THE UNIVERSITY OF COLORADO STUDIES

VOL. IX

FRANCIS RAMALEY
EDITOR

PUBLISHED BY THE
UNIVERSITY OF COLORADO
BOULDER, COLO.

FEBRUARY, 1912, TO SEPTEMBER, 1912

CONTENTS OF VOLUME IX

No. 1

Nos. 2 and 3

Volume IX Number 1

THE UNIVERSITY OF COLORADO STUDIES

FRANCIS RAMALEY
EDITOR

PUBLISHED BY THE
UNIVERSITY OF COLORADO
BOULDER, COLO.

February, 1912

Price, 50 Cents

Four numbers of this publication are issued each college year, the first number in the volume generally appearing in December.

All exchanges should be addressed to the "Library of the University of Colorado, Boulder, Colo."

Educational institutions, libraries, societies and individuals desiring to be placed on the exchange list should make request to the "Secretary of the University of Colorado, Boulder, Colo.," to whom also should be addressed any correspondence in regard to purchase of single copies.

Volume IX Number 1

THE UNIVERSITY OF COLORADO STUDIES

FRANCIS RAMALEY
EDITOR

PUBLISHED BY THE
UNIVERSITY OF COLORADO
BOULDER, COLO.

February, 1912

Price, 50 Cents

CONTENTS

THE BOY IN THE GERMANIC HERO-SAGAS

By Grace Fleming van Sweringen

The sources of the *Heldensage*, used in this paper: *Beowulf*, ed. by Heyne, 6th ed., Paderborn, 1898; *Deutsches Heldenbuch*, 5 vols., ed. by Jänicke, Amelung, Martin and Zupitza, Berlin, 1866–73; *Eddica Minora*, ed. by Heusler and Ranisch, Dortmund, 1903; *Fornaldar Søgur Norþrlanda*, ed. by Rafn, 3 vols., Copenhagen, 1829; *Die Lieder der älteren Edda*, ed. by Hildebrand, 2d ed. by Gering, Paderborn, 1904; *Saga Þiþriks Konungs af Bern*, ed. by Unger, Christiania, 1853; *Saxonis Grammatici Gesta Danorum*, ed. by Holder, Strassburg, 1886; *Snorri Sturluson, Edda*, ed. by F. Jónsson, Copenhagen, 1900; *Vǫlsunga Saga*, ed. by Ranisch, Berlin, 1891.

The Boyhood of the Hero

Regarding the birth and boyhood of a great hero, the Helgakviþa Hundingsbana I tells us, that when Helgi was born there was a great disturbance of the elements, a roaring of waters and the screaming of eagles. The Norns came in the darkness of night and wove for the prince his web of fate—a fulness of glory, the most splendid of names in all the circle of heroes. The power of a ruler they granted to him from the East to the West, and far to the North should his name be remembered. From his father the boy received lands and estates, and a glittering sword. Well did he thrive in the circle of kinsmen, like a proud elm tree in the glow of good fortune. With fifteen years his boyhood was ended, and, bent upon war, he set out for himself.

In contrast to this triumphant entry into the world of heroes is the coming of the little Scyld Scêfing,[1] alone and helpless, over the sea from no one knows where to the land of the Danes. He became a great ruler, and was the first of the royal house of the Scyldings.

[1] *Beowulf*, l.4; l.19; l.27 ff.

A bit of simple child life is in the story of the three-year-old Wolfdietrich,[1] who saved himself from the sword that had slain its "hundert man." Berhtung von Mêrân, who had been commanded to make way with him, could not find it in his heart to kill the little lad as he laughed up into his face and played with the rings of his armor. So he carried the boy to the edge of a pond and left him, hoping that he would be attracted by the water-lilies and would so find his death in the water. From his hiding-place in the thicket the old warrior watched how the child turned away from the water and played on the green grass of the meadow, scarcely knowing that it was alone. When the sun went down and night came on, the wild beasts of the forest came down to the water's edge to drink. Far from being afraid, the boy made friends with them, grasping at the bright eyes of the wolves as they shone in the moonlight.

Then Berhtung exclaimed, "The like of this I have never seen. If I had the will to kill thee, I have not the courage. Since the wicked wolves have made peace with thee, why should not I? . . . . From now on shalt thou be called Wolf hêr Dietrîch."

There are several heroes who, in their boyhood, gave no promise of the great deeds they were later to perform. Of Beowulf[2] we are told in the Anglo-Saxon Epic, that he was long scorned when the children of the Géats could tell no good of him. Nor would the lord of the men do him great honor at the mead bench. They strongly suspected him of being idle and lazy, a worthless young atheling.

Even worse was the reputation earned by Uffo,[3] the Dane, in his boyhood. Of great stature and marvelous strength, Uffo neither spoke nor laughed until he was thirty years of age. He was considered an utter fool, and was apparently of no use in the world. King Wermund, his father, grew old and blind, and, because he had no one to defend his rights, the neighboring Saxon king decided that he would take the Danish kingdom for his own. Accordingly he sent word to Wermund that upon a certain day he must have a man of his own blood ready to meet the Saxon prince and fight for the

[1] "Wolfdietrich" A. *Deutsches Heldenbuch*, B.3.

[2] *Beowulf*, ll.2188 ff.

[3] *Saxo. Gram.*, B. IV, pp. 106 ff.

two crowns. The one who came out victorious should have both kingdoms. Wermund bowed his head and wept bitterly when this message came to him.

"That is to mock my blindness and my childless old age. Whom have I to fight for me?"

All the Danes who stood about were embarrassed in the presence of the Saxon messengers. No one thought of Uffo. Suddenly a strange voice was heard begging the king's leave to answer the ambassadors. "In vain," it cried, "does yon stranger covet the throne. The king's son will save the land for his people and the crown for his father." And thereupon the dull and witless Uffo took up the challenge of the Saxons; and bade them send not only their king's son, but the bravest of their warriors as well, whom he would withstand in single combat. The blind old Wermund could not believe that this brave man was his own son, on whom he had long ago ceased to rely. When asked why he had been silent and inactive for so many years, the young man replied, "Why speak? My father and my country have had no need of me until now."

Uffo met the men of the Saxons at the appointed time and place. His mighty arm with the magic sword "Skrep" soon dispatched his two opponents. Wermund wept for joy when the good news was brought to him. And, while the Saxons withdrew to bury their dead, Uffo was received by the Danes with joyous songs of victory.

Starkaðr,[1] whose elemental fierceness in later life was the topic of many a story, was a *kolbítr* in his boyhood, and lay grovelling in the ashes with apparently no thought of future great deeds. Three years before he became of age, Starkaðr was discovered by Víkarr, a king's son and a great warrior. Víkarr was attracted by the wonderful size of the boy's body. He bade him rise up, measured his long arms, and gave him war-garments and weapons. From that time Starkaðr was in the service of Víkarr for many years, and his life as a warrior began. He was later spoken of as the most celebrated of all the warriors in the early stories.

Dietleib[2] was another overgrown boy whose great bodily size was

[1] "Víkarsbálkr," *Eddica Minora*, p. 38. [2] *Þiþriks Saga* C. III (Þetleifr).

not matched by an heroic spirit in the days of his youth. The Þiþriks Saga says of him that he preferred crouching by the fire to riding out with the men and preparing for warlike deeds. He was slovenly in his personal appearance, refused to bathe either at home or at the public bath, and never touched a comb to his hair. His chosen companions were the kitchen boys and beggars.

In the case of the young Amlethus[1] the stupidity and silliness were feigned for the purpose of deceiving people and making them think he was harmless, while he was preparing to avenge the death of his father. Sitting by the fireplace, Amlethus seemed to take no interest whatever in manly occupations. The unkempt person of Dietleib, the gruffness of Starkaðr, the silence of Uffo, or his own foolish remarks were for Amlethus a disguise which enabled him to carry out his plans with sureness, and safety to himself.

The Boy as Hero

The duty of avenging a death devolved first upon the nearest of kin. Naturally this was the task of a man. But, in the absence of an older male relative, the work of vengeance was taken up manfully by the young son or brother. No task was too great for him when once he became convinced of his responsibility for it.

The boys Hamþir and Sǫrli,[2] roused by their mother's reproachful words, set out against the powerful King Jǫrmunrekk to avenge the death of their sister Swanhilde. As they were riding out of the court their half-brother joined them. But on the way a quarrel arose and Erpr, the half-brother, was felled to the ground. So only the two went on into the land of the Goths. When their arrival was announced to Jǫrmunrekk in the drinking-hall, he laughed as he stroked his beard. "Gladly would I see Hamþir and Sǫrli here in my hall. The boys I should bind with bow-strings and hang them high on the gallows."

At that moment the boys burst into the hall, rushed up to the king, and hewed off, the one his hands, the other his feet. But,

[1] *Saxo. Gram.*, B. III, pp. 87 ff.

[2] "Guþrúnarhvǫt," *Edda*, p. 443; "Hamþismǫ́l," *Edda*, p. 451.

before they could do more, Jǫrmunrekk's men came to the rescue, and Hamþir and Sǫrli had to look to their own safety. Blow upon blow was showered upon them, but with no effect, for they wore magic garments, which made them proof against iron. "Stone them with stones," cried the King, "since iron cannot harm them." As they sank to the ground, Hamþir exclaimed with his last breath, "Off were his head, if Erpr had lived, our brother whom we slew by the way. We have fought a good fight. There lie the Goths slain at our feet. What matters it if we die now or tomorrow? The evening over can no man live when the fates have spoken."

The murder of King Halfdann by his brother, Fróði, was fully avenged by his sons Hróarr[1] and Helgi long before they had reached the age when a man's work was to be expected of them. On the death of their father the boys were taken to an island by their foster-father, Reginn. Vífill, the peasant, lived there, a rich man, and still loyal to the memory of the murdered Halfdann. Vífill had two dogs, the one named Hopp, the other Ho. This island seemed to Reginn the best hiding place for the boys, in order that they might be saved from the fate of their father. The peasant could keep a sharp lookout for Fróði, and give the warning in time for them to escape. Vífill himself was none too eager for the task. "We are struggling against what is fated," he said, but he promised to do his best to help the young princes. So he took them to his home and made a cave for them. In this they generally spent the nights, but wandered about the peasant's forests in the daytime. Thus they were separated from Reginn, who, because of his possessions in Denmark, had to go to Fróði the king, and swear allegiance to him. Fróði now sent out messengers in all directions far and near, promising great gifts to anyone who could give him information about his nephews, but threatening with dire vengeance those who concealed the boys from him, if they were discovered.

No one was able to tell the king any news of the missing boys. At last he had seeresses and soothsayers from all lands come to him, and had the country scoured from one end to the other, but without

[1] "Saga Hrolfs Konungs Kraka," *Fornaldarsǫgur*, vol. I, pp. 3 ff.

result. Then he sought out magicians who had proved themselves able to guess all riddles if they chose, and they told him that "the boys are not being brought up in the land, but they are not far from the king." "It would indeed be strange if they were near, when we have sought in vain so far," said Fróði.

Then they set out to search Vífill's island, with a great and mighty force of men. "Rise, Halfdann's sons," cried the peasant when he saw the king's men, "keep to my woods today." They ran off to the forest and the king's men searched the island, but without finding a trace of the boys. Fróði's men were dissatisfied with the result of their expedition, the peasant seemed "shadowy" to them, but there was nothing to do but go back to Fróði and tell him they could not find his nephews. "Then you've not looked in the right place," answered the king, "that peasant is too clever for you. Now go back again, and in such a way that he will see you too late to get them out of sight, if they are there." The king's men did exactly as he had bidden them, and went a second time to the island. The peasant also spoke again with the lads. "This is no safe place for you. Get to the woods the quickest you can." And the boys did as they were told. After that, the king's men swooped down suddenly upon the island, ransacked the house, opened every door and drawer, but found no one.

"Now," said the king, "there shall be no more trifling with this peasant. I will go to the island early tomorrow morning."

And so it happened that the king went himself. But the peasant was, for the third time, awake earlier than the king. "This you must bear in mind, my lads, when I call my dogs quite loud—so, 'Hopp and Ho!'—you are to betake yourselves with all speed to the cave, and mark this, you will have no further peace on this island, but must save yourselves as best you can; for Fróði, your kinsman, leads now in the search, he who seeks your life with every kind of stratagem and trick, and I see no way that I can conceal you longer."

When the peasant on the strand saw the king's ship coming in, he did as if he saw nothing, and went on watching his flock so closely that he never once looked up at the king or his men. "Bring that man to me," commanded the king. "You are a very clever rascal, my man, very sly indeed. Tell where the sons of Halfdann are, for that you surely know." "Let me go, Sire," cried the peasant, "do not detain me, or the wolf will tear my flock asunder." Then he shouted at the top of his voice, "Hopp and Ho, save the flock, I cannot!"

Once more the boys escaped, and the king went back home, baffled, but not convinced, having accomplished nothing more than his men by all his questioning and searching. After he had gone, the peasant, Vífill, lost no time in getting rid of the boys. He sent them forthwith to Saevil, Iarl, the husband of their sister, Signy. "Your only safety now is with your kinsman, Saevil. Farewell, my lads, you will grow up to be great men, if you live."

Hróarr was twelve years old at this time and Helgi ten. They were both large and strong from their rude out-of-door life, more like wild men than like kings's sons. They remained with Saevil nearly three winters, without disclosing their identity, what sort of men they were, or even to what class they belonged. They wore cowled cloaks, which they never laid aside, and called themselves Ham and Hrani instead of Hróarr and Helgi, their right names. At length Fróði, the king, began to suspect that Saevil knew something of the whereabouts of his young brothers-in-law, and he sent for the Iarl to come to a banquet. When the boys saw the preparations for the journey, they begged to be allowed to go too. This being denied them, they secured unbroken colts and followed, unseen, in the rear of the train.

The Iarl soon discovered them, and saw at once that they could not ride well. The wild colts plunged and reared under the inexperienced riders. And Hrani's hood fell back from his head. Before he had time to replace it, Signy, who was riding with her husband, happened to glance that way, and recognized her brother at once. Thereupon she began to weep bitterly. When Saevil, the Iarl, heard who the boys were, he rode back to them and bade them stay behind, saying that such wild youths would be a disgrace to a company of good men. They did not leave the train, however, but followed on with the others to the banquet-hall. Sometimes they galloped back and forth, and once, by chance, they came near their sister, who warned them as they passed her not to enter the hall. But they paid no heed to this.

After all the guests had assembled, Fróði, the king, instituted a search for the sons of Halfdann, offering to show great honor to the man who could tell something of them. Heiðr, the Volva, was there, and Fróði commanded her to make use of her craft as a seeress, and try what she could tell about the boys. And she opened her mouth and spoke:

Two are inside.
I trust neither,
Those who from fire
Somewhat far sit.

"Where are the boys, or they who have hid them?" cried the king. "Say on, Woman." And she continued:

In Vífill's isle
Dwelt they long.
There they were called
By names of hounds,
Hopp and Ho.

At this moment Signy tossed a golden ring into the lap of the prophetess. The woman broke off suddenly, dazzled by the unexpected gift, and declared what she had just said to be a lie. The king angrily bade her go on with her tale, if she did not wish to be tortured. What she had revealed had only whetted his curiosity, and not helped him at all. Thus pressed, the seeress continued:

I see there sitting
The sons of Halfdann,
Hróarr and Helgi,
Hale both of them.
They are the men
To rob Fróði of life,

if they are not with all speed dispatched—but that will not be." And she leaped down from her place crying out, as she fled:

Sharp are the eyes
Of Ham and Hrani,
The noble ones.

On hearing this the boys rushed out of the hall in great fear. Reginn, their foster-father, alarmed to learn that his wards were in the hall, pondered much as to how he might aid them and still not break his oath of allegiance to the king. He now put out all the lights in the hall, thus giving the boys a chance to make good their escape in the confusion. Fróði and his men then gave up the chase for the time being, and were soon fast asleep after the drinking bout was ended.

When the boys had been in the wood for some time, they saw with joy their foster-father riding toward them. They went out to meet him, but to their surprise, he took no notice of them. He turned his horse's head, and rode back toward the hall. Greatly wondering at this, they took counsel together as to what could be the meaning of their friend's strange conduct. Now Reginn turned again in the direction of the boys, and looked frowningly about as if he wished to fight someone. "I have it," exclaimed Helgi, "so means my foster-father. He will not break the letter of his oath to Fróði, our uncle, by speaking with us, but he means to help us."

They mounted their horses and kept near to Reginn as he rode back to the hall, at the same time watching carefully for further signs. As Reginn rode along they heard him muttering, "If I had a feud with King Fróði, I should burn up this wood." In a moment they had dismounted and were gathering wood to burn the king's hall. They had understood what Reginn meant them to understand. Thereupon Saevil, the Iarl, and all his followers came out to help them. "I am bound by no oath to King Fróði," said Saevil, and preparations were soon made.

That night King Fróði had a bad dream, and wakened in alarm. His men tried to reassure him, but in vain. He rose up and went to the door of the hall and there was a great uproar without. The house was in flames. Then the king offered to make peace with Hróarr and Helgi, urging them not to stain their hands with the blood of a kinsman. But Helgi replied, "No man can trust you, and you will surely deceive us later, as you did our father, Halfdann. The time is now come for you to pay for that bad deed."

The king, finding every means of escape cut off, turned back into the hall, and perished in the flames, together with all his men. And thus was the death of Halfdann avenged by the boys, Hróarr and Helgi.

Wøgg[1] was a mere boy, "lítill sveinn," when he vowed the vow, the fulfillment of which in later years raised him to the rank of hero. Having heard much of the splendid qualities of King Hrolf, this simple peasant youth came a long way to see for himself what the man was like. Now, in those days Hrolf was young in years, tall and very slender, anything but royal in appearance.

Wøgg went before the king and stared up at him without uttering a word. "Well," said Hrolf, "what have you to say, boy, as you stand there and look at me?" "In my home," replied Wøgg, "I heard say that Hrolf, the king at Hleithra, was the greatest man of the Northland and now there sits in the high seat nothing but a bean-pole (kraki) whom they call king." Then answered the king, "Thou, boy, hast given me a name. Hrolf Kraki shall I be called henceforth. But what gift dost thou give at the christening?" "Alas," sighed Wøgg, "I can give no gift, for I am a fee-less man." Then the king, "It falls to him to give who has to give," and he drew from his arm a golden ring and handed it to Wøgg. "Be thou blessed above all men," exclaimed the grateful Wøgg, "this shall be my highest treasure. And this oath I swear, to be the death of that man, who shall be the death of thee."

. . . .

The boyish love of adventure, together with the bravery of a man but without the caution of a man, led more than one young hero to his early death. Alphart[2] was the foster son of Hildebrand, Dietrich's master-of-arms. He was still a lad when the feud arose between the Emperor Ermenrich and his nephew Dietrich. But, eager to show

[1] *Snorri, Edda*, "Skáldskaparmál," C. 41.

[2] "Alpharts Tod," *Deutsches Heldenbuch*, B. 2.

his mettle, Alphart begged to be sent out as a scout to report on the movements of Ermenrich's army. Refused by one and another because of his youth and inexperience, Alphart exclaimed with determination, "Why do I bear weapons if I am to stay at home like a woman? No one can turn me from my purpose. Today will I be counted with the warriors, or today I die." Hereupon they gave up the attempt to restrain him. With the helmet bound fast, shield on arm, and spear in hand, Alphart rode forth over the heath in lion mood. His first encounter was with the old Hildebrand himself, who, anxious for the boy's safety, rode out after him. This was a victory for Alphart. But, far from satisfying him, it only whetted his courage. And he paid no heed to Hildebrand's entreaties to ride back to Bern with him. "I am on guard today," replied the boy, more confident than ever because of his first conquest. And the old Hildebrand rode away alone with fear in his heart.

Many a man fell by the hand of Alphart that day. His last fight was two against one, and even then Alphart was not to be overcome except by treachery. A blow from behind felled him and he sank at last in the grass, his blood mingling with that of the many foes he had slain.

Three other boys, Orte and Scharphe,[1] the sons of Attila, and Diether, the younger brother of Dietrich of Bern, lost their lives because of an overdaring spirit. Their first and last fight was with the same Wittich who slew the young Alphart. Diether recognized Wittich as a former follower of Dietrich of Bern, who had gone over to the ranks of the enemy. Quick to see his duty and his opportunity, Diether greeted him with a challenge as soon as he came near. "Today is your last day, Sir Wittich. At our hands you are to receive the reward for your treachery to my brother, Dietrich of Bern." "Spoken like a child," scoffed Wittich. "What is Italy to you? Ride back to the Huns whence you came. And, I warn you, provoke me not further, or that land you shall never see again."

Like men they bore themselves, these three, whom Wittich had taunted as children. Quickly they drew their swords and charged

[1] "Rabenschlacht," *Deutsches Heldenbuch*, B. 2.

upon their foe with all their might. But, brave as they were, the lads were no match for such a warrior as Wittich, and one by one they sank down dead at his feet. Scharphe was the first to fall, but not before he had dealt Wittich a blow which struck fire from his helmet. Orte then rushed upon Wittich to avenge his brother's death. But he, too, was helpless against the strength of a man, and after a brave fight for his life, was laid low by the sharp sword Mimung.

As soon as Diether saw that both Orte and Scharphe were dead, he rode at Wittich in a frenzy of rage, resolved either to give up his own life or to avenge the death of his foster-brothers. He dealt out blows thick and fast until even the war-tried Wittich was hard pressed. But Wittich's helmet, the work of Wieland, was harder than any steel, and Diether's sword finally glanced and struck the head of Wittich's steed. Then, leaping to the ground, Wittich threw away his shield, grasped his sword with both hands, and Diether fell at last, his body cleft in twain by the mighty blow.

The Boy as a Minor Character

In one instance the boy appears in an important secondary rôle as the helper in a great tragedy. Sinfjǫtli,[1] son's son and daughter's son of King Vǫlsung, was the instrument of his mother, Signy, in carrying out her great work of vengeance. From his birth he was trained for the task which was to mark him as a fit man for the world of heroes.

More often the boy is a merely passive character, sacrificed to a feud in which he was too young to have had any part. To avenge himself for the wrong done to him by Níþǫþr, the king, Vǿlundr,[2] the magic smith, murdered the young sons of Níþǫþr, and presented him later with drinking-cups made of their skulls. Gûdrûn[3] cut off the heads of her two sons, in order to avenge the death of her brothers upon Attila, her husband. And Signy,[4] the greatest of the avenging

[1] *Vǫlsunga Saga*, C. 7 ff.

[2] "Vǿlundarkviþa," *Edda*, p. 211.

[3] "Atlamǫl," str. 75, *Edda*, p. 413; "Guþrúnarhvǫt," str. 5, *Edda*, p. 443.

[4] *Vǫlsunga Saga*, C. 7 ff.

women, ordered that two of her young sons be put to death because they had shown themselves unfit to assist in the work of avenging her kinsmen upon her husband.

From the above brief study it will be seen that the boy as a character has his place in the *Heldensage*. But he appears rather as the hero in making, than as the independent hero. As would naturally be expected, the characteristics which are prominent in the Germanic boy-hero are the same as those which went to make up the ideal man of the Saga—the same great bravery, the same fidelity to duty, especially the duty of vengeance, and an equal defiance of death, when met in a good fight.

On the other hand, the love of adventure and the lack of caution and foresight which characterize the youth of every age, were not lacking, and made the presence of a guardian or counselor necessary to the preservation of the boy. In no case is youth represented as superior to mature years. The young Alphart did overcome the old Hildebrand in his first fight, but in the end Alphart lost his life because he refused to listen to the counsel of older people.

WHY TEACH MODERN LANGUAGES?

By J. Raymond Brackett

The more weighty reasons for the study of modern languages may be obscured by a misapprehension of the importance of certain advantages that are realized only in exceptional cases. One or two out of a hundred young people taking French or German in school may advance into a career where these languages are indispensable instruments of research; one or two may find them useful in business; one or two may go to France or Germany. But a well-educated person can in a few weeks learn to dig out a technical subject by means of grammar and lexicon; the best place to learn a spoken language is among its speakers. The exceptional conditions looked forward to by the five or six are not sufficient grounds for teaching modern languages to the hundred.

Among important reasons why the study of modern languages may hold a strong position as a means of education are the following: the resulting improved interest in English; the power that comes with mastery; and the furtherance of literary study.

In education the roundabout way may often be better than the direct. The vernacular is too much a matter of course with the young student. He is too near to it to see it, like a fish in water or a child in air. The phenomena of his own language do not appeal to him. Such a simple thing as accent has little meaning: he hears no difference between *un*to and un*to*. The rhythms of prose and verse have no significance: he reads the plays of Shakespeare and tells you that they are written in prose.

The American boy is unluckily born to a phonetic system that is a hopeless wreck. He is taught to look for short *i* in *spin* and for long *i* in *spine*. He tries in his mouth and finds that he can hold "short *i*" as long as he has breath *ĭ* . . . . ; but when he opens his lips to say "long *i*," it shuts itself off like an automatic faucet; "long *i*" is no vowel at all but a diphthong. Again, however long he may continue vocalizing the "short *a*" of *fat*, he can never make it at all like what his teacher calls the "long *a*" in *fate*. The result is that he has no proper conception of long and short; time values he can get only from music; and the musical notes are always contradicting what he has been taught about long and short in vowels. To him the art world of sound is a chance world. It is a great help to be brought in contact with a living language of reasonably honest spelling like German or Italian; then he may come back to his English with a more appreciative ear for its marvelous harmonies. Our spelling is bad; but Shelley, Milton and Shakespeare have erected palaces of sound whose wealth of vocal expression is approached only by the ancient Greek.

Teaching the Roman pronunciation of Latin will not do as well: for if the student learns to pronounce Latin instinctively by quantity, he is at the same time acquiring a tendency instinctively to mispronounce thousands of domesticated or derived words in his own tongue; he adds another jumble to the chaos of his English phonetics. Nor will the study of the English dictionary help matters: the muddle is in the dictionary; that is where the teacher gets it. Let us read the first line of *The Merchant of Venice*—

In sooth I know not why I am so sad.

The dictionary tells us that *sooth* is long and *sad* is short; but the appreciative reader may give the "short" *sad* a half more time than the long *sooth*. Quantity is properly duration of utterance. The dictionary marks quality or the kind of utterance. Speakers and poets use the same qualities as either long or short in duration.

Duration, pitch and stress are the great modes in which human language is delivered; but these are for the most part undiscriminated by the student trained only in English.

In the deeper matters of grammar and word-formation the student trained only in English is at a disadvantage; any inclination toward linguistic study may be baffled by the anomalous wreckage of Anglo-Saxon confused with débris from Romance and classic tongues; but in German he finds a systematic and orderly language, yet living, still developing from indigenous materials, suggesting laws of evolution that invite study.

Translation is a great incentive to literary activity. The history of the new nations begins with translation, usually of the Bible. Then someone tries to express native thought in the vernacular. This importance of translation holds not only for national literatures but also for individuals; as Chaucer's first work of any extent was a translation of *The Romance of the Rose*. A good piece of work in a foreign tongue incites to art performance: it supplies subject-matter and suggests studies in accent, rhythm, tone-color—the mechanism of verse. Prose comes later than verse; is more formless; its articulations and movements are more elusive. The mastery of prose is hastened by a study of great works in a foreign tongue; simplicity, transparency of style elude the admiration of the pupil trained only in the vernacular, but he may appreciate them in a text that he has to translate.

If a chief value of a foreign language is to produce a kind of shock in the pupil, to make him suddenly aware of basic elements about which he has not reasoned in his own language; if it is by its strangeness to charge his brain with new ambitions, new potencies; if it is to make a distinct change setting the gold free!—then the modern language should not be introduced too soon. The last one or two years of the high school is early enough. To put foreign languages in the grades, to try to make German, for instance, a second mother-tongue, to produce a boy who can ask in German for a piece of bread and butter almost as well as a man, to whom German will be as commonplace as English, may be done at the cost of other things of more worth to the pupil; and this very intimacy cuts him off later from a chief advantage of language-study—the reaction from a fresh subject. If it is defensible to try to make German a second mother-tongue to the child, it is much more defensible to do the same for French—a language whose pronunciation is so difficult to acquire, a language holding a more important literature, a language that as a means of communication is world-wide. And where shall we end? Our case is somewhat different from that of the Germans; they acquire both English and French in the public schools. But English has the greatest literature that the world has ever seen; both English and French are world-languages, while the German ceases to speak his German when he goes abroad, using French or English even in the German dependencies. Why, then, is German taught in elementary schools? I suppose there is but one true answer: it is because we love the German language, the German literature and the German people.

But in education it is our duty to keep a distinct curb over our likes and hold to that which is best for the child. If the educator chooses the pleasant path, how can we blame the child for doing the same? And here we come to the very heart of the crisis. Modern languages are not studied from any one of the reasons assigned at the beginning of this paper; the great multitude are studying French and German largely to escape the more difficult and disciplinary studies, such as mathematics, Latin, Greek and the severer forms of science. The modern-language teacher may be too easily satisfied with his victory over the ancient classics, complacently pluming himself on the numbers that frequent his courses rather than on the work accomplished. Then, too, he compares his language-work with the language-work of the Greek and Latin teachers after Greek and Latin had ceased to be the main part of the course of study. Greek and Latin are immense civilizations as well as very difficult languages. They cannot be acquired in a few odd hours sandwiched into courses of study.

Most of the best writers of English never had any instruction in English. Their elementary schooling began with Latin grammar. They learned to read Latin, talk Latin and write Latin; it was their literary vehicle. They were at home with the great writers of antiquity, reading them easily. Latin and Greek were their ordinary studies, the things of course, the things with which they were familiar. These languages are remote in sentence structure, remote in genius from the vernacular: the university student of former times got more of a reaction in turning from classics to English than the student of today gets in turning from English to French or German.

