawk has an extensive range in the Basin. It was most numerous in the shrub deserts, but I saw large numbers at Green Lake, Uinta Mountains, at an altitude of 8000 feet. On July 3 a nesting population frequented the open yellow pine forests that were scattered over large strips of broken rocky ridges.

From July to the middle of September nighthawks were often seen along the numerous watercourses of the Basin. The largest concentration seemed to be centered out over the shrub desert, particularly in the more barren "bad land" sections. Nighthawks continued to be seen after the middle of September, but most of them were flying southward, following the Green River valley. By the last week of September only an occasional bird was seen. Ridgway (1876) reports collecting a nest with one egg in the Uinta Mountains (head of Duchesne River) on July 8; a nest with one egg at Parley's Park on July 17; a nest with two eggs at Parley's Park on July 23; and two females and one male at Parley's Park between July 24 and August 26, 1869.

Chordeiles minor sennetti Coues. SENNETT NIGHTHAWK.

One specimen: two miles south of Jensen. Little could be learned about this bird, since only the single specimen was collected. A small group of six or eight birds appeared around camp on the evening of September 21. They flew very close to the ground, feeding on the swarms of gnats that had gathered. One of the birds was collected and found to be *sennetti*, but unfortunately no others were taken. The first published record of this bird for Utah appeared in 1940. The bird was taken at Utah Lake near Provo, in August, 1931 (Hayward, 1940). This was doubtless a migrant, as was my specimen taken on September 21.

Chordeiles minor henryi Cassin. WESTERN NIGHTHAWK.

One specimen: eight miles north of Elk Springs, July 23. This single specimen of *henryi* was collected from a concentration of feeding nighthawks, numbering between fifty and one hundred. The two others taken from this flock were *howelli*. Evidently, *henryi* was not the nesting form, although its presence at this date makes it possible to assume that a few individuals nest in the general locality. From available data it seems that the nesting ranges of *howelli* and *henryi* meet approximately in the region of the Uinta Basin. It appears that in certain restricted areas of the Basin each of these forms might nest separately. Hayward (1940) found a single

female with two immature young at Jensen on July 23, 1937. This would substantiate a breeding record for this form in the Basin. The breeding ranges of *henryi* and *howelli* obviously overlap here with the odds in favor of *howelli*. The subspecies *hesperis* (Oberholser, 1914), which meets *howelli* at the western extremity of the Basin, has been designated as the breeding form in northwestern Utah. Hayward (1940) has extended the range of *hesperis* to the southeastern part of the state. A more intensive survey of Utah nighthawks ought to bring to light an interesting problem in the breeding ranges of the three related forms: namely, *henryi*, *howelli*, and *hesperis*.

Aeronautes saxatalis sclateri Rogers. WHITE-THROATED SWIFT.

Nine specimens: twelve miles east of Vernal and two miles south of Jensen. On an average the wing measurements of the Uinta Basin specimens (males, 142.8 mm., females, 144.3 mm.) are larger than southern specimens from Sonora (males, 134.3 mm., females, 137.0 mm. [Rogers, 1939]), which agree with the limits of *A. s. sclateri*. The wing measurements of the Uinta Basin birds are not so large as specimens from Montana, which average: males, 147 mm., females, 146.2 mm. The Uinta birds are intermediate in this character. Rogers points out that there are no subspecific variations in color between *A. s. saxatilis* and *A. s. sclateri*. The race *A. s. sclateri* cannot be called well marked. The only differentiating character is the slightly larger average wing measurements.

Although these large swifts were numerous in the Basin, they seemed to be somewhat restricted in their distribution. The first were seen at the Ashley Creek marshes near our camp site on May 1. A large flock of two or three hundred suddenly appeared and continued to fly high over the marshes from 5:00 P.M. until about 7:30 P.M. Just before dusk they disappeared as quickly as they had appeared. The birds, flying off in the direction of the marshes, continued to return and depart each evening at the same hour.

On the 26th of May, while at Ashley Creek Canyon and along the Dry Fork, a tributary of Ashley Creek, two nesting colonies were located: one in the canyon, and the other on the face of a very high cliff. Here, at times, the air seemed to be full of twittering swifts as they went through their aerial acrobatics far up among the highest cliffs. The nests were located in crevices in the face of the cliff from two hundred to five hundred feet up the precipitous walls. The birds evidently had young, for there was a continuous stream of adult birds going back and forth. The incom-

ing birds seemed to fly directly to the nesting holes without hesitation in their flight.

During the summer I discovered large colonies scattered over the Basin, and always in localities where high precipitous cliffs offered suitable nesting sites. Colonies were seen at Hill Creek, forty miles south of Ouray; Florence Canyon, seventy-five miles south of Ouray; Indian Canyon, twenty miles southwest of Duchesne; Blue Mountain, Uinta Mountain, twenty-five miles east of Vernal; Green Lake, Uinta Mountains, forty miles north of Vernal; Whiterocks; mouth of Green River Gorge; Provo River, twenty miles southeast of Kamas, Wasatch County; and Yampa River, eight miles north of Elk Springs, Colorado.

In September, large flocks would come to the Ashley Creek marshes and along the Green River valley to feed at about 10:00 in the morning and again at about 4:00 or 4:30 in the afternoon. On September 25 a flock of several hundred birds appeared at the usual time in the morning and increased in numbers, until by noon there were thousands flying about. The day was calm and warm with a consequent concentration of flying insects over the marshes and fields. The swifts kept shifting from one locality to another. First, there would be hundreds flying by, only four or five feet above the grass; suddenly, the whole group would rapidly gain altitude until, flying in great circles, they were several hundred feet in the air. And then like plummets, they would drop close to the ground at some particular spot over the marsh. A few birds were noticed on September 27, but after that day swifts were not seen again. The concentration of September 25 and 26 was apparently a final gathering before the main southward migration.

Archilochus alexandri (Bourcier and Mulsant). BLACK-CHINNED HUMMINGBIRD.

Three specimens: ten miles west of Vernal; eight miles west of Vernal; and two miles south of Jensen. This hummingbird was rare in the Basin in 1937; a single specimen was taken ten miles west of Vernal on May 28. The locality was along the banks of a dry stream in a deep canyon, which at this point was densely wooded with junipers (*Juniperus utahensis*). The single male was first observed as it buzzed angrily about, apparently annoyed and acting as if there were a nest close by. However, after I waited for an hour or more, the bird showed no signs of having a nest. A. C. Lloyd found this hummingbird an uncommon visitor at the Ashley Creek marshes, where he collected one male on May 8, 1935. He collected

a single male eight miles west of Vernal in the Juniper Community on May 28, 1934. The available information seems enough to show that the Black-chinned Hummingbird nests in the Basin, but is sparsely scattered throughout the juniper communities.

Selasphorus platycercus platycercus (Swainson). BROAD-TAILED HUMMINGBIRD.

Five specimens: twenty-five miles east of Vernal; twenty miles southwest of Duchesne; and respectively twelve, twenty, and forty miles north of Vernal. This hummingbird was the common nesting form found in the Basin. The first bird was seen on May 20, when it came to rest on a fence near my camp at the Ashley Creek marshes. The bird was very shy and darted away before it could be approached closely. On May 24, while on the southeast slope of Blue Mountain at an altitude of 6500 feet, several were observed in a deep canyon of the juniper forest. They did not appear to be feeding, but they kept flying out from favorite perches, disappearing for a moment and then suddenly appearing again on a particular dead branch.

Later, several pairs of these birds were found to be nesting at various places on the mountain slopes between 6000 and 8000 feet, the greatest numbers being found at 7000 feet. From five to fifteen birds were seen at Ashley Canyon twelve miles north of Vernal; on the southeast slope of Blue Mountain; at Florence Canyon, seventy-five miles south of Ouray; ten miles south of Green Lake; and fifteen miles below Paradise Park.

The above distribution places the birds in the vegetational zones that constitute the Juniperus-Pinus and Aspen communities.

After September 20 these hummingbirds were not seen in the Basin, although during the last week of August and the first two weeks of September there was a considerable concentration in the vicinity of Ashley Creek marshes. A. C. Lloyd reports having seen only one male, which he collected at the Ashley Creek marshes on May 7, 1935.

Selasphorus rufus (Gmelin). RUFOUS HUMMINGBIRD.

The Rufous Hummingbird is an erratic visitor to the Basin. In 1937 I did not notice one of these hummingbirds throughout my entire stay. A. C. Lloyd did not record any in 1934 until July 20, but after that date each patch of fireweed (*Chamaenerion angustifolium*) attracted at least three or four of these birds. Mr. Lloyd saw only two birds during the 1935 season.

Megaceryle alcyon alcyon (Linnaeus). EASTERN BELTED KINGFISHER.

One specimen: five miles south of Heber. Kingfishers were not numerous in the Basin. Their distribution was chiefly along the mountain streams and in the high mountain lakes to an altitude of 9000 feet. Individuals and pairs were seen at Ashley Creek Canyon, twelve miles north of Vernal; Green River in the vicinity of Jensen, and the Ashley Creek marshes; Paradise Park; Moon Lake; Blue Mountain; Beaver Creek, seven miles northwest of Ladore, Moffat County, Colorado; Junction of the Green and White rivers at Ouray; Duchesne River, six miles east of Duchesne; Strawberry Reservoir; and the Provo River five miles south of Heber. Because of its feeding habits and consequent effect on the trout streams, the kingfisher is not encouraged in many vicinities, which no doubt is responsible for its scarcity and spotty distribution in the Basin.

Colaptes cafer collaris Vigors. RED-SHAFTED FLICKER.

Nine specimens: twelve miles east of Vernal along the Green River; forty miles north of Vernal; and two miles south of Jensen. This species has a wide selection of habitat preferences, ranging from the river floodplains and desert scrub to the Picea-Abies Community of the high mountains at altitudes of 10,000 feet. Among the specimens collected and those observed, there was no indication of hybridization with *Colaptes auratus luteus*. Probably because of its wide adaptability and its large size, the Red-shafted Flicker was one of the most common and prominent birds found in the Basin. No matter where I went, the flickers were present with their loud, lusty cries and incessant sunrise hammerings.

The cottonwood river floodplain at the Ashley Creek marshes was one of the large concentration areas for the flickers. In a two-mile strip of cottonwoods along the west shore of the Green River, twenty pairs nested. The first nesting birds were observed on May 15. From this date until July 28, flicker nests were occupied, resulting in a surprising increase of these birds by August. During August it was common to see a flock of from twenty-five to fifty birds gathered along the cottonwood floodplains, where they were able to feed on quantities of ants and other insects gleaned from the trees and the ground cover. Flickers were still seen on September 30. They apparently remained in the Basin until the first cold weather in October. Later, on October 25, at St. George in southern Utah, large numbers of migrating flickers passed through.

Melanerpes erythrocephalus caurinus Brodkorb. RED-HEADED WOODPECKER.

On July 28, five miles southwest of Ouray, along the cottonwood floodplains of the Green River, an adult male was found dead. No doubt the bird had been injured in some way, but its condition was too bad to tell exactly. It had died evidently several days before, and it was impossible to save the skin. This was the only evidence found of the Red-headed Woodpecker in the Uinta Basin. This bird is designated *M. e. caurinus* on geographical grounds.

Asyndesmus lewis Gray. LEWIS WOODPECKER.

Three specimens: two miles south of Jensen; and Ouray. This large woodpecker was rather rare. I found it in only two localities—four miles south of Jensen and five miles southwest of Ouray—both on the east bank of the Green River. The localities were similar in character, being situated in a late Cottonwood Floodplain Community in which the trees were large and widely spaced. Here, still standing, were numerous large dead trees which were used by the woodpeckers for nesting sites. At the locality below Jensen four pairs nested. One pair was feeding its young on June 5. It was interesting to watch the birds catching insects, flying out for them like flycatchers. At Ouray on July 25, only the one pair was seen. A. C. Lloyd collected a single female on July 19, 1935, two miles south of Jensen. This was the only bird of this species seen by him in 1934 and 1935.

Sphyrapicus varius nuchalis Baird. RED-NAPED SAPSUCKER.

Seven specimens: Green Lake, Uinta Mts.; two miles south of Jensen. These sapsuckers were not over-abundant in the Basin. They nested in the ecotone between the aspens and the pines of the Uinta, Wasatch, and Book Cliff mountains. Three pairs were seen at Green Lake on June 29. These birds were feeding young at nesting holes which they had made in live aspen trees. One nest was only five feet from the ground, but the other two were at least fifteen feet up.

The first juvenal bird collected was taken two miles south of Jensen near the Green River on August 9. With the young bird was an adult male in very worn and molting plumage. Adults in their fall plumage were encountered at Green Lake on September 15. From this date to the end of the month large numbers began migrating to the lower valleys of the

Basin's rivers. Specimen 122038, a male collected two miles south of Jensen on September 21, had acquired its full adult plumage except for a scattering of a few gray juvenal feathers on the breast. Specimen 122064 retained the gray juvenal breast feathers, but the remainder of its plumage was that typical of adult males.

Sphyrapicus thyroideus nataliae (Malherbe). NATALIE SAPSUCKER.

Eight specimens: Green Lake, Uinta Mountains; twenty miles southwest of Duchesne. This species was rather scarce in the Basin, being found only in the two localities mentioned. The birds were shy and difficult to locate. At times they could be heard pounding softly or calling, but, even with these evidences of their presence, they had a habit of keeping a tree trunk between them and the observer. The birds at Green Lake were found in the yellow pine forests, usually in places where the aspens and pines made up a mixed forest. Here, in an area of about five square miles, at least eight pairs nested. In early September they were seen feeding young in the same locality in which they had been seen during June and July. At Indian Creek Canyon, twenty miles southwest of Duchesne in an alpine fir, Douglas fir, and aspen forest, three pairs were seen on June 18 and 19. On June 18 a male was seen to fly over to a tall aspen and disappear into a newly constructed hole, fifteen feet from the ground. From the squeaks that issued it was apparent that there was a family of young in the nest. Both parent birds were seen carrying food to the young. The male would fly to a dense alpine fir forest about 150 yards to the south, while the female flew northeast to a small stand of aspens. The birds were watched for an hour and a half, and during that period the male made five visits to the nest with food while the female made ten. With field glasses it was apparent that the greater bulk of the food consisted of flying insects such as small moths and gnats. These were the only two places in the Basin where the birds were seen. C. L. Hayward collected a specimen of the Natalie Sapsucker at Elk Park, ten miles west of Green Lake, between July 25 and 29, 1936.

Dryobates villosus monticola Anthony. ROCKY MOUNTAIN HAIRY WOODPECKER.

Fifteen specimens: Green Lake, Uinta Mountains; five miles south of Jensen; Uinta Canyon, twenty miles southwest of Duchesne; and twenty-five miles northeast of Kamas. Juvenal males: 121607, 121581, and 121736, had a scarlet patch high on the crown; the forehead was black,

spotted with white. The distribution of this species in the mountains of the Basin was rather general, without any noticeable concentration. Where the birds occurred, they showed a preference for nesting sites in the higher altitude communities, from 7000 to 9000 feet in scattered yellow pine, alpine fir, aspen, and Douglas fir forests.

The first birds to come down from the mountains were seen at the Ashley Creek marshes on August 25. There was, however, no migration or general movement of the birds at this time from their nesting grounds in the mountains; they just seemed to filter down as fall approached. During the last two weeks of September a few individuals were seen in company with small groups of downy woodpeckers along the Green River floodplains.

Dryobates pubescens leucurus (Hartlaub). BATCHELDER WOODPECKER.

Eleven specimens: Jensen; two miles south of Jensen; Green Lake, Uinta Mountains; Uinta Canyon, twenty miles north of Roosevelt. In early May this race of the Downy Woodpecker was found to be numerous along the floodplains of Green River and Ashley Creek. Here the birds were seen busily working over the bark of the cottonwoods and willows. They had all vanished by the end of May and were not re-encountered until July, when immature birds were collected at Green Lake, Uinta Mountains. During the first week of July two nests, each with young birds that were still fed by the parent birds, were located in dead aspen limbs. On August 25 the first Batchelder woodpeckers were again seen along Green River, but it was not until September 20 that the birds moved down in any numbers into the lower valleys of the Basin.

Picoides tridactylus dorsalis Baird. ALPINE THREE-TOED WOODPECKER.

Four specimens: Paradise Park, Uinta Mountains; Bald Mountain, Uinta Mountains. This three-toed woodpecker has a restricted range in the mountains of the Basin. It was found at an altitude of 10,000 feet in the Lodgepole Pine (*Pinus Murrayana*) and Engelmann Spruce (*Picea Engelmanni*) communities. The birds were sparsely scattered through the dense coniferous forests, where they were found to be shy and retiring. The female, collected at Bald Mountain on July 20, still had distinct brood-patches, indicating that the bird had raised young at this locality. C. L.

Hayward collected six specimens of this woodpecker in July and August, 1930, at Mirror and Tryol lakes. Tryol Lake is four and one-half miles west of Mirror Lake, Uinta Mountains.

Tyrannus tyrannus hespericola Oberholser. WESTERN KINGBIRD.

Eight specimens: twelve miles east of Vernal; and two miles south of Jensen. This flycatcher was not numerous in the Basin; the first appeared at the Ashley Creek marshes on May 15. At least two pairs nested along the cottonwood floodplain just south of Jensen. On July 12 a pair of kingbirds with five young that were just able to fly appeared close to my camp at the mouth of Ashley Creek. The parent birds fed the young at brief intervals but kept them moving along. Two kingbirds were observed at Brush Creek on June 29; three, at the Yampa River, eight miles north of Elk Springs, Colorado, on July 23; two, at Hill Creek, forty miles south of Ouray, on August 7. A. C. Lloyd regarded this kingbird as an infrequent summer resident at the Ashley Creek marshes in 1934 and 1935. He noticed only a few scattered pairs.

Tyrannus verticalis Say. ARKANSAS KINGBIRD.

Seventeen specimens: twelve miles east of Vernal; Blue Mountain, 8000 feet altitude; six miles north of Jensen; Yampa River, Colorado, (juvenal male, July 24); Beaver Creek, Colorado. These kingbirds were very numerous in the cottonwood floodplains of the drainage systems in the Basin. They occurred in large numbers along the banks of Green River. The first birds appeared on May 4. From this date until the first week of September, they were among the most characteristic birds of the floodplains. For the most part, they preferred old stands of cottonwoods where the large trees were well scattered and the tall standing dead trees were numerous. From favorite perches near their nesting holes, they could be seen or heard throughout the summer. There was never any indication of migration among these birds. They seemed just to filter in and then vanish as the first cold of fall approached. The breeding population was, however, well distributed along the watercourses and even up on some of the mountain slopes. Four pairs were seen on the east slope of Blue Mountain at an altitude of 8000 feet on May 22. During August a decided movement was noticeable in the kingbirds, for they were then more frequently seen out on the shrub deserts and "bad lands." These birds were last seen in the Basin about the middle of September.

Myiarchus cinerascens cinerascens (Lawrence). ASH-THROATED FLYCATCHER.

Six specimens: near Jensen; two miles south of Jensen; ten miles west of Vernal; two miles south of Jensen; Cottonwood Springs; Blue Mountain. This flycatcher was not abundant in the Basin even during migrations. It had very secretive habits, although its loud call could be heard frequently. These flycatchers preferred the shelter of the dense willow thickets along the watercourses or that high up in the dense foliage of the cottonwoods. On June 28 a pair was seen at Cottonwood Springs, where they evidently had a nest close by, but they refused to approach it as long as anyone was near. Later, a few birds were seen in migration as they passed through the vicinity of Ashley Creek marshes. The last was seen on September 21.

Sayornis saya saya (Bonaparte). SAY PHOEBE.

Twelve specimens: twelve miles east of Vernal; two miles south of Jensen; twelve miles, and fifteen miles southwest of Vernal. The Say Phoebe was a comparatively common bird of the "bad lands." During May a pair was seen almost every day in the vicinity of Ashley Creek marshes; but the birds always moved on, never remaining in any one locality. On a strip of shrub desert fifteen miles southwest of Vernal, a pair of phoebes was seen on June 12. By their actions it was soon discovered that they had a nest. The nest was built on the side of a rocky hill in a crevice in the rock. There were five young, that were just ready to leave the nest. The two parents made such a fuss that within a few minutes six other adults, seeming to come from nowhere, had joined them. A careful search uncovered three nests in similar locations. On June 21 I was surprised to find a nest of a Say phoebe with well-developed young on the rafters of a machine shed on Ramsey Stewart's ranch, which borders on the Ashley Creek marshes. The young left the nest on June 24.

While traveling over the Basin, one or two birds were frequently seen at such places as along the main highway, ten miles west of Myton; Ashley Creek; ten miles north of Vernal; along the main highway, fifteen miles southeast of Jensen; and at Horseshoe Bend on Green River. The last birds observed in the Basin were seen at Ashley Creek marshes on September 21. A. C. Lloyd found these birds to be very common in 1934 and 1935. Several pairs nested close to the Ashley Creek marshes.

Empidonax traillii adastus Oberholser. MOUNTAIN FLYCATCHER.

Twelve specimens: near Jensen; Hill Creek, forty miles south of Ouray; and five miles south of Heber. The Uinta Basin birds show on their dorsal surface more brown and gray than *E. t. traillii;* the bills are larger but not so large as *E. t. brewsteri.* Oberholser (1932) states that birds he examined from northern Utah were intermediate between *adastus* and *brewsteri* but leaned more toward *adastus.* The measurements of the Uinta specimens are comparable with those of Oberholser for *adastus.*

	Wing	Tail	Exposed Culmen	Tarsus
Uinta specimens				
12 ♂♂	(68.5-73.0) 70.1	(56.5-64.0) 60.0	(12.0-13.0) 11.7	(16.0-18.5) 16.4
Oberholser, *E. t. adastus*				
10 ♂♂	(69.5-73.8) 71.8	(59.0-62.0) 60.6	(11.0-12.8) 12.1	(17-18) 17.4

This flycatcher was found to be common along the floodplain district of the Green River during spring migration. At least four pairs nested in the vicinity of the Ashley Creek marshes; their calls could be heard frequently during June. Juvenal birds were seen in the dense willow growth on the west side of the Green River, three miles south of Jensen, on June 25. In the vicinity of the upper Hill Creek district, about forty miles south of Ouray, three alder flycatchers were seen in the cottonwood floodplain, and one male was collected on August 6. Later, during migration, a single bird was taken on the Provo River, five miles south of Heber, on September 7.

Empidonax hammondi (Xantus). HAMMOND FLYCATCHER.

Three specimens: two miles south of Jensen; and Green Lake, Uinta Mountains. These birds were rare in the Basin; the first was seen and collected at Green Lake, Uinta Mountains, forty miles north of Vernal, on July 2 and 3. Although yellow pine was the dominant tree, these flycatchers preferred the scattered aspen thickets. On July 2 a single bird was seen catching flying insects at the edge of a grove of aspens. Disturbed by my presence, it became quite noisy. An attempt was made to locate the nest or possible young, but none was found. The following day, in another locality just a half-mile away in some aspens, a second bird was found. Both were males in very worn plumage. A third specimen was taken in the cottonwood floodplain of the Ashley Creek marshes, two miles south of Jensen, on August 9. This bird had evidently started its early migration along the Green River valley. C. L. Hayward collected

two specimens at Beaver Creek Ranger Station, twelve miles southwest of Green Lake, on May 30, 1936.

Empidonax wrighti Baird. WRIGHT FLYCATCHER.

Five specimens: two miles south of Jensen; twenty miles southwest of Duchesne; seventy-five miles south of Ouray; and Blue Mountains, east slope, 8000 feet. These flycatchers were distributed rather unevenly over the Basin. During both the spring and fall migrations they were seen along the Green River valley, where they sought the protection of the dense willow and cottonwood thickets. Early migrants, they passed along the river valleys from the 17th of May to the end of the month. Later they moved to the high altitudes, where they nested at about 8000 feet in the aspen and willow thickets of the yellow-pine and lodgepole-pine forests. Although no nests were located, the birds observed at Blue Mountain on June 26, at Indian Canyon, twenty miles southwest of Duchesne on June 18, and at Florence Canyon, seventy-five miles south of Ouray, on July 30, were obviously summer residents. The individuals observed were all shy, keeping to the dense shrubby growths, where they fed close to the ground. At the slightest disturbance they would dart quickly out of sight.