The native language was a free land of artistic endeavor unhampered by teaching. English literature was not taught in universities; no credit was given for it; but the English poets were read far more widely than under the present system with its fifty electives in drama and other forms of English. What candidate for the degree of Doctor in Philosophy comes to the examiners with that wide reading in English authors accomplished by Tennyson without credit at Cambridge in England or by Phillips Brooks at Cambridge in Massachusetts? In those days of leisure young men would take up an author in Greek or in English and read him entire for the pleasure of the thing, without credit. What student now reads authors either in Greek or in English? The student exists to read notes appended to brief extracts.

If we take a long look over English writers we find that modern languages were to them largely outside the curriculum; that these subjects, like English, were among the play things; but that also like the English they were not neglected. Our English writers of prose and verse have looked to France, to Italy, to Spain for form, for inspiration and often for matter. The mighty Teutonic race had a crude art-form in alliterative verse of uncounted and unmeasured syllables; it could have produced no Spenser, no Shakespeare, no Shelley. From marriage with the new south—the south of Italy, France and Spain—arose an unequaled prosody; the wealth of rhyme, of assonance, of couplets, of stanzas; the pastoral, the sonnet, blank verse; all the movement, the flow, the ornament, the sparkle, the richness of poetic form from the rhymed pentameter of Chaucer, through the mighty verse of Marlowe, Shakespeare and Milton, to the myriad melodies of our own day. The father of English poetry with his Latin education was very fond of Ovid; in his first productive period he is a student of French matter, meter and modes; in his second period he comes under the more imaginative sway of Italy; and in his third period he is the great master of English. Chaucer's art life is typical: the strict discipline of the classics, the blossoming under sunny influences from the south and the final vintage of English soul wine.

We do not expect to see ancient languages come back as the staple of education. They can do the work, and it is doubtful whether they would ever have been displaced if the teaching of Latin and Greek had been wise. Modern languages are now on trial; and, if the teaching is wise, they may retain a large place in the curriculum. It is a pity that all teachers of modern languages are not fine classical scholars, so that they might realize what they are called upon to replace. In the long view of English education the teacher of modern languages has held no position comparable to that of the professor of Latin or of Greek; the position of the teacher of French, on the whole, has been nearer the rank of the dancing-master. This position was due, not to his subject, but to his view of it; and today, if a man teaches a foreign language merely as an accomplishment, as a means of getting on, he is hardly worthy of a place in the public-school system. Modern-language teaching has not often equaled the classics; to succeed, it must put away all infantile methods and grapple with the things of most worth.

Teachers of modern languages should seriously ask: How can I develop my students? What can I furnish that will make up for the loss of a drill in mathematics? for a drill in Latin? for a drill in Greek? Here the German schoolmaster has an advantage over the American. If he is seeking an equivalent for Aeschylus, for Sophocles, for Euripides, he can turn to England. But where in continental Europe can the American teacher find an equivalent for Caesar, for Xenophon; for Horace, for Pindar; for Virgil, for Homer? We must admit that in general the modern languages are less difficult than Latin and Greek. Modern-language teachers usually overrate the difficulties of modern texts. There is no advantage in hunting easy texts for students who have read the fortieth chapter of the first book of *Caesar* in the second year of the high-school course and the ninth chapter of the first book of the *Anabasis* a year later. But difficulty is not a full measure of educational fitness. We are coming to know the value of light gymnastics. The training that will yield the richest return from foreign-language study is literary training. Though the highest forms of literature in modern Europe do not surpass or equal in absolute standard the consummate flowers of ancient times, yet they are of great value for instruction. We have seen that our poets in all ages have gone to such fields; it is possible that we may help the average mind to do by instruction something like that which the mind of genius does instinctively. Here the ease of translation is a help. We can never expect to have all the long years of youth for modern languages as the older masters had them for classics, but fortunately more ground can be covered in the short time given us.

It is really a pity for any boy or girl to grow up without coming in contact with the rich song treasures of Germany. For many years it was the custom of Mary Rippon, Professor of German in the University of Colorado, to devote much time to the singing of German lyrics by the class. When a roomful sing together *Annie of Tarau*, Luther's *Hymn*, or the *Watch on the Rhine*, they are for the moment Germans, and their hearts throb with a new sweet sadness, with a new and manly religion, with martial spirit and with growing patriotism. There is no better approach to art composition than is afforded by a strange new melody ringing in the ears.

The prose in German seems to me to be much less valuable. There may be a reason for using some of the folk-lore for the very beginning; and if one really wants to find difficult modern language with valuable content, he can be accommodated in the art prose of Lessing and Winckelmann. The German prose sentence is less helpful to the English writer than the French. One who has compared a few pages of Hegel's *Aesthetik* in German with the same passage in Bernard's French translation knows how the latter gains in clearness.

Schiller was the great dramatist of the eighteenth century, and it is interesting to discuss the growth and structure of a play like *Love and Intrigue;* but Germany does not hold an important position in the evolution of the drama. *Faust* is not a right acting drama but an immortal poem. Its dedication, its prologues, its numerous verse forms, its rich content, are a sufficient reward for the study necessary to read it; there is no other modern poem of its class so rich in opportunities for literary study. There are passages of not too intricate construction that challenge the best minds for a rendering day after day and year after year; it is a work that a mind of any literary insight loves, and in which it grows; not a book to be forgotten after the school days are over.

When planning a trip abroad some of us figure very closely on time and money; many interesting things have to be passed by. So in planning for the hosts of young people in language-study, we ought to weigh what we would give for just one of their golden years. It is possible for a language-loving and literature-loving teacher to give a class of young people within the space of two school years a possession in German including some folk-lore, a rich treasury of lyrics and the first part of *Faust*—furnishing a very considerable incentive to English studies and an invaluable contribution to the wealth of life. Depend upon it, the fate of modern languages and the fate of classics as studies depend on the answer to these questions: How much soul stuff can they give? How much of the divine fire can they kindle?

Before dismissing Italian let us remember that Florence is the Athens of the modern world. From Florence England received the Renaissance; from Florence she received the Greek of the New Testament. Chaucer, Spenser, Shakespeare, Milton, turned to Italy for style and matter; the Brownings, Shelley, Keats, Byron, Landor, are connecting links with Italy.

> Literature has its mountain heights, peaks accessible only to the most hardy climbers. Such is Dante, separated from us by an ocean of years, veiled in the mists of a foreign tongue, and rendered almost inaccessible by pitfalls of mediaeval mysticism; but the successful climber finds in that mist rills of fairy music, and from the summit catches glimpses of the tops of distant thoughts that other men never know.[1]

Goethe's *Faust* is a sort of neo-Gothic glory for Germany. The *Divine Comedy* is the Gothic glory of all Europe; it stands perfect as Giotto's Campanile. Dante is the beginning of the Christian love story, the foundation of modern poetry. Homer and Shakespeare are the only poets in his class. Shakespeare is fortunately ours, and Dante is closer to us than Homer. It is worth while to

[1] The author's *Literature as Fine Art.*

learn Greek for the sake of reading Homer; it is worth while to learn Italian for the sake of reading Dante. If we are really in earnest in asserting that modern languages can give a full literary training, we cannot omit Dante: Germany, France, Spain, have no epic poet in his class. He is indispensable.

In one year a college class can be taught the elements of Italian, and can read the whole of the *Divine Comedy* in the original with time for comment and interpretation. How many soul journeys of one hundred and sixty days can reveal such wealth?

The great middle term between Aeschylus and Ibsen is Molière. He is the first great master to write for the modern stage. He was born only six years after Shakespeare's death; but compared with Molière, Shakespeare's stage is well-nigh mediaeval. Aeschylus played in an immense open air theater; the stage a complete circle on the ground before the spectators. Shakespeare wrote for a stage projecting into the audience in a theater open to the sky and lighted by the sun. Molière is the first of the moderns. A great master can not transmit his genius; but a great master of conditions like Aeschylus or Molière can transmit his technique. After the death of Molière in 1673 England had the most vigorous and vivacious school of comic dramatists in Europe; but the model then and thenceforth was not Shakespeare but Molière. During many years of the nineteenth century France produced the chief dramas that were acted in continental Europe, in England and in America. France cannot be left out by the earnest student of the most interesting of all art forms.

Earlier I suggested another use of French—as a model for prose. The novels are too long for undergraduate study in French; but the short story of the school of Poe is available; and this has been cultivated with the highest success in France.

In two years a student can acquire the elements of French, read the best short stories of the age, learn Molière in his plays and in his marvelously complete biography—what would the world not give for such light on Shakespeare?—and trace the development of the drama from the chantlike recitative of Corneille to the tensest and most straightforward prose.

Let us review: Two years of literary study of folk-lore, of verse form, of rhythm, with much memorizing of German lyric, and an analysis of the incomparable *Faust*; a year of Italian, culminating in the *Paradiso* of Dante; two years of French stories, of Molière and the emancipation of the drama—in all, only a third of a boy's school time for five years, making the complete round of the highest expression of modern literary form—Germany for the lyric, Italy for the epic and France for the drama. Whether one year or five, no year should be taken without returning an eternal possession of poetry, of art, of fulness of life, that can be attained as well in no other way.

THE VALUE OF MODERN LANGUAGES IN A TOUR ROUND THE WORLD

By Charles C. Ayer

In considering the value of modern languages in a tour round the world, we will confine ourselves to those of the modern languages which are taught in our high schools and colleges. These are German, French, Spanish and Italian, named in the order of their importance or what at the present time is regarded as their importance, though standards sometime change. Forty years ago, for example, French was regarded as the modern foreign language *par excellence*. German at that time seemed almost as remote as Greek. Within the past twenty-five years, however, the point of view has changed, and German has become the popular foreign tongue. In many high schools, and especially in Colorado, French is not taught at all. Since the Spanish-American war, Spanish has been introduced into many schools, being regarded as a practical addition to the curriculum. Italian is not taught in any of the secondary schools, nor is there any demand for it. Even in the colleges it attracts but few students outside those who are making Romance languages their major subject, and therefore take Italian to complete the group.

Of course there are other modern languages at the present time that are spoken by millions of people belonging to the white race, but it is only in the very largest institutions that we find courses offered to a few students in such languages as Portuguese, Dutch, Scandinavian, and Russian. With the exception of the last named, these languages can easily be acquired by one who is familiar with some of the others.

The four languages first mentioned, together with English, are therefore the important modern languages which are taught in the schools and colleges the world over, even in those countries where neither one of them may be the national language. Everywhere it is possible to get instruction so that one may learn to translate a language with absolute correctness, pronounce it well, and also speak and understand it somewhat. To speak and to understand foreign languages are of course valuable accomplishments if one is to travel abroad.

Let us suppose that an American, speaking five languages, starts on a tour westward round the world. If he has spent years of study on modern foreign languages, it is but natural that he should wish to make use of his powers. Indeed, such a practical demonstration would seem to many Americans to be the only justification of the time spent in such study.

His first stopping-place will be the Hawaiian Islands. In Honolulu he will find himself in a New England town situated in the tropics. The architecture is but slightly modified to meet tropical needs. The manners and customs are American, the heritage of the early missionaries modified by their descendants. The language is English, which is spoken not only by the white population but by the Chinese, Japanese and native Hawaiians. This is obviously not the place to begin to make use of our foreign languages. Of course the visitor to the Hawaiian Islands soon becomes aware of the presence of the native Hawaiian tongue. He hears snatches of it from natives holding conversation, but no white tourist is ever expected to understand it. This is then the right time to say a few words with regard to the oriental languages in general. No tourists and only a very few scholars are ever able to speak them. Even the missionaries, after long years of residence in oriental countries, speak only a minimum of the local language. This condition of things is unfortunate from the point of view of the traveler who is curious and desirous of information at every point. Of course guidebooks and books on travel tell the essentials, but they do not tell everything, and many a traveler of good general intelligence has to pass on wondering about many things. Even an accredited native guide leaves much to be desired. With the English he may have acquired he explains things as best he can, but he prefers to expound in a conventional manner, and does not encourage too much questioning, often because he is unable to get the point of view of his questioner, who finally gives up in despair. If a guide speaks poor English, the situation is all the worse. For this reason many wealthy tourists, who engage a guide as the proper thing to do on arriving in the Orient, dismiss him at the earliest opportunity. A courier is serviceable, as bearing the brunt of the disagreeable details of traveling, but he does not always satisfy the educated tourist. Let us suppose, however, that the traveler arriving in Japan does meet with a satisfactory native guide. What languages does he speak? English and only English from among the modern European languages. It would be odd indeed to imagine such a guide speaking German, French, or Spanish, and there are good reasons for this. The guide would die of starvation waiting for a client. The English, or rather the English-speaking people, are the people who travel. If a German travels for pleasure or on business in Japan, he is usually able to speak English. If he is traveling for pleasure, he must be a person of more or less wealth and position, and a German of that class is not content, like the average wealthy American, to speak only his native tongue. To speak English is one of his accomplishments. It is good form. It is expected of him. If, on the other hand, the German in Japan is there on business, he also is able to speak English for the reason that business is business and English is the world-language of business. The Japanese are ambitious to learn English. In their hotels the guests are well looked out for in English; in the shops likewise. Japan is therefore not a favorable field for the exercise of one's acquisitions in the other modern languages, any more than Hawaii was; and the same condition prevails throughout the Orient, with a few modifications. In Korea, Manchuria and China, the tourist gets along with English because he is expected to get along with it. The native takes it for granted that foreigners will accost him in English. In the capitals of oriental countries, where foreign embassies and legations are represented, it is of course a decided advantage to speak modern languages, just as it is in the European countries, but it is not absolutely necessary. The average round-the-world American tourist on a seven months' schedule does not meet the diplomatic society of the countries he visits, unless there is some good reason why he should. He is usually more than absorbed by the new sights he is seeing, and he has enough society, as he understands it, at home. In Shanghai, however, there is a large French settlement, with French hotels and cafés, where the French contingent feel at home and where French may be heard, but the life there is but a feeble reminder of French life. To find a really French city in the Orient one must go to Saigon, the capital of French Cochin China. Here there is full-fledged French society with an excellent theater and a season of French opera which is said to compare favorably with that of New Orleans. On reaching the Philippine Islands the American equipped with Spanish quite naturally feels that he will have an opportunity to speak it. In Manila he does indeed find some vestiges of Spanish, but he hardly is obliged to make use of it. Since the Spanish-American war, the English language has made remarkable progress in Manila and the few other large towns. Ten years of persistent teaching of English have had their effect. The young people growing up speak English with ease. The native clerks in the stores are obliged to know English, and it goes without saying that the present wide-awake business done in this American colony is carried on in English. The conquerors have imposed their language upon the conquered. On leaving Manila and going into the interior one finds that the Spanish of the old days did not penetrate very far. During the Spanish supremacy the Spanish language was only a veneer. The mass of the native population spoke, as they still speak, the Malay tongues. The Spaniards in power were not concerned with the educational welfare of the Filipinos. Similarly in Java the Dutch government is even said to discourage all intellectual advance on the part of the natives and to keep the Dutch language safeguarded. The Dutch themselves, with their polyglot accomplishments, of course speak English with ease, so that the American tourist is able to travel in comfort without Dutch from one end of Java to the other. In Hongkong one finds one's self in an English city, where, in spite of oriental suggestions on all hands, the tone is English. The names of the streets are English. The outlying districts, with the private homes, country clubs and barracks make one forget how far it is from the mother-country. And what is true of Hongkong is equally true of the other English dependencies, Singapore, Rangoon and India in general. The British have been for a long time a nation of aggressive and successful colonizers, and where they have established themselves they have implanted their language. The English are not regarded by the Germans, for example, as good linguists. Where a German learns a foreign language and speaks it with enjoyment, conquering the difficulties with genuine gusto, an Englishman resists as long as possible, and yields only as a last resort. In this respect the English and the French have one point in common. The Frenchman learns a foreign tongue only under compulsion. Having for centuries listened to the flattery that his own is the most beautiful, the most perfect of all languages, he finds it quite right that foreigners should rise to the standard and speak French. Only within comparatively recent years, with the growing commercial spirit of the age, have the French begun to learn foreign languages with a better grace, and especially English. Meanwhile the French language is less and less cultivated throughout the world. At one time there was a current opinion more or less true that French was the foreign language of the Orient, but this held true only with regard to the countries of the immediate Orient bordering on the east shores of the Mediterranean. In the extreme Orient it is hard to see how French could ever have been much in use excepting in diplomacy and at diplomatic dinners. When one looks back over a long journey in the Far East, and remembers the quantity of English spoken and recalls but one person, a Chinese railway official, who spoke French but did not know English, one cannot help feeling that whatever may have been true in the past, times have now changed. In India it is but natural to find the English language the predominant one. Indeed, the insistence upon English is regarded as the most effective method of civilization. The missionaries may or may not know a little of the native dialects in the places where they are stationed, but they feel that their greatest influence is exerted through the English language and the teaching of English standards of life as well as the doctrine of Christianity. In Egypt, too, English is the most practical language to have at one's command, in that it is spoken by the greatest number of both natives and tourists. In Cairo, however, French may also be used and to advantage, for there is no doubt that if one makes use of it he may often settle his bill in francs, where an Englishman would pay shillings, and an American perhaps dollars. English talks and talks loud, being the leading language of business and travel, but it has to pay for the privilege. If we examine a steamer-list with a view to finding out the nationality of the persons traveling for pleasure, we shall find that by far the large majority have English names, and that the majority of those bearing English names are Americans. On the boats bound for India and Australia the passengers are probably to a great extent British subjects, but elsewhere the Americans are the world's greatest travelers, and also the world's richest travelers. Hence the popularity of the English language in the most remote parts of the world. The American is thought to be rich, whether he is or not, and he usually lives up to his reputation and spends freely among the people who will speak English with him, from Japan to Egypt. On arriving in Italy, if he has learned Italian while at college he may have an opportunity to speak it. But Italy has long been a playground for England, and from Sicily to the Alps the tourist is well cared for in English. French may have been the language of travel in former times when only the aristocracy indulged in travel, but it is no longer so. The French themselves are noted for not being travelers, and for feeling an aversion to leaving their country under any circumstances. The Germans are the only continental nation with a real love of travel, and this love has not as yet become a mania, as it has among the Americans, owing to lack of funds. Until within very recent years, Germany was a poor country, or at least in very modest circumstances. The parvenu class scarcely existed. The substantial, intelligent class did not travel, much as they would have liked to. Now conditions have changed, and one meets many well-to-do Germans in the Orient, Germans who speak English very well, and being Germans, travel to good advantage, speaking English even in Italy, if they do not happen to know Italian. Thus it can be inferred that if English can be used in Italy, that is to say, in the hotels and shops of Italy, it can probably be used in all other European countries where the current of travel is established and steady, Such is the case. With English one can get along. Now, to get along is much, but it is not all. If one wishes to do more than get along, there is no limit to the possibilities within his reach, if he is able to speak his modern languages. The conversations with chance acquaintances in their own tongue are of more enduring satisfaction than all the information gathered from guide-books. It is the impossibility of conversing with the people at large in the Asiatic tongues that makes one return home filled with the impenetrability of the East. In Europe one feels much less ill at ease, not knowing the language of a particular place, from feeling the kinship of race. It requires no violent shock to interpret what we see before our eyes. Thus it is that most Americans traveling in Europe are contented and happy, without being able to speak the foreign languages, and not knowing what they are missing. They are perhaps all the happier. English suffices. German, French, Spanish and Italian may add to one's comfort, but are after all not necessary—why then learn them? That is what many college students ask, and they decide not to study them. They can graduate without them, after having fulfilled the requirements for graduation by passing in other courses which seem more valuable for the purpose, and it is a fact that an undergraduate student in the classics, mathematics, history, economics, philosophy and the natural sciences can have his time more than taken up without studying modern languages. Moreover, he will tell you that as for acquiring a reading of French and German, for example, that is after all a luxury and not a necessity, as everything worth while is to be had in an English translation, or at least in a review which gives the gist. There is much truth in this. Many things are to be had in translations, such as they are. Usually these translations are sufficiently satisfactory, but often they are so inaccurate as to be very disturbing to the reader with a critical mind. Some years ago the New York *Evening Post* published two parallel English versions of a passage from Tolstoy. They were so different that it was hard to note any resemblance. An American reader would be helpless to decide which was the better or the worse translation, for he would be unable to compare the English with the Russian original. In the case of a translation from the German, the modern-language student would be able to find out the truth. If, for example, he were to compare the recent translation of Wagner's autobiography with the original, he would discover inaccuracies in profusion. Not only is the sense in many places inaccurately rendered, but the tone of the English is in places misleading. Wagner speaking a dignified German is made to speak an English that is colloquial and even flippant.

The whole question of foreign books in English editions is more than a question of mere accuracy. The Germans and the French claim in all sincerity and not only in their jocose moments that the English are both prudish and hypocritical. Mrs. Grundy sits at the elbow of the English translator as he prepares an English edition of works which in the original German or French enjoyed a free and unrestricted sale in their native land. The English reader is offered a volume by some author plus the translator plus Mrs. Grundy. In other words, unless one reads his books in the original he does not know what he is getting. If he depends on the English translation he may or may not be getting the truth, and unless Mrs. Grundy is willing he gets no book at all. In any case she is very apt to suppress or ignore what she does not approve of, so that her editions cut a pathetic, not to say ridiculous, figure behind the bars of the closed cabinet in English and American libraries. Though expurgated, they are still regarded as harmful. Be that as it may, the adult, and still more the adult student or scholar, cannot afford to be at the caprice of Mrs. Grundy. In matters of the mind he must be free of her chaperonage, and the only way to rid himself of it is to learn modern languages. They may not be indispensable to him in a mere tour round the world, but in the larger aspects of life they will help him to maintain his self-respect.

VOLUME IX NUMBERS 2 AND 3

THE UNIVERSITY OF COLORADO STUDIES

FRANCIS RAMALEY
EDITOR

PUBLISHED BY THE
UNIVERSITY OF COLORADO
BOULDER, COLO.

MAY, 1912

Price, 50 Cents

Four numbers of this publication are issued each college year, the first number in the volume generally appearing in December.

All exchanges should be addressed to the "Library of the University of Colorado, Boulder, Colo."

Educational institutions, libraries, societies and individuals desiring to be placed on the exchange list should make request to the "Secretary of the University of Colorado, Boulder, Colo.," to whom also should be addressed any correspondence in regard to purchase of single copies.

VOLUME IX NUMBERS 2 AND 3

THE UNIVERSITY OF COLORADO STUDIES

FRANCIS RAMALEY
EDITOR

PUBLISHED BY THE
UNIVERSITY OF COLORADO
BOULDER, COLO.

MAY, 1912

Price, 50 Cents

CONTENTS

THE FAUNA OF BOULDER COUNTY, COLORADO. II.[1]

By T. D. A. Cockerell

Class **CRUSTACEA** Lamarck
Subclass ENTOMOSTRACA Müller

Size small or moderate; number of body-segments differing greatly in different groups; young (except in many Cladocera and Ostracoda) appearing as unsegmented larvae with two or three pairs of appendages, of which two are constantly biramose (Nauplius larvae). For a list of Colorado Entomostraca, see G. S. Dodds, *Univ. of Colo. Studies*, V, pp. 243–250.

Order *BRANCHIOPODA*
Suborder Phyllopoda Latreille

Relatively large animals, with at least ten pairs of legs, often many more; antennae usually small, not used for swimming.

Family **BRANCHIPODIDAE** Fischer

Carapace rudimentary; eyes stalked; the second antennae flat and unjointed in the female, jointed and prehensile in the male (Weldon). The following key to the genera is mainly based on that of Weldon:

1. Posterior abdominal segments united with telson to form a fin, deeply notched apically, and with setose margins; head of male with a branched median process ("frontal shrub" of Packard); second antennae of female oar-like (subfamily Thamnocephalinae Packard) . . . *Thamnocephalus* Packard.
   Posterior abdominal segments not thus modified . . . . 2.
2. Anal lobes small or none, sparsely or not at all setose; abdominal segments five or fewer, and a telson (terminal piece) (subfamily Artemiinae) *Artemia* Leach (Utah).
   Anal lobes well-formed, their margins setose; abdomen of six well-formed segments and a telson (subfamily Branchipodinae Packard) . . . . 3.
3. Second antennae of male without lateral appendages; ovisac of female elongated . . . . *Branchinecta* Verrill.
   Second antennae of male apparently three-jointed, the last joint bifid or trifid; first joint with a curved appendage . . . . *Streptocephalus* W. Baird.

[1] *Publication of the Colorado Biological Survey*, No. 6. In this and subsequent parts the fauna of Tolland will be included with that of Boulder County. Species which have been found on the University campus are marked with an asterisk (*).

Part I was issued in Vol. VIII, No. 4, of these *Studies*, under date of June, 1911.

Thamnocephalus platyurus Packard was discovered at Ellis, Kansas, and has not been reported from Colorado, but good specimens of both sexes were found by Mr. H. C. Markman in a roadside pool, at Montclair, Denver County, July 15, 1908. The figure accompanying Dr. Packard's original description does not show the deep lobing of the apex of the abdomen, but it is correctly described by him.
Streptocephalus texanus Packard has been reported by Beardsley from the Mesa de Maya (misprinted Mayo) in Las Animas County. Mr. Markman took it at Montclair on July 15, in company with *Thamnocephalus*. I give a figure of the second antenna of the male, modified for clasping.
The Colorado species of *Branchinecta* have been fully discussed by H. L. Shantz in *Biological Bulletin*, IX, pp. 249–264. *B. coloradensis* Packard occurs in the mountains, *B. lindahli* Packard on the plains. *B. lindahli* can be distinguished easily from *B. coloradensis* by the smaller eye and egg, by the difference in the shape of the eye, by the greater number of eggs in the ovisac (often 50 or more in *lindahli*, seldom as many as 30 in *coloradensis*), by the absence of the basal tubercle on the second antennae of the male, by the difference in the tips of the second antennae and by the longer and more slender caudal appendages (Shantz).

Family APODIDAE[1]

Carapace well developed as a depressed shield, covering at least half the body; eyes sessile; no male clasping organs.
Telson not produced backward as an ensiform plate . . . *Apus* Scopoli.
Telson produced backward as an ensiform plate, entire in *L. couesii* Packard (Utah, Montana), emarginate in *L. bilobatus* Packard (Colorado) . . *Lepidurus* Leach.
Apus obtusus James, 1823 (*longicaudatus* Le Conte, 1845), was described from rain-water puddles on the Platte River, near the Rocky Mountains. The type of *longicaudatus* came from the Rocky Mountains, near Long's Peak. Mr. Markman collected numerous specimens of this species at Montclair, July 15, in company with *Thamnocephalus*, etc. The little spines at the caudal end of the abdomen are variable.

Family LIMNADIIDAE W. Baird

Body compressed, with a carapace in the form of a bivalve shell; second antennae alike in both sexes; the first or first and second thoracic limbs prehensile in the male. The following key is mainly based on that of Weldon:
Carapace spheroidal, without lines of growth; only the first thoracic limbs prehensile in the male (subfamily Limnetinae Packard)
Limnetis Lovén (Kansas, Montana).
Carapace otherwise, with concentric lines of growth; first and second thoracic limbs prehensile in the male (subfamily Limnadiinae) . . . .
Carapace with the valves oval or oblong, with well-marked umbones and numerous lines of growth . . . . *Estheria* Rüppell.
Carapace with the valves narrowly ovate, with only four or five lines of growth *Eulimnadia* Packard.

At Montclair, July 15, along with *Thamnocephalus*, etc., Mr. Markman took

[1] *Apidae* Burmeister, not Leach.

several specimens of *Estheria compleximanus* Packard. I refer them to *E. compleximanus* rather than to *E. mexicana* Claus (the only *Estheria* hitherto in the Colorado list) because the shape of the carapace is exactly as in Packard's figure of *compleximanus*, and the "hand" and telson (with many more than 20 teeth, though these are not all of the same size) also agrees. The carapace of *E. mexicana* is less elongated. Thus Mr. Markman's roadside pool at Montclair yielded four species of Phyllopod Crustacea, two species and one genus being new to Colorado; it also contained a mollusc, *Galba bulimoides cockerelli* (Pilsbry and Ferriss).

Suborder Cladocera Latreille

Small, short-bodied animals, with not more than six pairs of thoracic limbs; second antennae used in swimming. They are commonly known as "water-fleas."

Family SIDIDAE

Six pairs of thoracic feet, the first pair not prehensile; second antennae two-branched in both sexes. The genus *Latona* Strauss[1] (*L. setifera* Müller) has been found by Juday at Twin Lakes.

The remaining families, with four to six pairs of thoracic feet, the anterior pair prehensile, may be separated as follows, after Weldon:

Ventral branch of second antenna with three joints, the dorsal with four . 1.

Both branches of second antenna three-jointed . . *Chydoridae* (*Lynceidae*).

1\. Five pairs of thoracic feet, with a gap between the fourth and fifth pairs *Daphniidae*.

Four (*Lathonura*), five (*Macrothrix*, *Drepanothrix*, etc.), or six (*Acantholeberis*, etc.) pairs of equidistant thoracic feet, the first two pairs prehensile *Lyncodaphniidae* (*Macrothricidae*).

Family DAPHNIIDAE W. Baird

Weldon gives the following key to the genera:

First antennae of female long, mobile; posterior margin of carapace without a spine . . . . *Moina* W. Baird. (*M. affinis* Birge was found by Beardsley near Greeley, often extremely abundant in pools formed by summer rains.)

First antennae of female short . . . . 1.

1\. A median dorsal spine on posterior margin of carapace . . . . . . 2.

A pair of ventral spines on posterior margin of carapace *Scapholeberis* Schoedler.

No spine on posterior margin of carapace . . . *Simocephalus* Schoedler.

2\. First antennae of female not mobile; head separated from thorax only by a slight constriction or not at all; cuticle with a quadrate rhomboid pattern *Daphnia* O. F. Müller.

First antennae of female mobile; head separated by a deep depression from thorax; cuticle with a polygonal pattern . . . *Ceriodaphnia* Dana.

[1] *Latona* was proposed independently in Mollusca and Crustacea in 1817; I do not know which has priority. I take the date of *Latona* Strauss from the *Nomenclator Zoologicus*, but according to Birge, it appears that the work of Strauss was not really published until 1820.