Empidonax griseus Brewster. GRAY FLYCATCHER.

Two specimens: male and female; Cottonwood Springs, June 28. The Gray Flycatcher is rare in the Uinta Basin. The two specimens taken were observed and collected on June 28. They showed well-worn plumage. The male sex organs were well developed; the female organs indicated that the birds had either recently laid or that the laying period was imminent. It seemed rather strange to find only one pair at Cottonwood Springs. The nest was not located but it could have been overlooked, for Linsdale (1936) states that the birds are restricted to sagebrush-covered areas during the time of nesting. This locality was at an altitude of 6000 feet and consisted of a stand of cottonwoods and dense shrubbery about the spring, which was entirely surrounded by a forest of juniper (*Juniperus utahensis*) and pinyon (*Pinus edulis*). The open areas among the junipers and pinyons had a shrub cover of sagebrush (*Artemisia nova*), and it was probably here that the birds were actually nesting. They were catching flies about the spring when observed and seemed to be centering their activities in this locality. The spring was also a center of concentration for a large number of other birds, since this was the only water available within six or seven miles on this semi-arid mountain slope.

Empidonax difficilis difficilis Baird. WESTERN FLYCATCHER.

Two specimens: ten miles west of Vernal; and Uinta Canyon, twenty miles north of Roosevelt. This flycatcher was very rare in the Basin; only two were taken during migration. The first, a male in full adult plumage, having a decided greenish yellow wash over the underparts, crown, and back, was collected on May 28, ten miles west of Vernal. An immature bird was collected on August 28 at Uinta Canyon. It was seen alone at the edge of a dense growth of willows overhanging a small stream, where it was busily feeding upon flying insects.

Myiochanes richardsoni richardsoni (Swainson). WESTERN WOOD PEWEE.

Eleven specimens: twelve miles east of Vernal; Paradise Park, Uinta Mountains, 10,050 feet; Ouray; Moon Lake, forty miles north of Duchesne; and Uinta Canyon, twenty miles north of Roosevelt. This was one of the commonest flycatchers in the Basin. It occurred as a summer resident and ranged from the floodplains of the river and creek valleys to the high altitude spruce-fir forests, such as we found at Paradise Park in the Uinta Mountains at an altitude of 10,050 feet. In a broad sense, the birds occurred wherever trees grew in the Basin.

Nuttallornis borealis borealis (Swainson).[2] OLIVE-SIDED FLYCATCHER.

Nine specimens: thirteen miles east of Vernal; eight miles west of Vernal, two miles south of Jensen; Moon Lake, forty miles north of Duchesne; and five miles south of Heber. This flycatcher is found in considerable numbers along the main river valleys of the Basin during spring migration, from May 15 to June 10, and also in the fall, during September. It was nesting in the spruce-fir forests at Paradise Park, Uinta Mountains, at an altitude of 10,050 feet on July 1-10. Four males were observed and heard along the edges of the forest where the conifers bordered the mountain lakes. Their loud whistling song was characteristic of these regions. Very shy, they fed, for the most part, high up in the tallest spruce trees, and only came to lower levels when no one was in sight. Later, on August 20, while at Moon Lake, several flycatchers were observed in the dense coniferous forests about the lake. A female, collected from a group of

[2]A. J. van Rossem, Transactions San Diego Society of Natural History, 1934, 7:352 and Harry C. Oberholser, Scientific Publications, Cleveland Museum of Natural History, 1930, No. 1, v. 1:83-124.

four birds, was in very worn plumage. The birds were, as before, very shy and preferred the tallest dead pine trees, from which they would fly out and catch insects. The earliest fall records for the lower valleys at Jensen were made by A. C. Lloyd, who collected a male and a female on August 10, 1934, and a female on August 24, 1935, at the Ashley Creek marshes.

Otocoris alpestris leucolaema (Coues). DESERT HORNED LARK.

Ten specimens: near Jensen; twenty-two miles east of Vernal; ten miles west of Vernal; fifteen miles south of Vernal; twelve miles east of Jensen; fifteen miles, and seventeen miles southwest of Vernal; Cottonwood Springs; Horseshoe Bend, Green River.

This bird was common in both the spring and fall migrations and was an abundant summer resident. It was characteristic of the arid shrub deserts, particularly at the edge of the semi-arid and barren"bad land" sections of the Basin. This lark probably remains in the Basin or moves south two hundred miles or so during the winter months. It is the first to arrive in the early spring, appearing in medium-sized flocks in April, just as the snow begins to leave the plains. As early as May 10, young birds just able to fly were seen on the shrub desert, ten miles west of Vernal. Adults and birds in fully developed immature plumage were seen throughout the remainder of the summer in this general vicinity, also fifteen miles southwest of Vernal, and on the "bad lands" east of Green River. In late August the larks began to gather in flocks of from twenty to fifty birds, which were seen most frequently on the shrub desert plateaus.

Tachycineta thalassina lepida Mearns. VIOLET-GREEN SWALLOW.

Ten specimens: near Jensen; Hill Creek, forty miles south of Ouray. These swallows were numerous in the Basin, but rather unevenly distributed. In the summer they were found in the surrounding mountains, where they nested at altitudes from 6000 to 8000 feet. On May 31, the first birds were seen along the Green River in the vicinity of the Ashley Creek marshes. Here, large groups of between twenty-five and one hundred individuals were seen catching flying insects close to the surface of the water. From the above date onward, throughout the summer, they were frequent visitors to the marshes, appearing in the early morning and again at about four in the afternoon. The birds while feeding flew within a few inches of a small pool of water, wheeled about, and came back over the same spot; thus they formed a long string which made a continuously moving circle. These birds from the mountains seemed very tame

and flew about catching insects within a few inches of the observer's face.

Nesting populations were noticed particularly at Green Lake in the Uinta Mountains, Strawberry Reservoir, and at Hill Creek, forty miles south of Ouray. In many instances the main feeding localities were located ten or even thirty miles from the nesting grounds. These places were along the valleys of Green River, White River, Duchesne River, Ashley Creek, Strawberry Reservoir, Yampa River, Beaver Creek, and Hill Creek. The last birds to be seen in the fall were at the Ashley Creek marshes on September 25. For four or five days before this period, very large numbers of swallows began to gather, and they could be seen sitting in long strings along the telephone wires or flying out over the rushes of the marsh, where they gathered by the thousands in the evenings.

Riparia riparia riparia (Linnaeus). BANK SWALLOW.

A very common swallow during spring and fall migrations, but as summer residents they were rather spottily distributed. A nesting colony was observed at Ashley Canyon, ten miles north of Vernal, on June 15, and one on Hill Creek, forty miles south of Ouray, on August 5. By late August and September large flocks were observed congregating about the Ashley Creek marshes. The last birds were seen on September 28 on Green River, two miles south of Jensen.

Stelgidopteryx ruficollis aphractus Oberholser. WESTERN ROUGH-WINGED SWALLOW.

Three specimens: twelve miles east of Vernal; and Ashley Canyon, ten miles north of Vernal. In these specimens the middle of the abdomen is white and the upperparts are much darker than in *Stelgidopteryx ruficollis serripennis*. This swallow was more numerous than was at first supposed, for it was observed in mixed flocks with bank swallows, the latter predominating. It was first found in Ashley Canyon on June 15, when a single bird was collected from a flock of five bank swallows that had come to rest in a dead tree. Later, in August and September, odd individuals of this species could be picked out of the congregating flocks of bank swallows. The last birds were observed at the end of September.

Hirundo rustica erythrogastra Boddaert. BARN SWALLOW.

The barn swallow was common in the farming districts along the river and creek valleys of the Basin. Two pairs arrived at the Ramsay Stewart ranch at the western edge of the Ashley Creek marshes in early June.

Here they remained throughout the summer, building their nests in the barn. The young appeared on July 12, but even after they were well able to fly, the swallows stayed about the ranch until late in September. Other nesting pairs were seen at Brush Creek, twelve miles north of Vernal; at the junction of the Dry Fork and Ashley Creek; Ouray; four miles west of Myton; Dinosaur National Monument; Strawberry Reservoir and five miles south of Heber on the Provo River.

Petrochelidon albifrons albifrons (Rafinesque). NORTHERN CLIFF SWALLOW.

Seven specimens: two miles south of Jensen. This swallow is a common migrant and summer resident, nesting along the cliffs of the rivers and creeks of the Basin. The largest colonies were observed on the east bank of the Green River, six miles south of Jensen, and on Hill Creek, forty miles south of Ouray. The birds were seen in large migratory flocks in the vicinity of the Ashley Creek marshes in late September.

Progne subis subis Linnaeus. PURPLE MARTIN.

The martin was not plentiful in the Basin. The main group of about thirty birds were seen about the town of Vernal, where they nested in bird boxes. Three pairs were seen at Ashley Creek canyon on June 22, and five on the Duchesne River, three miles east of Duchesne.

Perisoreus canadensis capitalis Ridgway. ROCKY MOUNTAIN JAY.

Twelve specimens: Paradise Park, Uinta Mountains, 10,050 feet; Bald Mountain, 10,500 feet. These birds were found to be restricted to the high spruce-fir forests at an approximate altitude of 10,000 feet. In both localities they were found in the same general environment. In July and August they wandered about in small family bands made up of the two parent birds and from four to six dark juvenal birds. The young birds taken on July 9 and 10 at Paradise Park were still dark, while those from the Bald Mountains taken on July 16 and 17 were much lighter in color, although still showing a little of the dull gray of the juvenal plumage. The birds were numerous in the high-altitude coniferous forests and a flock could be seen or heard in the forest at almost any daylight hour. Around camp the jays became very tame and came down for food that was offered them. A pair of these jays was seen at Moon Lake, forty miles north of Duchesne, atlitude 9500 feet, in the Uinta Mountains. On September 14 and 15, three jays were seen at Green Lake in the Uinta Mountains at an altitude

of 8000 feet. Here they had already descended to the yellow-pine forests. People who live the year around at Green Lake report that these jays remain throughout the winter in this Yellow Pine Community. C. L. Hayward collected six specimens between July 11 and August 18, 1930, at Mirror and Tryol lakes, four and a half miles west of Mirror Lake, Uinta Mountains.

Cyanocitta stelleri cottami Oberholser. UTAH JAY.

Six specimens: Green Lake, Uinta Mountains; Uinta Canyon, twenty miles north of Roosevelt; and Indian Canyon, twenty miles southwest of Duchesne. The measurements of the Uinta Basin specimens compare favorably with those given by Oberholser (1937), except for the length of the middle toe without the claw, which is consistently longer (two to three mm.) than in those reported by him.

MEASUREMENTS IN MILLIMETERS

	Wing	Tail	Exposed culmen	Height of bill at base	Tarsus	Middle toe without claw
Uinta Basin						
Average ♂♂.	153.0	140.0	24.0	11.0	41.1	25.2
Range of measurements	148-160	135-152.4	28.7-31.2	10.3-11.9	39.0-43.9	24-27.0
Average ♀♀.	149.1	136.5	28.1	10.2	42.5	24.7
Range of measurements	147-151.2	133-140	28-28.2	9.6-10.8	42-43	23.5-26
Oberholzer						
Average ♂♂.	150.7	137.6	28.8	11.0	43.8	21.6
Range of measurements	144-160	129-154	27-30	10.5-12	42-45.5	20-23.5
Average ♀♀.	148.6	137.8	27.5	10.6	44.1	21.3
Range of measurements	140-156	131-144	25-31	10-11.8	42-46	20-22

This jay was not abundant in the Basin. It occurred only in isolated bands or family groups. At Indian Canyon, twenty miles south of Duchesne, a single pair was seen on June 19. Six birds were observed at Green Lake, Uinta Mountains, on July 2. At least three of the number were fully developed but still in their immature plumage. These birds had traveled down from the lodgepole pines into the yellow pines, where they were feeding. Upon being disturbed, they became very wary, and flew into the lodgepole pines at higher altitudes.

This jay nests between altitudes of 8000 and 9500 feet in the mountains of the Basin from the middle of April well into June. In summer it ranges from the yellow pines and blue spruce to the Engelmann spruce-alpine fir forests and on up to timberline at 10,000 feet. Several were seen at the edge of timberline in the Picea-Abies Community at Paradise Park, Uinta Mountains. The first indication of its descent to lower levels was observed on August 28 in the Uinta Canyon. A single bird was seen about halfway up the canyon at 7500 feet. But farther up, at an altitude of 8000 feet, a great many of these jays were observed in places where stands of aspen began to appear.

Aphelocoma californica woodhousei Baird. WOODHOUSE JAY.

Four specimens: Blue Mountain, 8000 feet; Hill Creek, forty miles south of Ouray; twenty miles north of Vernal; Dry Fork, ten miles northwest of Vernal. This jay was a resident of the mountains of the Basin, being particularly numerous in the Uinta and Book Cliff mountains. Birds were seen in the Juniper forests near the Yampa River about six miles north of Elk Springs, Colorado, July 24; at Beaver Creek, seven miles northwest of Ladore, Moffat County, Colorado, July 25; and in the junipers along the road between Ladore and Graystone, Colorado, on July 27. No nests were observed, but fully grown juvenal birds were seen, and one was taken at Brush Creek, twenty miles north of Vernal, on June 29. A female taken at this date was in advanced molt. During the first week of May, several individuals of this species were observed flying over the Ashley Creek marshes. However, by the middle of May and up until September, they were seen only in the forests and canyons at altitudes between 6500 feet and 8500 feet. It was a fairly common occurrence in September to see these birds in the river and creek bottoms of the Basin and in the general vicinity of the Ashley Creek marshes.

Pica pica hudsonia Sabine. AMERICAN MAGPIE.

Three specimens: twelve miles east of Vernal; and two miles south of Jensen. The magpie was a very common summer resident of the Basin, confining its nesting activities to the dense willow and cottonwood growths of the river and creek floodplains. In the vicinity of the Ashley Creek marshes at least thirty pairs of magpies nested. The greatest concentrations were in the farming districts, where there was an abundance of food. Three pairs were seen on the high plateaus of Blue Mountain at an altitude of 8000 feet on June 26; two pairs were observed at Green Lake, Uinta

Mountains, at an altitude of 8000 feet, on June 30, but for the most part these birds preferred the valleys at lower altitudes.

Corvus corax sinuatus Wagler. AMERICAN RAVEN.

These birds are residents of the Basin, but they are much scattered in their distribution. From fifteen to twenty individuals were seen in the general locality of Strawberry Reservoir and ten were seen at Hill Creek, forty miles south of Ouray. Old nests were seen at Strawberry Reservoir on the face of a large cliff that faces the northeastern side of the Reservoir. Residents of the district report that several pairs nest here each year. Rasmussen (1938, p. 863) found that the ravens at Strawberry Reservoir were responsible for a certain amount of predation. At least seven nests of the Sage Grouse were destroyed by ravens.

Corvus brachyrhynchos hesperis Ridgway. WESTERN CROW.

Crows were numerous during migration along the Green River Valley. A few remained to nest in the Basin; six nests were known to be occupied in the general vicinity of the Ashley Creek marshes. The birds were rather scarce as summer residents.

Cyanocephalus cyanocephalus cyanocephalus (Wied). PIÑON JAY.

Five specimens: near Jensen; Beaver Creek, Colorado, 6000 feet. In early May the Piñon Jay was frequently seen along the Green River valley, but by the first of June the birds were found only in the Juniperus-Pinus forests of the Basin. These forests are located within the approximate altitudes of 5500 to 7000 feet on the south slope of the Uinta Mountains, and 6000 to about 7500 feet on the Tavaputs Plateau (Graham, 1937). In the forests the juniper (*Juniperus utahensis*) is the dominant species, while the pinyon (*Pinus edulis*) is of secondary importance. From the time of nesting in early June until the young were able to fly in July, the jays were seen only in pairs or as single individuals. However, by the middle of July family groups were observed frequently as they passed through the juniper forests. At Beaver Creek, two miles northwest of Ladore, Moffat County, Colorado, from July 25 to 27, large flocks of from fifty to one hundred and fifty jays were seen feeding along the steep juniper-covered hillsides. Again, on July 27, on the highway between Ladore and Graystone, large flocks were feeding on the sagebrush flats that bordered the Juniperus-Pinus forests. During September several small flocks of from twenty-five to thirty jays were recorded along Green River. The

ranchers said that these jays spend the winters in the lower-altitude creek and river valleys.

Nucifraga columbiana (Wilson). CLARK'S NUTCRACKER.

One specimen: Green Lake, Uinta Mts. These birds were surprisingly scarce in the mountains bordering the Basin. The Uinta range that forms the northern boundary of the Basin was the only place where the birds were seen, and here they were observed only at Green Lake and at Paradise Park. Two birds were seen at Paradise Park, Uinta Mountains, altitude 8500 feet, on July 8. At Green Lake, Uinta Mountains, from four to fifteen birds were seen on June 10, between June 29 and July 5, and September 11 and 15. On the June 10 trip, a small flock of ten birds passed over the yellow pine forest, but they were very wary and would not allow a close approach. From June 29 to July 5, single birds and pairs were heard calling from some of the tall pines during the early morning, but they were very difficult to approach, remaining motionless and flying out at the opposite side of the dense canopy of the pine branches whenever they saw me walking toward them. On the September 11 to 15 trip only a single bird was observed.

Penthestes atricapillus septentrionalis (Harris). LONG-TAILED CHICKADEE.

Sixteen specimens: near Jensen; two miles south of Jensen; five miles south of Heber; Yampa River, eight miles north of Elk Springs, Colorado; Uinta Canyon, twenty miles north of Roosevelt. These chickadees were not so plentiful in the Basin as might have been expected. During the early spring and late fall they could be found at lower levels, particularly along the larger river and creek valleys. In the Basin they nested at any place where there was a good cover of willows or aspens, the altitudes ranging from 6500 to 9000 feet. Small families of four or five birds were seen traveling along the creek valleys on July 4 near the Yampa River, eight miles north of Elk Springs, Colorado, and in Uinta Canyon, twenty miles north of Roosevelt, on August 25. The adults were busy feeding young that were just able to fly. By the first week of September, the chickadees began to appear in small family groups at lower elevations, particularly along the Green River valley and the floodplains of the other larger rivers and creeks of the Basin. Resident ranchers and farmers along the Green River reported that these birds are found here throughout the

winter months. A. C. Lloyd collected four specimens on August 24, 1935, in the vicinity of the Ashley Creek marshes.

Penthestes gambeli gambeli (Ridgway.) MOUNTAIN CHICKADEE.

Nineteen specimens: Green Lake, Uinta Mts.; Indian Canyon, twenty miles southwest of Duchesne; Paradise Park, Uinta Mts., 10,050 feet; Florence Canyon, seventy-five miles south of Ouray; Hill Creek, forty miles south of Ouray; Uinta Canyon, twenty miles north of Roosevelt; Moon Lake, forty miles north of Duchesne. The Mountain Chickadee is a resident of the Basin, nesting in large numbers at the higher altitudes of the mountains from 8000 feet to timberline, which in most places reaches 10,000 feet. At Green Lake, Uinta Mountains, on June 10, only a few scattered groups of two or three were seen feeding high up in the yellow pines; but at this same locality on July 1 the birds were numerous, and families of from four to six birds were often seen. The adults were feeding the fully developed juvenal young. At Paradise Park, Uinta Mountains, from July 7 to 10, these family groups were very common and could be seen in considerable numbers in the forest. They remained near the mountain tops even in the fall, when the coming of the first snows to the high mountains drove many of the alticoline summer residents to low elevations.

Baeolophus inornatus griseus (Ridgway). GRAY TITMOUSE.

Two specimens: Cottonwood Springs. These birds were rare in the Basin; only two families, of five and seven birds respectively, were seen on June 28. A male and a female were taken, but the others disappeared at once into the dense growths of the forest. This locality, at an altitude of 6600 feet, was in a very well-developed Juniperus-Pinus Community. When first detected, the birds were making considerable noise. The male whistled at frequent intervals as the group passed down a small valley. They hunted food close to the ground, often dropping down to scratch about among the shrubs.

Sitta carolinensis uintaensis subsp. nov. UINTA NUTHATCH.

Type: Carnegie Museum, no. 121,558, adult male; Green Lake, forty miles north of Vernal, Uinta Mountains (altitude 8000 feet), Utah; July 1, 1937; collected by Arthur C. Twomey.

Subspecific characters: Similar to *Sitta carolinensis nelsoni* but throat and breast white. White on sides of head and neck extensive, spreading to sides of nape and back. Fawn-color of flanks and abdomen of juvenal

birds much more extensive than in juvenal birds of *nelsoni*. A more pronounced fawn-color in flanks of adults, and a less rich brown on abdomen than in *nelsoni*. In most specimens, the white of the second and third rectrices extends to the tip, while the dark spot is greatly diminished or is entirely wanting. The bill of *uintaensis* is blunt and only slightly tapered from the ramus to the tip, while in *nelsoni* it is more slender and sharply tapered from the ramus. Similar also to *Sitta carolinensis aculeata*, but whiter on throat and breast. The bill of *aculeata* is the same in length, but narrower and more sharply pointed:

	Exposed culmen	Length of gonys	Width of bill beyond ramus
S. c. uintaensis:			
average, 4 ♂♂	20.0	13.9	2.5
" 2 ♀♀	19.0	13.0	2.5
S. c. nelsoni (topotypical):			
average, 3 ♂♂	18.1	12.5	2.0
" 1 ♀	17.0	11.8	2.0
S. c. aculeata:			
average, 5 ♂♂	20.0	14.3	2.0
" 2 ♀♀	20.0	14.0	2.0

Range: From an altitude of 8000 feet in the Aspen, Lodgepole Pine and Yellow Pine communities to 10,000 feet in the Spruce-Fir Community of the Uinta Mountains of northeastern Utah.

Remarks: Sitta carolinensis aculeata is widely separated from the Uinta form. *Sitta carolinensis nelsoni* nearly encircles *uintaensis*, since specimens from Arizona, New Mexico, Colorado, and Texas, agree with *nelsoni*. From the evidence at hand, it seems that the form is restricted to the Uinta Range. Further work in southwestern Wyoming and northwestern Colorado would no doubt throw additional information on the distribution of *uintaensis*.

Although this nuthatch was found nesting, it was not uniformly distributed over the mountains of the Basin. At Green Lake, in late June and early July, the nuthatches were flying about in family groups, usually a pair of adults and from three to five immatures. They were most numerous in the Aspen-Yellow Pine Community at 8000 feet. Family groups were recorded on July 20 at Mirror Lake, altitude 10,000 feet, in the Picea-Abies Community. On August 29, in Uinta Canyon, altitude 7800 feet, these nuthatches were plentiful in the transition between the Lodgepole Pine and Aspen communities. The last seen in 1937 were at Green Lake during the middle of September. They were still in family groups and were feeding about the trunks of the yellow pines. Ridgway (1873a)

found the White-breasted Nuthatch to be rare on the Wasatch and Uinta mountains.

Sitta canadensis Linnaeus. RED-BREASTED NUTHATCH.

Six specimens: Green Lake, Uinta Mountains; Moon Lake, forty miles north of Duchesne. This nuthatch was first observed in the Yellow Pine and Aspen communities at Green Lake, Uinta Mountains, on June 30. At this time only three birds were seen, but upon returning to the same locality at the end of June, I observed two family groups in the yellow pines. An immature individual, from a family of three young and two adults, was collected on July 1. This nuthatch was not seen again until August, when a male was collected at Moon Lake, forty miles north of Duchesne. No other individuals of this species were listed at that time. A male was collected at Green Lake, Uinta Mountains, on September 11, but it was the only one seen. There was never an indication that there was a migratory movement of this species in the Basin, except on September 30, when a single bird was recorded in the dense willows near the junction of Ashley Creek and the Green River on the Green River floodplain, two miles south of Jensen.

Sitta pygmaea melanotis van Rossem. BLACK-EARED NUTHATCH.

Three specimens: Green Lake, Uinta Mountains. The only nuthatches observed were two bands feeding in the crowns of the tallest yellow pines at Green Lake on June 30. There were five in one group and twenty in the other. They were very shy and flew off down the mountainside upon my approach. These birds undoubtedly nested in the general vicinity, and the young which had left their nests probably made up the small bands of nuthatches seen on June 30. Every day from September 11 to 15, small groups of from five to fifteen birds were seen working over the high crowns of the yellow pines.

Certhia familiaris montana Ridgway. ROCKY MOUNTAIN CREEPER.

Five specimens: Green Lake, Uinta Mountains; Indian Canyon, twenty miles southwest of Duchesne; Uinta Canyon, twenty miles north of Roosevelt. A male (no. 121353), collected on June 10 at Green Lake, is in full plumage that shows no sign of wear. The dorsal surface has a decided grayish wash. The rumps of all the Uinta Basin birds are lighter than those of topotypical specimens from Mt. Graham, Arizona. This creeper was not found in large numbers. One or two birds would be encountered

whenever we worked through the Lodgepole Pine and the Picea-Abies communities of the high mountains. Immature birds, usually in family groups of five individuals, were observed at Uinta Canyon, twenty miles north of Roosevelt, on August 29.

Cinclus mexicanus unicolor Bonaparte. DIPPER.

The dipper was not found in large numbers, although there were from two to four birds to every mile or so of the swift mountain streams. They were observed to be most numerous along upper Ashley Creek, from the junction of Whiterock and Uinta rivers to the end of the Uinta Canyon road, below Moon Lake on the West Fork River, and along the Provo River below Heber.

Troglodytes aedon parkmani Audubon. WESTERN HOUSE WREN.

Twenty specimens: twelve miles east of Vernal; twenty miles southwest of Duchesne; Green Lake, Uinta Mountains; and Ouray. Both the breeding and migrant forms of the House Wren found in the Basin are of this subspecies. The following measurements compare with those of Oberholser (1934) as follows:

		Uinta Basin				Oberholser (1934)		
		Average	Max.	Min.		Average	Max.	Min.
Male:	wing	52.2	54.5	50.0	Male:	51.3	53.5	49.5
	tail	46.0	48.5	43.5		44.2	45.5	42.0
	culmen	12.9	14.9	11.2		12.4	13.5	11.5
	tarsus	17.2	18.0	15.9		17.0	17.5	16.5
	mid. toe without claw	11.3	12.0	10.5		12.2	13.0	11.0
Female:	wing	51.3	52.0	51.0	Female:	51.0	52.3	49.0
	tail	44.3	45.0	44.0		44.8	47.0	42.0
	culmen	13.0	14.0	12.0		11.7	12.7	11.0
	tarsus	16.6	17.1	16.2		16.8	18.0	16.0
	mid. toe without claw	11.5	12.0	11.0		12.1	13.0	11.0

The house wrens were particularly common along the drainage systems of the Basin from the lowlands to timberline in the mountains. The lowland specimens were very light grayish birds and seemed pallid in contrast with the higher-altitude specimens, which were much darker; the latter were brownish above and buffy below. These wrens were first seen in the Basin on May 1, and from that date until the end of September, they were always in evidence throughout the area.

Telmatodytes palustris plesius (Oberholser). WESTERN MARSH WREN.

Four specimens: two miles south of Jensen. Marsh wrens were encountered only at the Ashley Creek marshes, where a few birds nested. On several occasions they were heard singing along the west end of the marsh. The birds collected were taken at the edge of the rushes along the west side of the marsh on September 22, 29, and 30.

Catherpes mexicanus conspersus Ridgway. CAÑON WREN.

Three specimens: Hill Creek, forty miles south of Ouray. This wren was restricted in its distribution in the Uinta Basin but was found along the deep canyon walls of Hill Creek. The birds were numerous, with from three to four pairs for every large precipitous rocky face. They were shy and remained on the edges of the loftiest crags, from which they would sing loudly. At a locality on Hill Creek, about forty miles south of Ouray, the stream valley averaged a half-mile or more across, with cliffs running from fifty to two hundred feet high on either side. Lateral canyons came down to the river, cutting the cliffs into rugged formations at many points. This was the ideal environment for these wrens. Here, on the badly broken rock walls, a pair of wrens, with from four to six fully developed young, was seen during a visit from August 5 to 7. But upon my close approach, they vanished quickly into the cracks and crevices. In a few moments the adults reappeared, scolding from the crest of a nearby cliff. After the disturbance was over the male started its rambling song, to be joined shortly by another male on the high cliffs nearly half a mile away on the opposite side of the river. This behavior was characteristic, recurring every time we appeared on the scene.

Salpinctes obsoletus obsoletus (Say). ROCK WREN.

Twenty-three specimens: six miles, and five miles, north of Jensen; near Jensen; five miles south of Jensen; fifteen miles southwest of Vernal; twenty-five miles east of Vernal; eight miles west of Vernal; twelve miles southwest of Vernal; Hill Creek, forty miles south of Ouray; Green Lake, Uinta Mts.; and Bald Mt.

				Wing	Tail	Cul.	Tarsus	Mid. Toe
121589	♂	July 13	Green Lake, Uinta Mts.	68.3	49	19	21	14
121967	♀	Sept. 13	"	71.0	54.5	17	20.5	13
121968	♂	Sept. 13	"	70.0	52	16	20	13

The above three specimens were taken at 8000 feet in the yellow pine forest. The two fall specimens appeared dark over the whole of the dorsal

surface, because of their dark gray ground-color. The spots that extend from the base of the bill over the back were reduced more than in comparable birds from the desert. The single (July 3) breeding specimen was quite worn, but showed the light warm buff shades that are characteristic of the lower-altitude forms. The three specimens show a distinct light buffy wash over the breast and belly. The measurements, however, fall within the limits of true *obsoletus*.

The rough rocky "bad lands" of the Basin and arid slopes of the river systems would be truly barren were it not for the almost continuous clear, rambling song of this wren. Here, where but few other birds can nest, the Rock Wren makes its home. In late June, even on the hot, parched desert, a nest of from five to seven young would often be uncovered beneath a flat shelving rock along the bank of a dry wash. These were often in exposed locations, where the young were subjected to high temperatures. Nests were most numerous in the semi-arid and arid deserts of the Basin, decreasing in numbers as the altitude increased. At altitudes of 8000 feet, such as at Green Lake, and at Mirror Lake (10,000 ft.), a few individuals were seen along the lower rock slides where they had nested earlier in the summer.

Mimus polyglottos leucopterus (Vigors). WESTERN MOCKINGBIRD.

One specimen: Powder Springs, twenty miles east of Vernal. The Mockingbird was an uncommon bird in the Basin. Two were observed at Cottonwood Springs on June 14, and a bird in juvenal plumage was taken at Powder Springs on August 23. This young bird was accompanied by three other juvenal birds and the two parents, which were shy and retreated into the dense junipers. The two localities above were similar in that they were at the lower edge of the juniper forest. Although such locations were numerous in the Basin, no other individuals of this species were observed in 1937. A. C. Lloyd in 1935 discovered a mockingbird in the vicinity of the Ashley Creek marshes during the latter part of May. LeRoy Kay told me of seeing one or two pairs at Horseshoe Bend on the Green River on several occasions during the past ten years.

The status of the Western Mockingbird in Utah is of interest. Tanner (1936) found the species to be scattered in its distribution in Utah. In the Virgin River valley around St. George, it is a common bird of the low deserts and river bottoms. In October, 1937, the author found the bird abundant at St. George. In the northern part of the state this species is very scattered. Three sets of eggs were taken just north of Utah Lake in

1936. Tanner (1936) points out that the whole of the northeastern part of the state is without a record. The present establishment of the Mockingbird in the Uinta Basin extends its range to the extreme northeast corner of Utah.

Dumetella carolinensis (Linnaeus). CATBIRD.

Eight specimens: two miles south of Jensen, and twelve miles east of Vernal. Catbirds were numerous during the spring migration, May 10 to May 25, in the vicinity of the Ashley Creek marshes. After the first week of June, at least four pairs nested in the dense thickets near the marshes. Along the dense willows that skirt the east river bank of the Green River, almost opposite the mouth of Ashley Creek, two pairs were observed feeding young on August 9. In 1934, A. C. Lloyd did not record the Catbird for the Ashley Creek marshes, but in 1935 he found it common at certain points in the woods about the marshes. On August 5, 1935, he collected a juvenal female at the marshes.

Oreoscoptes montanus (Townsend). SAGE THRASHER.

Twenty-one specimens: near Jensen; twelve miles southwest of Vernal; east slope Blue Mountain, 7000 ft.; fifteen miles south of Vernal; and Cottonwood Springs. Sage thrashers were found abundantly over the lowlands of the Basin. They had arrived in large numbers by May 1, and they began to nest almost at once. The first nest with two eggs was found on May 14 in a dense growth of greasewood (*Sarcobatus vermiculatus*) two miles south of Jensen. On May 25, a nest with four heavily incubated eggs was found again in a greasewood thicket. Young thrashers were encountered about the first of June and were recorded until well into August.

The Sage Thrasher had a wide range in the Basin, although it was discontinuous at certain elevations. It extended from the lowest elevations at 4500 feet upward to elevations of 6000 feet, where it would follow the complex Desert Shrub communities part way up the deep canyons. This thrasher also nested in large numbers in at least two localities at an elevation of 8000 feet in the mountain sagebrush: the Blue Mountain plateau and the high plateau at the head of Florence Canyon. The first indication of a movement in the Sage Thrasher population was noticeable the first week of September. With the coming of cold nights the thrashers suddenly began to disappear. By the last of September they had nearly all moved out of the Basin.

Turdus migratorius propinquus Ridgway. WESTERN ROBIN.

Twelve specimens: near Jensen; twenty miles southwest of Duchesne; Bald Mt., 10,500 ft., twenty-five miles northeast of Kamas, Wasatch Co.; Uinta Canyon, twenty miles north of Roosevelt; Green Lake, Uinta Mts., forty miles north of Vernal; and Indian Canyon. The robins already had arrived in the Basin by May 1 and were particularly abundant along the Green River around the Ashley Creek marshes and along the other watercourses. Although the main population moved on, six pairs remained and nested at Ashley Creek marshes after May 20. Later, during trips to the various mountain ranges, robins were found to be abundant above an altitude of 8000 feet. They increased in numbers up to timberline, which ran from 9500 to 10,000 feet. At these high altitudes, nests with fresh eggs were observed as late as July 16 on Bald Mountain. In the same locality fully developed juvenal birds were seen. Both adults and young were seen by August 25 in flocks of from ten to twenty-five individuals along the watercourses of the Basin. During the last two weeks of September, large numbers, apparently moving down the river, appeared along the Green River valley. Robins were observed by A. C. Lloyd to be very common as spring and fall migrants and as summer residents along Green River in 1934 and 1935.

Hylocichla guttata auduboni (Baird). AUDUBON HERMIT THRUSH.

Fourteen specimens: near Jensen; twenty miles southwest of Duchesne; Green Lake, Uinta Mts.; Paradise Park, Uinta Mts.; Bald Mt., Uinta Mountains; and Moon Lake, forty miles north of Duchesne.

					Wing	T.	Tar.	Cu.	M.T.
121423	♂	June	18	20 miles s. w. of Duchesne	99.7	71	27.9	15.2	17.2
121422	♀	"	20	"	97.2	70	29.2	15.2	16
121443	♂	"	20	"	103	76	28.1	14.9	16.5
121575	♀	July	3	Green Lake	101.2	69	29	15.5	17
121653	♀	"	10	Paradise Park	96	71	27.2	15.2	15.2
121636	♂	"	8	"	106	79.9	28.8	15	15.2
121681	♂	"	16	Bald Mt.	99.4	74	28	15	15
121682	♂	"	16	"	103.4	78	29	15	16.2
121998	♂	Sept.	14	Green Lake	105.5	72	30	14	16.5
121965	♂	"	11	"	100.5	69	28.5	13	17
121984	♂	"	14	"	103	72	28.3	13.8	17

Two young birds, 121703 and 121721 (not listed above) taken at Bald Mountain, altitude 10,500 feet, twenty-five miles northeast of Kamas,

Wasatch County, on July 17 and 19 respectively, were very gray. Both were about half grown, the rectrices just beginning to develop. The backs have a gray wash that tends to subdue the light rufous mottling. They appear in sharp contrast to the rufous wash of the young of *guttata* and the very rich rufous of *nanus*. The ventral surfaces of the young of *auduboni* and of *guttata* are similar, both having a slightly flecked throat, a heavily mottled grayish black upper breast with a light tan wash over all. The lower breast and bellies of both are grayish white with faint gray lateral pencillings. The young of *nanus* is as heavily mottled over breast and throat, but has heavier marks on the belly with a tan wash over the whole ventral surface. Specimen 121873 was taken at Moon Lake, Uinta Mountains, forty miles north of Duchesne, on August 20. This bird is in almost perfect first winter plumage; a few juvenal feathers still persist as warm buff flecks over the nape, back, and upper wing-coverts. The belly retains a few fine lateral marks.

During May these thrushes migrated along the Green River valley, stopping to feed only in the most dense vegetation. After the migration period they were very common in the upper coniferous forests of the high mountains of the Basin. The birds were first heard singing in their nesting grounds at the edge of the aspens, altitude about 7500 feet. From here on up into the lodgepole pines the birds became more numerous until, reaching the Engelmann spruce-alpine fir forests, Audubon hermit thrushes could be heard singing from every quarter. In these dense forests they built their nests, and although they were ever wary, their melodious songs signified that the birds were plentiful. The first to be seen in the fall migration was in late September along the valley of the Green River just below Jensen.

Hylocichla guttata oromela Oberholser. CASCADE HERMIT THRUSH.

One specimen: twelve miles east of Vernal. This specimen, a male, number 121111, was collected on May 7. It measured, wing—91, tail—65, tarsus—30, exposed culmen—12.5, middle toe without claw—17 as compared to the average measurements of *oromela*, Oberholser (1932), wing—88.9, tail—66.7, tarsus—28.9, exposed culmen—12.7, middle toe without claw—16.1. The measurements of this specimen fit into the limits set for *oromela*. It is of the gray phase and in details is similar to comparable specimens of *oromela*. The bird was a migrant, passing along Green River valley at the height of the spring migration. This subspecies

may have been more common, although only this one specimen was collected. It was migrating with numbers of *Hylocichla guttata auduboni*.

Hylocichla ustulata swainsoni (Tschudi). OLIVE-BACKED THRUSH.

One specimen: two miles south of Jensen, May 29, 1935. This specimen was collected by A. C. Lloyd and is now in the Royal Ontario Museum collection. Ridgway (1877) found this thrush nesting in considerable numbers on the east slope of the Wasatch Mountains below the pine region. A nest with four eggs was collected at Parley's Park (Wasatch Mountains) on June 23, 1869. This thrush was not observed on the slopes of the Uinta Mountains in 1937.

Sialia currucoides (Bechstein). MOUNTAIN BLUEBIRD.

Eleven specimens: Green Lake; Ashley Canyon; Bald Mt.; near Jensen; and nine miles west of Vernal. At the mouth of Ashley Creek, where it enters Green River, a few scattered individuals were seen during May, but they gradually disappeared until by the first of June all had left. A pair was seen feeding at the edge of the Juniperus-Pinus Community along the road, nine miles west of Vernal, near Cottonwood Springs, on June 14. They were shy and could not be approached easily. Four days earlier (June 10), at Green Lake in the yellow pines, bluebirds were plentiful; three nests were found, all containing young that had hatched recently. On a later trip to Green Lake (June 20), fully developed young were flying about with the adult birds in early family groups.

The mountain bluebirds were most abundant at altitudes between 8000 and 10,000 feet, which means, in vegetational communities, from the yellow pines to the sub-alpine regions of Engelmann spruce and alpine fir. By the middle of July, the birds became more numerous in the junipers and pinyons but did not reach the lower river valleys until the first week of September. After September 1, bluebirds appeared along Ashley Creek and the Green River valley in flocks of from ten to twenty-five individuals; many of them could be distinguished as young birds by their thin mottled plumage. During this period bluebirds were found moving down the slopes in all of the valleys and canyons, that broke off sharply to the lower plains of the Basin. They were feeding as they traveled, stopping on high, dead bushes to watch for flying insects. These birds were still fairly plentiful in the Basin on September 30. Their residence in the Basin

after this late date was no doubt short, for by early October snows were already covering the high mountains.

Myadestes townsendi (Audubon). TOWNSEND SOLITAIRE.

Eight specimens: two miles south of Jensen; Green Lake, Uinta Mts.; and Paradise Park, Uinta Mts. At the Ashley Creek marshes a few scattered birds passed through between May 15 and 20. They were following the dense willow and cottonwood groves of Green River, moving up the river into the high mountains. On June 10, at Green Lake in the Uinta Mountains, three pairs were seen feeding among the yellow pines; usually they could be found perched on a dead branch between ten and twenty feet from the ground overlooking a clearing in the forest. From these points of vantage they would fly out in pursuit of insects, frequently following larger forms to the ground, where they would often remain long enough to eat them. A female collected on June 10 had very large ovaries, which indicated that the bird had already started to lay or was on the point of laying. Later, on July 1, a pair was collected and again the ovaries of the female were very large, with one egg in the oviduct encased within the egg membrane. One other individual was observed, but it was extremely shy and could not be approached. A female was taken on July 2 at Paradise Park, Uinta Mountains, at the edge of an alpine meadow in the spruce-fir forests. This individual had a brood-patch which was wrinkled and fatty, indicating that the bird had young. A second bird in the same locality, probably the male, was wary, showing considerable interest in us, but flying the moment it was approached.

On July 17, on Bald Mountain, twenty-five miles northeast of Kamas, Wasatch County, a pair with four young birds was seen following the rim of a high canyon wall. They kept moving along, hesitating only a moment, and then disappeared over the canyon rim. A single bird was seen at Florence Canyon, seventy-five miles south of Ouray, on July 29. On August 20, two were observed at Moon Lake, forty miles north of Duchesne, in the pine-aspen transition at an altitude of 4500 feet. Later, while at Green Lake on September 15, two groups of six birds each were seen feeding in the sagebrush (*Artemisia tridentata*) in the openings among the yellow pines. A male, which was collected, was almost in its full adult plumage but showed on the belly and lower breast a few mottled feathers, the remnants of its juvenal plumage. During September the solitaires were seen singly or in pairs along the cottonwood floodplains of the Green River, where they rested and fed during their southward migration.

Polioptila caerulea amoenissima Grinnell. WESTERN GNATCATCHER.

One specimen: two miles south of Jensen. A. C. Lloyd collected this specimen, which is in the Royal Ontario Museum of Zoology, on May 20, 1935. On May 27, 1937, the author observed a pair in a dense stand of junipers at the edge of a small semi-arid valley, one-half mile west of the Dinosaur National Monument. The birds became very much excited while we were in the vicinity, but a nest was not located.

Corthylio calendula cineraceus (Grinnell). WESTERN RUBY-CROWNED KINGLET.

Four specimens; three miles south of Jensen; and near Jensen. This species was a common migrant along the lowland valleys of the Basin during the spring and fall. The first seen were in small flocks of from ten to thirty individuals in the vicinity of Ashley Creek marshes on May 3. These migrants were most numerous along the dense willow thickets of the Green River floodplains. At all points in the mountains of the Uinta Basin, from the altitude of the lodgepole pines to the spruce-fir forests, these kinglets nest commonly during the summer. The greatest concentration always was found in the spruce-fir forests, where their rambling song could be heard from the time of their arrival until their departure.

The main spring migration reached its peak on May 7, the last transient individuals being observed on May 29. By June 10, when the first trip was made into the mountains at Green Lake, the kinglets were already very active and could be heard singing in all parts of the forest. At Indian Canyon, twenty miles southwest of Duchesne, a pair was observed carrying nesting material on June 18, but the birds disappeared into some tall pines and were not located again.

From July 7 to 10, at Paradise Park, Uinta Mountains, in the lodgepole-pine-spruce forests, this kinglet occurred in the largest concentration of any place visited in the Basin. Two nests were located in a dense stand of Engelmann spruce. Here they were well protected in the top of the dense spruce crown, and attempts made to reach the nests met with no success. The adults were observed later feeding young. On August 21, at Moon Lake, in a mixed stand of aspen and pines, small family groups of from six to eight individuals were feeding throughout the forest. The adults were still feeding fully developed immature birds. In the fall, the first birds to appear in the lower stream valleys arrived in early September, and reached the peak of their fall migration by September 22. By Sep-

tember 30 there was already a noticeable decrease in the migration along Ashley Creek and the Green River valley. On September 20 snow began to fall on the upper altitudes, reaching down to about 7500 feet. This sudden change probably was responsible for the fall migration peak coming on September 22, just two days after a mountain storm.

Anthus rubescens alticola Todd. ROCKY MOUNTAIN PIPIT.

Fifteen specimens: Paradise Park, Uinta Mts.; and Bald Mt. Numbers 122003, 122005, and 122006 are fall birds taken at an altitude of 8000 feet at Green Lake. They showed an early development of the fall plumage, having heavily blotched breasts and flanks in contrast to the spring plumage, which is buffy and shows a decided reduction in the markings on the breasts and flanks.

During the early weeks of May, pipits were seen in flocks of from ten to twenty, feeding along the mud flats of the Ashley Creek marshes or next to the water along the banks of the Green River. By May 27, no more pipits were seen in the lower country of the Basin. In June these pipits were found breeding in the Uinta Mountains in the upper alpine meadows at an altitude of 10,000 feet. The two places where they were observed were Paradise Park, Uinta Mountains, and Bald Mountain, twenty-five miles northeast of Kamas. In both localities these birds were nesting in large numbers. Their nesting sites were on the alpine meadows above timberline or in the lower meadows of the spruce-fir forests. A prerequisite was the sloping shore of a lake or stream, and there, under the edge of a stone or sod clump, they constructed their nests. The nests were made of coarse grass and lined with very fine grasses. On the meadows in the spruce-fir forests at Paradise Park from July 7 to 10, nests were found about every two hundred yards, twenty-five to fifty yards back from a pond or small stream under the edge of rocks. Fifteen nests were found; ten had young that had just hatched, while the remainder contained eggs that were on the verge of hatching. From July 16 to 20, at Bald Mountain, pipits were found nesting in comparatively large numbers on the alpine meadows just above timberline, at an altitude of 10,500 feet. Here twelve nests were located, each under the edge of a boulder and up to fifty yards from the nearest pool. All the nests found contained young birds, which had not been hatched more than three or four days.

In both nesting localities, the males frequently were seen flying to heights of from three to five hundred feet, from which they could be heard singing. The singing was generally carried out some place above the

general vicinity of the nest. Both birds helped with the feeding of the young, going to the edge of the pools, where they walked about searching for adult midges and diptera. Then, with bills crammed to capacity, they would fly quickly to the nest and feed their young.

At Green Lake (altitude 8000 feet) on September 15, pipits were observed feeding on some of the lower meadows among the mixed yellow pine, lodgepole pine and aspen forests. The flocks were small, numbering from four to six individuals, probably representing family groups since the larger number in each flock was of immature birds. These flocks were, no doubt, the forerunners of larger migrating flocks. By September 20 a few individuals were seen along the muddy shore of the Ashley Creek marshes. On September 29, the first large flock of between forty-five and fifty birds flew over my camp at Ashley Creek.

Lanius ludovicianus excubitorides Swainson. WHITE-RUMPED SHRIKE.

Four specimens: twenty-five miles south of Ouray; twenty-five miles east of Vernal; and fifteen miles southwest of Vernal.