(135) **Ceriodaphnia** Dana. *C. dentata* Birge. Boulder (Dodds).
(136) **Scapholeberis** Schoedler. *S. mucronata* (O. F. Müller). Boulder (Dodds).
(137) **Simocephalus** Schoedler. *S. serrulatus* Koch. Boulder (Dodds). *S. vetulus* (O. F. Müller) Boulder and Redrock Lake (Dodds).
(138) **Daphnia** O. F. Müller. *D. pulex* (DeGeer)* University campus (Dodds). Dodds reports *D. dentifera* Forbes from Redrock Lake and Tolland, but is not positive about his identification.

Family LYNCODAPHNIIDAE

In *Drepanothrix* Sars, known from Twin Lakes (*D. dentata* Eurén), the four-jointed branch of the second antenna has only three swimming hairs;[1] in *Macrothrix* W. Baird this branch has four swimming hairs.

(139) **Macrothrix** W. Baird. *M. laticornis* Jurine. Near Boulder (Dodds).

Family CHYDORIDAE Leach
Subfamily EURYCERCINAE

Six pairs of thoracic limbs; head and thorax separated by a deep depression; female carries many summer-eggs (Weldon).

(140) **Eurycercus** W. Baird. *E. lamellatus* (O. F. Müller). Tolland (Dodds). The antennules have a crown of long teeth around the apex, from within which arise the sense-hairs; on the basal joint of the antennae, about the middle of its hinder side, is a large tubercle, covered with short, stout, black spines (Birge).

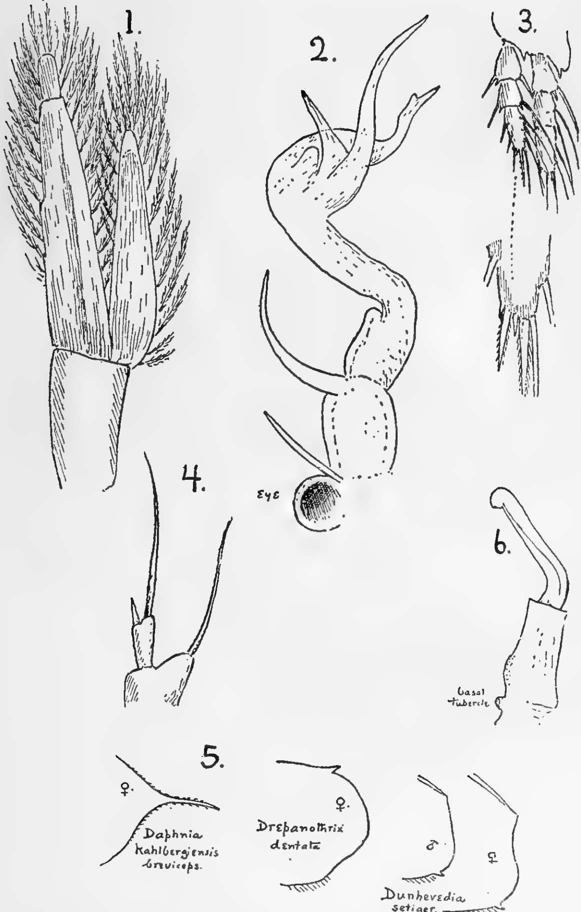
Subfamily CHYDORINAE

Five pairs of thoracic limbs; head and thorax separated by a slight groove or not at all; female carries only one or two summer-eggs.

Body small, spheroidal, the head depressed; compound eye present *Chydorus* Leach.
Body more elongate or oval . . . .
- Head carinate, the eye (as seen in lateral view) far from the anterior cephalic margin; second antennae with seven swimming hairs; telson more than half as long as carapace . . . . *Camptocercus* Baird (Twin Lakes).
- Head not carinate, the eye near the anterior cephalic margin.
  - Terminal claws of telson with three accessory teeth *Alonopsis* Sars (near Greeley).
  - Terminal claws of telson with two accessory teeth . *Pleuroxus* W. Baird.
  - Terminal claws of telson with one accessory tooth *Alona* W. Baird, *Graptoleberis* Sars, and *Dunhevedia* King.
  - Terminal claws of telson small and unarmed *Graptoleberis inermis* Birge.

(141) **Graptoleberis** Sars. *G. testudinaria* Fischer. Common in several lakes near Boulder (Dodds).
(142) **Alona** W. Baird. *A. guttata* (Sars), Boulder (Dodds); *A. quadrangularis* (O. F. Müller). Boulder and Redrock Lake (Dodds).

[1] If *Drepanothrix* and other Cladocera are placed with water in a watch glass, and exposed to a strong light, *Drepanothrix* will hurry away from the light, while *Chydorus*, *Pleuroxus*, *Daphnia*, etc., will approach the light (Birge).



FAUNA OF BOULDER COUNTY, COLORADO

1. Third uropod of *Gammarus limnaeus* from Sulphur Springs, Colo. 2. *Streptocephalus texanus*. Second antenna of male. 3. *Cyclops viridis* var. from Florissant. Fourth foot. 4. *Cyclops viridis* var. from Florissant. Fifth foot. 5. Figures illustrating the structure of posterior margin of carapace (Birge). 6. Second antenna of male *Branchinecta coloradensis* (after Shantz).

(143) **Pleuroxus** W. Baird. Dodds says that *Pleuroxus* occurs abundantly in collections from several lakes about Boulder; no two individuals are alike, and he was unable to determine the species. *P. procurvatus* Birge is reported from Pike's Peak and Twin Lakes.

(144) **Dunhevidia** King. *D. setiger* (Birge), near Boulder (Dodds).

(145) **Chydorus** Leach. *C. sphaericus* (O. F. Müller). Boulder and Redrock Lake (Dodds). Birge (*Trans. Wisc. Acad. Sci.*, 1909, p. 1051) remarks that the species of Chydorinae are readily distinguishable, but the genera are in many cases ill-defined, and in some cases seem to be indefinable. Thus *Chydorus* and *Pleuroxus*, widely separated in the above table (mainly from Weldon), he considers hardly separable. *Camptocercus* is an extreme type of the *Alonopsis* group. *Dunhevedia* is not so near to *Alona* as is *Graptoleberis*.

Order *COPEPODA*

Small Crustacea, composed typically of about sixteen segments, in which the biramous type of limb predominates; they are devoid of a carapace; paired compound eyes are absent, except in Branchiura, the adult retaining the simple eye of the Nauplius (Geoffrey Smith). This does not well apply to the Branchiura (Argulidae) which are parasitic on fish. These animals become quite large (*Argulus catostomi* Dana and Herrick, found on suckers, 12 mm. long) and have the cephalothorax developed into a broad lobed shield or carapace. The anterior maxillipeds in *Argulus* are transformed into large sucking disks.

Suborder Gymnoplea

The division between the front and hind part of the body falls immediately in front of the genital openings and behind the fifth thoracic feet; the latter in the male are modified into an asymmetrical copulatory organ (Geoffrey Smith).

Family **CENTROPAGIDAE**

Cephalothorax distinctly separated from abdomen; first antennae long and composed of 24–25 segments; female with only one egg-sac.

(146) **Diaptomus** Westwood. Inner branch of first pair of legs two-jointed; of the following three pairs three-jointed. *D. signicauda* Lilljeborg, near Boulder (Juday) and Boulder Lake (C. F. Baker); *D. leptopus* var. *piscinae* Forbes,* University campus (Marsh) and Redrock Lake (Dodds); *D. nudus* Marsh, Boulder (Dodds); *D. coloradensis* Marsh, Corona and Tolland (Marsh). *D. shoshone* Forbes, Tolland (Marsh in litt.). Eight other species of *Diaptomus* are reported from Colorado by Marsh.

Suborder Podoplea

The boundary between the fore and hind parts of the body falls in front of the fifth thoracic segment; the appendages of the fifth thoracic pair in the male are never modified as copulatory organs (Geoffrey Smith).

Superfamily **CYCLOPOIDEA** (Ampharthrandria)

First antennae of male differing greatly from those of female, being often geniculated and acting as prehensile organs (Geoffrey Smith).

Cephalothorax clearly separated from abdomen; female with two egg-sacs *Cyclopidae.*
Cephalothorax not clearly separated from abdomen; female with one or two egg-sacs . . . . *Harpacticidae.*

Family CYCLOPIDAE Burmeister

(147) **Cyclops** O. F. Müller is common in Colorado, but Dodds does not mention any species from Boulder County, the material collected not having been determined when he published his paper. Dr. C. Dwight Marsh informs us that he has *C. bicuspidatus* Claus from Tolland, and *C. serrulatus* varieties *montanus* Brady and *elegans* Herrick from Boulder. At Florissant I found a variety of *Cyclops viridis* (Jurine), small and colorless, in a well which received its water from the Miocene shales. Much water flows through these shales, and it is possible that the *Cyclops* is essentially subterranean. I figure the fourth and fifth feet. In *Biological Bulletin*, April, 1912, Mr. R. Chambers, Jr., has a very interesting article on the forms usually regarded as varieties of *Cyclops viridis*, showing that certain of them (*americanus* Marsh, *parcus*, Herrick, and *brevispinosus* Herrick) have distinct chromosome numbers, armature of swimming feet and seminal receptacles, and must be regarded as distinct species.

Family HARPACTICIDAE

Canthocamptus Westwood is represented at Greeley by *C. minutus* (O. F. Müller), as reported by Beardsley. It is very small; Beardsley gives length of female 0.65–0.75 mm., of male 0.60–0.65 mm.

Superfamily CALIGOIDEA (Isokerandria)
Family LERNAEOPODIDAE

Parasitic on the gill-arches of fishes. *Achtheres* Nordm. is recorded from Colorado, the species being *A. carpenteri* Packard. This was the first copepod to be reported from our state.

Order *OSTRACODA*

Small Crustacea, the body consisting of very few (about eight) segments, and completely inclosed in a carapace which has the form of a bivalve shell; development direct, without a Nauplius stage (Geoffrey Smith). Mr. R. W. Sharpe has discussed the American forms at some length in *Proc. U.S. National Museum*, XXVI, XXXV and XXXVIII. The Boulder County species have not been studied, but I give a synopsis of the Colorado genera based on Sharpe's tables.

Family CYPRIDIDAE

Natatory setae shortened; no swimmers. Second foot with a beak-shaped end segment and a short claw . . . . *Erpetocypridinae.*
Natatory setae reaching beyond end claws, or approximately to tips of claws. Second foot with a beak-like end-segment and a claw . . *Cypridinae.*
Natatory setae usually long. Second foot usually beak-shaped at tip, with a claw. Furca rudimentary, with a lash-like end bristle . . . *Cypridopsinae.*

Natatory setae very long, usually twice as long as distance from their origin to tip of end claws. Second feet with three setae, one long, the other two rather short and backwardly directed. Furca usually normal . *Cyclocypridinae.*

Natatory setae lacking or little developed. Second antennae of female five-segmented; of male mostly six-segmented, and with two sense-clubs. Terminal segment of second foot with three unlike setae, two of which are backwardly directed . . . . *Candoninae.*

Subfamily ERPETOCYPRIDINAE

Erpetocypris Brady and Norman has furca normal, and two setae on first segment of first foot. *E. olivacea* Brady and Norman was found by Beardsley in abundance in Carter's slough near Greeley.

Subfamily CYPRIDINAE

Cypris O. F. Müller, with the subgenus *Cyprinotus* Brady, are represented by species recorded by Chambers in 1877. *Cypris altissimus* Chambers, a "bright deep green" species, was found on Mount Elbert, at an altitude of about 12,000 ft. *Cypris (Cyprinotus) grandis* Chambers was from the Mount Harvard region, at an altitude of about 8,000 ft. It was of a bluish-white color, some specimens pale greenish. According to Sharpe, *C. grandis* is not properly a *Cyprinotus,* but rather represents an unnamed subgenus. *Cypris fuscata* (Jurine) was found near Greeley by Beardsley. It has both spines on first process of first maxilla toothed, whereas these spines are smooth in *C. altissimus*, *C. virens*, etc. *Cypris florissantensis* Cockerell is fossil in the Miocene shales of Florissant.

Subfamily CYPRIDOPSINAE

Cypridopsis Brady, a regularly parthenogenetic genus, is represented by *C. vidua* (O. F. Müller) at Greeley (Beardsley). It is a very plump form, with three transverse dark bands on dorsal and lateral aspect of carapace.

Subfamily CYCLOCYPRIDINAE

Natatory setae reaching but to tips of end-claws or slightly beyond; furca normal; shell tubercled or furrowed in region of eyes . . . *Ilyocypris* B. and N.

Natatory setae reaching well beyond end-claws.

Terminal segment of second foot small; ductus of circlets of spine-like setae, and a distinct central axis; fourth segment of second antenna of male with two sense-organs . . . . *Cypria* Zenker.

Terminal segment of second foot long and narrow, three times as long as broad; ductus of numerous long filaments, and no distinct central axis; fourth segment of second antenna of male with no sense-organ on distal end *Cyclocypris* Brady and Norman.

Ilyocypris Brady and Norman is represented by *I. bradyi* Sars at Greeley.

Cypria Zenker includes *C. mons* (Chambers), collected on Mount Elbert at about 11,000 ft. Sharpe separates this from the other American species of the genus by the white, shining carapace, with numerous almost confluent punctures, and the terminal short setae of second foot evidently unequal. It is less than 1 mm. long. *Cyclocypris* Brady and Norman has the species *C. laevis* (O. F. Müller), found by Beardsley near Greeley.

Subfamily CANDONINAE

Candona W. Baird has the natatory setae of first antenna shorter than antenna; second antenna six-segmented in male and five-segmented in female; furca normal; eye present, small. *C. acuminata* Fischer was found by Beardsley near Greeley. It is a species of uniform color, white to brownish. These animals cannot swim, but creep along the bottom, or burrow.

Bairdia McCoy, a genus assigned to the Cyprididae, occurs in the Carboniferous strata in the Leadville district (Girty).

Subclass MALACOSTRACA Latreille

Generally large Crustacea, with a definite and constant number of body-segments. In addition to the paired eyes we can distinguish two pairs of antennae, a mandibular segment, and two maxillary segments composing the head-region proper; there then follow eight thoracic segments, the limbs belonging to the anterior thoracic segments being often turned forward toward the mouth, and modified in structure to act as maxillipedes, while at any rate the last four are used in locomotion. The abdomen is composed of six segments, which typically carry as many pairs of two-branched pleopods, and the body terminates in a telson (Geoffrey Smith). Miss Richardson indicates only seven thoracic segments in the Isopoda.

Order *ISOPODA* Latreille

The body is dorso-ventrally flattened, and is divided into three parts—a head, a thorax composed of seven segments and an abdomen of six segments; the head appendages are two pairs of antennae, a pair of maxillipeds, two pairs of maxillae and a pair of mandibles; eyes sessile and compound; seven pairs of legs, the last pair sometimes wanting; marsupial plates developed in the female, forming an incubatory pouch (Richardson). Miss Harriet Richardson has published a monograph of the North American species (*Bulletin* 54, U.S. National Museum).

Uropoda lateral, forming together with the terminal segment of the abdomen a caudal fan . . . . *Cymothoidea.*

Uropoda terminal; pleopoda fitted for air-breathing . . . . *Oniscoidea.*

Suborder Cymothoidea

This group contains the family Sphaeromidae, a genus of which, *Exosphaeroma* Stebbing, though usually marine, possesses a few fresh-water representatives. I discovered *E. thermophilum* (Richardson) in a warm spring near Socorro, New Mexico, which remains the only known locality for it. Warm springs, wherever they occur, should be searched for these remarkable animals.

Suborder Oniscoidea

External antennae generally long, close together; body as a rule scarcely able to be contracted in a ball; legs generally long; uropoda produced, reaching beyond the terminal segment of the abdomen . . . . *Oniscidae.*
External antennae generally short; body able to be contracted into a ball; legs generally short; uropoda short, not reaching beyond the terminal segment of the abdomen . . . . *Armadillididae.*

Family ONISCIDAE

The following key is based on that of Richardson:
Flagellum of external antennae triarticulate . . . . 1.
Flagellum of external antennae biarticulate . . . . 2.
1. Abdomen abruptly narrower than thorax . . . . . *Philoscia* Latreille.
Abdomen not abruptly narrower than thorax; surface of body granulate or tuberculate; terminal segment of body conically produced *Oniscus* Linnaeus.
2. Body very convex, capable of being rolled up into a ball; joints of flagellum of external antennae subequal; external opercular ramus of all the abdominal appendages furnished with tracheae . . . . . *Cylisticus* Schnitzler.
Body more or less depressed, scarcely contractile; external opercular ramus of first and second pairs of abdominal appendages furnished with tracheae; second antennae long . . . . *Porcellio* Latreille.

Metoponorthus Budde-Lund, found in Kansas and New Mexico, has the abdomen abruptly narrower than thorax, and the flagellum of external antennae biarticulate.

(148) **Cylisticus** Schnitzler. *C. convexus* (DeGeer). Boulder, 1907 (C. DeVoss).

(149) **Porcellio** Latreille. These common wood-lice must occur with us, but we have no records.

Miss Richardson thus separates the commoner species of *Porcellio:*
Surface of body smooth or minutely granular; second pair of antennae long, equal to half the length of the body; color dark gray, with two longitudinal bands of a lighter color in wavy stripes . . . . . . *P. laevis* Latreille.
Surface of body roughly granulate or tuberculate.
Inner face of the mandibles with four to five pencils; color varying from gray to black, with three longitudinal lines of white spots *P. rathkei* Brandt.
Inner face of right mandible with four to five pencils, of left mandible with seven to eight pencils; body without spots . . . *P. scaber* Latreille.

Family ARMADILLIDIDAE

(150) **Armadillidium** Brandt. *A. vulgare* (Latreille). Greenhouse at Boulder, abundant, January, 1911 (Warren E. Watkins).

Order *AMPHIPODA* Latreille

Body laterally compressed; branchial organs attached to the thoracic limbs. Aquatic. Only one genus has been found in our region, but at Las Vegas Hot Springs, New Mexico, in the hot water, I collected a species of *Hyale* Rathke, a genus new to the United States. This was named in manuscript by Mr. W. P. Hay, but apparently has not yet been published.

Family **GAMMARIDAE**

First antennae with a small secondary flagellum; fifth peraeopods longer than the preceding; second gnathopods generally larger than the first (Weckel).

(151) **Gammarus** Fabricius. Telson cleft; uropods two-branched; inner branch of third uropods not rudimentary, outer one two-jointed. *G. limnaeus* S. I. Smith has been collected by Mr. G. S. Dodds at Corona and Sulphur Springs. In a lake at Ward I found a *Gammarus* abundant; I did not examine it minutely, but it is practically certain that it was *G. limnaeus*. The locality Corona is at the top of the divide, close to the point of junction of Gilpin, Grand and Boulder counties; altitude 11,660 feet.

Order *DECAPODA* Latreille
Suborder Macrura Latreille

Abdomen large, with five pairs of two-branched pleopods, and ending in a tail-fan composed of the telson and the greatly expanded sixth pair of pleopods.

Superfamily **NEPHROPSOIDEA**

Includes the lobsters and crayfishes.

Family **ASTACIDAE** (Potamobiidae)

The crayfishes.

(152) **Cambarus** Erichson. Last thoracic somite without gills. *C. (Bartonius) diogenes* Girard.* Boulder. The subgenus *Bartonius* Ortmann includes species in which the sexual organs of the male are short and thick, the inner and outer part each terminating in only one short and thick spine, tapering to a point; both terminal spines are strongly recurved, forming with the basal part about a right angle (Ortmann). Only the third pereiopods of the male possess hooks.

The subgenus *Cambarus* s. str. is represented in New Mexico by *C. gallinus* Cockerell and Porter.

For an excellent summary of our knowledge of *Cambarus*, see Ortmann, *Proc. Amer. Philosophical Society*, XLIV (1905). This work includes tables for the subgenera, groups and species.

A very interesting parasitic worm was discovered on *Cambarus diogenes* by Miss Margaret Hankins during the summer of 1911. Mr. E. Bethel kindly preserved a number of specimens, and these have been found by Dr. Max M. Ellis to represent a new genus and species. A brief account of the worm follows:

APPENDIX

By Max M. Ellis

A new species of worm, belonging to the *Discodrilidae*, has been taken from specimens of *Cambarus diogenes* collected on the University campus. This species, *Cambarincola macrodonta*, may be recognized by the following characters: anterior nephridia opening by a single median dorsal pore on the third post-cephalic segment; dorsal and ventral jaws dissimilar; head elongate, its greatest diameter less than the greatest diameter of the body; lips two; body terete in all regions.

This worm is a small, colorless, leech-like animal, not exceeding 5.5 mm. in length. It is composed of 11 segments (of which the first 8 are easily seen) and a head. The terminal segment bears a sucking disk by means of which the worm attaches itself to the host. It may be found on almost any part of the ventral surface of the host.

A full description, with figures, is about to be published.

THE MOLLUSCA OF COLORADO.[1] PART III[2]

By Junius Henderson

This paper has for its purpose the recording of material in the University of Colorado Museum obtained since the publication of Parts I and II, by the following collectors: H. A. Aurand, E. Bethel, L. C. Bragg, Norman deWitt Betts, T. D. A. Cockerell, J. S. Congdon, Albert Dakan, G. S. Dodds, Terry Duce, A. H. Felger, Wm. Fleming, R. D. George, E. E. Hand, Harvey C. Markman, Miss Rosamond Patton, Frank Rohwer, S. A. Rohwer, W. W. Robbins, D. W. Spangler, E. R. Warren and the writer. These records greatly extend our knowledge of the distribution of many of the species, but the time has not yet come for a full discussion of the matter of distribution.

The several greenhouse records of exotic species are included only because they may become important as matters of history in case any of those species become hereafter incorporated in the out-of-door fauna.

Ingersoll[3] long ago recorded dead shells of *Arca* and *Truncatella*, marine genera, from a pond between Animas and La Plata, with living Crustacea of the family Astacidae, which records I omitted from the former parts of this catalogue, but for the purpose of making this series of papers an index to all the records which have come to my attention it seems better to mention them. It is much more likely that the shells were thrown away by someone who had collected them at the seashore—as such occurrences are not infrequent—than that they were natives of that locality, but the presence of the crabs is not so easily accounted for if, as Ingersoll said, they are really of salt-water species, which may well be doubted.

[1] Part I of this paper appeared in 1907 in Vol. IV of these *Studies*, at pages 77 to 96, inclusive, and contained an introduction, bibliography, locality list, key to species and an annotated catalogue of the *Pelecypoda*. Part II appeared in the same volume, at pages 167 to 185, inclusive, and consisted of an annotated catalogue of the *Gastropoda*.

[2] *Publication of the Colorado Biological Survey*, No. 7. Parts I and II of this contribution were issued before the organization of the Biological Survey, hence they are not included in the Survey publications.

[3] *Popular Science Monthly*, Vol. XLXIX, p. 45, 1876.

The following species and subspecies herein recorded were not included in the former list: *Pisidium abditum huachucanum* Pilsbry and Ferriss, *Pisidium* near *roperi* Sterki, *Oreohelix haydeni gabbiana* Hemphill, *Pupilla syngenes dextroversa* Pilsbry and Vanatta, *Bifidaria agna* Pilsbry and Vanatta, *Vertigo coloradensis basidens* Pilsbry and Vanatta, *Vertigo milium* Gould, *Vitrea cellaria* Müller, *Vitrea cellaria margaritacea* Schmidt, *Vitrea alliaria* Miller, *Milax gagates* Draparnaud and variety *plumbea*, *Galba doddsi* Baker, *Galba hendersoni* Baker, *Physa walkeri* Crandall.

Additions to Bibliography

Baker, Frank C. "Descriptions of new species of *Lymnaea*." *The Nautilus*, Vol. XX, pp. 125–127, 1907. (This was published after the appearance of Part I of this catalogue, so was not included in the Bibliography, but was referred to in Part II, under *L. leai*, and is now inserted to make the bibliography complete.)

———. "A new species of *Lymnaea*." *The Nautilus*, Vol. XXII, pp. 140–141, 1909. (Describes *L. hendersoni*.)

———. "The Lymnaeidae of North and Middle America." *The Chicago Academy of Sciences, Special Publication*, No. 3, 1911.

Cockerell, T. D. A. "*Milax gigates* and *Vitrea cellaria* in Colorado." *The Nautilus*, Vol. XXI, pp. 131–132, 1908.

———. "Land Mollusca at Tolland, Colorado." *The Nautilus*, Vol. XXV, pp. 58–59, 1911.

Hanna, G. D. "The American species of *Sphyradium* with an inquiry as to their generic relationships." *Proc. U.S. Nat. Mus.*, Vol. XLI, pp. 371–376, 1911.

Henderson, Junius. "*Zonitoides alliaria* in Colorado" [Vitrea alliaria]. *The Nautilus*, Vol. XX, p. 144, 1907.

———. "Scientific expedition to Northeastern Colorado. 4. List of Mollusca collected." *Univ. of Colo. Studies*, Vol. IV, No. 3, pp. 158–159, 1907.

———. "Mollusca collected in Northwestern Colorado." *Univ. of Colo. Studies*, Vol. VII, No. 2, pp. 125–126, 1910.

Oreohelix colonies in Colorado." *The Nautilus*, Vol. XXV, pp. 133–139; Vol. XXVI, pp. 9–11, 1912.

Pilsbry, H. A., and Vanatta, E. G. "Description of a new *Bifidaria* (*B. agna*)." *The Nautilus*, Vol. XX, pp. 140–142, 1907.

Vanatta, E. G. See under Pilsbry.

PELECYPODA (Lamellibranchiata)

Genus ANODONTA (Bruguiere *em.*) Lamarck

Anodonta grandis Say.

Professor Ellsworth Bethel has shown me some very fine specimens of this species which were said to have been collected "about thirty miles north of Denver."

Genus **SPHAERIUM** Scopoli

Sphaerium near **striatinum** Lam.

S. striatinum was recorded from Kremmling by Professor Cockerell (*Nautilus*, XX, p. 21). I have since collected many dead shells from the same place, and they are not quite typical. We have the same form from mouth of Sand Creek, on Bear River, Routt County (Warren), from near Meeker (Bethel), from near Greeley (Beardsley), and I recently collected 71 specimens alive from the Bear River just above Steamboat Springs.

Genus **CALYCULINA** Clessin

Calyculina near **securis** Prime.

Specimens not quite typical (the same form as that recorded from Magnolia) have been collected from a small lake between Gresham and Ward (S. A. Rohwer) at about 8,000 feet, associated, as at Magnolia, with *Lymnaea* (Galba) *palustris* and *Planorbis exacuous*.

An undetermined species of this genus was found by Dr. G. S. Dodds at Sulphur Springs.

Genus **PISIDIUM** Pfeiffer

Pisidium compressum Prime.

I found a few specimens in Owen's Lake, east of Boulder.

Pisidium abditum huachucanum Pilsbry and Ferriss.

A large number were found by Professor E. E. Hand, of Chicago, on the ranch of G. W. Ames, at Evergreen, Jefferson County, and identified by Dr. V. Sterki. This is an Arizona species described in 1906, in the *Proceedings of the Academy of Natural Sciences of Philadelphia*, for that year, at page 173. It is interesting to find an Arizona species so far north in the Rocky Mountains, as most of our known Colorado species came down the range from the north, as pointed out by Pilsbry and Ferriss at page 150 of the paper just cited.

Pisidium near **roperi** Sterki.

This form is abundant at the head of Silver Lake, Boulder County, altitude about 10,000 feet. Dr. Sterki says it is not quite typical. It was described in *The Nautilus*, Vol. XII, p. 77.

We have undetermined *Pisidia* from a number of other localities. The distribution of the various species in Colorado is as yet very little known.

GASTROPODA

Genus **OREOHELIX** Pilsbry

The genus *Oreohelix* includes the largest land snails of Colorado. A number of species have been found in enormous numbers at many localities and much interesting information obtained as to habitat, distribution, etc. We omit all but the mere locality records from this paper, because a rather extended report has just appeared [*The Nautilus*, Vol. XXV, pp. 133–139; Vol. XXVI, pp. 9–11, 1912].

Oreohelix strigosa depressa Cockerell.

Ohio City, Gunnison County, 11,800 feet (Frank Rohwer); Floyd Hill and Beaver Brook, near Golden (Hand); Treasury Mt., Gunnison County, 10,900 feet (George); Hagerman Pass, west of Leadville, 12,700 feet (Aurand); Morrison (F. Rohwer and Henderson); Steamboat Springs and Rifle Gap (Henderson); nine miles north of Boulder (Spangler). Semi-fossil at Pueblo. All the Oreohelices of the *strigosa* type in Colorado are now referred to this variety.

Oreohelix cooperi W. G. B.

Treasury Mt., near Marble, Gunnison County, 10,900 feet (George); five miles above Gleneyrie, Jackson County (Fleming); Eldorado Springs, Wolcott, Toponas and Montrose (Bethel); South Canyon, near Glenwood Springs (Duce); Crested Butte and Brush Creek, Gunnison County (Warren). East of the Continental Divide this species is seldom or never found alive, but west of the Divide it is much more common than *depressa*. I have found it very abundant along the Grand Hogback from Newcastle to Meeker and Axial, less abundant up White River to Trapper's Lake, very abundant in North and Middle Parks and at Steamboat Springs. We have one reversed specimen from Middle Park.

Oreohelix cooperi minor Cockerell.

In Part II, I suggested the identity of *minor* Cockerell and *concentrata* Dall. Last summer I collected what appears to be typical *minor* at McCoy, near Professor Cockerell's type locality, and have been able to compare them directly with typical *concentrata* furnished by Dr. Dall. Dr. Dall has also permitted me to examine the specimen from Alpine, Chaffee County, between 10,000 and 12,000 feet, identified by him as *concentrata* and so recorded by Professor Cockerell (*Nautilus*, XVI, pp. 106–107). Unfortunately the apex of the shell was crushed in its original transmission to Washington, but a comparison with typical *concentrata* and *minor* makes it quite clear that it is the latter. Therefore *concentrata* is eliminated from the Colorado fauna. I also found two colonies of *minor* near Meeker and one at Sulphur Springs. We have specimens from Placerville in San Miguel County and Montrose (Warren); Ohio City, Gunnison County (F. Rohwer). It is also interesting to note its occurrence in Johnson County, Wyoming (Betts). We have one reversed specimen from McCoy.