	Uinta Basin	Miller (1931)		
		excubitorides	*nevadensis*	*gambeli*
Wing	102	99.92	*100.22*	99.62
Tail	96	*100*	102.42	102.26
Amount of white on outer rectrix in per cent of length of tail	31.5	42.1	33.3	*30.5*
Culmen from nostril	12	11.32	*12.1*	11.94
Width of bill	7	5.92	6.02	*6.17*
Depth of bill	9	8.24	8.35	*8.37*
Hind toe	10	10.13	*10.03*	10.11
Tarsometatarsus	27.9	*27.4*	27.22	27.39

Only measurements of males are included in the table. The characters in which the Uinta Basin birds are most nearly approached are italicized in the table.

The single adult male taken in the Uinta Basin is *Lanius l. excubitorides*. Comparisons were made with specimens of *excubitorides* taken at Davidson and Last Mountain Lake, Saskatchewan, Canada. The Utah specimen in question was in badly worn plumage, which may account for the darker gray back and flanks compared to specimens of *Lanius ludovicianus excubitorides*. Although the measurements of a single specimen can hardly be considered adequate, it is interesting to compare the measurements with those of Miller (1931) of typical *Lanius ludovicianus*

excubitorides, *Lanius ludovicianus nevadensis*, and *Lanius ludovicianus gambeli*. It becomes apparent that if these measurements are at all diagnostic, the bird in question is more than likely an intergrade, having qualities of all three forms, with a tendency toward *excubitorides*. Miller's map (1931) of the breeding ranges of *excubitorides*, *nevadensis*, and *gambeli* shows the Uinta Basin as a transitional zone where the three races are apt to meet.

A. C. Lloyd considered the White-rumped Shrike rare, for he saw only two or three birds in 1934 and 1935. On July 26, 1934, he collected an immature male twenty miles south of Vernal.

Vireo solitarius plumbeus Coues. PLUMBEOUS VIREO.

Four specimens: three miles south of Jensen; two miles south of Jensen; and eight miles west of Vernal. The males of this vireo were first heard singing in the dense willow, sycamore, and cottonwood floodplains of Green River valley on June 2. The birds, however, were exceedingly wary and were not easily located. On June 5 a male which had been heard singing from the dense crown of a large cottonwood tree, and a female, were collected on the east side of Green River, three miles south of Jensen. The female had a well-formed brood-patch, and the gonads of the male were in full breeding condition. This established the Plumbeous Vireo as a sparsely distributed summer resident of the watercourses in the Basin. Later, on June 8, a male was heard singing from some willows on the south side of the Ashley Creek marshes. After careful watching, I was able to detect the bird feeding in the dense foliage of the willows, fifteen to twenty feet from the ground. This male hunted along slowly, singing every half minute as he carefully scanned the underside of each leaf. A stir from my direction was always enough to make him fly thirty-five or fifty yards farther, where he would resume his feeding and singing. Although this individual was watched for fully an hour, he never gave any indication that a nest was nearby. A fourth bird was heard at Cottonwood Springs, eight miles west of Vernal, on June 28. This male suddenly began to sing in some dense willows close to the spring, but, although he was watched for some time, he never gave any indication of a nest. After this date I never heard this vireo's song, but three birds were seen feeding high up in some cottonwood trees four miles south of Jensen on August 9. This vireo then must be considered as fairly rare in the Basin; it nests only in very restricted areas in the lower valleys where it can find water and dense cover.

Vireo solitarius cassini Xantus. CASSIN VIREO.

One specimen: two miles south of Jensen. The Cassin Vireo occurred in the Basin as a rare migrant, but none was observed during the spring migration. Only one specimen was taken, on September 25, at the Ashley Creek marshes. This bird was seen in company with a flock of six pileolated warblers.

Vireo olivaceus (Linnaeus). RED-EYED VIREO.

One specimen: four miles south of Jensen. This bird was not abundant in the Basin during the spring and fall migrations. Only one specimen was taken. From May 29 to June 9, singing males were heard nearly every day. They were not observed again until from September 6 to 9. At this time the birds were seen along the Provo River, five miles south of Heber, where they were migrating through the Provo Canyon in large numbers. From September 20 to 28, they all had passed through on their way south.

Vireo gilvus swainsoni Baird. WESTERN WARBLING VIREO.

Eight specimens: five miles, and four miles, south of Jensen; Green Lake, Uinta Mountains; twenty miles southwest of Duchesne; Hill Creek, forty miles north of Duchesne; and Uinta Canyon, twenty miles north of Roosevelt.

The warbling vireos appeared at the Ashley Creek marshes on May 10. The birds were seldom seen, although males could be heard singing a great deal. They showed preference for the upper strata of leaves among the cottonwoods, where they might have been overlooked but for the song of the males. By May 18 they had become very scarce, and by the first of June they all had moved into the high mountains of the Basin.

The warbling vireos were found nesting throughout the Basin at altitudes between 7000 and 9000 feet. This represents the transition that exists between the Aspen and Sub-montane Shrub zone (Graham, 1937). Their nesting preference was for small aspen groves, such as are found at Green Lake, Moon Lake, Indian Canyon, Paradise Park, and Uinta Canyon. Great nesting activity was observed at Green Lake on June 10; males were singing from every aspen grove. Upon the second visit to Green Lake, June 29 to July 5, the warbling vireos were feeding young birds in the nest, and many were feeding fully grown young. Their singing was still persistent at this late date. At Parley's Park, Wasatch

Mountains, Ridgway (1877) found nests and eggs of the Warbling Vireo on June 23 and 26, 1868.

The month of September marked the fall migration, the largest numbers passing along the Green River valley and the Ashley Creek marshes between September 20 and 26. From September 11 to 15, however, when we were again at Green Lake, we noticed that small numbers of warbling vireos were still in the vicinity. The main population had already started their movement to lower altitudes in preparation for the southward migration.

Vermivora celata celata (Say). ORANGE-CROWNED WARBLER.

Two specimens: Green Lake, Uinta Mountains; and two miles south of Jensen. This species was found in the Basin during the fall migration. At Green Lake, on September 13, a female was taken from a number of migrating warblers. Again, on September 29, a male was collected at the Ashley Creek marshes, just after the main warbler migration peak had passed.

Vermivora celata orestera Oberholser. MOUNTAIN ORANGE-CROWNED WARBLER.

Six specimens: twenty miles southwest of Duchesne; Uinta Canyon, twenty miles north of Roosevelt; Green Lake, Uinta Mountains; and two miles south of Jensen.

The Uinta Basin birds have an average wing measurement of 65 mm. and tail length of 49.5 mm., which, when compared with measurements of *orestera*, *celata*, and *lutescens* (Oberholser, 1905), fit those recorded for *orestera*. (*V. c. orestera:* wing, 63.4, tail, 50.4; *V. c. celata:* wing, 61.4, tail 49.2; *V. c. lutescens:* wing, 59.6, tail, 46.9.)

The plumage of the Uinta Basin birds has more lemon-yellow throughout than that of *celata*, with a dark olive-yellow back tinged with gray. The lemon-yellow wash over the breast is not so bright as in *celata*, which has much more gray on the back, head, and breast. As a further comparison, the Uinta birds have a prominent yellowish green superciliary line over the eye, as should be present in specimens of *orestera*. From the above characters it is obvious that *orestera* is a distinguishable form, representing the breeding bird found in the mountains of the Uinta Basin. On May 10, four orange-crowned warblers were seen passing through the Basin at the Ashley Creek marshes, but none was collected. Later, on June 19, a single male in badly worn plumage was collected in a mixed

stand of lodgepole pine, Colorado blue spruce, and aspens in Indian Canyon, 7600 feet altitude. At first the bird was much excited and kept chirping loudly, but it soon lost interest and moved into a tall spruce where it began to feed. This individual, in breeding condition, had large and well-developed gonads. We spent five days at this locality, but this warbler was not seen again. On June 20, while at Green Lake, we heard a male singing from the top of a tall yellow pine, but the bird disappeared and was not observed again.

A male and two young were taken (August 29) in Uinta Canyon, twenty miles south of Roosevelt; the young had almost attained their adult plumage except for some gray mottled patches of the early juvenal plumage on the breast. The male was *orestera* in new fall plumage. This is the only actual evidence of breeding in the Basin, other than those records already mentioned of individuals seen in late June in typical nesting localities in the mountains of the Basin. By September 25 a few birds were seen in migration at the Ashley Creek marshes. One was collected on September 29 from a small flock of five birds which were feeding along a dense willow and cottonwood growth on the Ashley Creek floodplain just south of the marsh proper. Ridgway (1877) reported the Orange-crowned Warbler to be a common nesting bird of the Wasatch Mountains. He collected a bird in juvenal plumage and two adult males at Parley's Park, on July 17, and August 12 and 16, 1869.

Vermivora ruficapilla ridgwayi van Rossem.[3] CALAVERAS WARBLER.

Two specimens: Kamas; Soapstone, twenty miles southeast of Kamas. These specimens, nos. 891 and 1678 of the Brigham Young University collection, were taken by C. L. Hayward. The birds were migrants, for the Kamas bird was taken on September 21, 1930, and the Soapstone specimen on September 30, 1940.

Vermivora virginiae (Baird). VIRGINIA WARBLER.

Three specimens: near Jensen; and Ashley Canyon, twelve miles north of Vernal. On May 5 three birds were seen in the vicinity of Ashley Creek marshes; one male was collected. One or two specimens were seen nearly every day until June 1. While on a trip on June 22, up Ashley Creek to a point twelve miles north of Vernal (where the river runs through

[3]A. J. Van Rossem proposed *Vermivora ruficapilla ridgwayi* nom. nov. to replace *Vermivora ruficapilla gutturalis* (Ridgway), preoccupied. Proc. Biol. Soc. Wash., 1929, vol. 42, p. 179.

a deep canyon), we saw several Virginia warblers. They were out on the floodplain in the dense mats of undergrowth, consisting principally of skunk bush (*Rhus trilobata*), rose bramble (*Rosa puberulenta*), western cottonwood (*Populus Sargentii*), and peach-leaved willow (*Salix amygdaloides*). Several birds were chirping loudly from a dense growth of rose brambles. They proved to be extremely wary and did not expose themselves for more than a second or two at a time. The two which were collected were both males; their plumage was still bright, although the ends of the feathers were worn. From the action of the birds and the lateness of the season, it would seem to be correct to assume that these warblers were nesting in the dense growths of vegetation along the upper Ashley Creek floodplains. Ridgway (1874) found the Virginia Warbler to be a common breeding form at Parley's Park, Wasatch Mountains, and at Pack's Canyon, Uinta Mountains, in 1869.

On September 20 a single bird, feeding with migrating flocks of other warblers, was seen along the dense willows of the Ashley Creek marshes. From this date to the end of the month, only one or two individuals at a time were observed as they passed through in migration. A. C. Lloyd reported having seen several in migration at the Ashley Creek marshes during the middle of May, 1935.

Dendroica aestiva brewsteri Grinnell. CALIFORNIA YELLOW WARBLER.

Nineteen specimens: Vernal; two miles, and five miles south of Jensen; and Hill Creek, forty miles south of Ouray.

TABLE OF AVERAGE MEASUREMENTS

			Wing		Tail	
D. a. aestiva	9	♂♂	63.0	(67.5-61.0)	43.5	(46.0-40.6)
"	7	♀♀	60.90	(62.5-59.3)	42.7	(46.9-39.0)
D. a. rubiginosa	7	♂♂	62.50	(63.5-62.0)	43.3	(45.5-42.0)
"	4	♀♀	59.90	(62.0-57.9)	42.5	(43.1-41.9)
Oregon & Cal.						
D. a. brewsteri	5	♂♂	63.60	(66.20-61.30)	44.8	(47.8-42.6)
"	6	♀♀	59.90	(61.00-58.50)	43.3	(45.1-40.8)
Utah						
D. a. subsp.	12	♂♂	61.90	(63.00-58.00)	45.5	(47.6-43.0)
"	7	♀♀	59.50	(61.00-58.00)	43.9	(45.0-42.9)
Texas						
D. a. subsp.	1	♂	63.00		44.5	
"	8	♀♀	58.80	(61.00-57.00)	42.8	(45.5-38.3)
D. a. brewsteri	*54	♂♂	63.41	(66.29-57.15)	49.78	(55.88-45.72)
"	30	♀♀	60.34	(62.99-55.37)	48.98	(55.88-43.18)

*Converted to mm., *ex* Grinnell, Condor, vol. 5, May, 1903, p. 71.

After an examination of a series of yellow warblers from Beaverton, Oregon; and Colean, Corona, and Valladares, in Lower California, which are designated *Dendroica aestiva brewsteri*, I was impressed with the striking similarity of these specimens with those from the Uinta Basin, Utah, and southwestern Texas, which have been identified by Dr. Oberholser as *morcomi*. Van Rossem (1931) recognizes that the Rocky Mountain race of the Yellow Warbler is worthy of consideration. He distinguishes *morcomi* from *aestiva* by the slightly larger size and duller (less yellowish) green coloration. These facts are true of the Utah birds in so far as color is concerned, but the wing measurements are slightly less and the tails are slightly longer than the average of *aestiva;* the average wing and tail measurements of the Texas birds are almost identical with *aestiva*. On the other hand, when measurements of the Utah and Texas birds are compared with those of *brewsteri* examined, and those of *brewsteri* (Grinnell 1903), the measurements are nearly identical.

These western birds differ considerably from *aestiva* in that the chestnut streaks on the underparts are narrower and not nearly so distinctly marked. Van Rossem (1931) likewise points out a distinct difference between *morcomi* and *brewsteri* in that *brewsteri* is a much smaller bird. This fact has not been apparent in the specimens examined. The chestnut streaking of the Utah and Texas birds is identical with that of *brewsteri* from California and Oregon. Females of the Rocky Mountain birds are indistinguishable from females of *brewsteri*. They are paler than any examples of *aestiva* on hand and lack the brighter lemon yellow of the females of *rubiginosa*.

Since at this time the types and topotypes of *brewsteri* and *morcomi* have not been examined, it might be presuming to consider that *brewsteri* is a synonym of *morcomi*. Until these types are examined, the yellow warblers of the Uinta Basin must be considered as *Dendroica aestiva brewsteri*.

These warblers appeared in the Basin after the first week of May. They were found most numerous along the drainage systems. They showed a preference for the early developmental stages of the river floodplains, where there was dense cover and ample food. Birds were found nesting along Green River, at Jensen; along the White River at Ouray; and at Hill Creek, south of Ouray. Young birds were collected at Hill Creek, forty miles south of Ouray, on August 6. A. C. Lloyd collected young on July 24, 1935, at Vernal.

There was never any indication of migration of yellow warblers in the

Basin. They appeared during the first two weeks of May and disappeared early in September.

Dendroica auduboni memorabilis Oberholser. ROCKY MOUNTAIN AUDUBON WARBLER.

Twenty-one specimens: near Jensen; twenty miles southwest of Duchesne; Green Lake, Uinta Mountains; Paradise Park, Uinta Mountains; and Uinta Canyon, twenty miles north of Roosevelt.

After comparisons were made with birds from Comox, Vancouver Islands, which are typical *auduboni*, and additional material from Beaverton, Oregon; Silverton, Colorado; Wilcox, Arizona; Apache, Grant County, New Mexico; San Diego, California; several localities in Lower California; and Chisos Mountains, Texas, it was found that the measurements of the wing and tail held true within limits as a character in separating the two races, *auduboni* and *memorabilis*. The following averages show the Uinta Basin birds compared with the measurements given by Oberholser (1921) for *memorabilis* and *auduboni*.

		Uinta Birds		Oberholser	
		Wing	Tail	Wing	Tail
D. a. memorabilis	♂	78.9	59.9	80.5	63.0
	♀	73.9	56.6	73.9	58.1
D. a. auduboni	♂	75.3	57.2	74.9	58.2
	♀			71.6	56.6

The color of the plumage shows considerable variation. Birds which according to measurements are *memorabilis* had a black breast, this black extending down the flanks more extensively than in *auduboni;* yet this character is lacking in many individuals. It is noticeable that the black of the lores becomes more pronounced, running back over the auriculars in *memorabilis*. Several of the intergrading Uinta Basin birds show a variation in the extent of black over the lores and auriculars. The British Columbia specimens (true *auduboni*) also show a variation in the extent of this marking. Apparently, the only dependable distinguishing characteristic between the two races is the difference in wing and tail measurements. In considering a large number of specimens (excluding the very distinctive *Dendroica auduboni nigrifrons* of southern Arizona and Mexico), the birds fall into two groups: the smaller birds of the west coast, *auduboni;* and the larger individuals of the central Rocky Mountains east to central western Texas, central New Mexico, central Colorado and central Montana, *memorabilis*.

In the Uinta Basin the breeding birds are *memorabilis*, with a few indi-

viduals showing intermediate characters. The same is true of birds taken in Brewster County, Texas (Van Tyne and Sutton, 1937). On the other hand, fall birds show no plumage characters that would make one suspicious of variations; therefore in these cases, measurements alone are the means of differentiation.

Of the warblers in the Uinta Basin the Audubon Warbler was the most abundant spring migrant. On May 1 large numbers of these birds already were passing up the river courses of the Basin. About ten per cent of these migrants were *Dendroica a. auduboni*, while the remainder were *Dendroica a. memorabilis*. This migration continued throughout May, but after the first of June birds were not seen in the low country. At Green Lake, on June 10, they were numerous and could be heard singing from every corner of the yellow-pine forest; the males used the upper branches of the pines for singing posts. A pair of birds was seen carrying nesting material to a large yellow pine. Careful scrutiny revealed the partly built nest within a foot of the terminal end of a large branch. The branch was the lowest one on the tree, although it was forty feet from the ground and ten feet out from the main trunk. Upon my second visit to Green Lake, from June 29 to July 5, the warblers of this nest were feeding young. Because of the location of the nest, it was not possible to observe the activities closely. There was still considerable singing by the males at this late date, but it was much more subdued than it had been on the earlier visit. At Indian Canyon, June 17 to 20, Audubon warblers were encountered in considerable numbers; their excited chirps indicated nests. Two females collected at this time had brood-patches with well-developed ovaries, indicating nesting activities.

On July 8, just below Paradise Park, Uinta Mountains, at an altitude of 8000 feet in the transition between the aspens and lodgepole pines, a pair of Audubon warblers was seen in some tall pines. From their actions it was apparent that they had young in the vicinity. Several others were observed at Paradise Park, altitude 10,050 feet, in the Engelmann spruce -alpine fir forest on July 9. A female was collected with a well-marked brood-patch. Ridgway reports (1877) that the Audubon Warbler was a common breeding form at Parley's Park and Pack's Canyon. On June 23, 1869, a nest with one egg and three young was found. The nest was located near the extremity of the branch of a pine tree about ten feet from the ground.

The fall migration of this warbler was late. The birds, with a large number of young, were still on their breeding grounds in considerable

numbers on September 15 (Green Lake). In Uinta Canyon, twenty miles north of Roosevelt, Audubon warblers (*memorabilis*) were still in molt on August 9, but they were beginning to move down to lower altitudes. At the Ashley Creek marshes the first migrants were noticed on September 20. After this date and until I left the Basin in early October, there was a steady movement of Audubon warblers down the Green River valley. Again, only about ten per cent of the migrants were *auduboni*. Audubon warblers, according to A. C. Lloyd, were very common in migration in the vicinity of the Ashley Creek marshes. Specimens were collected as early as April 27 and until May 17 during 1935.

Dendroica auduboni auduboni (Townsend). AUDUBON WARBLER.

Three specimens: 12 miles east of Vernal; and two miles south of Jensen. This warbler occurred only as a migrant in the Uinta Basin in the spring and fall; during these seasons it was only about one-tenth as numerous as *Dendroica auduboni memorabilis*. There was no evidence from the specimens of Audubon warbler collected on their breeding grounds that this race occurred in the Basin during the nesting period. In the field there is no satisfactory method of distinguishing *auduboni* from *memorabilis*.

Dendroica nigrescens halsei (Giraud). ARIZONA BLACK-THROATED GRAY WARBLER.

Nine specimens: ten miles west of Vernal; near Jensen; Cottonwood Springs, nine miles west of Vernal; and Hill Creek, forty miles south of Ouray.

During May the Black-throated Gray Warbler was common in the low country of the Basin, particularly along the main drainage systems. At the Ashley Creek marshes the first birds were seen on May 1, and several could be seen each day along the Green River floodplain. They showed a preference for the upper cottonwood canopy, where they could be seen feeding energetically in the thickest foliage. In 1934 A. C. Lloyd reported the same occurrence at the Ashley Creek marshes.

Only an odd straggler was seen in these lower altitudes by June 1. But at Cottonwood Springs, ten miles west of Vernal, I was surprised to find this warbler abundant at the edge of the Juniperus-Pinus Community, at an altitude of 6200 feet. The black-throated gray warblers were heard singing on all sides at Cottonwood Springs. The birds would come to water, feed among the dense foliage immediately around the water-holes,

and then disappear into the juniper-pinyon woods. Although the birds were watched continually, there was no indication of nesting activities. Later investigations revealed that the birds had already built their nests and were laying or brooding, which was responsible for the activity shown by the males. On June 28, while at Cottonwood Springs, only a few of these warblers were seen. They began to chirp loudly and to become very excited. Soon several juvenal birds that evidently had just left their nests and some that were able to fly were discovered. Although feathers of the natal down were still in evidence, the light gray of the juvenal feathers showed up strikingly. The back was very dark and there was a light gray line over the eye to a point just in front of the eye, similar to the superciliary line of the adult. The ventral surface was light gray streaked with dark gray, shading to a dark gray throat and breast. At Hill Creek, forty miles south of Ouray, on August 5, juvenal birds and a female with a brood-patch were collected in the dense willows and cottonwood thickets of the Hill Creek floodplain. These birds had moved from the scattered junipers and pinyons of the surrounding hills where they had nested.

The fall migration of these warblers had already commenced by August 9; at least, it was the first initial move from their nesting grounds to the lower floodplains of the Uinta Basin drainage system. From this date, until September 20, there was a gradual increase in the migration, which reached a peak between the 18th and 22nd of September. After September 22, to the end of the month, few black-throated gray warblers were seen.

Seiurus noveboracensis notabilis Ridgway. GRINNELL WATER-THRUSH.

Three specimens: Vernal; and two miles south of Jensen. These specimens were collected by A. C. Lloyd: a male on May 8, and two females on August 11, 1935. They agree with the light-colored, heavily streaked birds from Brewster County, Texas. In the Basin they were found only as migrants in the spring and early fall.

Oporornis tolmiei (Townsend). MACGILLIVRAY WARBLER.

Six specimens: Ashley Canyon; near Jensen; Hill Creek, forty miles south of Ouray; twenty miles north of Vernal; five miles south of Heber; and five miles south of Jensen.

Two birds were seen on May 25 at the Ashley Creek marshes, but these were the only ones observed during the entire spring migration.

A. C. Lloyd collected a female at the marshes on May 27, 1935, and reports that he saw several during the May migration.

A trip was made on June 22 to the Ashley Creek Canyon about twelve miles north of Vernal. Here I was surprised to find this warbler in the dense shrub cover of the cottonwood floodplain. The birds were very energetic, chirping loudly and flying nervously here and there as I approached certain areas. A male in badly worn plumage was collected. The female was shy and would not show herself for more than a moment. On June 29, farther up the river (about 20 miles north of Vernal), another pair was heard, and later the male was collected. This bird's gonads were still in breeding condition. Its plumage also was badly worn. At these late dates and from the actions of these two pairs, they were undoubtedly nesting. Ridgway (1877) found nests and eggs of the Macgillivray warbler at Parley's Park, Wasatch Mountains, on June 22, 1869, and at Pack's Canyon, Uinta Mountains, on July 3, 1869.

Later (August 5) on Hill Creek, forty miles south of Ouray, Macgillivray warblers were common but very wary. Several were heard and seen, but only one was collected, a male in badly worn plumage that was starting to molt. Young birds were seen on two occasions in the dense willow growths of the creek valley. They would either disappear before one could be collected or would come up so close in the brush that it was impossible to shoot them.

In the lowlands along the Green River floodplain and Ashley Creek marshes the first birds were seen on August 25. From this date until the last of September they were plentiful. The largest migration was noticed in the Provo River Canyon on the west side of the Basin, five miles south of Heber. Large numbers of these warblers were migrating down the river from September 6 to 9 in company with a heavy movement of white-crowned sparrows.

Geothlypis trichas occidentalis Brewster. WESTERN YELLOW-THROAT.

Fourteen specimens: near Jensen. This yellow-throat is the breeding form in the Basin. Comparisons were made with birds from Texas, Oregon, British Columbia, and Saskatchewan, Canada. The measurements show considerable variation, but all fall within the limits of *occidentalis*. The Uinta Basin birds, however, show a variation in color that makes them stand out from other western specimens available. There is a much brighter yellow wash from the throat well down to the upper belly, where it fades out into light creamy tan, faintly yellow. The

flanks are much the same as the lower belly, but darker with a yellow shading from the breast. The under tail-coverts are yellow, tinged with cream-buff. The upper border of the black mask has a conspicuous white band, which is more extensive over the fore crown. The white, black, and yellow of this yellow-throat's head make it exceedingly conspicuous in the field. It seems that the present status of this warbler in the Rocky Mountains and Great Plains areas is in need of revision. This can be done only with a large number of specimens from a wide range of localities.

The Western Yellow-throat appeared during the first week of May, and became plentiful by May 19. It began to decrease after that date, but at least four pairs nested in the dense growths of the Scirpus-Typha swamp. Near the edges of the swamp, where willow growths were dense, the birds frequently were seen or heard singing. Fully developed young were sighted at the edge of the marsh just east of the Stewart ranch house on August 9. The birds remained well out in the rushes. A. C. Lloyd collected both a juvenal and an immature bird on August 4 and 5, 1935, at the Ashley Creek marshes.

Birds were seen at various points in the Uinta Basin, as follows: July 6, in some roadside ponds between Myton and Duchesne; July 18, along the upper Provo River ten miles southeast of Kamas; July 24, along the dense willows of the Yampa River, eight miles north of Elk Springs, Colorado; July 25, Beaver Creek, seven miles northwest of Ladore, Colorado; July 27, at the junction of the Green and White rivers, Ouray; August 5 to 7, along Hill Creek, forty miles south of Ouray; and August 28, Uinta Canyon, twenty miles north of Roosevelt. There was a heavy migration of yellow-throats down the Green River and Ashley Creek valleys from September 20 to the end of the month. In the vicinity of the Ashley Creek marshes they were especially numerous during the fall migration. Ridgway (1876) found the Yellow-throat to be a breeding bird at Parley's Park, Wasatch Mountains, but considered it rare.

Icteria virens auricollis Bonaparte. LONG-TAILED CHAT.

Five specimens: near Jensen; Yampa River, and eight miles north of Elk Springs, Colorado.

The first chats were heard in the dense willow, rose bramble, and greasewood thickets on May 10 at the Ashley Creek marshes. The birds were exceedingly wary and furtive. By May 18 they had become abundant in the densest growths of the Green River valley as well as in the lower stream valleys of other sections of the Basin. The birds began nest-

ing in the vicinity of the Ashley Creek marshes during the last week of May. Two nests were found on June 21 in an extensive growth of rose brambles in the south end of Ashley Creek marshes. One nest contained three eggs and the other, four; in both cases the eggs were heavily incubated. When I visited the two nests on June 24, the young birds were just hatching. The adults lost their shyness, scolded loudly and approached within two feet of me. When I visited the nests again, on July 12, the young had gone. The only indication of a chat was the angry call note that was given when I walked into the territory.

On July 24, while on the Yampa River, eight miles north of Elk Springs, at the northeast corner of the Uinta Basin, chats were numerous. A male in very worn plumage and a juvenal bird were collected. The juvenal bird was well able to fly and was beginning to develop a yellow throat and breast, but it still retained some downy cream-colored feathers. The chats left early. A good number of them passed down through the lower valleys during the first two weeks of September. The birds were not seen in the Basin after September 25.

Wilsonia pusilla pileolata (Pallas). NORTHERN PILEOLATED WARBLER.

Thirteen specimens: two miles, and five miles south of Jensen; near Jensen; Green Lake, Uinta Mountains; Uinta Canyon, twenty miles north of Roosevelt; Bald Mountain, Uinta Mountains; and Moon Lake, Uinta Mountains.

The birds from the Uinta Basin are clearly *Wilsonia pusilla pileolata*, in that they are a brighter yellow and their wing measurements average 59 mm. in the males and 55 mm. in the females.

As a transient in the Basin, this species was found to be plentiful along the dense willow thickets in the early floodplain development of the Green River and about the Ashley Creek marshes. In the spring it was not noticed until May 12, when several males were seen at the south edge of the Ashley Creek marshes. From then until June 8 the pileolated warblers kept passing through in fairly large numbers, following the river systems of the Basin, which may be considered avenues leading to the higher altitudes on the mountain slopes. But by this date these warblers had passed on out of the lowlands, and none was seen again until July 19, when two adults were observed on the south slope of the Uintas about twenty miles northeast of Kamas, at an altitude of 9000 feet. These birds were in the transition between the aspens and the lodgepole pines.

In the tangle of shrub growth, principally willows, along the edge of a swift mountain stream, the warblers were disturbed. Their actions could mean only that they had a nest or young birds close by. Both adults, with crests partly raised to show their annoyance, chirped loudly and fluttered about in the dense thicket. A third adult appeared, uttered its disapproval, and then disappeared. Several young birds were near by, and after a careful search, a partly developed juvenal bird was discovered sitting motionless in some willows. The bird was able to hop about but could not fly more than a few feet. The upper surface of this specimen is a dark olive green with a faint wash of olive lake. The underparts are a light greenish yellow, much darker on the throat and upper breast. The only mark that might be considered as conspicuous on the bird is a straw-yellow wing-bar at the terminal end of the greater wing-coverts. The female was taken to ensure a positive identification of the juvenal bird. Later in the day two birds were heard singing from a thick stand of willows bordering the stream a half-mile above this point. There were probably more nesting birds in the vicinity than my observations show, for this warbler was found in numbers at the Ashley Creek marshes as early as August 25.

Pileolated warblers in family groups were feeding among the dense alders and willows at Moon Lake, Uinta Mountains, on August 21. The slightly darker immature birds showed up in distinct contrast to the bright yellow adults. As late as September 13, birds were collected at Green Lake, Uinta Mountains, at an altitude of 8000 feet. From August 20 to the end of September this bright yellow warbler was very common along the flocdplains of the river and creek valleys of the Basin. Excepting the Audubon Warbler, this was the commonest warbler seen during the migration seasons in the Uinta Basin. In 1935 A. C. Lloyd collected but one of these warblers at the Ashley Creek marshes and regarded the form to be rare in the vicinity. From the numbers seen in migration and the breeding birds in the near-by mountains in 1937, I am at a loss to account for the lack of birds in 1935.

Setophaga ruticilla (Linnaeus). AMERICAN REDSTART.

One specimen: two miles south of Jensen. A single male was collected by A. C. Lloyd on August 20, 1935. On September 20, 1937, a pair was seen in some dense willows at the Ashley Creek marshes. Ridgway (1876) reported that this bird was common and that it nested at Parley's Park, Wasatch Mountains, and at Pack's Canyon, Uinta Mountains,

but was limited in its distribution by the arid and treeless regions of the Great Basin.

Dolichonyx oryzivorus (Linnaeus). BOBOLINK.

One specimen: Jensen. This single male was taken on May 21 in a hay field at the southwestern extremity of Ashley Creek marshes. Although I watched for further evidence of others in the Basin, none was seen. Some of the older residents, who are quite reliable, told of seeing numbers of these birds on the open hay flats south of the marshes, but stated that the birds were rather irregular and put in an appearance only every other year or so.

Sturnella neglecta neglecta Audubon. WESTERN MEADOWLARK.

Twenty-one specimens: two miles south of Jensen; Jensen; ten miles east of Vernal; and Blue Mountain, 8000 feet.

A male (No. 121157), collected on May 15 at Blue Mountain, is a very dark-plumaged bird; the dorsal surface is heavily marked with dark gray-brown; the bars of the secondaries and rectrices are broad and run together at the shaft; the flanks and sides of the breast are heavily marked with black spots and streaks. It has a wing measurement of 123 mm., tail 76 mm., culmen 33 mm., and tarsus 37.5 mm., which fall within the average for *neglecta*. This bird has the distinguishing characteristic of being very dark. During a second trip to Blue Mountain another male was taken. This example is slightly darker than the lowland birds, but the difference is so inconsiderable that the bird must be regarded as the same form as the lowland *neglecta*. The series of twenty-one specimens all show a tendency to be darker on the dorsal surface and flanks than specimens of *neglecta* from Boulder, Colorado, and Marathon, Texas. Specimens from Davidson, Saskatchewan, compare favorably with those from the lower arid country of the Uinta Basin.

Meadowlarks were very common in the Basin. On May 1 they were already plentiful and remained to nest in the meadows and cultivated fields, wherever there was sufficient cover and grass. They were limited in their distribution to the lower altitudes up to the edge of the Juniperus-Pinus Community, except at Blue Mountain, where, at 8000 feet, three pairs were found nesting on the high-altitude sagebrush (*Artemisia tridentata*) plateaus. They were wary, and it was only with difficulty that two specimens were collected. Down on the lowlands they were tame, and their loud clear songs added much to the hot dry days of sum-

mer when all else was quiet. As early as August 12, meadowlarks in family groups were the most common birds seen in the Basin. By the first of September they began to gather into larger flocks in the low country. When I discontinued my work in the Basin on September 30, meadowlarks were still numerous, but it was already apparent that a good portion of the population had begun to migrate southward.

Xanthocephalus xanthocephalus (Bonaparte). YELLOW-HEADED BLACKBIRD.

Nine specimens: Jensen. These birds were first noticed on May 2 at the Ashley Creek marshes. At this time, from forty to two hundred males could be seen flying in compact flocks, but no females were in evidence. It was not until May 15 that females were noticed, and they likewise were in segregated flocks. The yellow-heads were coming and going from the center of the large Scirpus-Typha marsh. By May 20 there were females among the flocks of males, and soon after this the nesting season commenced. Eggs and young were found in the marsh from June 10 to the end of July.

While it was not possible to make a comprehensive survey of the nesting population, it was noticed that, although the yellow-headed blackbirds were in the marsh in large numbers, they were nesting in scattered colonies. There were usually from ten to forty pairs in these colonies, which seemed to be separated slightly from those of the red-wing blackbirds. The one species apparently did not interfere with the other's territory.

From the middle of August to the end of September the fall flocking increased steadily. The main migratory flocks reached their peak about the middle of September. After this period there was a noticeable decrease in the population, although there were still several flocks in the Ashley Creek marshes on September 30. Yellow-headed blackbirds were seen at only one other point in the Basin, in some small Scirpus swamps in the Duchesne River between Myton and Duchesne. Ridgway (1874) reports that this blackbird was breeding at Parley's Park, Wasatch Mountains, in the summer of 1869.

Agelaius phoeniceus fortis Ridgway. THICK-BILLED RED-WING.

Twenty-four specimens: near Jensen; two miles south of Jensen; Ouray; Hill Creek; and forty miles south of Ouray. This series of breeding males and females are of the form *Agelaius phoeniceus fortis*. Follow-

ing are the limits and averages of the specimens in question. The author is indebted to Dr. H. C. Oberholser for his identification of a portion of this series as *fortis*.

Uinta Basin breeding birds:

	Wing	Tail	Culmen	Depth of bill
9 ♂♂	121-128	88.5-96	21.2-22.8	9.9-11
	(125.7)	(91.2)	(22.1)	(10.6)
8 ♀♀	102.2-108	72-77.8	17-19.5	8.9-9.5
	(106)	(74.5)	(18.2)	(9.2)

About ninety per cent of the spring and fall migrants were *fortis*. During the latter half of September, when the red-wing migration was at its peak, three specimens of *nevadensis* were collected. There was no striking exemplification of intergradation in the Uinta Basin breeding birds. In describing a new race of red-wings from Utah, Bishop (1938) remarks that it seems rather surprising to find races of *phoeniceus* such as *nevadensis* in a breeding colony of *utahensis*, an adult male of *sonoriensis* in a breeding colony of *mailliardorum*, and a typical female *mailliardorum* in a breeding colony of *nevadensis*. Such intermingling of apparently distinct races would, even though it were the exception, produce in a relatively short time a highly confused population of intermediates. This circumstance already has become in many cases a problem that calls for an intensive revision of the systematics of the groups involved.

The red-wings appeared in very large flocks in the Basin by May 1. Many of the flocks were made up principally of males, although the females were already in the Ashley Creek marshes in large numbers. Nesting was well under way by June 1, and continued into the first week of August. The main breeding colonies occurred at the Ashley Creek marshes and along all of the lower drainage systems of the entire Basin. Wherever a suitable Scirpus swamp was lacking, scattered small colonies of from ten to thirty individuals could be found in the dense willow growths of the Basin's drainage system. Flocking began as early as August 9 and increased rapidly in the first week of September around the Ashley Creek marshes. These large fall congregations included several hundred birds, and at times there were from one thousand to fifteen hundred in a single flock. They invaded the cultivated fields, where they fed on grain.

The birds were still in the Basin by September 30. It was of interest that during the latter half of September these assemblages could be seen in the Green River valley in the evening, coming into the Ashley Creek

marshes in large compact flocks and flying into the Scirpus-Typha swamps to roost for the night. The noise of these thousands of roosting birds often could be heard a mile or more away. In the morning, as the sun rose above the eastern horizon, the birds would become very noisy and soon could be seen leaving the marsh, going in every direction, but always in large, dense, swiftly moving flocks.

Agelaius phoeniceus nevadensis Grinnell. NEVADA RED-WING.

Three specimens: two miles south of Jensen. These specimens were taken during the latter half of September. They averaged: wing, 132.5 mm.; tail, 97.9 mm.; culmen, 21.8 mm.; depth of bill at base, 11.1 mm.

This race appeared only as a migrant in the Basin, but it may have been more numerous as a migrant than the present evidence would warrant.

Icterus parisorum Bonaparte. SCOTT ORIOLE.

Five specimens (three immature): twenty-five miles southeast of Vernal; and Powder Springs, twenty miles southeast of Vernal. A pair of Scott orioles suddenly flew up from an isolated juniper tree at Powder Springs on May 8, while I was walking along the lower fringe of the Juniperus-Pinus Community at a point where it meets the "bad lands." Here, at an altitude of 5500 feet, a poor Mixed Desert Shrub Community exists. The birds were cautious and flew low into the dense juniper bushes. Finally the female was collected, and although a careful search was made, the male was not seen again. The female was in full breeding condition, with well-developed ovaries. The pair was undoubtedly preparing to nest, for when pursued they seemed reluctant to leave the general neighborhood.

The next trip made to this locality was on June 25. At a point five miles east of the first encounter with this species, a male was heard chirping loudly from the top of a juniper. Upon approaching him, I saw him drop quickly out of the tree and vanish over a near-by ridge. Following the bird proved futile. Calling loudly, he repeatedly evaded me by flying about in a dense stand of junipers, and then disappeared. When I returned to the spot where the bird was first observed, a second individual, a female, put in an appearance. The male with great anxiety came to the scene to add his alarmed notes to the female's. Eventually, three half-grown juvenal birds were located. These birds were feathered except for the wings and tail, which were only partly developed. The

young birds were soon caught, for they were barely able to fly a hundred yards or so. Likewise the female was collected, but the male made a hurried exit and was not seen again. The male probably had a juvenal bird that was able to fly with him and took it off into the dense juniper growths farther up the hillside. The female had a well-worn brood-patch and showed considerable feather wear throughout her plumage.

From the available published data this is an extension of this species' nesting range from southwestern Utah in the Beaverdam Mountains. Here, Dr. Merriam (Fisher, 1893) recorded having seen a few individuals in the juniper belt of the Beaverdam Mountains on May 10-11, 1891. It was from this report that the fourth edition of the A.O.U. "Check-List" places the range of the Scott Oriole in the southwestern corner of Utah. The Juniperus-Pinus Community, chosen by this bird in northeastern Utah, is very common throughout the region, from the Basin to the Arizona border. No doubt, with further work in the State, more records of this interesting oriole will be brought to light.

Icterus bullocki bullocki (Swainson). BULLOCK ORIOLE.

Fourteen specimens: near Jensen; and two miles, three miles, and four miles, south of Jensen. These orioles became very abundant during the first week of May, reaching their peak between the 7th and 15th of the month. The greater number of individuals during the early migration were males, but the females became more noticeable as the birds began to spread out over the river valleys, creeks, and cultivated areas of the Basin, wherever the floodplains afforded the dense foliage of cottonwoods. Nests were first observed on May 21. A pair of birds was seen carrying nesting material to a tall cottonwood near my camp on the Stewart ranch. The nest was hanging from a large branch some ten or twelve feet from the trunk and about twenty feet from the ground. The birds were tame and went about their work with little concern for our presence. After this date, numerous nests were found along Ashley and Brush creeks, Green, White, Duchesne, and Provo rivers, Willow and Hill creeks, and in all of the towns of the lower regions of the Basin. The birds were not observed above 6000 feet; they seemed to prefer the lower valleys of the Basin's drainage system.

Young birds were seen July 24 on the Yampa River, eight miles north of Elk Springs, Colorado. There was a noticeable decrease in the population after the first week of August. This gradual disappearance continued until, by the middle of September, the birds had left the Basin. There

was no indication of flocking; it was merely a gradual movement, until it became apparent that there were no more brilliant Bullock orioles in the cottonwoods.

A. C. Lloyd reported the birds very common from Jensen to Horseshoe Bend, on the Green River, in 1934 and 1935.

Euphagus cyanocephalus cyanocephalus (Wagler). BREWER BLACKBIRD.

Ten specimens: near Jensen; Blue Mountains; and Uinta Canyon, twenty miles north of Roosevelt. This blackbird was very common in the Basin from early May until late September; it occurred both in the agricultural districts and in the mountains at an altitude of 7500 to 9500 feet.

During May the birds appeared in flocks of from ten to three hundred individuals, but as the breeding season approached, they began to break up into small bands of from four to eight birds. These formed nesting colonies along the main watercourses of the Basin's drainage system. Along these river and creek banks the bulky nests could be seen often in the dense willows and cottonwoods. They probably used the same nesting sites year after year, for there were always a number of old nests scattered through the colony.

The first young were seen in the vicinity of the Ashley Creek marshes, on June 12, and from this period on the small resident flocks increased. They could be seen frequently around barnyards and cultivated fields during July and August. But large flocks were seen also along the mountain slopes of the Basin, particularly during August and September, when they were seen on the ground feeding on seeds and insects. Often in September they were observed in company with great flocks of red-winged blackbirds, feeding on grain in the cultivated fields. At this time of the year their food habits may seem detrimental to the interests of the agriculturist; yet, if this yearly consumption of food is considered in relation to their unrestricted war on insect pests from the time they arrive in early spring until they leave in the late fall, they might well be regarded one of the most valuable birds on the Uinta Basin farms.

A. C. Lloyd found the blackbirds common around Jensen during the 1934 and 1935 seasons. Several residents of the Basin said that flocks of from twenty to fifty of these birds often remain about sheep and cattle camps throughout the winter. Ridgway (1877) reports finding two nests and the eggs of the Brewer Blackbird at Parley's Park, Wasatch Moun-

tains, on June 24, 1869. One nest was in brush by a stream and the other was in a cottonwood along a stream. On July 28, 1869, at the same locality, he collected a juvenal male.

Molothrus ater artemisiae Grinnell. NEVADA COWBIRD.

Three specimens: near Jensen, Vernal. This cowbird was not very abundant in the Basin, but it was seen at most points throughout the lower and cultivated parts of the region. Three were noted at an altitude of 8000 feet on Blue Mountain, on May 22. Again, on July 29, seventy-five miles south of Ouray at the head of Florence Canyon, 8000 feet, five were seen with a herd of cattle. Small groups of from three to five individuals, usually two or three females, were seen about the Ashley Creek marshes and thickets during June and July. One robin's nest and a sage thrasher's nest were found to be parasitized by the cowbird. A. C. Lloyd noted a number of red-winged blackbird nests parasitized by these pests in 1935.

Piranga ludoviciana (Wilson). WESTERN TANAGER.

Fifteen specimens: two miles south of Jensen; Indian Canyon, twenty miles southwest of Duchesne; Beaver Creek, Moffat Co., Colorado; Green Lake, Uinta Mts.; Moon Lake, forty miles north of Duchesne; Uinta Canyon, twenty miles north of Roosevelt; and five miles south of Heber. This tanager was the most conspicuous bird of the upper altitudes of the Basin. At an altitude of 8000 feet in the yellow-pine forests, they were found to be very numerous. Throughout the Basin, however, this species ranges through a number of altitudinal communities, varying from 7500 to 10,000 feet, from the yellow pine, blue spruce, aspen, and lodgepole pine, to the alpine fir Communities.

Western tanagers frequently were heard singing from the tops of the highest cottonwoods along the Green River during May, but at no time were they ever numerous. The last to be seen and taken (June 9) in the low country was a female with well-developed ovaries. The following day, June 10, a trip was made to the yellow-pine forests at Green Lake. Here the western tanagers were at the height of their breeding season. Males could be heard from all corners of the forest, singing their clear song. The males always chose the highest pine tree, and from its topmost branch they would sing for an hour at a time. A female was seen carrying nesting material once, but other than that there was no indication of nests. On a later visit to this same locality, June 29 to July 5, young

birds were noted and on one occasion a pair was seen feeding young. The nest was in a large yellow pine, well out toward the tip of a long branch, and about forty feet from the ground. Few satisfactory observations could be made.

By July 25 the birds were in an advanced postnuptial molt, and already they were beginning to come down to lower altitudes. However, their movements were slow. On September 15 tanagers were seen at Green Lake, and on August 9 a female was seen in the cottonwoods on the east side of the Green River across from the Ashley Creek marshes. The main movement came a little later, for on August 28 young and adults were abundant halfway up Uinta Canyon. The main fall migration wave struck the lower river valleys of the Basin during the first two weeks of September. They never were seen in any numbers at this time. They seemed to scatter over the valleys and to move rapidly south. After the middle of September no further individuals were observed.

Hedymeles melanocephalus melanocephalus (Swainson). BLACK-HEADED GROSBEAK.

Eleven specimens: near Jensen; two miles south of Jensen; twenty miles north of Vernal; Green Lake, Uinta Mountains, forty miles north of Vernal; Beaver Creek, Moffat County, Colorado; and Moon Lake, forty miles north of Duchesne.

The Black-headed Grosbeak was a very abundant and conspicuous bird in the Uinta Basin during 1937. Throughout May they were numerous around the Ashley Creek marshes, where one or more of these birds inhabited every tangle of brush. For a time it looked as if two or three pairs would nest near my camp on the Stewart ranch, but after June 7 the whole population vanished. Ridgway (1877) reported that at Parley's Park, June 27 and 28, 1869, two nests with eggs were found in some willows along a stream. A male was incubating on one of the nests. According to A. C. Lloyd these birds were common at the Ashley Creek marshes in the spring of 1934 and 1935, but were not seen in the summer. Later their nesting range was established in the Basin. The lowest nesting altitude was at 5500 feet in some of the canyons, Ashley Creek, Brush Creek, and Uinta River, where there was a very dense growth of the Cottonwood Floodplain Community. From these projections into the low altitude country, the birds seemed to miss the Juniperus-Pinus belt, but in the Sub-montane Shrub they became abundant. Although at various points in the mountains of the Basin, between altitudes of 7000

to 10,000 feet, there were considerable variations in the components of the plant communities; yet these grosbeaks were most abundant in the Sub-montane Shrub, where yellow pines, oaks, and Douglas fir or Blue Spruce were closely associated with the lower aspen transition. Such conditions were prevalent at Moon Lake, Uinta; Canyon Indian Canyon; the head of Florence Canyon; Green Lake; from Kamas to a point where the lodgepole pines became a dominant community at an altitude of 9000 feet; and the northeast rim of Blue Mountain. Although most of the above localities were visited late in the nesting season, young birds were frequently seen after July 1. Young that were still being fed by the adults were observed on August 20 at Moon Lake. The first southward movement of the population started from the higher altitudes by July 23-27, when a considerable number were seen on the Yampa River, eight miles north of Elk Springs, Colorado, and at Beaver Creek, seven miles northwest of Ladore, Colorado. By August 9 they reached the Green River in the vicinity of Jensen and the Ashley Creek marshes. This migrating population steadily increased, until by the first two weeks of September all the lower drainage systems of the Basin contained a large population. Even at the end of September, five birds were seen in the Ashley River floodplains, but these, no doubt, were quickly moving south.