Oreohelix haydeni Gabb.

This species, ornamented by strong spiral ridges, was found alive in great numbers by Messrs. Bethel and Dakan, independently, at Glenwood Springs, the only known Colorado locality for the species.

Oreohelix haydeni gabbiana Hemphill.

Found in great numbers at Glenwood Springs (Bethel, Dakan), Newcastle (Dakan), and east of Meeker (Henderson).

Oreohelix n. sp.

A very fine colony on Little Thompson Creek, northeast of Lyons, was found by Mr. Dakan. The species is considered new.

Genus **THYSANOPHORA** Strebel and Pfeiffer

Thysanophora ingersolli Bland.

Near Marvine Lodge, Rio Blanco County (Felger); west of Allen's Park, at 9,000 feet (Spangler); Rio Blanco and Trapper's Lake (Henderson).

GENUS **PUPOIDES** Pfeiffer

Pupoides hordaceus Gabb.

I collected one specimen at Bellevue, Larimer County.

GENUS **PUPILLA** Leach

Pupilla muscorum Linn. (var.).

Tolland (Cockerell, *Nautilus*, Vol. XX, p. 59); Eldora (Henderson). We have a small form of this species from Floyd Hill, Clear Creek County (Hand), Magnolia (D. M. Andrews), Eldora Lake (Bethel), and Mr. E. G. Vanatta, who has seen a portion of our specimens, says the same form is in the Academy of Natural Sciences of Philadelphia, from Trinidad (Pilsbry), Estes Park (Ashmun) and Black Lake Creek (Cockerell). The shells from these localities are uniformly smaller than typical *muscorum* and not so acute as *minor* from Transylvania. It is perhaps entitled to a separate name as a variety of *muscorum*.

Pupilla blandi Morse.

Five miles above Gleneyrie, Jackson County (Fleming); Copeland Park, Boulder County (S. A. Rohwer); Ward, Tolland and Sulphur Springs (Dodds); Pike's Peak at 8,900 feet, and Swift Creek, Custer County (Cockerell); Denver (Bethel); near Ohio City (F. Rohwer); Calypso Falls, west of Allen's Park, Boulder County (Spangler). I have found it at Axial (Routt County), Owl Canyon (Larimer County), Morrison, mouth of Little Thompson Canyon northeast of Lyons, at Rio Blanco, Buford, above Meeker, Marvine Lodge and Mud Spring (Rio Blanco County), at various places in the southwest corner of North Park and other localities. It appears to be the most abundant and most generally distributed of the Colorado *Pupillidae*.

Pupilla syngenes dextroversa Pilsbry and Vanatta.

Professor Cockerell collected one at Tolland (*Nautilus*, Vol. XX, p. 59), and I obtained another at Eldora.

GENUS **BIFIDARIA** Sterki

Bifidaria agna Pilsbry and Vanatta.

Type locality Trinidad (*Nautilus*, Vol. XX, pp. 140–141, 1907).

GENUS **VERTIGO** Draparnaud

Vertigo concinnula Cockerell.

Professor T. D. A. Cockerell has recently examined all the Colorado *Vertigos* in the University cabinets and the records of *concinnula* and *basidens* included herein are based upon his identifications. Allen's Park (Spangler), Floyd Hill (Hand); Boulder (Bethel); Ward (Dodds); Tolland (Betts); Pike's Peak, 8,900 feet (Cockerell); Eldora, Marvine Lakes in Rio Blanco County and southwest corner of North Park (Henderson).

A comparison of the records of this species with the next indicates that *concinnula* is the common one east of the Continental Divide, while *basidens* is the common one west of the Divide. *V. concinnula* is quite variable and possibly should be divided into two or three varieties or races. One of these, from Tolland, has been recorded as *V. modesta parietallis* Ancey (Cockerell, *Nautilus*, Vol. XXV, p. 59), with the statement that it is not quite typical *parietalis*, belonging rather to the form which Ancey named *ingersolli*.

Vertigo coloradensis basidens Pilsbry and Vanatta.

Ouray (Bethel); Rio Blanco and Buford (Henderson). Probably the previous records of *V. gouldi* belong here and *gouldi* should be eliminated from our faunal list, but there is no way of now determining it.

Vertigo milium Gould.

Kremmling (Cockerell, *Nautilus*, Vol. III, p. 21). This record was inadvertently omitted from Part II of this catalogue.

Genus **COCHLICOPA** (Fér.) Risso

Cochlicopa lubrica Müller.

Lake George near Florissant, and Copeland Park in Boulder County, at 7,500 feet (S. A. Rohwer); Denver and Sulphur Springs (Bethel); near Magnolia at 8,500 feet (Henderson).

Genus **VALLONIA** Risso

Vallonia pulchella Müller.

Ft. Collins (Bragg, Congdon). Specimens were sent in for identification in 1909, with the information that they had appeared in great numbers. There were no specimens of the variety *costata* among those received. Probably *pulchella* may be found in all the towns of the state where eastern plants are grown, but I am convinced that the species is not native, and that the early records should be referred to one or the other of the next two species.

Vallonia cyclophorella Ancey.

I have recently gone over all the Colorado Vallonias in the University cabinets, and list herein the localities for each. It will be noticed that in a general way *gracilicosta* is found living at the edge of the plains and in the lower foothills regions, while *cyclophorella* extends into the mountains to considerable altitudes. The two species are occasionally found mingled, though but seldom. We have *cyclophorella* from the following localities: Florissant (Cockerell, S. A. Rohwer); Pike's Peak at 8,000 feet, and Lake George (Cockerell); Bluebird Mine and Copeland Park, Boulder County (S. A. Rohwer); Tolland and Sulphur Springs (Dodds); Morrison (F. Rohwer); near Axial, Buford, Rio Blanco, Mud Spring and Marvine Lodge, all in Rio Blanco County, Owl Canyon, Box Elder and Bellevue, all in Larimer County, Boulder, Eldora and Magnolia, in Boulder County, Muddy Creek north of Kremmling and southwest corner of North Park (Henderson).

Vallonia gracilicosta Reinhardt.

La Junta (Dodds); below Copeland Park, Boulder County (S. A. Rohwer); Morrison (F. Rohwer); Floyd Hill (Hand); Boulder, Left Hand Creek and Lyons in Boulder County, Box Elder and Owl Canyon in Larimer County, Meeker in Rio Blanco County (Henderson).

Genus **VITREA** Fitzinger

Vitrea cellaria Müller.

Vitrea cellaria margaritacea Schmidt.

Vitrea lucida Draparnaud.

Vitrea alliaria Miller.

These four *Vitreas* are recorded from Boulder greenhouse specimens (Cockerell, *Nautilus*, Vol. XXI, pp. 131–132). The latter had been recorded by me inadvertently as *Zonitoides alliaria* (*Nautilus*, Vol. XX, p. 144), but appeared under its proper name in Part II of this catalogue.

Vitrea hammonis Ström.

Specimens of this species from Rio Blanco County were identified by Dr. Wm. H. Dall as *V. rhoadsi* Pilsbry, and recorded by me under that name (*Univ. of Colo. Studies*, Vol. VII, p. 126). They have been submitted to Professor Cockerell and Dr. Pilsbry, who both agree with me that they are of the form usually called *hammonis*. Taylor (*Monograph of the Land and Fresh-water Mollusca of the British Isles*, part 15, 1908) discards the name *hammonis* because of the difficulty of identifying it from the descriptions, and calls the species *Hyalinia radiatula*, and Professor Cockerell records his Tolland specimens under the name *Vitrea radiatula electrina* var. *alba* (Jeffreys) Taylor (*Nautilus*, Vol. XXV, p. 58). I have never found more than two or three specimens at one place, always mingled with larger numbers of *Zonitoides arboreus*. Our present material permits the addition of the following localities: Tolland (Cockerell, Dodds); Floyd Hill (Hand); Long's Peak Inn (Spangler); Copeland Park and Allen's Park (Rohwer); Buford and ten miles east of Meeker (Henderson).

Genus **VITRINA** Draparnaud

Vitrina alaskana Dall.

Generally distributed in aspen groves throughout the mountains of the state. Allen's Park, Copeland Park and North Boulder Creek (S. A. Rohwer); Tolland and Sulphur Springs (Dodds); Floyd Hill (Hand); Morrison and near Ohio City (F. Rohwer); Pike's Peak at 10,000 feet (Cockerell); Axial in Routt County, Box Elder in Larimer County, upper Muddy Creek in Grand County, southwest corner of North Park in Jackson County, Buford, near Meeker, Rio Blanco, Mud Spring and Marvine Lodge in Rio Blanco County (Henderson).

Genus **EUCONULUS** Reinhardt

Euconulus fulvus alaskensis Pilsbry.

North Boulder Creek at 9,000 feet and Copeland Park at 7,500 feet, both in Boulder County, and Troublesome Creek in Grand County (S. A. Rohwer); west of Allen's Park at 9,000 feet (Spangler); Floyd Hill (Hand); Tolland (Dodds, Cockerell); Pike's Peak (Cockerell); near Ohio City (F. Rohwer); Box Elder in Larimer County, Magnolia at 8,500 feet, South Boulder Canyon at 6,800 feet, Southwest corner of North Park, Rio Blanco and along White River from Meeker nearly to Marvine Lakes (Henderson). The former Colorado records under the name *E. trochiformis* (Montagu) Dall are believed to belong here.

Genus **ZONITOIDES** Lehmann

Zonitoides arboreus Say.

Palmer Lake and Eldorado Springs (Bethel); Pike's Peak at 10,000 feet, and Sugar Loaf (Cockerell); Ward at 9,000 feet, and Tolland (Dodds); Floyd Hill at 7,200 feet (Hand); west of Allen's Park at 9,000 feet, and Long's Peak Inn (Spangler); northeast of Ohio City (F. Rohwer); North Boulder Creek at 9,000 feet, Copeland and Allen's Park, all in Boulder County, and mouth of Troublesome Creek in Grand County (S. A.

Rohwer); Box Elder in Larimer County, Magnolia at 8,500 feet, South Boulder Canyon at 6,800 feet, mouth of Little Thompson Canyon near Lyons, Steamboat Springs and along White River from Meeker to Marvine Lakes (Henderson). The right-hand figure on page 175 of Part II of this catalogue appears to represent *Vitrea hammonis*, instead of this species.

Genus **MILAX** Gray

Milax gagates Draparnaud.

Greenhouse specimens, Boulder (Cockerell, *Nautilus*, Vol. XXI, pp. 131–132), designated var. *plumbea*, probably representing the *hewstoni* form. In the autumn of 1911 Mrs. Max Ellis found the species living out-of-doors on University Hill, Boulder, so it may have become incorporated in the outdoor fauna of the region.

Genus **AGRIOLIMAX** Morch

Agriolimax campestris Binney.

North Boulder Creek at 9,000 feet, Copeland Park at 7,500 feet, both in Boulder County (S. A. Rohwer); two miles east of Longmont (Spangler); Tolland (Betts); Rio Blanco, Meeker and Marvine Lodge, all in Rio Blanco County, Kremmling and South Boulder Canyon (Henderson). Probably some of these specimens should be referred to the variety *montanus*, recorded from Tolland by Professor Cockerell.

Agriolimax agrestis Linn.

Greenhouse at Boulder, from light reddish to almost black (Cockerell, *Nautilus*, Vol. XXI, pp. 131–132). Mutant *reticulatus* Müller, a large specimen, like Taylor's pl. xv, f. 3, *Monog. L. and F.-W. Moll. Brit. Is.*, found in Boulder, May, 1907, by Guy Mason (Cockerell ms.). This exotic species has increased very rapidly at Boulder during the last two years. In digging up Gladiolus bulbs in a lot on Pine Street in October, 1908, the writer found them in the moist earth about the bulbs by dozens.

Genus **PYRAMIDULA** Fitzinger

Pyramidula cronkhitei anthonyi Pilsbry.

Palmer Lake (Bethel); mouth of Troublesome Creek in Middle Park, Lake George near Florissant, and Copeland Park in Boulder County (S. A. Rohwer); Floyd Hill (Hand); Tolland and Sulphur Springs (Dodds); Florissant, and Minnehaha Falls on Pike's Peak (Cockerell); Magnolia at 8,500 feet, Newcastle, eight miles east of Rabbit Ears in southwest corner of North Park, and along White River from Meeker nearly to Marvine Lakes (Henderson). The range of this species is on the whole lower than that of the next, though they overlap.

Pyramidula shimeki cockerelli Pilsbry.

North Boulder Creek at 9,000 feet (S. A. Rohwer); northeast of Ohio City (F. Rohwer); Ward at 9,000 feet (Dodds); Tolland (Betts, Henderson); west of Allen's Park at 9,000 feet (Spangler); Pike's Peak at 8,900 feet, Boulder Canyon at 7,300 feet (Cockerell); Floyd Hill (Hand). I have found this more abundant at Eldora, under aspen logs in the bottom-lands, than anywhere else. Last summer in a couple of hours my wife and I collected 474 specimens there, where it was the most common species except *Vitrina alaskana*.

Genus PUNCTUM Morse

Punctum pygmaeum minutissimum Lea.

Mrs. Cockerell found two specimens of this minute shell at Tolland last summer (*Nautilus*, Vol. XXV, p. 58).

Genus SPHYRADIUM Agassiz

Sphyradium alticola Ingersoll.

Floyd Hill (Hand); Tolland (Cockerell); near Ohio City (F. Rohwer); Long's Peak Inn (Spangler); Magnolia and Eldora (Henderson). Probably all of our Colorado records of *edentulum* should be placed under *alticola*. The differences have been recently discussed by Hanna (*Proc. U.S. Nat. Mus.*, Vol. XLI, pp. 373–376).

Genus SUCCINEA Draparnaud

Succinea retusa Lea.

I found it abundant on muddy banks of sloughs at Sulphur Springs and Steamboat Springs, less abundant at Kremmling and Buford.

Succinea grosvenori Lea.

I found live specimens abundant on muddy slough bank and dead shells abundant along a creek bank at Kremmling, a few dead shells along the shores of an alkali lake in the southwest corner of North Park.

Succinea avara Say.

Granby, Glenwood Springs, Radium and Denver (Bethel); Sulphur Springs (Dodds); Gibson Peak in Custer County and Florissant (Cockerell); Morrison and near Ohio City (F. Rohwer); Kremmling, McCoy, Lyons, Rio Blanco, Meeker, South Boulder Canyon and Magnolia (Henderson). Unlike *retusa* and *grosvenori*, this species seems to thrive in very dry places as well as in the immediate vicinity of water. The Radium specimens were under rabbit-bush and sage-brush, Glenwood Springs and McCoy specimens in very dry cedar forest.

Genus GALBA Schrank

Baker in his recent monograph on the Lymnaeidae of North America has separated from *Lymnaea* all our Colorado species heretofore recorded under that name, and placed them in the genus *Galba*.

Galba doddsi Baker.

Types collected at Sulphur Springs by Dr. G. S. Dodds, in 1907. Baker also places the West Cliff records of *L. truncatula* here.

Galba bulimoides techella Haldeman.

La Junta (Dodds), specimens identified by Baker.

Galba bulimoides cockerelli Pilsbry and Ferriss.

Reservoir seven miles northwest of Longmont (Spangler); Montclair (Markman); pond on Fossil Ridge, south of Ft. Collins (Henderson). Baker, at page 219 of his monograph, puts the Florence records of *techella* (Kenyon) under this species, and also records it from San Luis Valley (Ingersoll), and southeast of Denver (Putnam).

Galba hendersoni Baker.

Type locality, foothills west of Ft. Collins (*Nautilus*, Vol. XXII, p. 140). The types were collected by L. C. Bragg, and further specimens by E. Bethel.

Galba obrussa Say.

Mud Lake at 8,000 feet, north of Allen's Park, Boulder County (S. A. Rohwer); northeast of Ward at 8,500 feet, and Sulphur Springs (Dodds); Steamboat Springs, Box Elder and two miles below Trapper's Lake (Henderson).

Galba parva Lea.

I found it fossil in the Pleistocene deposits of Denver, and one of the specimens was identified and recorded by Dr. Baker.

Galba palustris Müller.

Smartweed Lake near Rollinsville (Robbins); Sulphur Springs (Dodds); Saguache (Cockerell); Grand River at Sulphur Springs, and Selah Lake at Granby (Bethel); Lake George near Florissant, divide north of Rollinsville, grass-grown pond at Kremmling, Muddy Creek above Kremmling, ditch at McCoy, an alkali lake in southwest corner of North Park, cool water at margin of stream flowing from hot spring at Sulphur Springs, on Curtis Creek northeast of Meeker and along White River from Meeker nearly to Trapper's Lake (Henderson). This is the most generally distributed species of the genus in Colorado, and is generally found in ponds, pools and lakes, rather than in streams.

It is interesting to note that *G. obrussa*, *cockerelli*, *hendersoni* and *caperata* are often found in ditches and shallow lagoons along the edge of the great plains, from which the water is withdrawn during several months each year, the mollusks burrowing into the mud and remaining dormant.

G. sumassi should be eliminated from our fauna. Dr. Frank C. Baker writes, under date November 23, 1908: "The *Lymnaea sumassi* is, as you suspected, only a form of *palustris*, the true *sumassi*, types of which I have recently seen, being quite another thing."

Genus **PLANORBIS** Guettard

Planorbis trivolvis Say.

Lake three miles west of Gold Hill at 8,500 feet (Miss Rosamond Patton); seven miles northwest of Longmont (Spangler); Marvine Lodge in Rio Blanco County, and Steamboat Springs (Henderson). This species seems to be much more common east of the Continental Divide than west of it.

Planorbis parvus Say.

Pool two miles east of Ward at 8,580 feet, Tolland and La Junta (Dodds); six miles below Trapper's Lake in Rio Blanco County, Fossil Ridge south of Ft. Collins, Buford and Kremmling (Henderson).

Planorbis exacuous Say.

Lake between Gresham and Ward, at about 8,000 feet (S. A. Rohwer); Kremmling (Henderson). The latter specimens are much larger than any I have seen from elsewhere in Colorado.

Planorbis antrosus Conrad.

Vanatta (*Nautilus*, Vol. XXIV, pp. 136–138) has shown that the name *P. bicarinatus* Say, commonly used for this species, was preoccupied, and Conrad's name is next in order.

The species has been known in Colorado from two or three localities, but only a few specimens had been seen until a fine colony was found on the St. Vrain, three miles west of Longmont (Spangler). He collected several hundred without any difficulty. The specimens are all rather small, but seem otherwise typical.

Genus **ANCYLUS** Geoffroy

Ancylus rivularis Say.

The records of *A. caurinus* in Part II of this catalogue, based upon identification by Dr. Bartsch, should be eliminated. The specimens have been submitted to Mr. Bryant Walker, who pronounces them *A. rivularis*, which I believe to be correct, and it avoids a serious difficulty as to distribution. A single dead specimen recorded from Kremmling long ago by Professor Cockerell (*Nautilus*, Vol. III, p. 21) as "probably *Ancylus caurinus*" likely belongs here. It is also likely that the Colorado records of *fragilis* and *parallelus* belong here.

Genus **PHYSA** Draparnaud

Physa gyrina Say

Saguache County (Cockerell); mouth of Sand Creek on Bear River in Routt County (Warren); Kremmling, Sulphur Springs, Steamboat Springs and southwest corner of North Park (Henderson). This is the most generally distributed *Physa* of Colorado. Long ago recorded from Eagle County by Professor Cockerell (*Nautilus*, Vol. III, p. 21) but the record inadvertently omitted from Part II of this catalogue. Professor Cockerell's suggestion, however, that this species is "generally replaced in this region by *P. heterostropha*," is not in accordance with recent notions of the distribution of the two species. Probably *P. heterostropha* and *P. lordi* should both be eliminated from our Colorado faunal list.

Physa walkeri Crandall.

Specimens from a pond on Fossil Ridge, south of Ft. Collins, were thus identified by Dr. Frank C. Baker.

Genus **APLEXA** Fleming

Aplexa hypnorum Linn.

I found a single specimen at Buford, Rio Blanco County.

Genus **VALVATA** Müller

Valvata sincera Say.

Valvata lewisi was included in Part II of this catalogue because of Dall's definite inclusion of Colorado within its range, and because he cut *sincera* out of the United States I placed Ingersoll's record of *sincera* for San Luis Valley under *lewisi*. It seems to me now that Dr. Dall was probably in error concerning these species. At any rate, I found *V. sincera* abundant in a small pond on Marvine Creek, Rio Blanco County, and consider it much safer to believe that Ingersoll's record was correct. Mr. Bryant Walker has confirmed the identification of the Marvine specimens.

PROTOZOA OF HIGH MOUNTAIN LAKES IN COLORADO[1]

By C. H. Edmondson[2]

In an article published recently in these *Studies*[3] there is given a list of the protozoa reported up to that time as occurring in Boulder County. The following list, which is the result of collections during the months of July and August, 1911, in Boulder, Grand, Gilpin and Clear Creek counties, is a duplication, in part, and some addition to the protozoan fauna previously reported from Colorado. Besides the work of the writer, Mr. G. H. Wailes, now of New York, and Dr. E. Penard, of Geneva, Switzerland, both authorities on Rhizopoda, rendered assistance by the identification of numerous species from material sent them.

The chief purpose of this study was to determine, if possible, the maximum alpine distribution of different groups of protozoa, and to observe conditions of environment under which certain species might exist at high altitudes.

For the most part, high mountain lakes were the source of material, although, in a number of instances, collections were made in moist localities at a considerable distance from lakes. Twenty-one lakes, in the four counties mentioned above, were visited and collections made from them. Of these, eighteen were 10,000 feet or more in altitude. A list of the lakes follows, with their elevations: Park Lake, 8,875 feet; Peterson Lake (Eldora Lake), 9,245 feet; Teller Lake, 9,300 feet; Redrock Lake, 10,000 feet; Echo Lake (Clear Creek County), 10,000 feet; Silver Lake, 10,200 feet; Brainard Lake, 10,300 feet; Long Lake, 10,400 feet; Yankee Doodle Lake, 10,600 feet; Jenny Lake, 10,800 feet; Echo Lake (Gilpin County), 11,072

[1] *Publication of the Colorado Biological Survey*, No. 5.

[2] *Editor's Note:* This report was kindly prepared by Professor C. H. Edmondson, of Washburn College, Topeka, Kansas, at the request of the editor of these *Studies*.

[3] Cockerell, T. D. A., "The Fauna of Boulder County, Colorado," *University of Colorado Studies*, Vol. VIII, p. 227 *et seq.*, June, 1911.

feet; James Peak Lake, 11,090 feet; Corona Lake, 11,185 feet; Emerald Lake, 11,200 feet; Pumphouse Lake, 11,300 feet; Reynolds' Lake, 11,300 feet; Stewart Lake, 11,305 feet; Ohmond Lake, 11,600 feet; Second Chicago Lake, 11,700 feet; Ice Lake, 12,188 feet; Summit Lake, 12,740 feet.

Collections were also made near the snowsheds at Corona, 11,660 feet, on James Peak, 12,500 feet and above Summit Lake, on the north side of Mt. Evans, at 13,000 feet. This latter elevation is probably the highest altitude at which protozoa have been recorded in North America.

Two lakes, Silver and Eldora, on which boats were available, were sounded and dredged. Contrary to local belief, the lakes are very shallow. Eldora Lake was found to be less than forty feet in depth, and Silver Lake at its present height is about fifty feet deep.

These mountain lakes of Colorado are evidently very old. Professor Henderson, of the University of Colorado, speaking with reference to the above list of lakes, says that all the lakes he has seen above 9,000 feet are glacial.

Protozoa were found at the bottom of the lakes dredged, but these lakes are too shallow to possess a peculiar fauna such as Penard found in the very deep lakes of Switzerland.

Temperature records of all the lakes mentioned above have probably not been taken. Dr. G. S. Dodds, in 1908,[1] took a number of readings, and has kindly furnished the following: Long Lake, August 20, 43 degrees; Yankee Doodle Lake, August 28, 53 degrees; Corona Lake, August 28, 52 degrees; Pumphouse Lake, August 28, 53 degrees; Teller Lake, August 31, 55 degrees; Redrock Lake, August 18, 62 degrees. The writer recorded the temperature of the following lakes during 1911: Eldora Lake, August 11, 58 degrees; Pumphouse Lake, August 12, 41 degrees; Silver Lake, August 14, 52 degrees. Although the temperature of the lakes no doubt varies considerably, the above readings may be considered as average temperatures during the summer. Ice Lake, at the base of James Peak, is very cold, snow and ice being found at its edge throughout the

[1] At that time an instructor in biology at the University of Colorado.

summer months. No temperature records of this lake were taken. The higher lakes are practically void of plant life, except the microscopic forms. At the outlets, however, algae and mosses are usually to be found abundantly. Here protozoa have their habitat and many species are obtained by collecting these plants. The ooze from stones and the beds of the lakes furnish other forms, especially rhizopods.

By comparing the following list with the protozoa reported from sea-level in tropical Tahiti (*Science*, September 9, 1910), there will be seen not only the latitudinal but also the great altitudinal range which many of our species have.

There follows a classified list of protozoa with the highest altitude observed for each genus or species identified:

PHYLUM **PROTOZOA**, SUBPHYLUM **Sarcodina**
CLASS RHIZOPODA, SUBCLASS AMOEBEA
ORDER *GYMNAMOEBIDA*

FAMILY **AMOEBIDAE**

Amoeba Ehrenberg. *A. proteus* Ehr., Ohmond Lake; *A. verrucosa* Ehr., Ice Lake; *A. radiosa* Ehr., James Peak Lake.

ORDER *TESTACEA*

FAMILY **ARCELLIDAE**

Arcella Ehrenberg. *A. vulgaris* Ehr., James Peak Lake; *A. discoides* Ehr., Summit Lake; *A. arenaria* Greeff, Summit Lake; *A. catinus* Penard, Summit Lake; *A. hemispherica* Perty, Summit Lake.

The first two species are widely distributed and are common at high altitudes. The last three species were identified by Wailes.

Centropyxis Stein. *C. aculeata* Stein; *C. laevigata* Penard.

The former species is very widely distributed, observed from Summit Lake to lower altitudes. The latter species identified by Wailes from Corona.

Cochliopodium Hertwig & Lesser. *C. bilimbosum* Auerbach. On James Peak. Very rarely observed.

Cucurbitella Penard. *C. mespiliformis* Penard.

A single specimen, but a very representative one, was found in Lake Eldora.

Difflugia Leclerc. *D. pyriformis* Perty; *D. constricta* Ehr.; *D. rubescens* Penard; *D. lobostoma* Leidy; *D. corona* Wallick; *D. lanceolata* Penard; *D. curvicaulis* Penard; *D. elegans* Penard; *D. acuminata* Ehr.; *D. bacillifera* Penard; *D. lebes* Penard; *D. fallax* Penard; *D. globulus* Ehr.; *D. oblonga* Ehr.; *D. oblongata*, var. *lacustris* Penard; *D. lucida* Penard; *D. pristis* Penard; *D. manicata* Penard.

The last five species and the variety were identified by Wailes. Of the above species *D. lebes* is the largest, *D. pyriformis* is the most common and *D. constricta* is found at higher altitudes. The latter was observed at 13,000 feet. *D. rubescens*, one of the smaller species, is common on James Peak at 12,500 feet. Other species range from Summit Lake to lower levels. The finest specimens of the larger forms were taken from the ooze at the bottom of Lake Eldora where they are very abundant.

Heleopera Leidy. *H. rosea* Penard, Summit Lake and James Peak, common; *H. petricola* Leidy, Summit Lake; *H. petricola*, var. *amethysta* Penard, Summit Lake; the latter species and variety identified by Wailes; former species very common on James Peak at 12,500 feet among mosses—also found in Pumphouse Lake.

Lecquereusia Schlumberger. *L. spiralis* Ehr.; *L. epistomium* Penard; *L. modesta* Rhumbler.

The first two of these three known species of the genus are not uncommon at an altitude of 11,000 feet. Both were observed as high as Summit Lake; the other species at Corona and lower levels. In material from Summit Lake Dr. Penard found a form shaped like *L. modesta* but with a test of typical vermiform pellets. He considers it a variety of *L. spiralis.*

Nebela Leidy. *N. dentistoma* Penard; *N. collaris* Ehr.; *N. lageniformis* Penard; *N. longicollis* Penard; *N. flabellum* Leidy; *N. tubulosa* Penard; *N. bigibbosa* Penard; *N. minor* Penard; *N. galeata* Penard; *N. tincta* (Leidy) Awer.; *N. vitraea* Penard; *N. collaris*, var. *retorta* Leidy; *N. dentistoma*, var. *lacustris* Wailes.

The last three species and the varieties were identified by Wailes. Dr. Penard identified *N. longicollis* and *N. bigibbosa* from the writer's slides. The genus is widely distributed, most of the species being found at very high altitudes, in Summit Lake, on James Peak and at Corona.

Phryganella Penard. *P. nidulus* Penard, Lake Eldora; *P. hemispherica* Penard, James Peak.

The latter identified by Wailes. The former species is common in the ooze at the bottom of Lake Eldora.

Plagiopyxis Penard. *P. callida* Penard, Lake Corona.

Identified by Wailes.

Pontigulasia Rhumbler. *P. spectabilis* Penard, Ice Lake; *P. compressa* Carter, Summit Lake.

The latter species identified by Wailes. Many specimens of the former species were found in the ooze at the bottom of Lake Eldora.

Pyxidicula Ehrenberg. *P. cymbalum* Penard, Summit Lake.

Identified by Dr. Penard. A rare form.