Passerina amoena (Say). LAZULI BUNTING.

Nine specimens: six miles north of Jensen; twelve miles east of Vernal; two miles south of Jensen; and Cottonwood Springs. This bunting was not plentiful in the Basin, but along the Green River from the Dinosaur National Monument to Ouray it was common. It was not observed until May 27, when a male was heard singing from the edge of a cultivated field. A male and female with fully developed testes and ovaries were collected. From this time on, these buntings were seen or heard during June and July whenever field work was carried on along the Green River near Jensen. They seemed to prefer the cultivated fields, where they could be seen along the margins, feeding in the dense weed-patches or in the fields just after they had been irrigated. On June 24 several families were seen at the Ashley Creek marshes; the young birds were fully grown and able to fly well. After the first week of September the Lazuli Bunting was not observed in the Basin. A. C. Lloyd says that they were rare at the Ashley Creek marshes in 1934 and 1935. He collected a male on August 7, 1934, two miles south of Jensen, and a second male, on June 2, 1935, ten miles north of Vernal at Steinicker Draw. Ridgway (1877) says that

this bunting was a very common species in all of the fertile valleys as well as the lower canyons of the mountains. At Parley's Park, Wasatch Mountains, he found nests and eggs of this bunting on June 23, 27, and July 2 and 16, 1869. The nests were found mainly in rose bushes close to a stream.

Hesperiphona vespertina montana Ridgway. MEXICAN EVENING GROSBEAK.

Three specimens: Green Lake, Uinta Mountains, forty miles north of Vernal.

This grosbeak was not plentiful in the Basin in 1937. It was observed at Indian Canyon, twenty miles southwest of Duchesne, on June 20; below Paradise Park in the aspen transition, on July 10; twenty miles northeast of Kamas on July 19; and at Moon Lake on August 20. In these instances more than from two to five individuals were never seen. They were in flight in nearly all cases, since always they were very wary. In all of the above localities they were in the aspens and the aspen transitions between the Sub-montane Shrub and Lodgepole Pine Communities. The specimens taken at Green Lake on July 2 and 3 were two females and one male. The birds had moved in close to our camp and were feeding on a tall mountain birch (*Betula fortinalis*), where there was a scattering of birches in a stand of aspens. Both females had brood-patches, and the male showed well-developed testes. The birds were nesting in the vicinity, but after an intensive search no further individuals were seen.

Carpodacus cassini Baird. CASSIN PURPLE FINCH.

Eighteen specimens: Green Lake, Uinta Mountains; Paradise Park, Uinta Mountains; and Bald Mountain, Uinta Mountains.

The Cassin Purple Finch was first seen at Green Lake on June 10. The birds were plentiful, the males singing from the topmost branches of the yellow pines. At times small flocks of from ten to thirty individuals would be found feeding on the ground at the foot of the pine trees. They were always shy, and at the slightest move the old red males would fly to a near-by pine. Immediately the whole flock would follow. It was always a surprise to see how easily these birds could simply vanish into the pine foliage, and still their musical, quiet chirps and songs could be heard on every hand. Only a day was spent on the first visit, and although a careful check was made, no nests could be located. From the actions of the singing males, it was evident that nests were close. From

June 29 to July 5 the finches were very numerous in the yellow pines of Green Lake. But this time many immature birds were among the feeding adults. Adult males were still singing, although not so continuously as three weeks before. At Paradise Park, July 9, a male was heard singing from the top of a tall Engelmann spruce. As it turned out, there were just a male and a female—the female having a well-developed brood-patch.

On July 17 on the Bald Mountain, twenty-five miles northeast of Kamas, a number of these finches were seen and heard in the spruce-fir forest, at an altitude of 10,500 feet at the edge of timberline. Several were collected and young birds were found to be about two-thirds grown. Hardly able to fly, they were being fed by the adults. It was amusing to see how busy the full-plumaged males were. For some reason or other, the males seemed to be doing at least three-fourths of the work; each male had two or three young to feed. The females were indifferent to the loud chirps of the young birds.

According to Ridgway (1877), Cassin purple finches were abundant in the Wasatch and Uinta Mountains from May to August and nested during the whole of this period. Most of the nests were found among the aspens and narrow-leafed cottonwoods of the higher portions of the ravines, where these trees replaced the conifers. Nests and eggs were taken at Parley's Park, June 23, 28, and July 19, 1869. Juvenal birds were taken at the same locality on August 16, 1869. In the fall, September 14, large flocks of these finches were encountered at Green Lake. The flocks, numbering from fifty to three hundred individuals, fed for the most part on the ground, where they were able to pick up seeds of various types. In these flocks there were many juvenal birds. A small flock of seven finches was seen in some tall, dead cottonwoods, just south of the Ashley Creek marshes, on September 28. These were the only individuals observed during either the spring or fall migrations.

Carpodacus mexicanus frontalis (Say). COMMON HOUSE FINCH.

Fourteen specimens: Cottonwood Springs; seventeen miles southwest of Vernal; twenty-five miles east of Vernal; twelve miles southwest of Vernal; ten miles west of Vernal; Green Lake, Uinta Mts., forty miles north of Vernal; seventeen miles southwest of Vernal; and two miles south of Jensen.

These finches were very abundant throughout the Basin. They seemed to prefer the cultivated portions of the area and the towns. In Vernal

and other towns of the Basin they were as numerous as English sparrows, and their melodious songs and the males in their red fronts added a touch of beauty to these western towns. They were always very numerous in the Juniperus-Pinus Community. Sometimes they would be the only bird form seen or heard on the sun-scorched juniper slopes. The House Finch is probably the widest-ranging bird found in the Basin, as it occurred from the low river floodplains and burning "bad lands" to timberline at 10,500 feet in the Uinta Mountains. The farmers and ranchers complain that these birds attack their fruits. When one considers that this bad habit lasts for only a month or so in the fall and that during the remainder of the year they feed on injurious weed seeds and insects, it is more than likely that the good done by this bird offsets its bad traits.

Pinicola enucleator montana Ridgway. ROCKY MOUNTAIN PINE GROSBEAK.

Eighteen specimens: twenty miles south of Duchesne; Paradise Park, Uinta Mts.; Bald Mountain, Uinta Mountains.

The above series contains twelve adult males, all of which are rich carmine flecked with buff and yellow spots over the breast, upper belly, head, back, and rump. This richer color in the birds collected at Paradise Park and Bald Mountain may be partly attributed to the loss of the feather barbules, giving the golden sheen effect. This pecularity of feather wear is discussed fully by Dwight (1900).

This grosbeak was not a particularly common bird in the Uinta Basin, but it was probably more numerous than a first impression would warrant. It was first encountered in Indian Canyon, twenty miles south of Duchesne, on June 17. The birds were feeding in a dense stand of blue spruce, but only a single pair was seen. The males were singing quietly as they fed high in the tall conifers. The next time these grosbeaks were encountered was on July 7 at Paradise Park. Here they were very numerous in the spruce-fir forest up to the edge of timberline. At timberline, where scattered stands of spruce or fir formed islands on the alpine meadows, it was common to see one or more pine grosbeaks flying back and forth across the intervening openings. Later, on July 17-20, at the Bald Mountain, twenty-five miles northeast of Kamas, at the edge of timberline, 10,500 feet in altitude, they were common. The locality was nearly identical with Paradise Park; the forest was again dominated by Engelmann spruce and alpine fir. The birds were in postnuptial molt,

with very worn plumage. On two occasions adults were seen feeding fully developed young. The male birds even at this late date were singing, but it was not the loud clear song of the breeding season. It was impossible at this time to determine whether there was any altitudial movement among these grosbeaks, for we left the Basin before the severe winter weather set in.

Leucosticte atrata Ridgway. BLACK ROSY FINCH.

Two specimens: Bald Mountain. These two specimens, a male and a female, were taken by Lawrence E. Hicks on July 20, 1939. The gonads of both birds indicated that they had nested. The plumages were very worn, showing no evidence of a molt. Dr. Hicks reports that he saw several pairs, which were probably mated. About one half-mile from the spot where the two specimens were collected, he found a nest with young, visited regularly by adults with food.

The Black Rosy Finch was reported by Stevenson (1872)[4] as *Leucosticte tephrocotis* (not of Swainson), for the Uinta Mountains. From the data published the specimens collected by Stevenson were probably taken on the upper north slopes of the Uinta Mountains. Several ranchers in the Basin gave descriptions of the Black Rosy Finch, which they said appeared in flocks about their sheep camps during the winter. These camps were in the lower altitude Desert Shrub communities.

Spinus pinus pinus (Wilson). NORTHERN PINE SISKIN.

Twelve specimens: two miles south of Jensen; Green Lake, Uinta Mountains; and Bald Mountain. During the first two weeks of May large flocks of pine siskins frequently were heard as they flew over or settled in some tall dead trees around the Ashley Creek marshes. These birds never seemed to remain in the lower valleys for any length of time, but were ever on the move northward toward the high mountains. On June 10 large flocks were found in the yellow pines at Green Lake. These flocks numbered from fifty to four hundred birds, and there seemed to be considerable activity and singing. From June 29 to July 5 the siskins were still at Green Lake, but in small numbers. They were seen flying back and forth from a lodgepole-pine forest higher up on the mountainside, apparently coming to the yellow pines to feed. Just before leaving on July 4, I saw juvenal birds that were just able to fly being fed by the

[4]Prelim. Rep. U. S. Geol. Surv. Terr. for 1871 (1872), 464.

adults. Small flocks of from four to ten birds were seen at Paradise Park, July 7 to 10, and at Bald Mountain, July 16 to 20. These small flocks were made up of family groups, a pair of adults and from two to five juvenal birds.

Ridgway (1877) remarks that the Pine Siskin in considerable numbers was in the Uinta and Wasatch mountains in 1869. Here it was found with the Cassin Purple Finch in the pine forests and in the aspen copses. The nests were extremely scattered. A set of eggs from a nest near the extremity of a horizontal arm of a fir tree, about fifteen feet from the ground, was collected at Parley's Park, on June 23, 1869. Two juvenal birds were taken at Parley's Park on August 10, 1868. September 21 was the first date that I noticed the siskins in the lower country along the Green River. From this date to the end of September there was a considerable migration from the higher altitudes, but the birds seemed to be moving south rapidly.

Spinus tristis pallidus Mearns. PALE GOLDFINCH.

Nine specimens: near Jensen; Ouray; five miles south of Heber; and two miles south of Jensen. The two females were in badly worn plumage, which probably accounts for the smaller measurements of both wings and tail; the seven males were taken from May to July. Consequently, they show considerable variation in the amount of wearing of the white on the edges of the tertials, greater coverts, secondaries, and rectrices. The general yellow of these specimens does not show any appreciable paleness from typical specimens of *tristis*.

The specimens have been ascribed to *pallidus* on the basis of measurements:

		Wing	Tail
Average for Uinta Basin	♂	76.9	50.5
	♀	72.2	45.5
Average for *pallidus**	♂	78.0-74.9	56.0-50.3
	♀	75.0-72.1	54.0-51.0
Average for *tristis**	♂	72.9-70.2	52.1-48.0
	♀	70.4-66.9	49.5-47.6

The Pale Goldfinch is a common summer resident in the Uinta Basin. It appeared during the first week of May, generally in small flocks of from ten to twenty birds. They seemed to prefer the cultivated areas and the towns of the Basin, where they built their nests and raised their young.

*Dwight, *Auk*, 19, April, 1902, p. 163, table 3.

After the nesting season they moved about over the farms, feeding on weed seeds. By the middle of August the flocks began to increase in size, and by the first of September from fifteen to fifty birds were frequently seen together; however, at the end of the month they had nearly all moved south. The inhabitants of the area enjoy these birds, referring to them as wild canaries.

Spinus psaltria psaltria (Say). ARKANSAS GOLDFINCH.

Rare in the Uinta Basin. A single male was observed at close range in a private flower garden in Vernal on July 22. Later, between the 10th and the 12th of August, three more, a male and two females, were seen in Vernal. Earlier, several townspeople who were interested in birds remarked that they frequently saw two kinds of goldfinches in their gardens. These reports from Vernal may indicate that a few individuals nest here each year. Ridgway (1877) found this goldfinch in the Wasatch and Uinta mountains, where he considered it uncommon. According to his report it usually was found associated in small numbers with large flocks of the Pine Siskin (*Spinus pinus pinus*). From a nest in the top of a willow bush along a stream, one set of eggs was collected at Parley's Park on June 22, 1869.

Loxia curvirostra benti Griscom. BENT CROSSBILL.

Twenty-three specimens (six immature): Green Lake, Uinta Mountains; and Bald Mountain.

		Wing	Culmen	Depth of Bill at Base	Coloration
From Griscom, 1937					
L. c. benti, typical	♂	91-96	17-19	10.0-10.5	Rosy and pale.
L. c. benti, Colorado	♂	92-98	17-19.5	10.0-10.5	Rosy and pale.
L. c. grinnelli, typical	♂	92-98	17-19.5	10.3-11.5	Scarlet.
L. c. grinnelli, Sierra Nevada Mts.	♂	93-96.5	17.5-19.0	10.3-10.8	
Specimens tending toward *grinnelli*.					
Uinta Basin					
121539 ♂ June 30	Uinta Mts.	93.0	20.0	10.8	Pale rose with not so much yellow.
121544 ♂ July 1	Uinta Mts.	93.2	20.0	10.8	Rosy red with considerable yellow green.
121719 ♂ July 19	Bald Mt.	95.0	19.3	10.8	Pale rose with little yellowish green.

Uinta Basin (Uinta Mts.) *L. c. benti.*

121357	♂	June 10	Uinta Mts.	92.3	18.5	10.5	Pale rose with a little yellow green.
121360	♂	June 10	Uinta Mts.	94.0	18.4	10.6	Pale rose with a little yellow green (worn).
121545	♂	June 1	Uinta Mts.	95.0	20.0	10.0	Rose red, considerable yellow green.
121560	♂	June 2	Uinta Mts.	92.5	19.5	10.0	Pale rose, little yellow green.
121559	♂	June 2	Uinta Mts.	95.0	20.4	10.2	Pale rose, little yellow green.
121608	♂	June 5	Uinta Mts.	93.0	19.0	10.0	Pale rose, little yellow green.
		Averages		93.1	19.3	10.2	

The above table compares Griscom's measurements with those of the Uinta Basin birds. Griscom states that the wing length and exposed culmen of *grinnelli* are exactly as in *benti*, but the former differ from *benti* in having a much deeper bill, 10.3-11.5, (*grinnelli*) versus 10.0-10.5, (*benti*). The three specimens 121538, 121544, 121719, in depth of bill, are decidedly *grinnelli*. Even in coloration there is a tendency for the rose to be deeper red, thus approaching *grinnelli*, yet upon comparison the birds are much paler and very rosy. Since the Basin lies in an area where *benti* from Colorado and *grinnelli* from the west and south might meet, one or both of these races will exert an influence on the breeding population of the Basin. Griscom (1937) states that there are definite breeding records for *grinnelli* from Arizona, in the Kaibab National Forest, Grand Canyon, near Williams, in the Mogollon Mountains, the San Francisco Mountains, and near Springerville. The bird, however, has an erratic occurrence in Arizona. Summer specimens of *grinnelli* have been collected in the Charleston Mountains and the Shell Creek range of Nevada. Griscom has not found a single breeding record from either Utah or Nevada. The range of *benti* is through the pine hills of northeastern Montana, eastern Wyoming and into northern Colorado.

The six remaining adult males are typical *benti* both in measurements and in general coloration. They are the same as the larger birds from Colorado, but average slightly larger: wing, 93.1; culmen, 19.3; and depth of bill at base, 10.2.

The first crossbills were seen on June 10 in the yellow pines around Green Lake. At this time they were flying in considerable numbers, but

usually in small flocks of from five to fifteen individuals. The males were singing and considerable activity was apparent. During the evening, after 4:00 P.M., these small flocks were seen flying from the yellow pines where they had been feeding to the lodgepole pines higher on the mountainside. The females all had brood-patches. From June 30 to July 5, numbers of crossbills were encountered at Green Lake, but at this date the population included a great many juvenal birds. These young birds were about two-thirds grown, and in most cases their tails were only half developed. It was obvious that they had not flown farther than the surrounding mountain slopes. The females had well-developed brood-patches, that were now gelatinous and thick. Both adults were kept constantly busy feeding the young birds. Most of the feeding was done on the ground or from the lower branches of surrounding trees.

Crossbills were not abundant at Paradise Park, but a single female was taken from a flock of three birds on July 9. These were the only individuals of this species seen; possibly, birds that had been here earlier had already moved to lower altitudes. A similar experience was had at Bald Mountain, twenty-five miles northeast of Kamas, where only one flock of nine birds was seen. Two were taken, a male and a female.

Oberholseria chlorura chlorura (Audubon). GREEN-TAILED TOWHEE.

Thirty specimens: Cottonwood Springs; Powder Springs; Blue Mountain; Jensen; twenty miles southwest of Duchesne; Green Lake; Yampa River, eight miles north of Elk Springs, Colorado; Beaver Creek, Moffat County, Colorado; Florence Canyon, seventy-five miles south of Ouray; Hill Creek, forty miles south of Ouray; and Heber.

The brown of the crown in the Uinta birds is a shade lighter than in comparable specimens from Texas, New Mexico, and Arizona. The birds are lighter than typical *chlorura*, although the gray of the breast is darker. Except for the crown, the gray cast in the Uinta specimens is probably due to feather-wear in the breeding individuals. The average measurements are the same as for typical *chlorura*.

This bird was an abundant spring migrant, passing up the drainage systems, where it could be found in the dense thickets of the early successional stages of the floodplains. For nesting territory, it occupied the Sub-montane Shrub Community, which occurs from about 7000 to 8000 feet on the mountain slopes. This includes dense growths of such shrubs as *Artemisia tridentata*, *Amelanchier pallida*, *Amelanchier prunifolia*, *Cercocarpus montanus*, *Purshia tridentata*, and *Symphoricarpos rotundifolius*.

A bird in juvenal plumage, just able to fly, was collected in the Sagebrush Community of Blue Mountain, altitude 8000 feet, on June 26. There was a large number of green-tailed towhees around at the time; the adults were conspicuous, for they were feeding young. Juvenal birds were taken on July 24 on the Yampa River, eight miles north of Elk Springs, Colorado, and on July 25 at Beaver Creek, Moffat County, Colorado. An immature male (no. 121787), taken on July 20 at Florence Canyon, still retains a little of the streaking on the breast, back, and head. The brown of the crown is already extensive. The first fall birds to appear in the lower parts of the Basin were seen in the vicinity of Jensen along the Green River floodplain in early September. They were still passing along the Green River valley in large numbers by the last of September.

Pipilo maculatus montanus Swarth. SPURRED TOWHEE.

Twelve specimens: Green Lake, Uinta Mountains; Ashley Creek Canyon; Hill Creek, from forty to seventy-five miles south of Ouray; Yampa River, eight miles north of Elk Springs, Colorado; Blue Mountain; and Uinta Canyon, twenty miles north of Roosevelt.

AVERAGE MEASUREMENTS

		Wing	Tail
P. m. montanus			
New Mexico, Colorado, Arizona	♂	90.2 mm.	104.2 mm.
	♀	84.6 "	98.0 "
P. m. gaigei			
Brewster County, Texas	♂	87.2 "	100.5 "
P. m. curtatus	♂	86.4 "	96.4 "
P. m. arcticus	♂	87.63 "	97.28 "
	♀	83.82 "	92.46 "
Uinta Basin specimens	♂	88.5 "	101.1 "
	♀	86.0 "	102.6 "

The Uinta Basin specimens show characters of both *montanus* and *arcticus* but appear more closely related to *montanus*. In measurements and general coloration, they are similar to *montanus*, although in most adults the heads, backs, and breasts are a tone darker. The buff flanks are a shade lighter than comparable specimens of *montanus* from New Mexico, Colorado, and Arizona.

They are also somewhat similar to *arcticus*, although the back, head, and breast are blacker. This character is not consistent even in *arcticus*, for there is considerable variation in the intensity of the black among individuals. The buff of the flanks is similar, although the Utah birds tend to be a little lighter. The measurements of *arcticus* are not ap-

preciably different, except that the tails are shorter than in the Uinta Basin birds. The females of *arcticus* are entirely dissimilar; they are much lighter over the dorsal surface (blackish gray), and the crown of one specimen is almost black. The Uinta Basin birds are similar to *curtatus*, except that the wing and tail measurements are longer and the buff of the flanks is lighter. The distribution of *montanus*, *arcticus*, and *curtatus* indicates the possibility of intergradation in the Basin between *montanus* from the east, *arcticus* from the north, and *curtatus* from the northwest through northern Nevada.

These towhees were abundant in the Basin. They passed up the river and creek valleys, seeking the dense undergrowth of the floodplains during May. They were not seen in the lowlands in June, for they had moved to the mountains. Their breeding grounds comprised a community between 7000 and 8000 feet. In the Basin this community consists of a dense shrub zone where the growth is three to four feet high and so thick that it is difficult to walk through. Graham (1937) calls it the Submontane Shrub or the Mid-altitude Artemisia Association. The chief components of the community of low, deciduous, bushy shrubs belong to the genera *Artemisia*, *Amelanchier*, *Cercocarpus symphoricarpos*, *Purshia*, etc. Although this major community is made up principally of shrubs, yet in the deep canyons and in other isolated localities, such trees as yellow pines, oaks, Douglas firs, and blue spruce occur. The adults and young remained in the Sub-montane Shrub Community until the middle of September. From then until the end of the month large numbers of birds passed down to the lowlands and migrated slowly southward along the river valleys of the Basin. They concentrated along the valley of the Green River, which with its tributaries drains the Basin. A considerable migration along the Provo River was observed between September 6 and 9. In following this route the birds passed through the Wasatch Mountains and emerged into the Great Salt Lake Basin.

Calamospiza melanocorys Stejneger. LARK BUNTING.

A single specimen, a juvenal male, was collected on July 30, 1869, at Parley's Park, by Ridgway (1877).

Passerculus sandwichensis nevadensis Grinnell. NEVADA SAVANNAH SPARROW.

Five specimens: ten miles east of Vernal. The Savannah Sparrow was not an abundant species in the Basin. They were fairly common along

the Green and White river floodplains. Although there was actually very little nesting territory in the area suitable to these birds, they were always found in the wet grassy flats around the mouth of Ashley Creek and along the edges of the marshes of the Green River. Appearing early in May at the Ashley Creek marshes, they could be heard singing at any time at our camp during May and June. Eight or ten pairs nested in the large grassy meadow southwest of Ashley Creek marshes. Two nests with eggs in an advanced state of incubation were located on June 25 at the edge of this meadow. On August 9, young were seen that were able to fly. They were still being fed by the parent birds. During fall migration in September only an odd individual of this form was observed at the Ashley Creek marshes. There was a considerable migration of savannah sparrows down the Provo River valley, five miles south of Heber, from September 6 to 9. A. C. Lloyd found this sparrow fairly common during 1934 and 1935, but at only one point. This was at the west end of the marshes in a cocklebur flat near Ashley Creek.

Pooecetes gramineus confinis Baird. WESTERN VESPER SPARROW.

Eleven specimens: near Jensen; Blue Mountain, two miles south of Jensen; Moon Lake, forty miles north of Duchesne; Green Lake, Uinta Mountains, forty miles north of Vernal; and 15 miles southwest of Vernal.

The Vesper Sparrow is the most uniformly distributed bird in the Basin. It appeared as a migrant on the first of May and increased until the middle of the month. After the tenth of May it became less conspicuous in the low country of the Basin. But a pair could always be put up in the rabbitbrush (*Chrysothamnus stenophyllus*), shadscale (*Atriplex confertifolia*), and sagebrush areas. Juvenal birds that were barely able to fly were encountered on June 12, fifteen miles southwest of Vernal. Vesper sparrows were plentiful about the cultivated farm land of the Basin and over a greater part of the shrub desert. They were numerous at Green Lake from June 10 to the middle of September, at which time they were beginning to collect into migratory flocks. In all of the high mountain sagebrush areas and alpine meadows these sparrows were found to nest in numbers. Ridgway (1877) found this bird to be common at Parley's Park, Wasatch Mountains. He found nests here on June 23 and 25 and in July, 1869.

Chondestes grammacus strigatus Swainson. WESTERN LARK SPARROW.

Fifteen specimens: near Jensen; five miles south of Jensen; ten miles west of Vernal; fifteen miles south of Vernal; and Cottonwood Springs, Blue Mountain.

This sparrow was the most abundant and conspicuous bird in the low country of the Basin. It was found also in the Juniperus-Pinus Community and at several localities as high as 8000 feet, such as at Green Lake, head of Florence Canyon, near the top of Diamond Mountain, and Blue Mountain. Here it frequented the high-altitude sagebrush areas. There was little sign of nesting until the first of June. After the middle of June large numbers of juvenal birds were encountered. By July the lark sparrows began to gather into flocks in the low country. As late as August 25 two birds that still retained some of their juvenal plumage were collected from a large flock five miles south of Jensen. This sparrow was still abundant in the "bad lands" and lower drainage systems of the Basin as late as September 30. A. C. Lloyd found the Lark Sparrow fairly common at Ashley Creek marshes during the spring and summer of 1934 and 1935.

Amphispiza nevadensis nevadensis Ridgway. NORTHERN SAGE SPARROW.

Five specimens: Cottonwood Springs; twelve miles southwest of Vernal; and fifteen miles south of Vernal. This sparrow was not found to be abundant in the Basin in 1937. A small nesting colony was found twelve miles southwest of Vernal in a hot, dry, sandy valley dominated by an Atriplex-Tetradymia Community (Graham, 1937). The males were singing from every corner of the valley—a fact which made the incident even more striking and memorable, for this was the first time that I had heard their song. The birds were exceedingly shy and not easily approached. After hunting for some time, I saw a sparrow suddenly fly out of a prickly clump of *Tetradymia* sp. just before I brushed against it. The bird chirped for a few minutes and then flew away. The nest, containing two fresh eggs, was well constructed of dried grass and lined with hair and a few feathers. It was not possible again to visit the nest until July 22, and by that time the female was brooding four heavily incubated eggs. A. C. Lloyd reported that the sage sparrow was abundant five miles west of Vernal in 1934. On several occasions he saw it on the arid shrub desert

that borders the Green River floodplain. Later, (October 8-25) I saw large flocks on the shrub deserts near St. George in southwestern Utah.

Junco hyemalis hyemalis (Linnaeus). SLATE-COLORED JUNCO.

One specimen: two miles south of Jensen (Royal Ontario Museum of Zoology). This specimen was collected by A. C. Lloyd near the Ashley Creek marshes on May 6, 1935. This species is probably more common during migration in the early spring and late fall than this single specimen would indicate.

Junco mearnsi Ridgway. PINK-SIDED JUNCO.

Eight specimens: Jensen; two miles south of Jensen; and Green Lake, Uinta Mountains. This junco occurs as a migrant in the Basin. In early May a few small flocks were noticed along the Green River valley near Jensen. The birds were found to be very abundant in the Yellow Pine Community at Green Lake, Uinta Mountains, from September 11 to 15. During the last week of September they had reached the lower valleys and were passing down the Green River in small flocks, usually associating with migrating sparrows. A. C. Lloyd collected eight specimens, now in the National Museum of Canada, from April 23 to May 16, 1935, at the Ashley Creek marshes.

Junco mearnsi < montanus. HYBRID BETWEEN THESE SPECIES.

Two specimens: Jensen. Two of these specimens were taken during the fall migration from small flocks of *Junco mearnsi*. The yellowish pink of *mearnsi* is in evidence over the flanks. The backs are the drab brown of *mearnsi*, but the black pigment of the hood is decidedly more intense, approaching *montanus*.

Junco caniceps Woodhouse. GRAY-HEADED JUNCO.

Twenty specimens: Jensen; Green Lake, Uinta Mountains; Indian Canyon, twenty miles southwest of Duchesne; Paradise Park, Uinta Mountains; and Bald Mountain. This junco was very abundant as a spring migrant along the drainage systems of the Basin throughout May. The birds nested in all the mountains of the Basin from altitudes of 7500 feet to timberline at 10,000 feet. Their range included the Douglas fir, yellow pine, blue spruce, aspen, lodgepole pine and Engelmann spruce-alpine fir forests. The first nests were found at Green Lake, Uinta Mountains, on June 10. The birds at that time could be heard singing

from all corners of the forest. The male always chose the top of a tall pine as a singing post. Considerable activity, consisting chiefly of pursuit and nest-building, was observed here. From June 17 to 20, at Indian Canyon, eighteen nests with fresh eggs were found in the mixed blue spruce, Douglas fir, yellow pine and aspen forest. The nests, averaging four or five eggs, were always on the ground, generally under a protecting shrub or a log. These were the most common nesting birds of this region.

At Paradise Park, between July 7 and 10, numerous nests were located, all containing eggs advanced in incubation. Birds in juvenal plumage were seen in large numbers at Bald Mountain in the Englemann Spruce-alpine fir forest from July 16 to 20. These juncos were nesting in larger numbers here than at any other place visited in the Basin. It is of interest that in this locality a *caniceps* < *mearnsi* hybrid was found. A female of this hybrid was taken from a nest of five eggs and within forty feet of a nesting pair of *caniceps*. There were so many *caniceps* individuals that it was impossible to locate the mate of this hybrid, but if it had shown the *mearnsi* characters of the hybrid, it would have been noticed at once among the nesting *caniceps* population. This hybrid bird has the red back of *caniceps* but with a yellowish tinge, and the pink flanks of *mearnsi*. In other respects the bird shows the characters of *caniceps*. Alden H. Miller (1939) remarks that in the *caniceps* < *mearnsi* hybrids, the *mearnsi* yellow pigment is dominant over the red of *caniceps*. This genetic character is apparent in the above hybrid.

The first movements of the juncos were noticed on July 25, when a few small flocks were observed at Beaver Creek, Moffat County, Colorado, at an elevation of 6000 feet. Again on August 5 a small flock of four birds was seen south of Jensen on the Green River. The main movement of fall migration was rather slow, for the population remained in the mountains above 8000 feet until after the middle of September. At the Ashley Creek marshes a large migration of juncos started after September 25 but did not reach a peak until the end of the month.

The author wishes to thank Dr. Miller for examining the series of juncos from the Uinta Basin.

Junco oreganus montanus Ridgway. MONTANA JUNCO.

Four specimens: two miles south of Jensen. This junco was noticed in the Basin only as a migrant (September 28 and 30). The birds appeared in small flocks of eight or ten, mixed with large migrating flocks of *Junco caniceps*. These few birds were the only juncos of this race recorded, but

the migrating population was probably larger than these observations warrant. Later, from October 14 to 22, a large migration of *montanus* was observed in the vicinity of St. George in southwestern Utah.

Spizella passerina arizonae Coues. WESTERN CHIPPING SPARROW.

Twenty-one specimens: Jensen; Green Lake; Ashley Canyon, near Jensen; Paradise Park, Uinta Mountains; Bald Mountain; Yampa River, eight miles north of Elk Springs; Hill Creek, forty miles south of Ouray; and Uinta Canyon, twenty miles north of Roosevelt.

These sparrows were common spring migrants, passing along the drainage systems of the Basin in early May. Following the watercourses into the mountains, they nested from the yellow pines to timberline. The greatest nesting population was observed between June 30 and July 3 at Green Lake, where six nests with young almost ready to leave were found. The nests were located in young pines, between five and twenty feet above the ground. Young birds, barely able to fly, were encountered in the Picea-Abies Community at Paradise Park, from July 7 to 10. When we visited Bald Mountain, the coniferous forest seemed overrun with young chipping sparrows that were just out of the nest. The last young bird seen was in Uinta Canyon, twenty miles north of Roosevelt, on August 29. At Green Lake, September 11 to 15, this species was beginning to gather in large flocks preparatory to the migratory move to lower levels. The first fall migrants were encountered on September 20 near Jensen. From then until the end of the month the number of chipping sparrows kept increasing as they passed down the Green River valley in flocks of from twenty-five to two hundred birds. When I left the Basin, on October 1, their migration still was progressing.

Spizella breweri breweri Cassin. BREWER SPARROW.

Nine specimens: Jensen; fifteen miles southwest of Vernal; and Strawberry Reservoir. This sparrow passed through the Basin in fairly large numbers during the spring migration. The first birds were noticed by May 7. A few nested in the sagebrush, rabbitbrush, and greasewood flats around the Ashley Creek marshes. A young bird was collected at the edge of the greasewood, five miles south of Jensen, on August 25. Brewer sparrows were common on the big grass and sagebrush flats at Strawberry Reservoir. The first noticeable migration of these sparrows started about September 21, and flocks of from fifty to one hundred were seen frequently until the end of the month. A. C. Lloyd collected a few Brewer

sparrows in the vicinity of the Ashley Creek marshes between May 6 and 8, 1935.

Zonotrichia leucophrys leucophrys (Forster). WHITE-CROWNED SPARROW.

Seventeen specimens: Jensen; Paradise Park, Uinta Mountains; Bald Mountain; and Heber.

This was one of the most common sparrows in the Uinta Mountains. The birds passed up the Green River in large flocks of from forty to two hundred birds from early May until the 20th of the month. During their steady movement north and into the high mountains, they kept to the densest cover along the floodplains. They were encountered first at Paradise Park, at an altitude of 10,000 feet, in the Picea-Abies Community. Here in the spruce-fir forests they nested in large numbers. Their melodious songs were characteristic of these forests in summer. Their nests were everywhere, generally at the edges of small clearings, under shrubs, logs, or anything that afforded a little protection. Without making a special effort to look for these nests, from four to ten were found each day while I was working through the forests. Most of them contained four or five eggs, that were well incubated or had just hatched. Juvenal birds, barely able to hop about, were noted on several occasions.

While in the Picea-Abies Community of Bald Mountain, July 16-20, white-crowned sparrows were observed to be very plentiful. Most of the young birds, having already left their nests, were found with the adults in dense cover. The males still could be heard singing throughout the Picea-Abies Community and up to timberline. They frequently were seen feeding along the edges of ponds in the alpine meadows, but in these instances there was always a dense growth of shrubs, spruce, or fir near by into which they could fly at the slightest disturbance. The first flocks of migrating sparrows were seen following the Green River floodplain on September 10. This migratory movement continued throughout the month and reached its peak by September 20. They were still plentiful when we left the Basin on October 1. The migration peak was encountered again at St. George in southern Utah on October 16.

Zonotrichia leucophrys gambeli (Nuttall). GAMBEL SPARROW.

Ten specimens: Jensen; Heber; and two miles south of Jensen.

The Gambel Sparrow, using the Green River valley as the main migratory route, appeared only as a migrant in the Uinta Basin. In the spring

a single male was taken from a large flock of *Zonotrichia leucophrys leucophrys* on May 4. A great many white-crowns were in migration during May; the greater part were *Zonotrichia leucophrys leucophrys*. In September the first of the migrating *gambeli* were observed near Heber on the Provo River, when the birds passed through the Provo Canyon. From September 10 to 20, at the Ashley Creek marshes, the migrating white-crown population was principally the local breeding *leucophrys*. The peak of the white-crown migration came on September 20 and continued until after I left in late September. The greater number passing down the Green River valley then were *gambeli*.

Passerella iliaca schistacea (Baird). SLATE-COLORED FOX SPARROW.

One specimen (No. 521, Brigham Young University collection): Long Lake, at the head of Ashley Creek, Uinta Mountains.

This specimen, collected by C. L. Hayward on July 21, 1930, is the only available evidence of the Slate-colored Fox Sparrow in the Uinta Basin.

Melospiza lincolni lincolni (Audubon). LINCOLN SPARROW.

Eight specimens (one female, seven males): twelve miles east of Vernal, and two miles south of Jensen.

The average measurements for these spring and fall migrants were: males, wing, 62.3, tail, 58.4; females, wing, 58.0, tail, 56.0 mm.

They first appeared on May 1 and migrated through until May 15. During the fall the first to appear came September 20, followed by a heavy migration that lasted until the end of the month. Although some of the birds were definitely rusty on the back, they all showed a light yellowish gray wash over the dorsal surface *Melospiza l. lincolni* did not breed in the Basin, although throughout both the spring and fall migrations it was found with the race *Melospiza lincolni alticola*.

Melospiza lincolni alticola Miller. MOUNTAIN LINCOLN SPARROW.

Eleven specimens: Bald Mountain; Green Lake, Uinta Mountains; two miles south of Jensen; and near Jensen. The spring migrants that passed up the Green River valley were in mixed flocks with *Melospiza lincolni lincolni*. The breeding birds found on Bald Mountain, twenty-five miles northeast of Kamas, at an altitude of 10,500 feet, were found in a bog in the spruce-fir forest. The average measurements of the four breeding males collected were: wing, 65.4; tail, 58 mm. From July 16 to

20 these birds were feeding fully feathered juvenal birds that were able to fly.

Lincoln sparrows appeared first in migration by the first of September but did not reach their peak until the 20th of September. From this date until the end of the month, they were abundant throughout the lower drainage systems of the Basin. There was again a mingling of the two races during this period. The specimens representing *Melospiza lincolni alticola* averaged for the males: wing, 66.1 mm; tail, 61.5 mm. The female: wing, 64.3 mm; tail, 60 mm. In all of these specimens the dorsal surface was a dull brown with a distinct rusty wash. *Melospiza lincolni alticola* is the breeding form on the south slope of the Uinta Mountains. Here they are not particularly abundant, occurring only in isolated localities. These locations are in the lodgepole pine and spruce-fir forest in local bog communities.

Melospiza melodia juddi Bishop. DAKOTA SONG SPARROW.

Four specimens: from two miles south of Jensen, in the National Museum of Canada. A. C. Lloyd collected these specimens during the spring migration of 1935 in the vicinity of Ashley Creek marshes. P. A. Taverner identified them as *Melospiza m. juddi.* The breeding population of the Basin is *Melospiza m. fallax.* In migrations, at least in the spring, a few of the race *Melsopiza m. juddi* pass up the Green River valley on their northward route.

Melospiza melodia fallax (Baird). MOUNTAIN SONG SPARROW.

Thirty-five specimens: Jensen; two miles south of Jensen; Beaver Creek, Colorado; Hill Creek, forty miles south of Ouray; Strawberry Reservoir; Uinta Canyon, twenty miles north of Roosevelt; and Heber.

In 1937 song sparrows were not abundant at any time in the Basin. During the spring migration of 1935, A. C. Lloyd collected specimens on April 23; whereas in 1937 the breeding population was not well established along the Green River until May 7. Throughout the remainder of May and June, song sparrows were heard singing at widely separated localities along the floodplains of the drainage systems. They were found in the densest cover, usually in the willows not far from water. Breeding birds were taken in the vicinity of Jensen, and young were collected at Strawberry Reservoir and Uinta Canyon, and also at Beaver Creek, Colorado. The fall migration became apparent on September 28, when this species was numerous around the Ashley Creek marshes.

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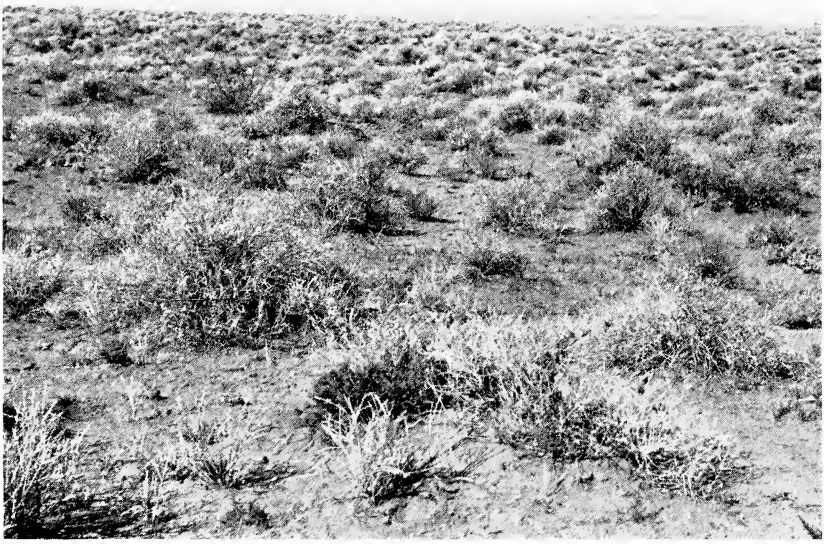
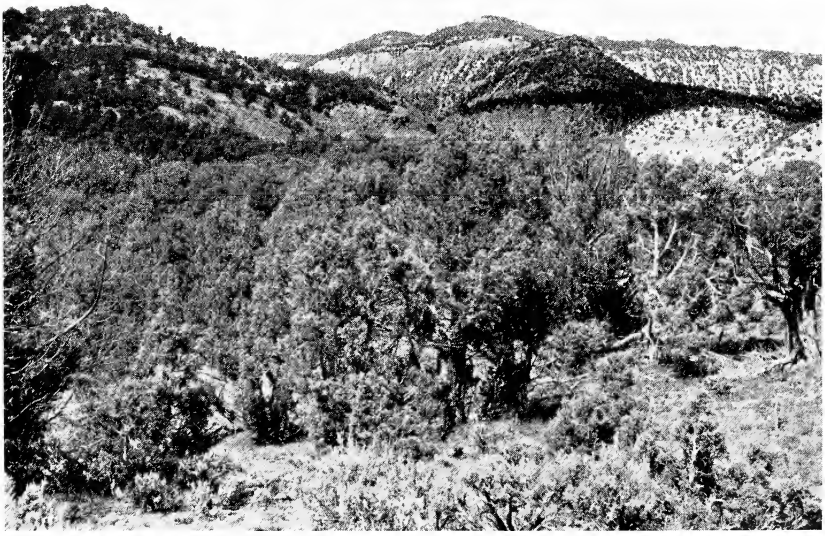


After Graham

FIG. 1. Atriplex-Tetradymia Community. An example of the Mixed Desert Shrub at an altitude of 5500 ft.



After Graham

FIG. 2. Juniperus-Pinus Community at an altitude of 6400 ft. *Artemisia tridentata* in the foregound.

FIG. 1. Western Burrowing Owl in Atriplex-Tetradymia Community.

FIG. 2. Young Western Burrowing Owls at the entrance of the nest burrow. Notice half-eaten Kangaroo Rat at entrance.

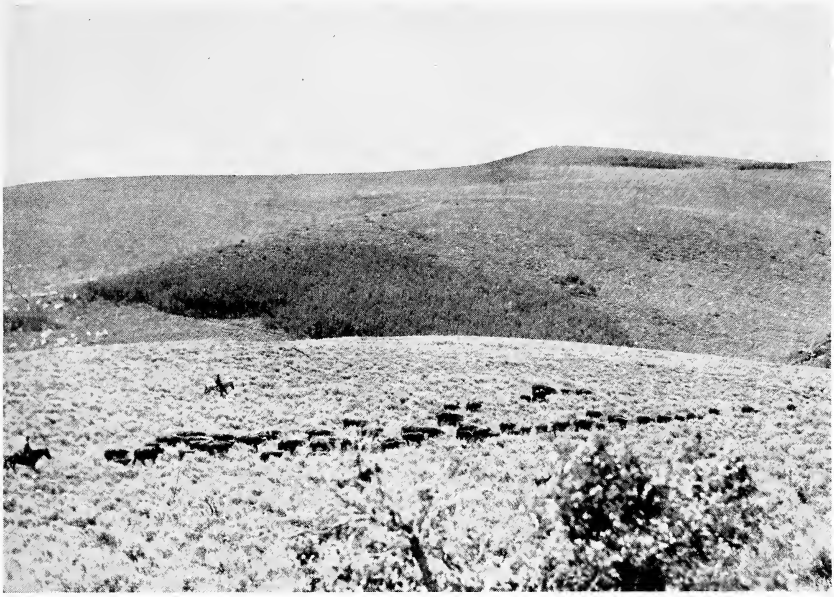
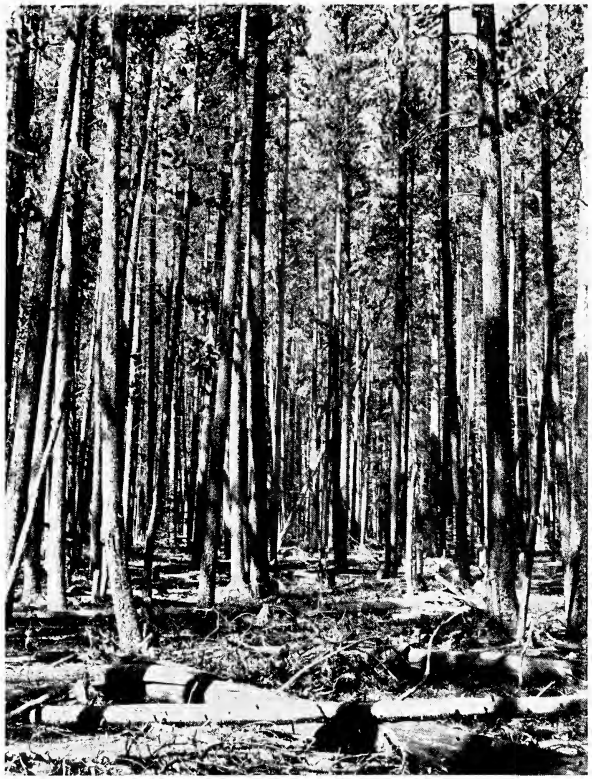


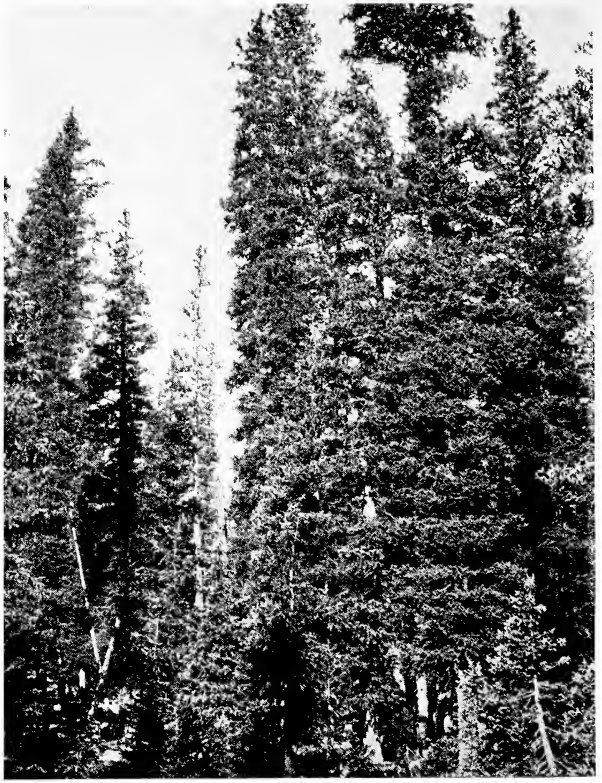
FIG. 1. Artemisia-Cercocarpus Community with an isolated stand of *Populus aurea* on a moist north-facing slope. Tavaputs Plateau, altitude, 8300 ft.

FIG. 2. Rocky Mountain Yellow Pine, *Pinus Scopulorum*, Green Lake, altitude, 8000 ft.



After Graham

FIG. 1. Pinus-Vaccinium Community. Below Paradise Park, altitude, 9500 ft.