FAMILY EUGLYPHIDAE

Assulina Ehrenberg. *A. minor* Penard; *A. muscorum* Greeff, Summit Lake. Identified by Wailes; *A. seminulum* Leidy, Corona. Identified by Wailes.

A. minor was observed in Summit Lake and above the lake at an altitude of 13,000 feet.

Cyphoderia Schlumberger. *C. ampulla* Leidy; *C. ampulla*, var. *papillata* Wailes.
The species was observed in Corona Lake, but both species and variety are abundant in decayed tissue of sponges in Lake Eldora.

Euglypha Dujardin. *E. alveolata* Duj.; *E. ciliata* Ehr.; *E. brachiata* Leidy; *E. filifera* Penard; *E. laevis* Perty; *E. strigosa* Leidy; *E. strigosa* f. *heterospina.*
The above species were all found in Summit Lake and most of them at lower levels. Wailes assisted in the identification of these species. [*Euglypha cristata* Leidy is added by Wailes (*in litt.*) from Summit Lake.]

Pamphagus Bailey. *P. mutabilis* Bailey, Reynolds' Lake.
But one specimen observed.

Placocista Leidy. *P. spinosa*, var. *setigera* Wailes, Summit Lake. Identified by Wailes.

Pseudodifflugia Schlumberger. *P. gracilis* Schlumb., Summit Lake and Corona. Identified by Wailes.

Trinema Dujardin. *T. camplanatum* Penard. Identified by Wailes; *T. enchelys* Ehr.; *T. lineare* Penard.
All species found in Summit Lake, the last two being observed in other high lakes.

Class ACTINOPODA, Subclass HELIOZOA
Order *APHROTHORACA*
Family **ACTINOPHRYIDAE**

Actinophrys Ehrenberg. *A. sol* Ehr., Jenny Lake.

Order *CHALARATHORACA*
Family **HETEROPHRYIDAE**

Raphidiophrys Archer. *R. elegans* Hertwig & Lesser.
Very abundant in Long and Redrock lakes.

Order *DESMOTHORACA*
Family **CLATHRULINIDAE**

Clathrulina Cienkowsky. *C. elegans* Cienk., Summit Lake.
Very abundant.

Subphylum **Mastigophora**
Class ZOOMASTIGOPHORA
Order *HETEROMASTIGIDA*
Family **NOTOSOLENIDAE**

Notosolenus Stokes. *N. orbicularis* Stokes.
Corona and lower altitudes. Common.

Family **ANISONEMIDAE**

Anisonema Dujardin. *A. acinus* Duj., Jenny Lake.
Not abundant.

Order *MONADIDA*

Family HETEROMONADIDAE

Anthophysa Bory d. St. Vincent. *A. vegetans* Müll., Corona and Yankee Doodle lakes.

Order *EUGLENIDA*

Family EUGLENIDAE

Euglena Ehrenberg. *E. viridis* Ehr., Ohmond Lake; *E. deses* Ehr., Long Lake; *E. spirogyra* Ehr., Long Lake; *E. acus* Ehr., James Peak; *E. torta* Stokes, Lake Eldora.

Of the above species all except the last are widely distributed among the lakes. *E. viridis* is the most common.

Phacus Dujardin. *P. pleuronectes* Müll., Lake Eldora; *P. longicaudus* Ehr., Redrock Lake; *P. pyrum* Ehr., Ohmond Lake.

Species of the genus were not found abundantly in any locality.

Trachelomonas Ehrenberg. *T. piscatoris* Stokes; *T. cylindrica* Ehr.; *T. armata* Stein; *T. horrida* Palmer; *T. crebea* Kellicott; *T. volvocina* Ehr.; *T. hispida* Stein.

Most of the above species are widely distributed from the Second Chicago Lake and Corona to lower levels. *T. volvocina* is most common. *T. crebea,* which has a curved neck, was observed in Redrock Lake only.

Family ASTASIIDAE

Astasia Ehrenberg. *A. trichophora* Ehr., Corona, Ohmond Lake and other lower lakes. Common.

Distigma Ehrenberg. *D. proteus* Ehr., Ohmond Lake.

Very widely distributed.

Family PERANEMIDAE

Petalomonas Stein. *P. abscissa* Duj. This species, which has a very prominent ridge, was observed in Reynolds' Lake only. *P. mediocanellata* Stein. A form which probably should be placed here was observed in Lake Eldora.

Entosiphon Stein. *E. sulcatus* Duj., Redrock Lake only.

Heteronema Dujardin. *H. acus* Ehr. Common in Lake Eldora.

Class PHYTOMASTIGOPHORA

Order *CHRYSOFLAGELLIDA*

Family CRYPTOMONADIDAE

Chilomonas Ehrenberg. *C. paramecium* Ehr.

Very widely distributed. Found in Ohmond Lake and at lower altitudes.

Cryptomonas Ehrenberg. *C. ovata* Ehr., Reynolds' Lake.

Common in nearly all of the lower lakes.

Chlamydomonas Ehrenberg.

Two species of this genus were observed, one in Summit Lake, one in Redrock Lake. Neither were identified. Not common.

Chrysomonas Stein. *C. pulchra* (?) Stokes.

A species corresponding to Stokes's species except for the lack of green coloring matter. Very common in Reynolds' Lake.

ORDER *CHLOROFLAGELLIDA*

Pandorina Bory d. St. Vincent. *P. elegans* Ehr., Jenny Lake. Also common in Long Lake.

SUBPHYLUM **Infusoria**

CLASS CILIATA

ORDER *HOLOTRICHIDA*

FAMILY **ENCHELINIDAE**

Coleps Ehrenberg. *C. hirtus* Ehr., Long Lake, common.

Lacrymaria Ehrenberg. *L. olor* Müll., Redrock Lake; *L. truncata* Stokes, Ice Lake. Neither species was found to be widely distributed.

Prorodon Ehrenberg. *P. teres* Ehr., Ohmond Lake and many other lower lakes.

Mesodinium Stein. An undetermined species observed at Corona, not common.

FAMILY **TRACHELIIDAE**

Lionotus Wrzesniowski. *L. fasciola* Ehr., Jenny Lake.

Common in the lower lakes.

Dileptus Dujardin. *D. gigas* C. and L., Corona Lake.

Apparently not a common species at high altitudes.

Loxodes Ehrenberg. *L. rostrum* Ehr., Redrock Lake.

Not common.

Amphileptus Ehrenberg. *A. meleagris* Ehr., Yankee Doodle Lake.

FAMILY **CHLAMYDODONTIDAE**

Chilodon Ehrenberg. *C. cucullulus* Müll., Ice Lake.

A very common species in many lakes.

Nassula Ehrenberg. *N. oronata* Ehr., Reynolds' Lake.

FAMILY **CHILIFERIDAE**

Leucophrys Ehrenberg.

An unidentified species common in Jenny Lake is referred to this species provisionally. The form possesses chlorophyll while the species *L. patula* Ehr. does not.

FAMILY **COLPODIDAE**

Colpoda Müller. *C. helia* Stokes, Corona and lower lakes. *C. campyla* Stokes, Yankee Doodle Lake; *C. saprophyla* Stokes, Corona and Jenny lakes.

Colpidium Stein. *C. striatum* Stokes, Jenny Lake.

Not common.

Glaucoma Ehrenberg. *G. scintillans* Ehr., Ice Lake and lower altitudes. Widely distributed.

Loxocephalus Ehrenberg. *L. granulosus* S. Kent, Corona and many lower lakes.

Frontonia Ehrenberg. *F. leucas* Ehr., Corona Lake. Distribution general.

Family MICROTHORACIDAE

Cinetochilum Perty. *C. margaritaceum* Ehr., Jenny and Long lakes.

Microthorax Engelmann. *M. sulcatus* Eng., Eldora Lake. Not common.

Family PARAMAECIIDAE

Paramaecium Müller. *P. caudatum* Ehr., Corona, Ohmond Lake and lower altitudes; *P. bursaria* Ehr. Common in Redrock Lake and other lower lakes, among algae. Green in color; *P. trichium* Stokes, Jenny Lake.

Family PLEURONEMIDAE

Lembadion Perty. *L. bullinum* Perty, Yankee Doodle and Redrock lakes. Common in these two lakes.

Cyclidium Ehrenberg. *C. glaucoma* Ehr., Jenny Lake.

Family CYRTOLOPHOSIDAE

Cyrtolophosis Stokes. *C. mucicola* Stokes, Jenny Lake and Redrock Lake.

Order *HETEROTRICHIDA*

Family PLAGIOTOMIDAE

Spirostomum Ehrenberg. *S. teres* C. and L., Jenny Lake and lower altitudes.

Blepharisma Perty. *B. lateritia* Ehr., Long Lake and Redrock Lake. Common. *B. elongata* Stokes, Reynolds' Lake.

Metopus Claparede and Lachmann. *M. sigmoides* Müll., Corona and lower altitudes; *M. acuminata* Stokes, Jenny Lake. Not common.

Family STENTORIDAE

Stentor Oken. *S. caeruleus* Ehr., Redrock Lake. Not observed in the higher lakes.

Family HALTERIIDAE

Halteria Dujardin. *H. grandinella* Müll., Corona and Jenny lakes.

Strombidium Claparede and Lachmann. *S. viride* (?) Stein. A form corresponding to Stein's species was found in Stewart Lake.

Family GYROCORIDAE

Gyrocoris Stein. *G. oxyura* Stein, Redrock Lake.

ORDER *HYPOPTRICHIDA*

FAMILY **OXYTRICHIDAE**

Oxytricha Ehrenberg. *O. pellionella* Müll., Ice Lake.
Very widely distributed.

Stichotricha Perty. *S. secunda* Perty, Jenny Lake.

Uroleptus Ehrenberg. *U. longicaudatus* Stokes, Reynolds' Lake; *U. dispar* (?) Stokes. A common form in Jenny and Yankee Doodle lakes corresponds closely to this species.

Stylonychia Ehrenberg. *S. mytilus* Ehr., Brainard Lake; *S. notophora* (?) Stokes, Corona and lower altitudes.
Very widely distributed. There is some doubt as to its identification but it closely resembles Stokes's species.

Histrio Sterki.
Further study of the species of this genus will be necessary to identify them. Members of the genus were taken from Ohmond Lake, and from lower altitudes.

FAMILY **EUPLOTIDAE**

Euplotes Ehrenberg. *E. charon* Müll., Corona; *E. patella* Ehr., Ohmond Lake.

Aspidisca Ehrenberg. *A. costata* Duj., Ice Lake.
Very widely distributed.

ORDER *PERITRICHIDA*

FAMILY **VORTICELLIDAE**

Vorticella Linnaeus. *V. campanula* Ehr., Jenny Lake; *V. alba* From., Corona; *V. macrophyla* Stokes, Yankee Doodle Lake; *V. octavo* (?) Stokes, Corona; *V. sphaerica* (?) D'Udek., Corona.

Epistylis Ehrenberg. *E. flavicans* Ehr.
This species was taken from Park Lake, Tolland, at slightly less than 9,000 feet altitude. Not observed in any of the higher lakes.

Vaginicola Lamarck. *V.* sp.—An unidentified form very common in Summit Lake is referred to this genus. The lorica is compressed and slightly concave at the margin in the middle of the compressed surfaces. The posterior extremity is broadly rounded, sessile. Dense and of yellowish hue. Characteristics of the polyp not known, as the forms were not observed until the material had been preserved and the soft parts destroyed.

Cothurnia Ehrenberg. *C.* sp.—Lorica transparent, cylindrical with margin slightly everted. Three or four annulations about the middle of the lorica. Stalk very short. Common in Summit Lake. Living polyp not observed. Probably a new species.

Class SUCTORIA

Family PODOPHRYIDAE

Podophrya Ehrenberg. *P. fixa* Müll. No active form of this species was found, but the cyst which is characteristic was taken from Lake Eldora. Not observed in higher lakes.

Sphaerophrya Claparede and Lachmann. *S. urostylae* (?) Maupas.

A form probably of this species was found in material from Corona Lake.

ANIMALS AND PLANTS DESCRIBED AS NEW FROM COLORADO IN 1911[1]

By T. D. A. Cockerell

It is proposed to issue each year a list of the animals and plants described as new from Colorado during the year before, with references to the place of publication, the type locality and the collector, if known. If the type locality is not in Colorado, but Colorado specimens are cited in the original publication, the species is included. At some later date it may be possible to catalogue the new forms described from Colorado prior to 1911, but this would be a great undertaking.

Although I have made every effort to complete the present list, there are probably some omissions. I shall be glad to hear of anything omitted, and will include it in next year's list. T. l. = Type locality. The year, when not stated for a publication, is understood to be 1911. Extinct species are marked †.

PLANTAE

Phylum THALLOPHYTA

Order *SPHAERIALES*

Family SPHAERIACEAE

The following represent new genera as well as species.

Comoclathris lanata Clements, Minnesota Botanical Studies, IV, Sept., 1911, p. 185. T. l. Silverton, July, 1907 (Clements).

C. ipomoeae Clements, l. c. T. l. Wray, Aug., 1907 (Clements).

Pezoloma griseum Clements, t. c., p. 186. T. l. Minnehaha, July, 1906 (Clements).

Leucopezis excipulata Clements, t. c., p. 187. T. l. Mountain View, Pike's Peak, July, 1905 (Clements).

Sirodothis populi Clements, t. c., p. 187. T. l. Long's Peak Inn, Aug., 1907 (Clements).

Sirocyphis nivea Clements, t. c., p. 188. T. l. Long's Peak, Aug., 1907 (Clements).

[1] *Publication of the Colorado Biological Survey*, No. 9.

Order *PEZIZALES*

Family ASCOBOLACEAE

Ascobolus xylophilus Seaver, *Mycologia*, III, March, p. 61. T. l. Geneva Creek Canyon, Colo., on coniferous wood, Sept., 1910 (Seaver and Bethel). It is the only North American species on wood; most occur on dung. *A. immersus* Pers. and *A. stercorarius* (Bull.) were found on cow-dung from Geneva Creek Canyon.

Family CENANGIACEAE

Godronia betheli Seaver, *Mycologia*, III, March, p. 64. T. l. Tolland, on branches of *Salix*, Aug., 1910 (Seaver and Bethel). Seaver in *Mycologia*, IV (1912), p. 123, states that this is apparently identical with *G. striata* (Ell. and Ev.) Seaver.

Order *SPHAEROPSIDALES*

Family SPHAEROPSIDACEAE

Septoria samarae Peck, *New York State Museum Bulletin*, CL (Botanist's Report for 1910), p. 63. Dated May 15, 1911, but was not sent out until Aug. 20 (Peck *in litt.*). T. l. Morrison (E. Bartholomew); also at Golden (E. Bethel). Mr. Bethel tells me that it is common at Boulder. It occurs in samarae of *Acer negundo* and *A. glabrum.*

Order *UREDINALES*

Family AECIDIACEAE

Uromyces aemulus Arthur, *Bull. Torr. Bot. Club*, Aug., p. 373. T. l. Yellowstone Park, on *Allium brevistylum;* also at Hot Sulphur Springs, Colo., July 24, 1907 (E. Bethel).

U. mysticus Arthur, t. c., p. 377. T. l. Denver, on *Hordeum jubatum*, Oct. 29, 1910 (E. Bethel). Mr. Bethel tells me that the type was from Washington Park.

Puccinia pagana Arthur, t. c., p. 372. T. l. Dead Lake, Pike's Peak, on *Allium reticulatum*, Aug. 20, 1904 (F. E. and E. S. Clements).

Gymnosporangium juvenescens Kern, *Bull. N.Y. Bot. Garden*, VII (Oct.), p. 448. T. l. Boulder, on *Sabina scopulorum*, April 27, 1907 (Arthur, Bethel and Kern). Mr. Bethel says the type came from Skunk Canyon. The aecia are on *Amelanchier*. This is the species formerly confused with *G. nelsoni.*

G. kernianum Bethel, *Mycologia*, III, May, p. 157. T. l. Paonia, on *Sabina utahensis* (Bethel). Also at Glenwood Springs (Bethel).

Phylum SPERMATOPHYTA

Class ANGIOSPERMAE

Subclass DICOTYLEDONES

Family SALICACEAE

Populus aurea Ivar Tidestrom, *Amer. Midland Naturalist*, II, March, p. 35. T. l. vicinity of Mount Carbon, May 29, 1910. Also from Horse Fly Mountain, Uncompahgre Plateau, Colo., and in Utah. The Colorado material was collected by Tidestrom. This is said to differ from *P. tremuloides* by the shorter and less dense aments, larger and more irregularly cleft bracts, larger anthers, and broader, shorter, somewhat translucent cupulae of the pistillate flowers. The leaves become golden or orange in the fall; those of *tremuloides* light yellow. From observations made in New York state, I feel satisfied that the Colorado tree is not quite like the true *tremuloides*, but how much of the difference is really racial or specific remains to be seen. Daniels proposes to call our tree *P. tremuloides aurea*. An earlier name, if the plant is regarded as a variety, is *P. tremuloides minor* Cockerell, *Nature Notes*, Jan., 1891, p. 14; type from gulch above Micawber Mine, Custer Co., Colo.

Family **BRASSICACEAE**

Erysimum cockerellianum Daniels, *Univ. of Missouri Studies*, II, No. 2, p. 131. Boulder County. This is a new name for *E. alpestre* (Ckll.), preoccupied. Rydberg refers it to *E. wheeleri* S. Wats., which is, however, a tall plant from San Francisco Mountain, Arizona, apparently distinct.

Family **CUNONIACEAE?**

†**Carpolithes macrophyllus** Cockerell, *Torreya*, Nov., p. 235. Miocene shales of Florissant (W. P. Cockerell).

Family **ROSACEAE**

Acomastylis arapahoensis Daniels, *Univ. of Missouri Studies*, II, No. 2, p. 146. T. l. Arapahoe Peak, Boulder County, at timber-line, 11,500 ft. (Daniels).

Rosa pratincola angustiarum Cockerell in Daniels, t. c., p. 148. T. l. Boulder Canyon, near Castle Rock, 7,340 ft. (Cockerell). The name *Rosa pratincola* is a homonym, and Dr. Greene has proposed a substitute.

R. pratincola setulosa Cockerell in Daniels, p. 148. T. l. Bluebell Canyon, Boulder, 1910 (Cockerell). New combinations will be necessary for *angustiarum* and *setulosa*, but these are not offered at the present time, owing to uncertainty regarding the number of species to be recognized in this group. Mr. D. M. Andrews and the writer propose to grow the various forms side by side, and hope eventually to be able to revise the Colorado species. The indications are that these plants include a great number of minor types, like the *R. canina* group of Europe, and consequently the number of true "species" will remain a matter of opinion.

The published description of *setulosa* merely states "fruit bristly." To this should be added the following, based on the original type:

Petals very pale pink, practically uniform; diameter of flower 42 mm.; sepals foliolar-tipped, not lobed, with many stalked glands; leaflets 9 to 11, pale beneath, sessile or almost, simply serrate; stipules entire. Runs straight to *R. pratincola* in Rydberg's key (*Flora of Colorado*), and in Nelson's to *arkansana* except for the bristly fruit.

Family **AMYGDALACEAE**

Prunus prunella Daniels, t. c., p. 151. T. l. Mesa at entrance of Gregory Canyon, and facing the first Flat-iron, Boulder (Daniels).

Family **FABACEAE**

Apios apios boulderensis Daniels, t. c., p. 161. T. l. Gulch at foot of Flagstaff Hill, Boulder, 1906 (Daniels).

Family EUPHORBIACEAE

Tithymalus marginatus tetramerus f. **inornata** Daniels, t. c., p. 165. T. l. about Boulder (Daniels).

T. philorus f. **dichotoma** Daniels, t. c., p. 165. T. l. Green Mountain, on high ridges, Boulder County (Daniels).

Family SPONDIACEAE

Schmaltzia pubescens Osterhout, *Muhlenbergia*, Feb., p. 11. T. l. near Rule Creek, Bent County (Osterhout). Differs from other Colorado species in its dense pubescence.

Family VITACEAE

Vitis boulderensis Daniels, *Univ. of Missouri Studies*, II, No. 2, p. 169. T. l. gulch at base of Flagstaff Hill, Boulder (Daniels).

Family EPILOBIACEAE

Chamaenerion angustifolium platyphyllum Daniels, t. c., p. 176. T. l. canyons on Green Mountain, Boulder (Daniels).

Family POLEMONIACEAE

Collomia linearis boulderensis Daniels, t. c., p. 198. T. l. plains about Boulder (Daniels).

Family VERBENACEAE

Verbena bracteosa albiflora Cockerell in Daniels, t. c., p. 204. T. l. University Campus, Boulder (Cockerell).

Family RHINANTHACEAE

Castilleja arapahoensis Daniels, t. c., p. 216. T. l. wet tundras, above timber-line, Arapahoe Peak, 11,000–12,000 ft., Sept., 1906 (Daniels). This has passed as *C. lauta*, but is apparently distinct.

C. linariaefolia filiformis Daniels, t. c., p. 215. T. l. barren ridges between Sugarloaf Mountain and Glacier Lake, 8,700–9,200 ft. (Daniels).

Family CARDUACEAE

Grindelia eldorae Daniels, t. c., p. 227. T. l. Eldora, 8,500–8,700 ft. (Daniels).

Tetraneuris lanigera Daniels, t. c., p. 245. This is *Actinella lanata* Nuttall, not Pursh. Boulder County, etc.

Cirsium vernale; *Carduus vernalis* Osterhout, *Muhlenbergia*, Feb., p. 12. Type from De Beque, Mesa Co. (Osterhout); also collected there, a year earlier, by E. Bethel.

ANIMALIA

Phylum ARTHROPODA

Class CHILOPODA

Family LITHOBIIDAE

Lithobius dopaintus Chamberlin, *Canad. Entom.*, p. 69. T. l. Manitou (Chamberlin).

Class ARACHNIDA

Order *ACARINA*

Family TETRANYCHIDAE

Stigmaeodes cinctus Ewing, *Psyche*, Feb., p. 39. Type in wild grass, Fort Collins (S. A. Johnson).

It will be well to record here that Mr. E. Bethel reports the discovery of **Tenuipalpus coronatus** Can. and Targ. (det. Banks) on *Sabina scopulorum* in the parks at Denver. This is a European species, not before reported from America.

Class CRUSTACEA

Order *COPEPODA*

Diaptomus coloradensis Marsh, *Trans. Wisc. Acad. Sci.*, Nov., XVII, p. 197. "Corona, Kremmling, Tolland and Mount Carbon, Colorado." Corona is herewith designated as the type locality. The material was doubtless collected by Marsh.

Class INSECTA

Order *NEUROPTERA*

Family MANTISPIDAE

Mantispa brunnea occidentalis Banks, *Trans. Amer. Ent. Soc.*, XXXVII, p. 348. "From Wawawai, Washington (Mann); Ormsby County, Nevada (Baker); and Chimney Gulch, Golden, Colorado (Oslar)." Wawawai is herewith designated as the type locality.

Family HEMEROBIIDAE

Spadobius bifasciatus; *Sympherobius bifasciatus* Banks, *Trans. Amer. Ent. Soc.*, XXXVII, p. 347. "From Colorado (Baker)." I fully agree with the opinion that the citation of a type species is sufficient to give validity to a generic name, from the nomenclatural standpoint; but is it sufficient to simply combine the new generic name with a specific term, without stating the origin of the latter, beyond naming the author? The priority of *Sympherobius* over *Spadobius* is based entirely on a citation, in a list, of "*Sympherobius amiculus* Fitch," without anything to show that *amiculus* was the insect described by Fitch in *First Rept. Ins. N.Y.*, 1856, p. 95. It is true, of course, that this would be surmised by anyone familiar with the group, but is this sufficient to establish the name?

Family CHRYSOPIDAE

Chrysopa pleuralis Banks, t. c., p. 341. "From North Boulder Creek, Boulder County, Colorado, 21 Aug. (Rohwer), and Steamboat Springs, Colorado, 27 May (Cockerell)." North Boulder Creek is herewith designated as the type locality.

C. separata Banks, t. c., p. 341. "From Chimney Gulch, Golden, Colorado (Oslar), and Pecos, New Mexico, 23 June (Cockerell)." Chimney Gulch is herewith designated as the type locality.

ORDER *LEPIDOPTERA*

SUPERFAMILY **PAPILIONOIDEA**

FAMILY **SATYRIDAE**

Oeneis alberta oslari; *Chionobas alberta oslari* Skinner, *Entom. News*, May, p. 220. T. l. Deer Creek Canyon, Colo., Sept. 25, 1909 (E. J. Oslar). Larger than true *alberta;* in color and markings above it much resembles *Œ. katahdin;* below it is exactly *alberta.*

FAMILY **HESPERIIDAE**

Urbicola pawnee montana; *Pamphila pawnee montana* Skinner, *Entom. News*, Nov., p. 413. Colorado, eleven collected by David Bruce; two only have more precise data, one Chaffee Co., 7,500 ft., the other Salida, May 21, 7,500 ft. The altitude of Salida is 7,038 ft.; the type locality must be understood as near Salida, at 7,500 ft. The insect is much darker than typical *U. pawnee.*

Anthomaster sylvanoides utahensis; *Pamphila sylvanoides utahensis* Skinner, *Entom. News*, Nov., p. 413. T. l. Park City, Utah. Also from Idaho, and "Grizzly Mountains," Colorado (no collector cited). Larger and paler than typical *A. sylvanoides.*

FAMILY **NOCTUIDAE**

Acronycta metra J. B. Smith. *Entom. News*, July, p. 311. "Seattle, Washington; Colorado (Bruce)." The Colorado specimen had been referred with doubt to *A. felina.* Seattle is herewith designated as the type locality.

Euxoa angulirena J. B. Smith. *Trans. Amer. Ent. Soc.*, XXXVI, "Nov., 1910" (received Feb., 1911), p. 257. T. l. Colorado (Bruce). Allied to *E. brevipennis.*

E. brevistriga J. B. Smith, t. c., p. 257. T. l. Colorado, probably near Denver, collected by David Bruce. Allied to *E. brevipennis.*

E. lenola J. B. Smith, t. c., p. 260. "Glenwood Springs, Colorado, in August (Barnes); Fort Collins, Colorado (Gillette); Hot Springs, New Mexico, 7,000 ft. (Hulst)." The last locality is evidently Las Vegas Hot Springs. Glenwood Springs is herewith designated as the type locality. The species was confused with *E. caenis* and *E. gagates.*

E. poncha J. B. Smith, t. c., p. 258. "Denver, Ft. Collins, Poncha Springs, Colorado, in July." Received from David Bruce and C. P. Gillette. Allied to *E. medialis* and *E. truva.* Poncha Springs is to be considered the type locality.

E. rabiata J. B. Smith, t. c., p. 255. "Volga, South Dakota; Colorado; Calgary, Canada." The Colorado specimen from the Hulst collection. Allied to *E. rumatana* and *E. niveilinea.* Volga is herewith designated as the type locality.

E. teplia J. B. Smith, t. c., p. 253. "Colorado (Bruce); Stockton, Utah, IX, 14 (Spalding)." Allied to *E. cinereopallida.* Stockton is herewith designated as the type locality.

E. truva J. B. Smith, t. c., p. 259. "Denver and Poncha Springs, Colorado; July and September." Received from D. Bruce. Allied to *E. caenis* Grote. Denver is herewith designated as the type locality.

Mamestra ortruda J. B. Smith, t. c., p. 266. "Denver and Glenwood Springs, Colorado, April, June, July and August." First received from David Bruce, since sent by Dr. Barnes. Compared with *M. obesula, farnhami* and *albifusa*. Denver is herewith designated as the type locality.

Perigonica eldana J. B. Smith, *Journ. N.Y. Ent. Soc.*, Sept., p. 143. Glenwood Springs, Colo., May (Barnes); here designated as the type locality. Also in Arizona. It is the species described and figured by Hampson (*Cat. Lep. Phal.*, V, p. 435) as *P. tertia* Dyar.

Family LIPARIDAE

Olene grisefacta Dyar, *Proc. Ent. Soc. Wash.*, XIII, p. 20. "Glenwood Springs, Colo. (W. Barnes); Colorado (D. Bruce)." Glenwood Springs must be considered the type locality. Allied to *O. pinicola* Dyar, from Wisconsin, but larger and paler. Belongs to the conifer-feeding group.

Family GEOMETRIDAE

Chlorosea proutaria Pearsall, *Canad. Entom.*, July, p. 250. T. l. Chimney Gulch, Golden, Aug. 26, 1904 (Oslar). Also in Utah. "In appearance much like *nevadaria* Packard, but easily distinguished from it by the absence of red markings on the abdomen."

Order *HYMENOPTERA*

Superfamily TENTHREDINOIDEA (Sawflies)

Family TENTHREDINIDAE

†**Eriocampa synthetica** Cockerell, *Bull. Amer. Mus. Nat. Hist.*, XXX, p. 74. T. l. Miocene shales, Florissant (W. P. Cockerell).

Aphilodyctium rubripes nigritarsis Rohwer, *Proc. U.S. Nat. Mus.*, XLI, p. 408. T. l. Steamboat Springs, Colo., May 27, 1910 (T. D. A. Cockerell). Middle and hind tarsi black.

Empria conciliata MacGillivray, *Canad. Entom.*, Oct., p. 344. T. l. Chimney Gulch, Colorado (E. J. Oslar).

E. concreta MacGillivray, t. c., p. 344. T. l. Colorado (C. F. Baker).

E. condita MacGillivray, t. c., p. 342. T. l. Colorado (C. F. Baker).

E. conferta MacGillivray, t. c., p. 344. T. l. Colorado (C. F. Baker).

E. contexta MacGillivray, t. c., p. 345. T. l. Colorado (C. F. Baker).

E. contorta MacGillivray, t. c., p. 343. T. l. Chimney Gulch, Colorado (E. J. Oslar). These species of *Empria* are described without any table, or comparison with their allies. The catalogue of localities corresponding to the numbers on the Baker specimens went with the Baker collection to the National Museum; it probably gave the precise data concerning the above species collected by Baker, but I am informed that it cannot now be found.

Lycaota coloradensis Rohwer, *Proc. U.S. Nat. Mus.*, XLI, p. 384. T. l. Colorado (C. F. Baker).

Aneugmenus flavipes occidentalis Rohwer, t. c., p. 390. T. l. "Colorado."

Hoplocampa alpestris Rohwer, *Bur. Entom., Dept. Agric., Tech. Ser.*, No. 20, Pt. IV p. 142. T. l. Veta Pass, June 6 (E. A. Schwarz).

H. occidentalis Rohwer, t. c., p. 144. T. l. Colorado (C. F. Baker). Also in Oregon.

Superfamily ICHNEUMONOIDEA (Ichneumons)

Family ICHNEUMONIDAE

Mesochorus perniciosus Viereck, *Proc. U.S. Nat. Mus.*, XXXIX, p. 407. T. l. Rocky Ford (H. O. Marsh). Bred from *Loxostege sticticalis*, but probably hyperparasite of *Apanteles laeviceps* Ashmead, which was reared under the same conditions at the same time.

Pristomerus coloradensis Brues, *Psyche*, Feb., p. 23. T. l. Florissant, at flowers of *Antennaria microphylla*, June 16, 1907 (S. A. Rohwer).

Family BRACONIDAE

Ephedrus nigricornis A. B. Gahan, *Bull. 152, Md. Agr. Exp. Sta.*, p. 159. T. l. Ft. Collins (Gillette).

Aphidius gillettei A. B. Gahan, t. c., p. 171. T. l. Ft. Collins, parasitic on *Lachnus* on *Abies lasiocarpa* (C. P. Gillette).

A. juniperaphidis A. B. Gahan, t. c., p. 174. T. l. Boulder, parasitic on *Lachnus* on *Juniperus sibirica* (C. P. Gillette).

Lysiphlebus flavidus A. B. Gahan, t. c., p. 186. T. l. Ft. Collins (Gillette). Parasitic on *Aphis albipes* Oestlund.

Trioxys coruscanigrans A. B. Gahan, t. c., p. 195. T. l. Ft. Collins (Gillette). Parasitic on *Macrosiphum frigidum* (Oestlund).

Meteorus loxostegei Viereck, *Proc. U.S. Nat. Mus.*, XXXIX, p. 401. T. l. Rocky Ford (H. O. Marsh). Bred from *Loxostege sticticalis.*

Chelonus shoshoneanorum Viereck, t. c., p. 402. T. l. Colorado Springs (Bethel). Bred from *Quercus*, probably parasitic on *Argyresthia.*

Apanteles betheli Viereck, t. c., p. 402. T. l. Colorado Springs (Bethel). Bred from *Quercus*, probably parasitic on *Argyresthia.*

Microgaster comptanae Viereck, t. c., p. 403. T. l. Rocky Ford, Colorado (H. O. Marsh). Parasitic on *Ancylis comptana.*

Superfamily CHALCIDOIDEA

Family MYMARIDAE

Anagrus puella Girault, *Trans. Amer. Ent. Soc.*, XXXVII, p. 293. T. l. Pulaski, Ill., also from Boulder, Colo. (Cockerell). The Boulder specimen was found on the University Campus, Aug., 1910.

A. spiritus Girault, *Entom. News*, May, p. 209. Type from Colorado, received from Professor Gillette, labeled, "parasites found on apple twigs, probably from eggs of *Aphis pomi*, 1904;" collected by S. A. Johnson. Another specimen, from Dr. E. P. Felt, was reared in New York state from galls of *Dasyneura serrulata* Osten Sacken.

Family EULOPHIDAE

Mimatomus peltatus Cockerell, *Entom. News*, Dec., XXII, p. 464. T. l. Glenwood Springs (E. Bethel). Parasitic on *Aleyrodes pruinosus euphorbiarum* Cockerell. The genus also is new.

Family TORYMIDAE

Syntomaspis warreni Cockerell, *Entom. News*, Feb., p. 82. T. l. Trinidad, Colo. (E. R. Warren). Bred from galls on *Quercus*, which Mr. Wm. Beutenmüller has determined as *Holcaspis rubens* Gillette.

Superfamily FORMICOIDEA (Ants)
Family FORMICIDAE

Camponotus herculeanus modoc Wheeler, *Ann. N.Y. Acad. Sci.*, XX, "Dec. 30, 1910," p. 333. Type from California, but also cited from Boulder Canyon, Colo. (Cockerell). This was perhaps actually published in 1910.

Superfamily VESPOIDEA
Family EUMENIDAE

Pterochilus senecionis Rohwer, *Proc. U.S. Nat. Mus.*, XL, p. 553. T. l. Florissant, at flowers of *Senecio cymbalarioides* (S. A. Rohwer). Also east of Lake George, near Florissant (W. P. Cockerell). The name is misprinted "seneconis" in the original publication.

Superfamily SPHECOIDEA
Family PEMPHREDONIDAE

Stigmus aphidiperda Rohwer, t. c., p. 558. T. l. Highspire, Pa., bred from young peach stems, the nests provisioned with *Aphis persicae-niger*. Also from Colorado.

S. fraternus coloradensis Rohwer, t. c., p. 559. T. l. Colorado (C. F. Baker).

Family NYSSONIDAE

Gorytes (Hoplisus) helianthi Rohwer, t. c., p. 569. T. l. Boulder, at flowers of *Helianthus* (Rohwer).

G. (Pseudoplisus) venustiformis Rohwer, t. c., p. 568. T. l. Boulder, at flowers of *Helianthus* (Rohwer).

Family LARRIDAE

Tachysphex argyrotrichus Rohwer, t. c., p. 572. T. l. Trinidad, Colo., July 19, 1899.

T. gillettei Rohwer, t. c., p. 571. T. l. Rocky Ford, Colo., June 4, 1904.

T. helianthi Rohwer, t. c., p. 570. T. l. Boulder, at flowers of *Helianthus* (Rohwer).

T. johnsoni Rohwer, t. c., p. 573. T. l. Cope (Washington County), Colo. (S. A. Johnson).

T. opwanus Rohwer, t. c., p. 574. T. l. Golden, Colo. (C. P. Gillette).

T. sphecodoides Rohwer, t. c., p. 578. T. l. Rocky Ford, Colo.

Superfamily APOIDEA (Bees)
Family ANDRENDIDAE

†**Andrena grandipes** Cockerell, *Bull. Amer. Mus. Nat. Hist.*, XXX, p. 73. T. l. Miocene shales of Florissant (T. D. A. Cockerell).

Family NOMADIDAE

Nomada (Gnathias) bella callura Cockerell, *Proc. U.S. Nat. Mus.*, XXXIX, p. 657. T. l. West Cliff, Colo. (T. D. A. Cockerell).

N. (Gnathias) custeriana Cockerell, *Proc. U.S. Nat. Mus.*, XLI, p. 241. T. l. West Cliff, Colo. (T. D. A. Cockerell).

N. xantholepis Cockerell, t. c., p. 239. T. l. Los Pinos, Colo., at flowers of *Erigeron* (C. F. Baker).

Family MELECTIDAE

Triepeolus rohweri Cockerell, *Ann. Mag. Nat. Hist.*, Nov., p. 668. T. l. North Boulder Creek, in the Canadian Zone, Aug. 22, 1907 (S. A. Rohwer).

Family MEGACHILIDAE

†Lithanthidium pertriste Cockerell, *Ann. Mag. Nat. Hist.*, March, p. 225. T. l. Miocene shales of Florissant (W. P. Cockerell). The genus also is new.

Family BOMBIDAE

Bombus lapponicus flavicollis Friese, *Deutsch. ent. Zeitschr.*, p. 572. T. l. Pike's Peak, Colo. Like *B. l. silvicola*, but head and thorax all yellow-haired, only the disc of the mesothorax with some black hairs.

Psithyrus tricolor Franklin, *Trans. Amer. Ent. Soc.*, XXXVII, p. 167. Alaska to Nova Scotia, and in Colorado at Ward (Cockerell) and Pagosa Peak. No type locality is given; Ward is herewith designated as such. I also have a specimen (det. Franklin) collected by S. A. Rohwer at Eldora, at flowers of *Gaillardia*. This species is described from males, which according to Franklin are probably to be referred to *P. fernaldae* Franklin.

Order *COLEOPTERA*

Family CARABIDAE

†Harpalus maceratus Wickham, *Bull. Amer. Mus. Nat. Hist.*, XXX, p. 54. T. l. Miocene shales of Florissant (W. P. Cockerell).

Family DYTISCIDAE

†Miodytiscus hirtipes Wickham, t. c., p. 54. T. l. Miocene shales of Florissant (S. A. Rohwer). The genus also is new. The mark "R." on the Florissant fossils, cited by Professor Wickham, refers to the collector, S. A. Rohwer.

Family PAUSSIDAE?

†Paussopsis nearctica Cockerell, *Bull. Amer. Mus. Nat. Hist.*, XXX, p. 71, fig. 1. T. l. Miocene shales of Florissant (S. A. Rohwer). The genus also is new.

Family HYDROPHILIDAE

†Hydrobius prisconatator, Wickham, *Bull. Amer. Mus. Nat. Hist.*, XXX, p. 55. T. l. Miocene shales of Florissant (U. of Colo. Exped.).

Family STAPHYLINIDAE

Gnypeta boulderensis Casey, *Mem. Coleop.*, II, p. 167. T. l. Boulder County, Colo. Colonel Casey has at different times described many beetles from Boulder County, without citing any collector. I am indebted to him for the information that they were collected by Mrs. Casey, "on the mountain side."

Atheta (Homalotusa) coloradensis Casey, t. c., p. 81. T. l. Red Cliff (Wickham).

A. (Nemota) marcescens Casey, t. c., p. 122. T. l. Boulder County (Mrs. Casey).

Family COCCINELLIDAE

Hyperaspis lateralis flammula Nunenmacher, *Entom. News*, Feb., p. 72. Type from Montana; also at Golden, Colo. The true *H. lateralis* Mulsant occurs in our mountains; last summer it was bred from *Artemisia tridentata* collected at 9,000 ft. on the mountain side near Tolland; the determination of the beetles was confirmed by Mr. E. A. Schwarz. The *Artemisia* was thickly infested by the coccid *Erium lichtensioides* (Cockerell), on which the beetles undoubtedly fed.

Family PARNIDAE

†**Dryops eruptus** Wickham, *Bull. Amer. Mus. Nat. Hist.*, XXX, p. 56. T. l. Miocene shales of Florissant (U. of Colo. Exped.).

Family LYMEXYLONIDAE

†**Lymexylon lacustrinum** Wickham, t. c., p. 57. T. l. Miocene shales of Florissant (W. P. Cockerell).

Family DASCYLLIDAE

†**Dascyllus lithographus** Wickham, t. c., p. 57. T. l. Miocene shales of Florissant (W. P. Cockerell).

Family BUPRESTIDAE

†**Chrysobothris gahani** Cockerell, *Bull. Amer. Mus. Nat. Hist.*, XXX, p. 72, f. 2. T. l. Miocene shales of Florissant (W. Rusk and T. Duce).

Family LUCANIDAE

†**Ceruchus fuchsii** Wickham, *Bull. Amer. Mus. Nat. Hist.*, XXX, p. 58. T. l. Miocene shales of Florissant (W. P. Cockerell).

Family SCARABAEIDAE

†**Aphodius florissantensis** Wickham, t. c., p. 59. T. l. Miocene shales of Florissant (U. of Colo. Exped.).

†**Ligyrus compositus** Wickham, t. c., p. 59. T. l. Miocene shales of Florissant (Willard Rusk).

Family CERAMBYCIDAE

†**Elaphidion fracticorne** Wickham, t. c., p. 60. T. l. Miocene shales of Florissant (U. of Colo. Exped.).

†**Callimoxys primordialis** Wickham, t. c., p. 61. T. l. Miocene shales of Florissant (W. P. Cockerell).

Family CHRYSOMELIDAE

†**Colaspis aetatis** Wickham, t. c., p. 61. T. l. Miocene shales of Florissant (U. of Colo. Exped.).

†**Diabrotica exesa** Wickham, t. c., p. 62. T. l. Miocene shales of Florissant (U. of Colo. Exped.).

Family MELANDRYIDAE

†**Synchroa quiescens** Wickham, t. c., p. 62. T. l. Miocene shales of Florissant (S. A. Rohwer).

Family RHYNCHITIDAE

†**Toxorhynchus grandis** Wickham, t. c., p. 63. T. l. Miocene shales of Florissant (U. of Colo. Exped.).

Family OTIORHYNCHIDAE

†**Otiorhynchites florissantensis** Wickham, t. c., p. 64. T. l. Miocene shales of Florissant (U. of Colo. Exped.).

†**Cyphus subterraneus** Wickham, t. c., p. 64. T. l. Miocene shales of Florissant (U. of Colo. Exped.).

Family CURCULIONIDAE

†**Geralophus scudderi** Wickham, t. c., p. 65. T. l. Miocene shales of Florissant (U. of Colo. Exped.).

†**Apion cockerelli** Wickham, t. c., p. 65. T. l. Miocene shales of Florissant (W. P. Cockerell). "W." on the fossil, cited by Professor Wickham, refers to the collector, W. P. Cockerell.

†**Cleonus rohweri** Wickham, t. c., p. 66. T. l. Miocene shales of Florissant (U. of Colo. Exped.).

†**Magdalis striaticeps** Wickham, t. c., p. 66. T. l. Miocene shales of Florissant (U. of Colo. Exped.).

†**Balaninus minusculoides** Wickham, t. c., p. 67. T. l. Miocene shales of Florissant (W. P. Cockerell).

Family CALANDRIDAE

†**Scyphophorus tertiarius** Wickham, t. c., p. 68. T. l. Miocene shales of Florissant (W. P. Cockerell).

Family ANTHRIBIDAE

†**Cratoparis adumbratus** Wickham, t. c., p. 69. T. l. Miocene shales of Florissant (W. P. Cockerell).

Order *STREPSIPTERA*

Family XENIDAE

Eupathocera luctuosae Pierce, *Proc. U.S. Nat. Mus.*, XL, p. 502. T. l. Colorado Springs; probably collected by L. Bruner, though this is not stated. Parasitic on *Sphex* (*Psammophila*) *luctuosa* F. Smith.

ORDER *HEMIPTERA*

SUBORDER *HOMOPTERA*

FAMILY PSYLLIDAE

†**Necropsylla rigidula** Cockerell, *Bull. Amer. Mus. Nat. Hist.*, XXX, p. 75, f. 3 (p. 73). T. l. Miocene shales of Florissant (G. N. Rohwer).

Psyllopa ribesiae D. L. Crawford, *Pomona College Journ. of Entom.*, III, Dec., p. 630. T. l. Boulder, on *Ribes longiflorum* (E. Bethel).

Aphalara artemisiae angustipennis D. L. Crawford, *Pomona College Journ. of Entom.*, May, p. 499. T. l. Colorado (C. F. Baker).

A. communis D. L. Crawford, t. c., p. 499. T. l. Pagosa Springs, Colo. (C. F. Baker).

A. communis metzaria D. L. Crawford, t. c., p. 499. Banner, Wyo. (C. W. Metz) and Pagosa Springs, Colo. (C. F. Baker). Banner must be considered the type locality.

A. nebulosa americana D. L. Crawford, t. c., p. 503. T. l. Colorado (C. F. Baker).

FAMILY APHIDIDAE

Aphis pulverulens Gillette, *Journ. Econ. Entom.*, June, p. 324. T. l. Fort Collins (L. C. Bragg). Occurs on *Sympharicarpos occidentalis*, at or below the surface of the ground.

Chaitophorus agropyronensis Gillette, *Entom. News*, Dec., XXII, p. 442. T. l. Ft. Collins, on *Agropyron glaucum* (Gillette).

C. artemisiae Gillette, t. c., p. 443. T. l. Boulder (L. C. Bragg). Also at Ft. Collins. Lives on *Artemisia dracunculoides*.

Atarsos grindeliae Gillette, t. c., p. 440. T. l. Fort Collins; rather common from Ft. Collins to Denver, taken by C. P. Gillette and L. C. Bragg. Occurs on *Grindelia*. *Atarsos* is a remarkable new genus, without tarsi in all stages.

Brachycolus tritici Gillette, t. c., p. 441. T. l. Fort Collins (L. C. Bragg). On *Agropyron glaucum* and wheat.

FAMILY ALEYRODIDAE

Aleyrodes pruinosus euphorbiarum Cockerell, *Entom. News*, Dec. XXII, p. 462. T. l. Glenwood Springs, Colo. (E. Bethel). On *Euphorbia robusta*.

ORDER *DIPTERA*

FAMILY TIPULIDAE

Tipula coloradensis Doane, *Psyche*, Oct., p. 164. T. l. Tabernash, Colo. Undoubtedly collected by E. S. Tucker, but the collectors of this and the next are inexcusably omitted by the describer.

T. rohweri Doane, t. c., p. 165. T. l. Florissant (undoubtedly collected by S. A. Rohwer). Also in Wyoming.

FAMILY CECIDOMYIIDAE

Lasioptera allioniae Felt, *Journ. Econ. Entom.*, Oct., p. 482. T. l. Boulder (E. Bethel). From gall on *Allionia*.

Dasyneura pergandei Felt, t. c., p. 480. T. l. Glen Eyrie (printed "Glenn Ayrie"), Colo. Reared by T. Pergande in 1878 from swollen fruit of wild cherry collected by C. V. Riley.

Rhopalomyia gnaphalodis Felt, t. c., p. 484. T. l. Boulder (T. D. A. Cockerell). Reared from gall on *Artemisia gnaphalodes.*

Dicrodiplosis gillettei Felt, *Journ. Econ. Entom.*, IV, Dec., p. 549. T. l. Ft. Collins (C. P. Gillette). Reared from an apical bud-like deformity on *Pinus scopulorum.*

Family MYCETOPHILIDAE

†**Leia miocenica** Cockerell, *Bull. Amer. Mus. Nat. Hist.*, XXX, p. 76. T. l. Miocene shale of Florissant (Geo. N. Rohwer).

Family BIBIONIDAE

†**Plecia melanderi** Cockerell, t. c., p. 77, pl. III, f. 1. T. l. Miocene shales of Florissant (U. of Colo. Exped.).

Family LEPTIDAE

†**Symphoromyia subtrita** Cockerell, t. c., p. 78, pl. III, f. 2. T. l. Miocene shales of Florissant (W. P. Cockerell).

Family ASILIDAE

†**Taracticus renovatus** Cockerell, t. c., p. 80. T. l. Miocene shales of Florissant (G. N. Rohwer).

†**Asilus amelanchieris** Cockerell, t. c., p. 79. T. l. Miocene shales of Florissant (U. of Colo. Exped.).

Family BOMBYLIIDAE

†**Megacosmus secundus** Cockerell, t. c., p. 80. T. l. Miocene shales of Florissant (G. N. Rohwer).

Family DOLICHOPODIDAE

Dolichopus jugalis E. S. Tucker, *Trans. Kansas Acad. Sci.*, XXIII, p. 106. T. l. Tabernash, Colo., 8310 ft., Aug., 1906 (E. S. Tucker).

Hydrophorus altivagus Aldrich, *Psyche*, April, p. 67. Marshall Pass, 10,856 ft., and Boulder; collected by Aldrich, though this is not stated. Marshall Pass is to be considered the type locality.

Family PLATYPEZIDAE

†**Eucallimyia fortis** Cockerell, *Bull. Amer. Mus. Nat. Hist.*, XXX, p. 82, pl. III, f. 4. T. l. Miocene shales of Florissant (G. N. Rohwer). The genus is also new.

Phylum MOLLUSCA

Class GASTROPODA

Family LYMNAEIDAE

Galba doddsi Baker, *Special Publ. No. 3, Chicago Acad. Sci.* (Feb., 1911), p. 203. T. l. Hot Sulphur Springs, Colo. (G. S. Dodds). Said also to occur at West Cliff, Colo. (Cockerell). It has passed for *L. truncatula.*

Phylum VERTEBRATA

Class PISCES (Fishes)

Family CYPRINIDAE

Notropis horatii Cockerell, *Science*, Nov. 3, p. 614. T. l. Julesburg (Horace G. Smith).

Class AVES (Birds)

Family PICIDAE

Dryobates scalaris symplectus Oberholser, *Proc. U.S. Nat. Mus.*, XLI, p. 155. Type from Texas, but also cited from St. Charles Canyon, Pueblo County, Colo.

THE SAWFLIES (*Chalastogastra*) OF BOULDER COUNTY, COLORADO[1]

By Sievert A. Rohwer

After having lived many years in Boulder, Colorado, it was a pleasure to work up the sawflies and wood-wasps for the county at Professor Cockerell's request. Although Boulder was for many years my home, it was not possible for me to do much sawfly collecting there, as I was usually in other parts of the state during the best season for these insects. For good collecting grounds I would recommend Boulder Canyon and all of the mountain meadows, more especially those of the Canadian life-zone. It should also be profitable to examine the conifers, as there are many species which feed on these trees.

In the present state of our knowledge of these insects in Boulder County it seems unwise to give any elaborate tabular arrangement of the few species known to occur there. In this paper more attention will be paid to the localities inhabited by members of the group with the idea of giving information as to how and where to look for them. To enable the insects to be studied easily, they should be pinned with black[2] pins through the right lobe of the mesoscutum. The wings should be partially spread so they can be easily studied, and so as not to interfere with the study of the body. The small species may be mounted on card-points or pinned with micro-pins. If the proper pins are not available, or if time cannot be given to mounting, they may be put into alcohol.

The adults of this suborder are seldom taken on flowers other than some of the large umbellifers which occur in the Canadian zone. They can however usually be taken by sweeping in meadows, or sweeping various trees and shrubs, more especially different willows. In most cases the adults fly in the spring or early summer. The

[1] *Publication of the Colorado Biological Survey*, No. 10.

[2] White pins should not be used because of verdigris.

adults are often sluggish, and if disturbed fall to the ground, yet there are some species which are alert and troublesome to net.

The larvae are, within their limits, very diverse. Many of them feed on leaves and are either gregarious or solitary; some of them are leaf-miners; a few leaf rollers; some live in galls made either on the leaf or twigs; others are internal feeders, living in trees, shrubs or grasses. They live on the most diverse plants from ferns to composites. The fern-feeders are a rather highly specialized group, while some of the more generalized ones feed on the higher plants, as *Rubus*. This would seem to indicate that they are either of recent origin, coming into existence after the plants had become well established—in which case we would assume that their food habits were specialized—or we may assume that they are polyphyletic, i.e., had many ancestors. It would be out of place to go into a phylogenetic discussion in this short paper, but it may be stated that, judged from characters other than food habits, the group is probably polyphyletic, or if they had one common ancestor, it was at such a remote period that the intermediate forms have long been extinct.

For the study of Chalastogastra it is desirable that a binocular microscope should be used. The ordinary hand lens does fairly well for the larger forms, but the smaller forms can be studied to a much greater advantage with the above-mentioned instrument. The student should endeavor to master the characters of the head given by Marlatt, 1896, Rohwer, 1909, and certain others which the writer will be glad to explain, until they have been published in collected form. The characters of the head are of great specific importance. Generic and group characters are found on the body, more especially the thorax, and one should become familiar with the thorax (see Snodgrass, 1910). The wings are subject to much variation but with a knowledge (gained only through experience) they can be used. They are well treated by MacGillivray, 1906.

The larvae of the western species are almost unknown and a study of them would form an interesting and profitable piece of work for someone to undertake. They have many food-plants, but probably more would be found on the willows and birches than elsewhere.

They may be bred by using means similar to those described for all leaf-feeding larvae. Mr. Cushman[1] has recently stated that he has secured better results by keeping the food supply in damp sand, covering the same with a lantern chimney, the top of which is screened. In studying the immature stages it is desirable, if possible, to ascertain the exact length of the pupal period. The larvae spin a cocoon in which they contract themselves, and remain in a prepupal condition for a long time. They then change to a pupal stage which is, as a rule, short, after which they emerge as adults.

Certain groups are, as yet, not known from the county. More collection will, no doubt, bring representatives of the family Cimbicidae, subfamily Arginae, subfamily Cladiinae, subfamily Empriinae, family Cephidae and family Megalodontidae, besides many additional species in groups already represented in the fauna. Of the latter one would expect many more Nematinae (including *Hoplocampa*) and Tenthredininae.

The plan of the following paper is to give a list of all the species known to occur in the county, with characters to separate all the genera and higher groups, as well as the species, from all other groups and species. In preparing this paper published and manuscript notes have been used, and it is believed that, up to the time of writing, the characters given will separate the genera or species from every other genus and species described. It is necessary, however, that more elaborate descriptions should be consulted for certain groups. A brief bibliography of articles referring to Boulder County Chalastogastra, or papers necessary in a study of the fauna, is added. Although this is not complete it will serve as a beginning.

Order **HYMENOPTERA,** Suborder **Chalastogastra**

The suborder Chalastogastra forms a very distinct group within the order Hymenoptera. It includes the insects commonly called sawflies (or leaf-wasps) and horntails (or wood-wasps). The insects belonging to this suborder may be distinguished from all other Hymenoptera (suborder Clistogastra) by the following characters:

Adults.—(1) First abdominal segment not transferred to the thorax and forming a part of it, i.e., the abdomen is consolidated with the metathorax by its entire width, and the second abdominal segment connected with the first for its entire width. (In the

[1] *Proc. Ent. Soc. Wash.*, Vol. XIII, p. 110, 1911.

Clistogastra the first abdominal segment is transferred to the thorax and forms part of the second division of the body. The second segment is connected with the first very narrowly along the median, longitudinal axis.) (2) Abdomen composed of ten tergites and ten sternites, in all species known from the county, and in all groups except the Oryssoidea. (In the Clistogastra there are usually not more than eight tergites, although in some Chalcids there are nine.)

Larvae.—Thoracic and at least one pair of abdominal feet present. The larvae of sawflies, in habits and habitus, resemble more closely those of Lepidoptera than they do those of the Clistogastra. Chalastogastra larvae may always be separated from Lepidopterous larvae by the simple ocelli. (In the Lepidoptera the ocelli are multiple.)

There are other characters which separate most Chalastogastra from the Clistogastra, but these do not all apply to all members of the suborder. All the Chalastogastra known to occur in Boulder County have the second anal vein of the fore wings present, and, in most of them, the cubitus of the same wing joins the costa and not the basal vein.

Superfamily **Megalodontoidea**

Posterior margin of the pronotum straight or nearly so, being nearly the shortest distance between the anterior margins of the tegulae; mesonotum short, never extending much beyond the anterior margins of the tegulae; proepimeron wanting.

This superfamily is known in the county at present by the family Xyelidae. The family Cephidae and subfamily Pamphiliinae (of Megalodontidae) should be found within the county.

Family XYELIDAE

First perapterum present, seen a short distance below the tegulae as a small free plate; anterior tibiae with two calcaria; basal joints of the flagellum consolidated so as to form one joint; intercostal vein present; radial cell with two cross-veins; robust species.

This family is represented in the county by the genus *Xyela*, but the species of *Macroxyela* which feed on elm may be introduced with elms.

Genus **XYELA** Dalman

Antennae 12-jointed; the third joint shorter than the following; malar space present; clypeus truncate; ovipositor of female as long as the abdomen. The larvae and larval-habits of this genus are very imperfectly known. One species belonging to this genus has been bred from young pine cones, and it seems probable that the species are internal feeders and that they may live in the young fruits of various plants. They are found only in the early spring and are very local, appearing for a short time only. It is usually profitable to look for them on willows, alders, box-elder and similar plants when their petals are falling.

(1) **X. negundinis** Cockerell. Black; legs below femora pale brown; sheath stout, short, straight below, oblique to the sharp apex above; vertex raised caudad to lateral ocelli; postocellar line distinctly shorter than the ocellocular.

Female; Boulder, Colorado, collected April 10, 1907, at flowers of *Acer negundo*, by Cora Bennett. (Type locality.)

(2) **X. luteopicta** Cockerell. Black; head and thorax much variegated with yellow; legs reddish-yellow; sheath stout, narrowing apically, obtusely pointed; postocellar line about half as long as the ocellocular.

Female; Salina, Boulder County, Colorado, collected April 14, on or about *Salix*, by T. D. A. Cockerell.

Two other species of *Xyela* have been collected in the county.

Superfamily Siricoidea

Posterior margin of the pronotum strongly curved; mesonotum extending well beyond the anterior margins of the tegulae; metanotum present; antennae inserted well above the clypeus; anterior wings with more than two cubital cells; propodeum divided by a longitudinal suture; scutellum separated from the mesoscutum by a suture; proepimeron wanting; anterior tibiae with one calcaria; cubitus joining the basal vein much below the costa; ovipositor very long and extending much beyond the tip of the abdomen.

The insects belonging to this superfamily are commonly called horntails (referring to their long ovipositor and the horn at the apex of the abdomen), or wood-wasps (referring to larval habits). The larvae have only one abdominal foot, are of a pallid color and have many jointed antennae. In all the species known from the county the apex of the abdomen is produced into a triangular shaped plate. They are internal feeders in wood, but their life cycle is but imperfectly known (for American species). It has been stated by some that the larvae take two years to mature, by others it is stated that they mature in one season.

Family SIRICIDAE

Notauli wanting; mesoscutum with oblique sutures from the tegulae to the anterior margin of the scutullum; pronotum large, perpendicular anteriorly and angulate laterally; anterior wings without an intercostal vein; apex of the abdomen with a triangular-shaped plate.

Subfamily *SIRICINAE*

Cerci present; antennae long and slender; transverse median received near the middle of the first discordal cell; second transverse cubitus present. The larvae of this subfamily attack only conifers.

Tribe Siricini

Hind tibiae with two calcaria; humerus and transverse median of the hind wings present.

Genus SIREX Linnaeus

Apical dorsal plate of the abdomen long, spear-shape in outline; fore wings with one brachial vein, i.e., no vein basad of the transverse median and similar to it; head black, marked with pale; third antennal joint usually a little shorter than the fourth.