After Graham

FIG. 2. Picea-Abies Community. Paradise Park, altitude, 10,000 ft.

FIG. 1. Sage Grouse on a grassy meadow in the high sagebrush plateau of Strawberry Valley, altitude, 8200 ft.

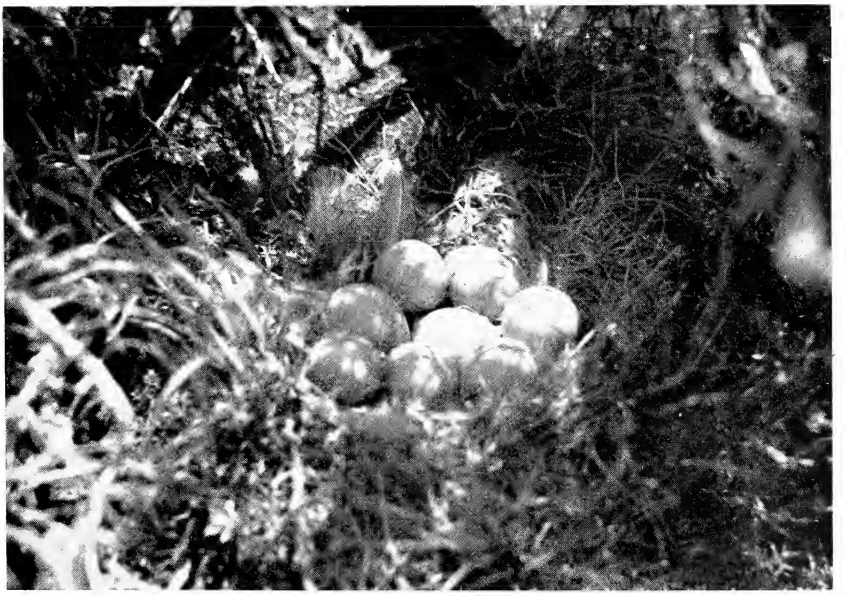
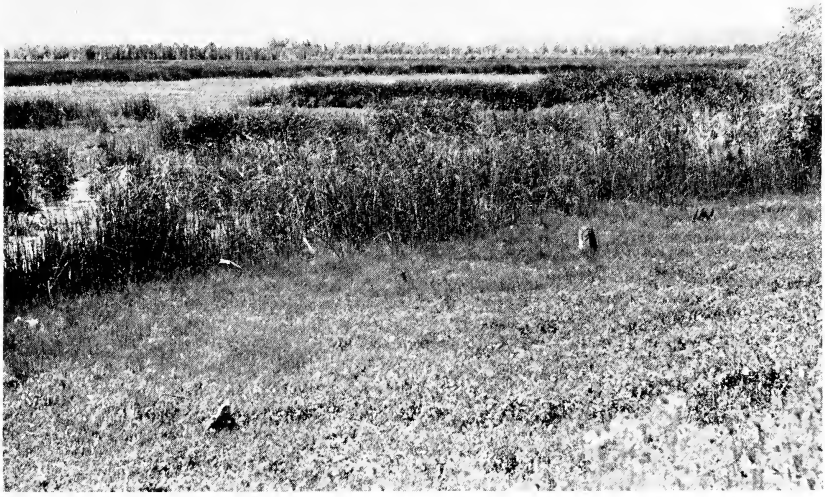


FIG. 2. Nest of Sage Grouse under sagebrush, *Artemisia tridentata*, Blue Mountain Plateau, altitude, 8000 ft.

FIG. 1. Sieversia-Carex Community with a Picea-Abies Community in the background. The Rocky Mountain Pipit nested on the meadows at the base of the slide, while the Black Leucosticte nested at the upper edge of the rock slide. Bald Mountain, altitude, 11,000 ft.

FIG. 2. Rocky Mountain Pipit nest with four young at the edge of Carex meadow.



After Graham

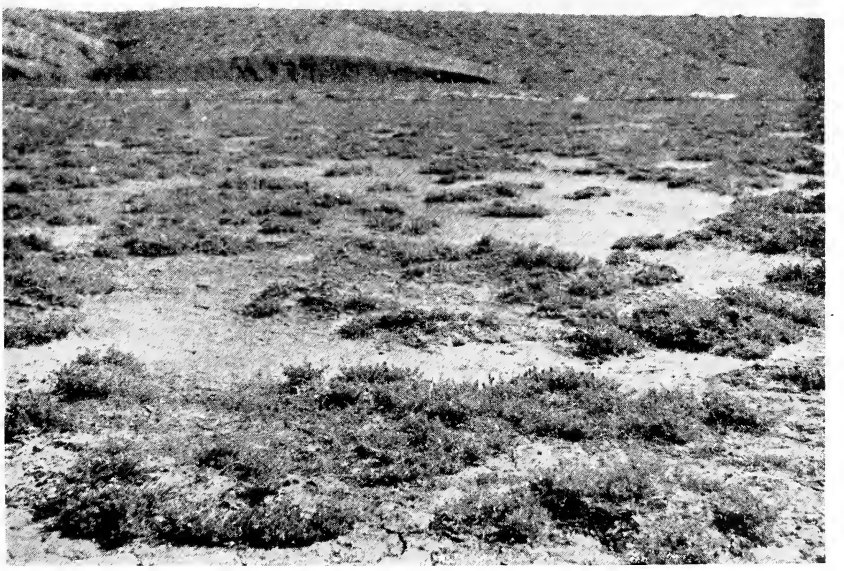
FIG. 1. Scirpus-Typha Community. Ashley Creek lake, altitude, 4700 ft.

After Graham

FIG. 2. Populus-Salix Community. Typical of the lower drainage systems of the Uinta Basin, altitude, 5000 ft.

After Graham

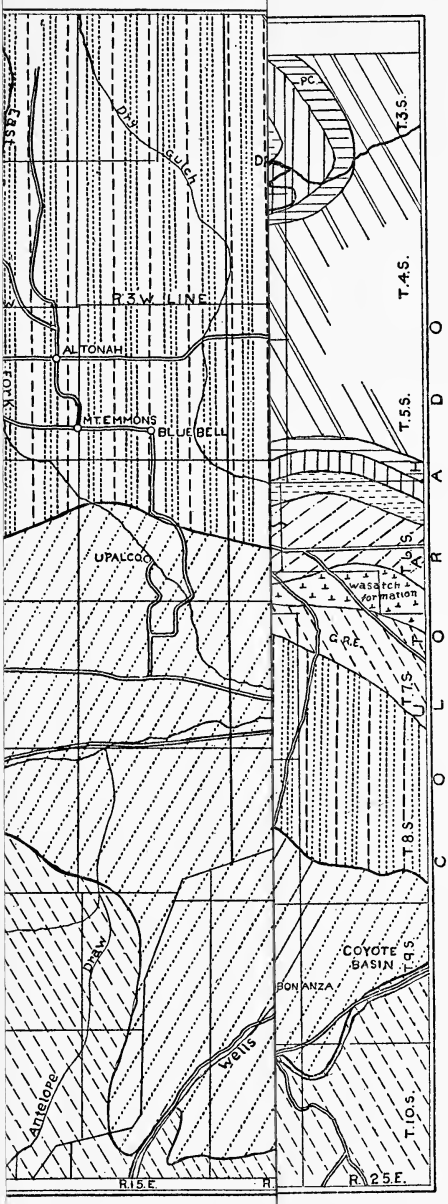
FIG. 1. Bare-ground Community. "Bad lands" north of Bonanza, altitude, 5500 ft.



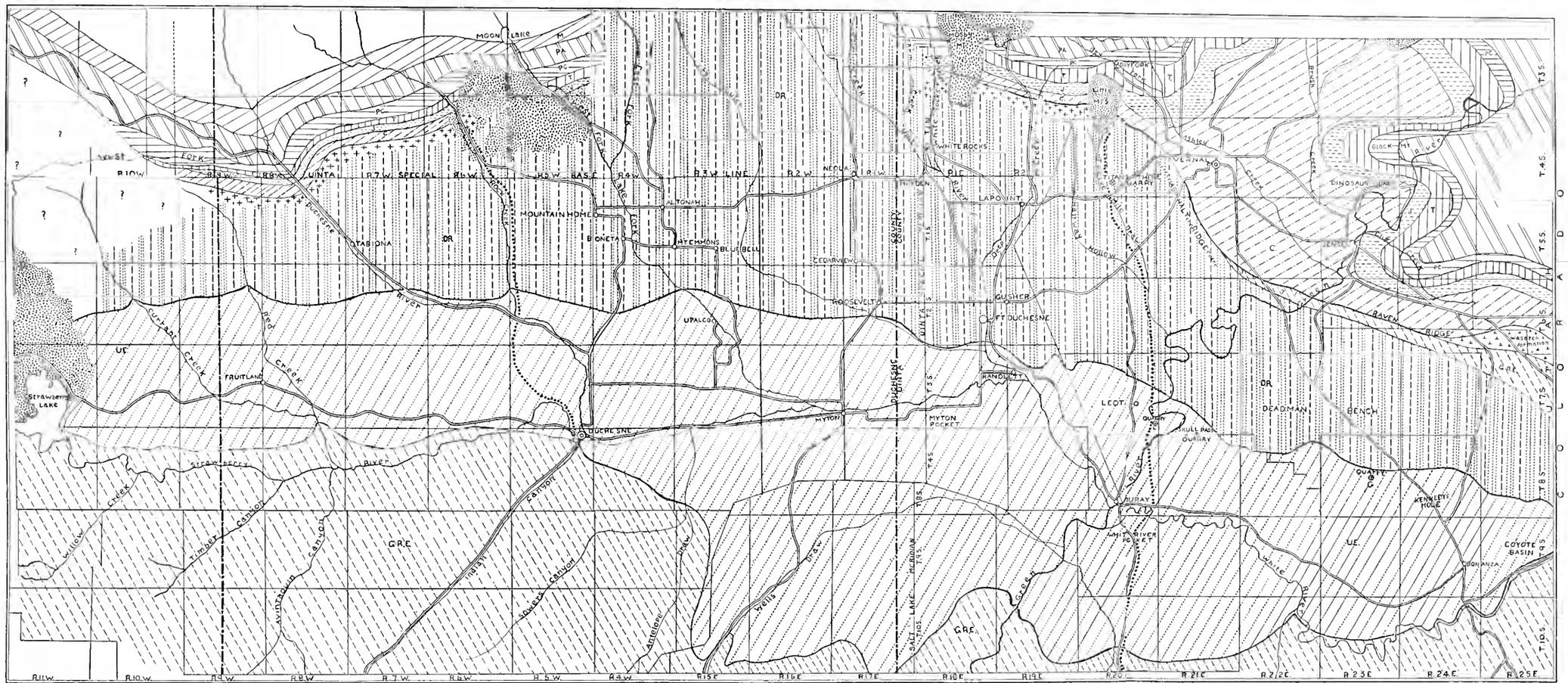
After Graham

FIG. 2. Mat Atriplex Community. The Desert Horned Lark often fed in this community. Altitude. 5000 ft.

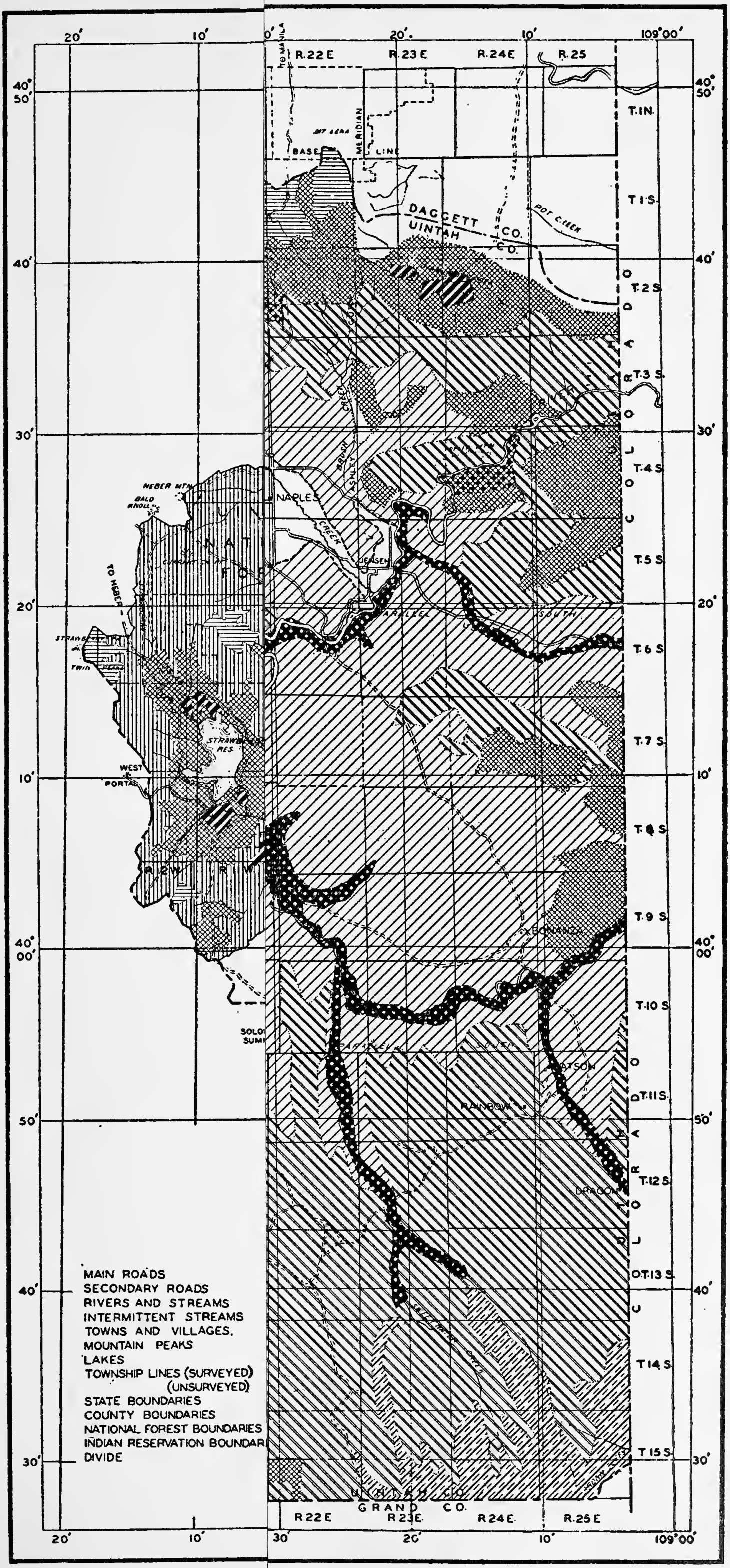
Plate XLVIII

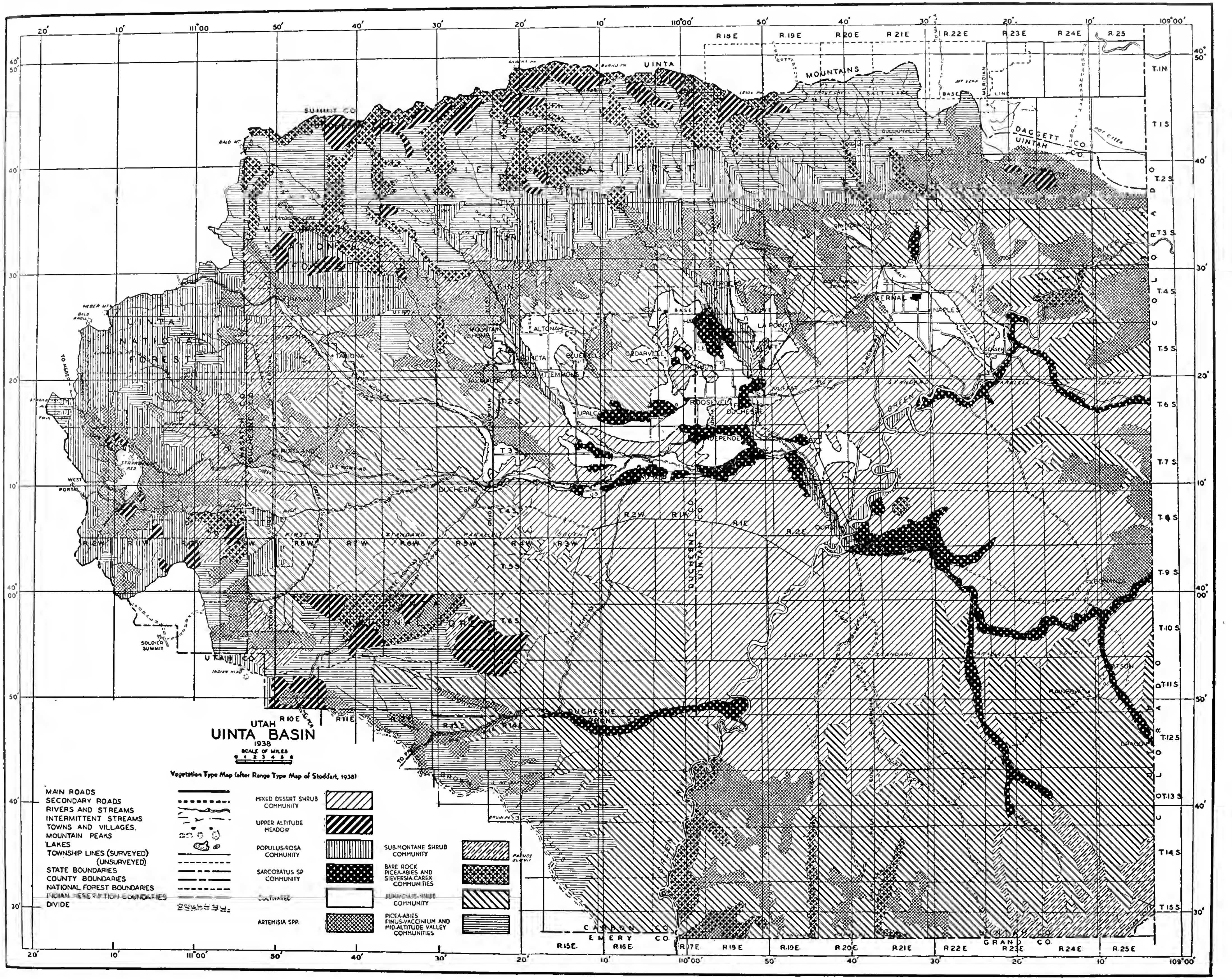


CENOZOIC	TERTIARY	?	
	PLEISTOCENE	?	Glacial moraines; outwash and pediment gravels.
	OLIGOCENE	DUCHESNE RIVER 1300′	Red shales with yellow and red sandstones.
	U.E. EOCENE	UINTA 2000′	Greenish, purple, red shales with yellow sandstones.
	G.R.E.	GREEN RIVER 2000′	Light yellow and grey shales; yellow sandstones; the latter are cliffmakers.
		WASATCH 600	Varicolored shales and sandstones.
MESOZOIC	CRETACEOUS	MESA VERDE 700′	Alternate yellowish sandstone and varicolored shales. Ridgemaker.
		MANCOS 2500′	Grey to black marine shale; Some concretionary nodules.
		FRONTIER 0–50′	Yellowish sandstones and carbonaceous shales. Ridge-maker.
		MOWRY 100′	Soft black marine shale.
		DAKOTA 0–200′	Yellowish sandstones and carbonaceous shales. Ridge-maker.
	JURASSIC	MORRISON 600′	Varicolored shales, sandstones, chert-beds.
		SUNDANCE 300′	Greenish oölites and marine shales; always erodes to a valley.
		NAVAHO 700-1200′	Massive crossbedded, yellow, eolian sandstones. Cliff-maker.
	TRIASSIC	AUBREY 1000′	(c) 200′ varicolored massive shales. (b) 100′ red sandstone and conglomerate (a) 700′ bedded red shales.
PALEOZOIC	PERMIAN	PARK CITY 130′	Grey and green shales and phosphates.
	PENNSYLVANIAN	WEBER 1000′	Cream-colored sandstones. Massive cliffmaker.
	PENNSYLVANIAN MISSISSIPPIAN	1500′	Dark grey limestones with black and red chert. Red shales.
	ORDOVICIAN	? 150	Yellow dolomite. Cliff-maker.
	CAMBRIAN?	LADORE 50	Red and green shales.
PRECAMBRIAN		UINTA MT. GROUP 10,000′	Red and white quartzites and red sandstones. Massive, often cliff-makers.



GEOLOGICAL MAP OF UINTA BASIN, UTAH BY J. LEROY KAY 1932
SCALE 4 0 4 MILES


R.22 E
R.23 E
R.24 E
R.25
T.1 N.
T.1 S.
T.2 S
T.3 S
T.4 S
T.5 S
T.6 S
T.7 S
T.9 S
T.10 S
T.11 S.
T.12 S
T.13 S
T.14 S
T.15 S
BASE
MERIDIAN
LINE
DAGGETT CO.
UINTAH CO.
HEBER MTN
NAPLES
JENSEN
TO HEBER
WEST PORTAL
BONANZA
RAINBOW
DRAGON
GRAND CO.
R 22 E
R 23 E
R 24 E
R.25 E
20'
10'
109°00'
40° 50'
40'
30'
20'
10'
40° 00'
50'
MAIN ROADS
SECONDARY ROADS
RIVERS AND STREAMS
INTERMITTENT STREAMS
TOWNS AND VILLAGES.
MOUNTAIN PEAKS
LAKES
TOWNSHIP LINES (SURVEYED)
(UNSURVEYED)
STATE BOUNDARIES
COUNTY BOUNDARIES
NATIONAL FOREST BOUNDARIES
INDIAN RESERVATION BOUNDAR
DIVIDE


UTAH
UINTA BASIN
1938
SCALE OF MILES
Vegetation Type Map (after Range Type Map of Stoddart, 1938)
MAIN ROADS
SECONDARY ROADS
RIVERS AND STREAMS
INTERMITTENT STREAMS
TOWNS AND VILLAGES.
MOUNTAIN PEAKS
LAKES
TOWNSHIP LINES (SURVEYED)
(UNSURVEYED)
STATE BOUNDARIES
COUNTY BOUNDARIES
NATIONAL FOREST BOUNDARIES
INDIAN RESERVATION BOUNDARIES
DIVIDE
MIXED DESERT SHRUB COMMUNITY
UPPER ALTITUDE MEADOW
POPULUS-ROSA COMMUNITY
SARCOBATUS SP. COMMUNITY
CULTIVATED
ARTEMISIA SPP.
SUB-MONTANE SHRUB COMMUNITY
BARE ROCK PICEA-ABIES AND SIEVERSIA-CAREX COMMUNITIES
JUNIPERUS-PINUS COMMUNITY
PICEA-ABIES PINUS-VACCINIUM AND MID-ALTITUDE VALLEY COMMUNITIES
UINTA
MOUNTAINS
ASHLEY NATIONAL FOREST
WASATCH NATIONAL FOREST
UINTA NATIONAL FOREST
SUMMIT CO.
DAGGETT CO.
UINTAH CO.
DUCHESNE CO.
CARBON CO.
EMERY CO.
GRAND CO.
UTAH CO.
WASATCH CO.
COLORADO
VERNAL
NAPLES
ROOSEVELT
DUCHESNE
MYTON
OURAY
LA POINT
TABIONA
ALTONAH
UPALCO
FRUITLAND
BONANZA
SOLDIER SUMMIT
GREEN
R.18 E
R.19 E
R.20 E
R.21 E
R.22 E
R.23 E
R.24 E
R.25
T.1 N.
T.1 S.
T.2 S.
T.3 S.
T.4 S.
T.5 S.
T.6 S.
T.7 S.
T.8 S.
T.9 S.
T.10 S.
T.11 S.
T.12 S.
T.13 S.
T.14 S.
T.15 S.
R.15E.
R.16E.
R.17E.
R.19 E
R.19E.
R.20 E.
R.21 E
R.22 E
R.23 E
R.24 E
R.25 E
20'
10'
111°00'
50'
40'
30'
110°00'
109°00'
40° 50'
40° 00'

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