(3) **S. flavicornis** Fabricius. About 30 mm. (not including the ovipositor) long; black; antennae, posterior orbits, two bands on abdomen, apical appendage, and legs below the femora yellow; wings yellowish hyaline, venation yellowish; pubescence black.

Recorded from Boulder Canyon, by Cresson, the specimen having been collected by Putnam.

Tribe Xeriini

Hind tibiae with one calcar; humerus and transverse median of the hind wings wanting.

Genus **XERIS** Costa

Ovipositor longer than the abdomen; antennae long; slender; apical plate of the abdomen long, spear-shape; only one brachial vein.

(4) **X. caudatus** (Cresson). Black; legs ferruginous; spot on posterior orbits, and lateral dorsal angles of pronotum white; wings hyaline, somewhat dusky, venation dark brown.

One female collected on Arapahoe Peak (above timber-line). September 1 (S. A. Rohwer).

Subfamily *TREMICINAE*

Cerci wanting; antennae short and stout; basal vein and transverse median vein interstitial or nearly; second transverse cubitus wanting.

The larvae of this subfamily confine their attacks to deciduous trees.

Genus **TREMEX** Jurine

Characters of subfamily. The species of this genus are parasitized by *Megarhyssa lunator*.

(5) **T. columba** var. **sericea** (Say).

Boulder, Colorado, August 27, 1907, one male at flowers of *Helianthus pumilus* (S. A. Rohwer). This is the pale form agreeing with Say's description of *sericea*.

Superfamily **Tenthredinoidea**

Posterior margin of the pronotum strongly arcuate; mesonotum extending much beyond the anterior margins of the tegulae; metanotum present; antennae inserted well above the clypeus; anterior wings with more than two cubital cells; scutellum never completely separated from the mesoscutum, the suture always wanting laterally; anterior tibiae with two calcaria; proepimeron present; cubitus joining the costa or touching the basal vein very close to the costa. In all Boulder County species the first perapterum and notauli are always present.

The larvae of this superfamily have diverse habits, but with exceptions of the leaf-miners and the gall-makers are external feeders. This is the group commonly called "sawflies," and contains all of the common sawfly pests.

Family ARGIDAE

Abdomen not sharply angled laterally; antennae not clavate; sternali (a suture separating the mesosternum from the mesoepisternum) present; posterior coxae contiguous, or nearly so; antennae three-jointed; proepisternum not divided.

Subfamily *STERICTIPHORINAE*

Fore wings without an intercostal vein; antennae of the male furcate; hind tibiae without lateral spurs.

The larvae of Sterictophinae are very imperfectly known in North America. Two species are said to feed on sweet potato, and the third was very common in the wheat-fields in the fall of 1911. It is very probable that the last mentioned species feeds on some weed which grows among the wheat plants.

Three species have been taken in Boulder County and it is probable that one or two more may be found there. The species are more southern in distribution and will probably be found to be more abundant in the Transition and Austral life-zones.

Genus **STERICTIPHORA** Billberg

(6) **S. abdominalis** (Cresson). Length 6 mm. Black; pronotum, abdomen except apex rufo-ferruginous; anterior tibiae and tarsi, and intermediate tibiae beneath pallid; wings subhyaline, venation black.

Male collected Boulder, Colorado, August 18, 1911, by Hester M. Rohwer.

(7) **S. collaris** (Rohwer). Length 4 mm. Black; pronotum sides of prescutum, and side of abdomen reddish-yellow; four anterior tibiae and tarsi and base of hind tibiae pallid; wings iridescent, hyaline slightly dusky; venation pale brown.

Female; Boulder, Colorado, August 1, 1908 (S. A. Rohwer).

(8) **S. lineata** (Rohwer). Length 5 mm. Black; pronotum, mesoscutum, meso-prescutum except a spot in the middle and sides of abdomen reddish-yellow; four anterior tibiae and tarsi and base of hind tibiae pallid; wings iridescent, hyaline slightly dusky; venation dark brown.

Female; Boulder, Colorado, August 18, 1911, collected by Hester M. Rohwer.

Family DIPRIONIDAE

Abdomen not sharply angled laterally; antennae many jointed, serrate in female, pectinate in male; sternauli (a suture separating the mesoepisternum from the mesosternum) wanting; posterior coxae contiguous, or nearly so; mesopimeron divided into two plates, the dorsal one sculptured similar to the mesoepisternum; proepisternum not divided into two plates; radial cell of fore wings without a cross-vein; costal cell of fore wings large; anal cell of fore wings contracted or with a cross-vein.

Genus **DIPRION** Schrank

Malar space wanting; antennae of male biramose; serrate in female; lanceolate cell of fore wings with a cross-vein.

Larvae gregarious, feeding on conifers.

(9) **D. hypomelas** (Rohwer). Length 5.5 mm. Black; labrum, apex of mandibles extreme apex of abdomen dusky reddish; venter very dark piceous; tegulae at the extreme base luteous; palpi pallid; legs except bases of four posterior coxae, and all of the anterior coxae, pale luteous; wings clear hyaline; venation brown. Hypopygidium broadly oval, with distinct rather sparse punctures. Female unknown.

Ward, Boulder County, Colorado, August 30, 1899 ("O.B."). (Type locality.)

Family TENTHREDINIDAE

Abdomen not sharply angled laterally; sternauli (a suture separating the mesoepisternum from the mesosternum) wanting; posterior coxae contiguous or nearly so; mesoepimeron not divided into two plates; proepisternum divided into two plates; antennae nine-jointed (or in a few cases eight-jointed, in some exotic genera with more than nine joints).

Subfamily *ALLANTINAE*

Prepectus wanting; proepisternum ventrally very large and meeting in the middle where it is truncate; prosternum triangular in outline; metapostnotum large; mandibles long, strongly falcate; basal vein joining the costa at or very near the origin of the cubitus; anal cell of the fore wings with an oblique cross-vein; transverse radius normally present.

Tribe Taxonini

Hind basitarsus distinctly longer than the following joints; posterior calcaria long; metapostnotum large and nearly flat; metascutellum not closely sculptured; pronotum large laterally.

Genus **MACREMPHYTUS** MacGillivray

First transverse cubitus wanting; transverse median vein very close to basal; pedicellum much longer than wide; head and thorax not closely sculptured.

Larvae of an unknown species were very abundant in the grounds of the courthouse at Boulder in 1908.

Tribe Allantini

Hind basitarsus shorter than or subequal with the following joints; posterior calcaria short, robust; pronotum small laterally; metapostnotum rather short, flat; metascutellum without punctures; head and thorax finely sculptured.

Genus **ALLANTUS** Panzer

Hind wings without a closed discal cell; transverse median of the fore wings distinctly basad of the middle of the cell; first transverse cubitus wanting; clypeus emarginate; tarsal claws cleft; cheeks nearly as broad as the greatest cephal-caudad diameter of the eye.

This generic name replaces *Emphytus* Klug.

(10) **A. gillettei** (MacGillivray). Posterior femora red or reddish; four anterior femora blackish; fourth abdominal segment white; wings hyaline, slightly dusky; venation dark brown.

Boulder, Colorado, May 17, 1902 (S. A. Johnson). This species lives on strawberries.

Genus **APHILODYCTIUM** Ashmead

Hind wings without a closed discal cell; transverse median of the hind wings distinctly basad of the middle of the cell; first transverse cubitus present (normally); clypeus emarginate; tarsal claws cleft; cheeks distinctly narrower than the cephal-caudad diameter of the eye.

(11) **A. rubripes** (Cresson). Black; margin of clypeus, labrum, and margin of pronotum pale; legs below the trochanters red; wings dusky hyaline; venation black; stigma pale at base.

Female; Boulder, Colorado, June 1, 1906 (S. A. Rohwer).

Subfamily *DOLERINAE*

Prepectus wanting; proepisternum very large ventrally and meeting in the middle; prosternum triangular; metapostnotum large; mandibles long and strongly falcate; third pleural suture strongly curved; the dorsal part of the metaepisternum very narrow; mesoepimeron with an oblique carina dorsally; basal vein joining the costa much basad of the origin of the cubitus; anal cell of the fore wings contracted basally and with an oblique cross-vein. In nearly every specimen the second transverse cubitus is wanting; in which case this subfamily may be easily recognized by its venation, as it is the only group which has the transverse radius present, and the second transverse cubitus wanting.

The larvae of Dolerinae live on grasses and sedges.[1] Very little is known about the habits of the American species and, in fact, nothing is known of the western larvae. The subfamily is of northern distribution and probably a number of species will be found in the county. The adults appear in the early spring and are closely related and are often difficult to separate into species, while the larvae may offer striking differences.

Genus **DOLERUS** Panzer

Eyes oval or rounded, strongly convex; malar space as long as or longer than the pedicellum; head and thorax coarsely sculptured.

(12) **D. aprilis** Norton. Black; abdomen, except two apical segments, rufo-ferruginous; wings hyaline, slightly dusky; venation black; scutellar appendage finely, longitudinally striate.

Boulder, Colorado (S. A. Johnson).

(13) **D. simulans** Rohwer. Black; pronotum, prescutum, scutum, and abdomen, except apex, reddish-yellow or red; wings dusky hyaline; venation black; scutellar appendage finely, longitudinally striate.

Boulder, Colorado, May, 1907 (S. A. Rohwer). Collected at the mouth of Boulder Canyon, on willow flowers.

Subfamily *TENTHREDININAE*

Prepectus wanting; proepisternum very large ventrally and meeting in the middle; prosternum usually triangular in outline; third pleural suture straight; mesoepimeron without an oblique carina dorsally; mandibles long, strongly falcate; basal vein joining the costa remote from the cubitus; transverse radius present; anal cell of the fore wings not contracted basally, either meeting in the middle, or with a short straight cross-vein; all of the transverse cubiti normally present.

Here again the larvae are nearly unknown, and as far as the species of the Rocky Mountains are concerned, they are entirely so. The food-plants of these insects are usually herbs or shrubs, but as far as known there is no definite correlation between the host-plant and these parasites. This subfamily is of northern distribution, and many more species may be found in the Canadian and Hudsonian zones of the county.

From the standpoint of North America this subfamily offers some interesting points in geographical distribution. *Macrophya* is the dominating genus in the east, while *Tenthre-*

[1] The species of *Dolerus* recorded from *Prunus* by Clarke is not a *Dolerus*, in fact it belongs to a different ubfamily.

della is the dominating one in the west. The adults are more numerous in mid-summer and may often be collected in great abundance on the flowers of *Heracleum lanatum.* The length of life of the adults is not known, but it is known that they are either herbivorous or carnivorous. Only the tribe Tenthredinini has been found in the county, although the Perineurini may be represented by the genus *Zaschizonyx* Ashmead.

Tribe Tenthredinini

Propodeal spiracle placed at, or near, the lateral dorsal basal angle of the propodeum; anterior margin of the scutellum truncate or nearly so, its cephal-caudad length much shorter than the width.

Genus **TENTHREDELLA** Rohwer

Mesial margins of the eyes strongly converging below; space between the eyes at the antennae less than the length of the eye; malar space very narrow; metaepimeron narrow; not rectangular in outline, curved above, reaching to, or very little beyond, the propodeal spiracle; hind coxae normal; nasal margins of the antennal sockets strongly dilated and hollowed out between; the antennae often longer than the head and thorax, 9-jointed, not thickened apically.

This genus will probably be well represented in the county as there are many species known from Colorado. They are boreal and are often found in numbers on the flowers of *Heracleum lanatum.*

One species (allied to *pectoralis* Norton) has been taken at Copeland Park, Boulder County, Colorado, on September 6, 1907, by G. M. Hite.

Subfamily *MESSINAE*

Prepectus wanting; proepisternum very small ventrally, and widely separated; prosternum T-shaped; metapostnotum short; mandibles short, not strongly falcate; robust, short species; basal vein and first recurrent vein strongly diverging; the first recurrent vein much shorter than the basal vein.

Tribe Phyllotomini

Anal cell of the fore wings contracted basally and with an oblique cross-vein.

Genus **CALIROA** O. Costa

Antennae 9-jointed; inner margins of eyes parallel. Larvae slimy, slug-like; skeletonizing leaves of shrubs and trees.

Subgenus CALIROA O. Costa

Clypeus truncate; pedicellum much wider than long, shorter than the scape; hind wings of female usually with only one discal cell.

(14) **C. aethiops** (Fabricius). The adults of this species have not as yet been taken in the county, but their work on rose leaves is not uncommon. For an account of the larvae and a summary of the habits, see Chittenden, 1903, p. 1.

Subgenus ERIOCAMPOIDES Konow

Clypeus emarginate; pedicellum subequal in length with the scape; hind wings of the female usually with two discal cells.

(15) **C. cerasi** (Linnaeus). This is the common cherry and pear slug. The adult may easily be recognized by the transverse radius nearly interstitial with the third transverse cubitus. For a figure of the adult and larvae, see Marlatt, 1897, p. 1.

Subfamily *NEMATINAE*

Prepectus present; metaepimeron with a small curved dorsal plate which usually projects laterally beyond the lower part of the small plate; the third pleural suture strongly curved; basal vein and first recurrent vein strongly divergent, the first recurrent vein being much shorter than the basal; basal vein joining the costa remote from the origin of the cubitus; anal cell contracted in the middle or petiolate; transverse radius present or absent, but most usually absent, and often when present it may not be constant in an individual (i.e., the transverse radius may be present in one wing and absent in the other).

Tribe Hemichroini

Anal cell of the fore wings contracted and closed in the middle.

Genus **HEMICHROA** Stephens

Malar space long; head and thorax shining, not coarsely sculptured; transverse radius present; second cubital cell receiving both recurrent veins; tarsal claws cleft.

(16) **H. americana** (Provancher). *Male:* Length 5 mm. Black; legs below coxae ferruginous, tibiae often paler; wings dusky hyaline, venation dark brown. Provancher's type has not been studied and this may not be his species.

Males collected on *Salix* and *Alnus* in May, 1907, Lower Boulder Canyon (S. A. Rohwer).

Tribe Nematini

Anal cell of the fore wings petiolate.

Many of the insects belonging to this tribe feed in the larval stage on species of the *Salicaceae*, and as a number of species of *Populus* and many species of *Salix* occur in Boulder County, many more species may be found in the county. There are, however, species of this tribe which feed on other plants, such as *Pteronidea ribesii*, which feeds on currants, *Pachynematus extensicornis* which lives on wheat, *Nematus erichsonii* which feeds on larch, *Pristiphora idiota* which feeds on cranberries, etc. This is another Holarctic group of northern distribution, the adults of which appear in the spring or early summer. In this tribe are leaf or stem gall-makers, and solitary or gregarious external feeders. Very little indeed is known about the western larvae, and anyone will do science a good turn who records careful observations on the western larvae.

The genera belonging to this tribe are rather numerous, but only three have so far been recorded from the limited area here treated. The species in this group are often superficially identical, although separated by valuable head characters, so in this group, more than any other, must one master the characters used in classification before careful identification can be made.

Genus **EUURA** Newman

Transverse radius wanting; second transverse cubitus wanting; clypeus emarginate; pentagonal area present or wanting; claws cleft or with a large subapical tooth.

The species belonging to this genus make galls on the stems of willows. The gall of an unknown species occurs on an undetermined willow in one of the gulches in front of the "flatirons" at Boulder. This gall is similar to that of *Euura cooperae* Cockerell. The larvae usually live in the gall and may easily be bred by bringing the gall into the laboratory before activity commences in the spring.

(17) **E. macgillivrayi** (Rohwer). *Female:* Length 6 mm. Almost entirely bright reddish-yellow; basal two thirds of the antennae, small spot about the ocelli spots on the mesonotum, and metanotum black. *Male:* Length 5.5 mm. Black; head below the antennae, posterior and superior orbits, pronotum, tegulae, venter, legs (except coxae), rufo-ferruginous. *Gall:* on *Salix luteosericea* Rydb.; a gradual enlargement of the twig about 30 mm. long. *Larva:* last stage, 5 mm. long, creamy white, head dark.

Boulder, Colorado, at the mouth of Boulder Canyon. Adults appearing early in May in the field, earlier in the laboratory (S. A. Rohwer). (Type locality.)

(18) **E. bebbianae** (Rohwer). *Female:* Length 6 mm. Mostly black; apical margin of the clypeus pale; ocellar basin present; frontal crest broken; apex of abdomen pale; orbits pale; stigma black, except extreme base. *Male:* Length 5 mm. Black; clypeus pale; legs below coxae reddish-yellow; stigma all dark; antennal foveae small; lateral ocellar furrows poorly defined. *Gall:* an abrupt laternal swelling on twigs of *Salix bebbiana*. *Larva:* About 5 mm. long (in last stage); creamy white, head dark.

Boulder, Colorado. Many males and females bred on galls on *Salix bebbiana* collected near the mouth of Boulder Canyon (S. A. Rohwer). (Type locality.)

Genus **PONTANIA** Costa

Transverse radius wanting; second transverse cubitus present; clypeus emarginate; tarsal claws cleft; posterior tibiae simple; apex of the eighth dorsal segment of male with a small blunt projection; small, 2 to 5 mm.; sheath rather narrow, pointed; usually gall inhabiters.

The larvae of this genus usually make galls on leaves of species of *Salix*, although there are a few species which are leaf rollers on *Populus*. Various galls have been noticed in the county, but only two adults are known. The galls are often pinkish in color, of various shape, and are easily seen near the close of the summer. The larvae, as a rule, leave the galls and pupate in the ground, although a few of them use old galls, or even enter decaying wood. During August galls of an unknown species may be found along the small creek at the head of Pine street, Boulder.

(19) **P. leucostoma** Rohwer. *Male:* Length 5 mm. Black; face below antennae (except supraclypeal foveae), clypeus, labrum, mandibles (except piceous tips), angles of pronotum, tegulae and apex of anterior coxae white; orbits, four posterior coxae, trochanters, intermediate femora (except a line above), intermediate tibiae and hind femora (except above and below), hind tibiae (except apex and venter), reddish-yellow; wings dusky hyaline.

Boulder, Colorado, May 22, 1907, on foliage of *Populus angustifolia* (S. A. Rohwer). (Type locality.)

(20) **P. nevadensis** (Cresson). *Male:* Antennae as long as the body of the insect; claws coarsely notched; middle fovea elongate; ocellar basin well defined, triangular in outline; reddish-yellow; a large spot on the head, thorax and abdomen above black;

four posterior tarsi brownish; wings hyaline, iridescent; venation dark brown, costa and stigma pallid. *Female:* Sheath broad at the base, sharply acuminate at tips and emarginate beneath; black color at the base of the abdomen only.

Male; Boulder, Colorado, August 11, 1911 (S. A. Rohwer).

Genus **PTERONIDEA** Rohwer

Transverse radius wanting; second transverse cubitus present; clypeus emarginate; tarsal claws cleft; pentagonal area present; head and thorax shining; posterior tibiae simple; sheath rather narrow; labrum but slightly projecting.

The larvae of the species belonging to this genus are external feeders on various plants, but as a rule they prefer species of *Salix*. They are often gregarious although certain species are solitary.

(21) **P. arapahonum** (Cockerell). *Female:* Length 6 mm. Black; mouth, angles of pronotum, spot on the mesoepisternum, scutellum, metanotum, abdomen, legs and antennae beneath rufous or reddish-yellow; wings hyaline, iridescent, venation black. This is probably the same as *ribesii*, but the European form will have to be more closely studied before a conclusion is reached.

Boulder, Colorado. Early in April (T. D. A. Cockerell, W. P. Cockerell, S. A. Rohwer). (Type locality.)

(22) **P. cockerelli** (Rohwer). Most of head, antennae, scutellum, abdomen, except sheath, hind tibiae, except apex, reddish-yellow; margin of pronotum, four anterior legs (femora reddish apically), hind coxae, trochanters, base of hind femora pallid; wings hyaline; venation dark brown.

Campus of University of Colorado, August (T. D. A. Cockerell). (Type locality.)

(23) **P. ventralis** (Say). Length 7 mm. Black; mouth-parts, orbits, pronotum, venter, coxae trochanters, most of tibiae, and anterior femora beneath pallid; wings hyaline, venation black.

Boulder, Colorado. Female, August 11, 1911 (S. A. Rohwer). New to Colorado.

Bibliography

Chittenden, F. H. "The Rose Slugs." *Circ. 105 U.S. Dept. Agric. Bur. Ent.*, pp. 1–12, 1908. [Gives descriptions and figures of adults, work and larvae of three sawflies injurious to roses.]

Cockerell, T. D. A. "A new sawfly of the genus Xyela." *Can. Ent.*, Vol. XXXIV, pp. 194–195, 1902.

———. "A new sawfly." *Ent. News*, Vol. XVII, p. 220, 1906.

———. "A new sawfly of the genus Xyela." *Can. Ent.*, Vol. XXXIX, p. 324, 1907.

Cresson, E. T. "Catalogue of the described species of Tenthredinidae and Uroceridae inhabiting North America." *Proc. Ent. Soc. Phil.*, Vol. I, pp. 33–39, 1861.

———. "List of Hymenoptera collected by J. Ducan Putnam, of Davenport, Iowa, with descriptions of two new species." *Proc. Davenport Ac. Nat. Sc.*, Vol. I, pp. 206–211, 1876. [Records one species from Boulder County.]

———. "Catalogue of the Tenthredinidae and Uroceridae of North America." *Tran. Amer. Ent. Soc.*, Vol. VIII, pp. 53–68, 1880.

———. "Descriptions of new North American Hymenoptera—Tenthredinidae and Uroceridae." *Tran. Amer. Ent. Soc.*, Vol. VIII, pp. 1–52, 1880.

Cresson, E. T. "Synopsis of the Hymenoptera of America North of Mexico." *Tran. Amer. Ent. Soc.*, supp. vol., pp. 1–350, 1887.

Dalla Torre, C. G. de. *Catalogus Hymenopterorum*, Vol. I, pp. 1–459, 1894.

Harrington, W. Hague. "Canadian Uroceridae." *Tran. Roy. Soc. Canada*, sect. IV, pp. 131–153, 1893.

Kirby, W. F. "List of Hymenoptera with descriptions and figures of the typical specimens in the British Museum." Vol. I, pp. 1–439, pl. 1–16, 1882.

Konow, F. W. "Family Lydidae" (27), "Family Siricidae" (28), "Family Tenthredinidae" (29). *Genera Insectorum*, fas. 27, 28, 29, 1905. [A synopsis of the Chalastogastra genera of the world with a list of the species.]

MacGillivray, Alexander Dyer. "A study of the wings of the Tenthredinoidea, a superfamily of Hymenoptera." *Proc. U.S. Nat. Mus.*, Vol. XXIX, pp. 569–654, pl. 21–44, 1906. [Figures of the wings of many genera of sawflies and a table to the subfamilies based on venational characters.]

Marlatt, C. L. "Revision of the Nematinae of North America." *Tech. Ser. 3, Bur. Ent. U.S. Dept. Agric.*, pp. 1–135, 1896.

———. "The pear slug." *Cir. 20 Bur. Ent. U.S. Dept. Agric.*, pp. 1–7, 1897.

Norton, Edward. "Catalogue of the described Tenthredinidae and Uroceridae of North America." *Tran. Amer. Ent. Soc.*, Vol. I, pp. 31– , pp. 193– , 1867; Vol. II, pp. 211– , pp. 321– , 1869. Bound together and paged separately when it is referred to as *Norton Cat.*

Rohwer, S. A. "New Western Tenthredinidae." *Jn. New York Ent. Soc.*, Vol. XVI (2), pp. 103–114, 1908.

———. "Notes on Tenthredinoidea, with descriptions of new species. Paper I." *Can. Ent.*, Vol. XL, pp. 175–180, 1908.

———. "Some new Nematid sawflies from Colorado." *Can. Ent.*, Vol. XL, pp. 45–50, 1908.

———. "Notes on Tenthredinoidea, with descriptions of new species. Paper II." *Can. Ent.*, Vol. XLI, pp. 9–21, 1909; *ibid.* Paper III. pp. 88–92, 1909.

———. "The sawfly genus Cryptocampus (=Euura) in boreal North America." *Jn. New York Ent. Soc.*, Vol. XVII, pp. 7–25, 1909.

———. "Notes on Tenthredinoidea, with descriptions of new species. Paper XI (Genera of Pamphiliinae)." *Can. Ent.*, Vol. XLII, pp. 215–220, 1910.

———. "A Classification of the suborder Chalastogastra of the Hymenoptera." *Proc. Ent. Soc. Wash.*, Vol. XIII, pp. 215–226, 1911.

———. "Additions and Corrections to 'The Genotypes of the sawflies and woodwasps, or the superfamily Tenthredinoidea.'" *Ent. News*, Vol. XXII, pp. 218–219, 1911.

———. "Studies of the sawfly genus Hoplocampa." *Tech. ser. 20 Pt. IV, Bur. Ent. U.S. Dept. Agric.*, pp. 139–148, 1911.

———. "The genotypes of the sawflies and woodwasps, or the superfamily Tenthredinoidea." *Tech. ser. 20, Pt. II, Bur. Ent. U.S. Dept. Agric.*, pp. 69–109, 1911. [A list of the generic names used on sawflies and the types species of each genus.]

Snodgrass, Robert Evans. "The thorax of Hymenoptera." *Proc. U.S. Nat. Mus.*, Vol. XXXIX, pp. 37–91, pl. 1–16, 1910. [Figures of the thorax of many Hymenoptera, including some sawflies, with names for all of the parts. The nomenclature used by Snodgrass is the one followed in the present paper.]

PRELIMINARY LIST OF THE ALGAE OF COLORADO[1]

By Wilfred W. Robbins

The following list of Colorado algae attempts to give all the known recorded species from the state together with a number of additions resulting from the writer's studies during the past three years. A few Colorado records are given in F. Wolle's *Fresh-Water Algae of the United States*, also in Miss Josephine E. Tilden's *Minnesota Algae* and Frank S. Collins' *The Green Algae of North America*. In 1889 Professor T. D. A. Cockerell[2] published a short list of algae from the Wet Mountain Valley. The identification of this material was made by Wolle, except one species which was named by Dr. W. G. Farlow. In 1903 Joseph A. Cushman[3] published a list of desmides from southwestern Colorado, based upon a collection made by Tower at the head of Tank Creek, altitude 10,970 feet.

The writer has examined the greater portion of the algal collection at the University of Colorado, this material having been accumulated by members of the biological staff for a number of years back; he has also been permitted to examine the collection of Entomostraca from Colorado lakes and ponds, made by Dr. G. S. Dodds, and has found in this a goodly number of species of algae. This material has also afforded additional locality records. Several students at the University of Colorado Mountain Laboratory for Field Biology at Tolland have rendered valuable assistance by their collections and studies. Louise Falk Robbins, while a student at the University of Colorado, helped to look over a number of vials and made drawings of some of the doubtful species.

The list is only a preliminary one; a number of doubtful species

[1] *Publication of the Colorado Biological Survey*, No. 11.

[2] Cockerell, T. D. A., "Contributions toward a List of the Fauna and Flora of the Wet Mountain Valley, Colorado," *West American Scientist*, Vol. VI, pp. 153–155, Nov., 1889.

[3] Cushman, Joseph A., "Desmids from Southwestern Colorado," *Bull. Torr. Bot. Club*, Vol. XXXI, pp. 161–164, 1904.

have been omitted and a great deal of material remains to be examined for the first time. The writer is at present engaged in a study of the algae in Colorado soils. Studies now in progress will afford a good number of additions to the list.

It is too early to discuss the distribution of Colorado algae; however, enough is known to indicate that certain species have a characteristic altitudinal distribution and rather marked ecological relations.

Mr. Frank S. Collins, of Malden, Mass., has kindly determined several species as hereinafter indicated. The number of the vial containing the species is placed in parenthesis, except in a very few cases in which the material was determined fresh and no specimen kept. The vial numbers preceded by "D" refer to the Entomostracan collection of Dr. Dodds. All other vial numbers refer to the general collection of algae at the University of Colorado.

Class CYANOPHYCEAE

Order *COCCOGONALES*

Family CHROOCOCCACEAE

Synechococcus racemosus Wolle. [Tilden, Minn. Alg., p. 11.]
Boulder, attached to sides of flowerpot, biological laboratory, University of Colorado, January 29, 1910, Robbins.

Chrootheca monococca var. **mellea** (Kuetzing) Hansgirg. [Tilden, Minn. Alg., p. 13.]
"Colorado, Wolle." Tilden.

Gloeocapsa conglomerata Kuetzing. [Tilden, Minn. Alg., p. 18.]
"Colorado, on Cladophora (Porter, Wolle)." Tilden.

G. mellea Kuetzing. [Tilden, Minn. Alg., p. 18.]
"Colorado, on walls and bare earth, often mixed with other algae (Wolle)." Tilden.

Microcystis marginata (Meneghini) Kuetzing. [Tilden, Minn. Alg., p. 34.]
Gregory Canyon, near Boulder, floating on stagnant water along creek, October 15, 1910, Robbins.

Coelosphaerium kuetzingianum Naegeli. [Tilden, Minn. Alg., p. 40.]
Eagle Lake, surface tow, August 19, 1910, Juday (48).

Merismopedium glaucum (Ehrenberg) Naegeli. [Tilden, Minn. Alg., p. 43.]
Redrock Lake, August 18, 1908, Ramaley (1).

M. tenuissimum Lemmermann. [Tilden, Minn. Alg., p. 45.]
Reservoir No. 1, near La Junta, July 28, 1908, Dodds (D277).

Eucapsis alpina Clements & Shantz. [Tilden, Minn. Alg., p. 45.]
"Colorado, Alpine pond on Bald Mountain (12,100 feet), September, 1904 (Shantz)." Tilden.

Family CHAMAESIPHONACEAE

Chamaesiphon incrustans Grunow. [Tilden, Minn. Alg., p. 55.]
Corona, on *Conferva*, July 25, 1911, Brannaman (77).

Order *HORMOGONALES*

Family OSCILLATORIACEAE

Oscillatoria curviceps Agardh. [Tilden, Minn. Alg., p. 67.]
"Colorado. On surface of slow-flowing water in swamp. Five miles east of Fort Collins, July, 1896, Cowen." Tilden.

O. formosa Bory. [Tilden, Minn. Alg., p. 80.]
Tolland, June 25, 1910, Robbins; Boulder, sides of aquarium jar in biological laboratory, University of Colorado, January 26, 1911, Robbins.

O. limosa Agardh. [Tilden, Minn. Alg., p. 65.]
Wet Mountain Valley, 1889, Cockerell.

O. splendida Greville. [Tilden, Minn. Alg., p. 76.]
Wet Mountain Valley, 1889, Cockerell.

O. tenuis Agardh. [Tilden, Minn. Alg., p. 71.]
Yankee Doodle Lake, August 28, 1908, Ramaley (6); Teller Lake, June 23, 1909, Robbins (8).

Spirulina major Kuetzing. [Tilden, Minn. Alg., p. 87.]
Pond near Boulder, in stagnant water, October 30, 1910, Robbins (59).

Phormidium tenue (Meneghini) Gomont. [Tilden, Minn. Alg., p. 98.]
East Lake, near Tolland, June 13, 1909, Ramaley (19); Boulder, in water fountain, March 8, 1910, Robbins (20).

Lyngbya aerugineo-caerulea (Kuetzing) Gomont. [Tilden, Minn. Alg., p. 116.]
Park Lake, near Tolland, forming a blackish mass along with other algae, July 8, 1911, Robbins.

L. majuscula (Dillwyn) Harvey. [Tilden, Minn. Alg., p. 123.]
Eagle Lake, surface tow, August 19, 1903, Juday (48).

Family NOSTOCACEAE

Nostoc comminutum Kuetzing. [Tilden, Minn. Alg., p. 165.]
North Forest Lake, floating in water, August 31, 1908, Dodds (D374); Lily Lake, July 14, 1911, Brannaman (69).

N. pruniforme (L.) Agardh. [Tilden, Minn. Alg., p. 178.]
Marshall, at bottom of ditch, March 30, 1910, Robbins (18).

N. sphaericum Vaucher. [Tilden, Minn. Alg., p. 173.]
Wet Mountain Valley, 1889, Cockerell.

N. verrucosum (L.) Vaucher. [Tilden, Minn. Alg., p. 179.]
Gregory Canyon, near Boulder, attached to stones in running water, October 15, 1910, Robbins.

Nodularia paludosa Wolle. [Tilden, Minn. Alg., p. 183.]
"Colorado, Wolle." Tilden.

Anabaena circinalis Rabenhorst. [Tilden, Minn. Alg., p. 190.]
Redrock Lake, August 18, 1908, Ramaley (1).

A. flos-aquae (Lyngbye) Brebisson. [Tilden, Minn. Alg., p. 189.]
Park Lake, near Tolland, very abundant, forming a blue-green scum along the shores where it is drifted by the wind, July 28, 1911, Robbins.

A. oscillarioides var. **stenospora** Bornet & Flahault. [Tilden, Minn. Alg., p. 194.]
"Colorado. On aquatic plants in slowly flowing stream in swamp. Five miles southeast of Fort Collins, July, 1896 (Cowen)." Tilden.

Family SCYTONEMACEAE

Scytonema crispum (Agardh) Bornet. [Tilden, Minn. Alg., p. 214.]
"Colorado (Brandegee)." Tilden.

S. mirabile (Dillwyn) Bornet. [Tilden, Minn. Alg., p. 222.]
"Colorado. In pannose layers upon the 'Pillars of Hercules,' South Cheyenne Canyon, near Manitou (Setchell)." Tilden.

S. myochrous (Dillwyn) Agardh. [Tilden, Minn. Alg., p. 224.]
"Wet rocks (Brandegee)." Tilden.

Tolypothrix distorta (Hofman-Bang) Kuetzing. [Tilden, Minn. Alg., p. 231.]
Lily Lake, attached to plants in the water, July 13, 1911, Brannaman (69); East Forest Lake, attached to *Fontinalis* sp., July 25, 1911, Robbins (79).

Family STIGONEMACEAE

Hapalosiphon fontinalis (Agardh) Bornet. [Tilden, Minn. Alg., p. 239.]
Teller Lake, attached to stems of *Carex utriculata* July 20, 1911, Brannaman (74).

Family RIVULARIACEAE

Calothrix parietina (Naegeli) Thuret. [Tilden, Minn. Alg., p. 269.]
"Colorado. Wet rocks, Canyon City (Brandegee)." Tilden.

Rivularia haematites (DC.) Agardh. [Tilden, Minn. Alg., p. 290.]
"Colorado. Forming a reddish crust upon dripping rocks, Bridal Veil Falls, Williams Canyon, near Manitou (Setchell)." Tilden.

R. natans (Hedwig) Welwitsch. [Tilden, Minn. Alg., p. 285.]
Smartweed Lake, forming colonies on submerged parts of *Myriophyllum*, July 4, 1910, Dodds (D504).

Class HETEROKONTAE

Order *CONFERVALES*

Family CONFERVACEAE

Ophiocytium parvulum (Perty) A. Braun. [Collins, Green Alg. of N.A., p. 94.]
University Lake, Boulder, July 8, 1908, Dodds (D248); East Lake, near Tolland, June 13, 1909, Ramaley (19); Corona Lake, July 25, 1911, Brannaman (76).

Conferva bombycina Agardh. [Collins, Green Alg. of N.A., p. 96.]
Stagnant pool near Goose Lake, September 3, 1905, Ramaley (7); Yankee Doodle Lake, August 28, 1908, Ramaley (6); Jenny Lake, July 8, 1910, Robbins; Corona Lake, July 25, 1911, Robbins.

Family BOTRYDIACEAE

Botrydium granulatum (L.) Greville. [Collins, Green Alg. of N.A., p. 98.]
Tolland, on moist soil in depression about 100 yds. east of laboratory, July 19, 1911, Brannaman (72).

Class CHLOROPHYCEAE

Order *CONJUGALES*

Family DESMIDIACEAE

Desmidium cylindricum Greville. [Wolle, Desmids of U.S., p. 25.]
Lake Eldora, July 14, 1910, Bruderlin.

D. swartzii Agardh. [Wolle, Desmids of U.S., p. 26.]
Redrock Lake, August 18, 1908, Ramaley (1, 10); Redrock Lake, August 18, Dodds (D297); Bog Lake, August 18, 1908, Dodds (D301); Lily Lake, August 19, 1908, Dodds (D321).

Penium closterioides Ralfs. [Wolle, Desmids of U.S., p. 35.]
South Boulder Creek, July 2, 1910, Goldsworthy; Park Lake, near Tolland, July 19, 1910, Goldsworthy.

P. closterioides spirogranatum Cushman. [Bull. Torr. Bot. Club, Vol. XXXI, pp. 161–164, 1904.]
At the head of Tank Creek, Southwestern Colorado, 1903, Tower.

P. digitus (Ehrenberg) Brebisson. [Wolle, Desmids of U.S., p. 34.]
At the head of Tank Creek, Southwestern Colorado, 1903, Tower.

Closterium acerosum (Schrank) Ehrenberg. [Wolle, Desmids of U.S., p. 41.]
Wet Mountain Valley, near Ula, 1889, Cockerell.

C. acuminatum Kuetzing. [Wolle, Desmids of U.S., p. 44.]
Manchester Lake, near Rollinsville, August 29, 1908, Ramaley (5).

C. acutum Brebisson. [Wolle, Desmids of U.S., p. 44.]
Manchester Lake, August 29, 1908, Ramaley (5).

C. cucumis Ehrenberg. [Wolle, Desmids of U.S., p. 40.]
Wet Mountain Valley, Short Creek, 1889, Cockerell.

C. leibleinii Kuetzing. [Wolle, Desmids of U.S., p. 46.]
Wet Mountain Valley, 1889, Cockerell.

C. parvulum Naegeli. [Wolle, Desmids of U.S., p. 45.]
Redrock Lake, August 18, 1908, Ramaley (1).

C. striolatum Ehrenberg. [Wolle, Desmids of U.S., p. 42.]
Boulder Creek, 2 miles above Tolland, July 9, 1910, Goldsworthy; Lake Eldora, July 14, 1910, Bruderlin.

Docidium coronatum Rabenhorst. [Wolle, Desmids of U.S., p. 49.]
Lily Lake, August 19, 1908, Dodds (D321).

D. trabecula (Ehrenberg) Naegeli. [Wolle, Desmids of U.S., p. 48.]
At head of Tank Creek, Southwestern Colorado, July, 1903, Tower.

Cosmarium balteum coloradense Cushman. [Bull. Torr. Bot. Club, Vol. XXXI, pp. 161–164, 1904.]
At head of Tank Creek, Southwestern Colorado, July, 1903, Tower.

C. botrytis Meneghini. [Wolle, Desmids of U.S., p. 74.]
At head of Tank Creek, Southwestern Colorado, July, 1903, Tower.

C. brebissonii Meneghini. [Wolle, Desmids of U.S., p. 75.]
South Boulder Creek, 2 miles above Tolland, June 15, 1910, Robbins (58).

C. margaritiferum Meneghini. [Wolle, Desmids of U.S., p. 74.]
At the head of Tank Creek, Southwestern Colorado, July, 1903, Tower; Teller Lake, June 23, 1909, Robbins (8).

C. meneghini braunii (Reinsch) Hansgirg.
At head of Tank Creek, Southwestern Colorado, July, 1903, Tower.

C. nitidulum DeNot. [Wolle, Desmids of U.S., p. 62.]
Wet Mountain Valley, 1889, Cockerell; Black Lake, June 10, 1908, Dodds (D217).

C. phaseolus Brebisson. [Wolle, Desmids of U.S., p. 81.]
Redrock Lake, August 18, 1908; Ramaley (1); Eldora Lake, July 14, 1911, Bruderlin.

C. sexangulare Lund. [Wolle, Desmids of U.S., p. 63.]
South Boulder Creek, 2 miles above Tolland, June 15, 1909, Robbins (9).

C. tetraophthalmum (Kuetzing) Brebisson. [Wolle, Desmids of U.S., p. 75.]
East Lake, June 9, 1908, Dodds (D204); Eldora Lake, July 14, 1910, Goldsworthy.

C. undulatum var. **crenulatum** Wolle. [Wolle, Desmids of U.S., p. 67.]
Semper Pond, July 11, 1908, Dodds (D256); South Boulder Creek, 2 miles above Tolland, June 15, 1909, Robbins (9); Teller Lake, June 23, 1909, Robbins (8).

Xanthidium antelopaeum var. **polymazum** Nord. [Wolle, Desmids of U.S., p. 94.]
Bog Lake, June 10, 1908, Dodds (D218); Baby Lake, August 19, 1908, Dodds (D323).

X. cristatum (Brebisson) Ralfs. [Wolle, Desmids of U.S., p. 93.]
Black Lake, June 10, 1908, Dodds (D217); Eldora Lake, July 14, 1910, Bruderlin.

X. hastiferum johnsoni forma **longispinum** Cushman. [Bull. Torr. Bot. Club, Vol. XXXI, pp. 161–164, 1904.]
At head of Tank Creek, Southwestern Colorado, July, 1903, Tower.

X. hastiferum toweri Cushman. [Bull. Torr. Bot. Club, Vol. XXXI, pp. 161–164, 1904.]
At head of Tank Creek, Southwestern Colorado, July, 1903, Tower.

Euastrum ansatum (Ehrenberg) Ralfs. [Wolle, Desmids of U.S., p. 99.]
Wet Mountain Valley, 1889, Cockerell.

E. compactum Wolle. [Wolle, Desmids of U.S., p. 107.]
Redrock Lake, August 18, 1908, Ramaley (1).

E. didelta (Turp.) Ralfs. [Wolle, Desmids of U.S., p. 99.]
At head of Tank Creek, Southwestern Colorado, July, 1903, Tower.

E. verrucosum (Ehrenberg) Ralfs. [Wolle, Desmids of U.S., p. 100.]
At head of Tank Creek, Southwestern Colorado, July, 1903, Tower; Duck Lake, July 18, 1908, Dodds (D371).

Micrasterias denticulata (Brebisson) Ralfs. [Wolle, Desmids of U.S., p. 109.]
Bog Lake, June 10, 1908, Dodds (D218); Bog Lake, June 26, 1908, Dodds (D231); Bog Lake, July 18, 1908, Dodds (D262).

M. rotata (Greville) Ralfs. [Wolle, Desmids of U.S., p. 109.]
At head of Tank Creek, Southwestern Colorado, July, 1903, Tower; Black Lake, June 10, 1908, Dodds (D217).

Staurastrum arctison Ehrenberg. [Wolle, Desmids of U.S., p. 148.]
East Lake, June 9, 1908, Dodds (D204); Lily Lake, August 19, 1908, Dodds (D321); East Lake, August 31, 1908, Dodds (D371).

S. cuspidatum Brebisson. [Wolle, Desmids of U.S., p. 123.]
Redrock Lake, August 18, 1908, Ramaley (1).

S. echinatum Brebisson. [Wolle, Desmids of U.S., p. 141.]
At head of Tank Creek, Southwestern Colorado, July, 1903, Tower.

S. johnsoni coloradense Cushman. [Bull. Torr. Bot. Club, Vol. XXXI, pp. 161–164, 1904.]
At head of Tank Creek, Southwestern Colorado, July, 1903, Tower.

Family ZYGNEMACEAE

Zygnema pectinatum (Vaucher) Agardh. [Collins, Green Alg. of N.A., p. 103.]
Creek below Long Lake, August 20, 1908, Ramaley (46).

Z. pectinatum var. **anomalum** (Ralfs) Kirchner. [Collins, Green Alg. of N.A., p. 103.]
Wet Mountain Valley, 1889, Cockerell.

Z. pectinatum var. **decussatum** (Vaucher) Kirchner. [Collins, Green Alg. of N.A., p. 103.]
Redrock Lake, August 18, 1908, Ramaley (10).

Z. stellinum (Müller) Agardh. [Collins, Green Alg. of N.A., p. 104.]
Twin Lakes, August, 1903, Juday (44).

Spirogyra catenaeformis (Hassall) Kuetzing. [Collins, Green Alg. of N.A., p. 108.]
Boulder Creek, near Boulder, in quiet water, March 3, 1910, Robbins (25).

S. communis (Hassall) Kuetzing. [Collins, Green Alg. of N.A., p. 109.]
In ditch near Marshall, March 30, 1910, Robbins (26).

S. crassa Kuetzing. [Collins, Green Alg. of N.A., p. 112.]
White Rocks, 5 miles east of Boulder, in spring at foot of sandstone cliff, November 30, 1910, Robbins (52); same locality, January 22, 1911, Robbins.

S. dubia Kuetzing. [Collins, Green Alg. of N.A., p. 115.]
Manchester Lake, August 29, 1908, Ramaley (5); Tolland, June 6, 1909, Ramaley (30), determined by Collins; Smartweed Lake, June 21, 1909, Ramaley (28); Boulder, near Sanitarium, March 10, 1910, Robbins (29).

S. gracilis (Hassall) Kuetzing. [Collins, Green Alg. of N.A., p. 114.]
Boulder, May 7, 1905, Ramaley (31).

S. grevilleana (Hassall) Kuetzing. [Collins, Green Alg. of N.A., p. 117.]
Boulder Creek, near Boulder, quiet water, March 3, 1910, Robbins (25).

S. hassallii (Jenner) Petit. [Collins, Green Alg. of N.A., p. 117.]

Teller Lake, July 4, 1908, Dodds (55); Teller Lake, July 4, 1908, Dodds (D242); Hummock Pool, July 18, 1908, Dodds (D265); Duck Lake, July 18, 1908, Dodds (D271); pool near Corona Lake, August 28, 1908, Ramaley (11); pool near Corona Lake, August 28, 1908, Dodds (D353); Smartweed Lake, June 15, 1910, Robbins (47).

S. longata (Vaucher) Kuetzing. [Collins, Green Alg. of N.A., p. 107.]

Hot Sulphur Springs, August, 1907, Ramaley (33); Hiram Prince Lake, July 11, 1908, Dodds (D252); Redrock Lake, August 18, 1908, Ramaley (1); Manchester Lake, August 29, 1908, Ramaley (5); Redrock Lake, September 7, 1908, Ramaley (32). This species is reported from Colorado by Collins.

S. maxima (Hassall) Wittrock. [Collins, Green Alg. of N.A., p. 112.]

Smartweed Lake, August 29, 1909, Ramaley (27); Park Lake, near Tolland, July 4, 1911, Brannaman (65); Boulder, in water tank one-half mile east of University of Colorado Campus, October 26, 1910, Robbins.

S. mirabilis (Hassall) Kuetzing. [Collins, Green Alg. of N.A., p. 113.]

East Lake, near Tolland, June 13, 1909, Ramaley (30), determined by Collins.

S. nitida (Dillwyn) Link. [Collins, Green Alg. of N.A., p. 110.]

Wet Mountain Valley, Westcliff, 1889, Cockerell.

S. porticalis (Müller) Cleve. [Collins, Green Alg. of N.A., p. 108.]

Wet Mountain Valley, near Short Creek, West Cliff, 1889, Cockerell; Hot Sulphur Springs, August, 1907, Ramaley (33); lake near Pine Glade school, August 22, 1907, Ramaley (34); Hiram Prince Lake, September 15, 1907, Ramaley (35); Frank Prince Lake, July 11, 1908, Dodds (D250); Eldora Lake, May 31, 1910, Robbins (49); Boulder Creek, near Boulder, January 29, 1910, Robbins (62).

S. ternata Ripart. [Collins, Green Alg. of N.A., p. 144.]

Boulder, May 3, 1909, Robbins (37). Reported from Colorado by Collins.

S. weberi Kuetzing. [Collins, Green Alg. of N.A., p. 116.]

East Lake, near Tolland, June 13, 1909, Ramaley (19); Smartweed Lake, August 29, 1908, Dodds (D363). Abundant in Park Lake, near Tolland, during the summer months, forming large floating masses near the shore line.

Family MESOCARPACEAE

Mougeotia laetevirens (A. Braun) Wittrock. [Collins, Green Alg. of N.A., p. 125.]

Eldora Lake, forming large floating masses on the surface, May 31, 1910, Robbins (17); Park Lake, near Tolland, July 11, 1911, Robbins. This species is very abundant in lakes and ponds at middle elevations.

M. scalaris Hassall. [Collins, Green Alg. of N.A., p. 123.]

Wet Mountain Valley, near Ula, 1889, Cockerell.

Order *VOLVOCALES*

Family CHLAMYDOMONADACEAE

Chlamydomonas sp. [Collins, Green Alg. of N.A., p. 128.]

University Lake, Boulder, so abundant in the lake at this date as to give a green color to the water, March 7, 1910, Robbins (4).

Haematococcus pluvialis Flotow. [Collins, Green Alg. of N.A., p. 130.]
"From dry 'water basin' in sandstone," Boulder, July 19, 1904, E. Bethel.

Family VOLVOCACEAE

Volvox aureus Ehrenberg. [Collins, Green Alg. of N.A., p. 135.]
East Lake, near Tolland, June 5, 1909, Ramaley (43); August 31, 1908, Dodds (D371); July 4, 1908, Dodds (D238); Teller Lake, July 4, 1908, Dodds (D242).

V. globator Linn. [Collins, Green Alg. of N.A., p. 135.]
Teller Lake, July 4, 1908, Dodds (55); Aspen Lake, August 21, 1908, Dodds (D343).

Family TETRASPORACEAE

Tetraspora cylindrica (Wahl.) Agardh. [Collins, Green Alg. of N.A., p. 138.]
Tolland, July 22, 1909, Ramaley (39).

T. gelatinosa (Vaucher) Desv. [Collins, Green Alg. of N.A., p. 139.]
Duck Lake, August 18, 1908, Dodds (D305).

T. lubrica (Roth) Agardh. [Collins, Green Alg. of N.A., p. 139.]
South Boulder Canyon, 2 miles above Tolland, August 30, 1908, Ramaley (53); June 15, 1909, Robbins (9); Mammoth Gulch, July 18, 1911, Brannaman (70).

Order *PROTOCOCCALES*

Family HALOSPHAERACEAE

Eremosphaera viridis var. **major** Moore. [Collins, Green Alg. of N.A., p. 155.]
Tolland, July 11, 1911, Brannaman (67).

Family SCENEDESMACEAE

Rhaphidium braunii Naegeli. [Collins, Green Alg. of N.A., p. 158.]
Teller Lake, June 23, 1909, Robbins (8).

R. falcatum (Corda) Cooke. [Collins, Green Alg. of N.A., p. 157.]
Gaynor Lake, September 15, 1907, Ramaley (21); Teller Lake, June 23, 1909, Ramaley (22).

R. setigerum (Schroder) W. & G. [Collins, Green Alg. of N.A., p. 158.]
Gaynor Lake, September 15, 1907, Ramaley (21).

Oocystis solitaria Wittrock. [Collins, Green Alg. of N.A., p. 160.]
Redrock Lake, August 18, 1908, Ramaley (1).

Nephrocytium naegelii Grunow. [Collins, Green Alg. of N.A., p. 161.]
Corona Lake, July 25, 1911, Brannaman (78).

Scenedesmus bijuga (Turp.) Wittrock. [Collins, Green Alg. of N.A., p. 168.]
University Lake, Boulder, June 9, 1908, Dodds (D213); Redrock Lake, August 18, 1908, Ramaley (1).

S. bijuga var. **alterans** (Reinsch) Hansgirg. [Collins, Green Alg. of N.A., p. 168.]
Hiram Prince Lake, July 11, 1908, Dodds (D252).

S. obliquus (Turp.) Kuetzing. [Collins, Green Alg. of N.A., p. 168.]
University Lake, Boulder, July 6, 1908, Dodds (D248); Duck Lake, July 18, 1908, Dodds (D271).

S. obliquus var. **dimorphus** (Turp.) Hansgirg. [Collins, Green Alg. of N.A., p. 169.]

University Lake, Boulder, June 9, 1908, Dodds (D213); East Lake, July 4, 1908, Dodds (D238).

S. quadricauda (Turp.) Brebisson, Forma **typicus** Kirchner. [Collins, Green Alg. of N.A., p. 169.]

Gaynor Lake, September 15, 1907, Ramaley (21); University Lake, Boulder, July 18, 1908, Dodds (D248); Reservoir No. 1, near La Junta, July 28, 1908, Dodds (D277); Redrock Lake, August 18, 1908, Ramaley (1); University Lake, Boulder, March 24, 1910, Robbins (23).

Kirchneriella lunaris (Kirchner) Moebius. [Collins, Green Alg. of N.A., p. 171.]

Teller Pool, July 4, 1908, Dodds (D244).

Coelastrum sphaericum Naegeli. [Collins, Green Alg. of N.A., p. 172.]

Hiram Prince Lake, July 11, 1908, Dodds (D252).

Dictyosphaerium pulchellum Wood. [Collins, Green Alg. of N.A., p. 174.]

Redrock Lake, August 18, 1908, Ramaley (1).

Family **HYDRODICTYACEAE**

Pediastrum boryanum (Turp.) Meneghini. [Collins, Green Alg. of N.A., p. 177.]

Hiram Prince Lake, July 11, 1908, Dodds (D252); Chicago Lake, August 21, 1908, Dodds (D349); East Lake, near Tolland, July 1, 1910, Robbins; Tolland, July 19, 1910, Goldsworthy.

P. duplex Meyen. [Collins, Green Alg. of N.A., p. 179.]

University Lake, Boulder, July 6, 1908, Dodds (D248); Hiram Prince Lake, July 11, 1908, Dodds (D252).

P. duplex var. **clathratum** A. Braun. [Collins, Green Alg. of N.A., p. 179.]

Semper Lake, July 13, 1908, Dodds (D258); Reservoir No. 1, near La Junta, July 28, 1908, Dodds (D277).

P. tetras (Ehrenberg) Ralfs. [Collins, Green Alg. of N.A., p. 179.]

South Lily Lake, August 19, 1908, Dodds (D331).

Order *ULOTRICHALES*

Family **ULOTRICHACEAE**

Ulothrix tenerrima Kuetzing. [Collins, Green Alg. of N.A., p. 183.]

South Boulder Canyon, 2 miles above Tolland, June 15, 1909, Robbins (9); Teller Lake, June 23, 1909, Robbins (8); Teller Lake, June 23, 1909, Robbins (22); ditch near Marshall, March 30, 1910, Robbins (40); Bluebell Canyon, near Boulder, April 29, 1910, Robbins (54).

U. tenuissima Kuetzing. [Collins, Green Alg. of N.A., p. 183.]

Ditch near Boulder, March 10, 1910, Robbins (41); stream at foot of Arapahoe Glacier, Henderson (13), determined by Collins.

U. oscillarina Kuetzing. [Collins, Green Alg. of N.A., p. 184.]

Jenny Lind Creek, near Tolland, June 27, 1911, Brannaman (66).

U. zonata (Web. and Mohr) Kuetzing. [Collins, Green Alg. of N.A., p. 184.]

Teller Lake, July 29, 1909, Robbins (51); ditch near Marshall, March 30, 1910, Robbins (42); South Boulder Canyon, 2 miles above Tolland, June 15, 1909, Robbins (9).

Stichococcus bacillaris Naegeli. [Collins, Green Alg. of N.A., p. 190.]

Boulder, on flowerpot, March 31, 1910, Fenner.

Microspora amoena (Kuetzing) Rabenhorst. [Collins, Green Alg. of N.A., p. 193.]

West Forest Lake, August 31, 1908, Ramaley (16), determined by Collins.

M. quadrata Hazen. [Collins, Green Alg. of N.A., p. 194.]

Teller Lake, June 23, 1909, Robbins (8), determined by Collins.

Family PRASIOLACEAE

Schizogonium murale var. **alpinum** Farlow. [Collins, Green Alg. of N.A., p. 218.]

James Peak, forming loose, floating tufts in small stream from melting snow bank, altitude 13,000 feet, June 28, 1910, Robbins (24).

Prasiola mexicana J. G. Agardh. [Collins, Green Alg. of N.A., p. 218.]

At foot of Arapahoe Glacier in cold running water, Henderson (13), determined by Collins; South Boulder Creek, near Tolland, June 24, 1910, Robbins.

Family OEDOGONIACEAE

Oedogonium crispum (Hassall) Wittrock. [Collins, Green Alg. of N.A., p. 244.]

Pine Cliff, in running stream, July 11, 1911, Brannaman (68).

Family CHAETOPHORACEAE

Chaetophora elegans (Roth) Agardh. [Collins, Green Alg. of N.A., p. 295.]

Park Lake, near Tolland, attached to under side of stones along the shore; also on erect sedge blades that are submersed, June 18, 1910, Robbins.

Stigeoclonium stagnatile (Hazen) Collins. [Collins, Green Alg. of N.A., p. 301.]

Boulder, in watering-trough, February 7, 1911, Watkins (63).

S. tenue (Agardh) Rabenhorst. [Collins, Green Alg. of N.A., p. 300.]

East Lake, near Tolland, June 13, 1909, Ramaley (38), determined by Collins; Park Lake, near Tolland, July 18, 1911, Brannaman (71).

Draparnaldia acuta (Agardh) Kuetzing. [Collins, Green Alg. of N.A., p. 303.]

Boulder Creek, near Boulder, January 29, 1910, Robbins (61); Corona, attached to stones in running water, July 25, 1911, Brannaman (75). This species is common in cold water streams, attached to stones at the bottom.

D. glomerata (Vaucher) Agardh. [Collins, Green Alg. of N.A., p. 303.]

Park Lake, near Tolland, July 19, 1911, Brannaman (73).

D. plumosa (Vaucher) Agardh. [Collins, Green Alg. of N.A., p. 303.]

Wet Mountain Valley in Swift Creek over 8,000 feet altitude, 1889, Cockerell.

Pleurococcus vulgaris Meneghini. [Collins, Green Alg. of N.A., p. 304.]

South Boulder Canyon, 2 miles above Tolland, June 15, 1909, Robbins (9); East Lake, near Tolland, June 19, 1909, Ramaley (19); Boulder Creek, near Boulder, March 6, 1910, Robbins (20). This species is common in Colorado but by no means as abundant as in moister climates.

Family COLEOCHAETACEAE

Coleochaete scutata Breb. [Collins, Green Alg. of N.A., p. 314.]
Reported from Colorado by Collins.

Order *SIPHONOCLADIALES*

Family CLADOPHORACEAE

Cladophora glomerata (L.) Kuetzing. [Collins, Green Alg. of N.A., p. 350.]
Boulder, in irritating ditch attached to stones, April 8, 1911, Robbins (64); Wet Mountain Valley, well distributed; also found in Pueblo Co., 1889, Cockerell.

Order *SIPHONALES*

Family VAUCHERIACEAE

Vaucheria dichotoma (L.) Agardh. [Collins, Green Alg. of N.A., p. 425.]
Wet Mountain Valley, Westcliff, 1889, Cockerell.

V. geminata (Vaucher) DeCandolle. [Collins, Green Alg. of N.A., p. 427.]
Wet Mountain Valley, Short Creek, 1889, Cockerell.

V. sessilis (Vaucher) De Candolle. [Collins, Green Alg. of N.A., p. 425.]
East Lake, near Tolland, June 13, 1909, Ramaley (38); Tolland, in standing water, June 22, 1909, Robbins (56).

Localities and Altitudes[1]

Aspen Lake, in Boulder County, west of Ward; altitude about 10,000 feet.
Baby Lake, same as above.
Black Lake, same as above.
Bog Lake, in Boulder County, near Ward; altitude about 10,200 feet.
Boulder, the seat of the University of Colorado; altitude 5,347 feet.
Canyon City, altitude 5,343 feet.
Chicago Lake, near Georgetown; altitude 11,700 feet.
Corona, in Grand County, near the point where Grand, Gilpin and Boulder counties join; altitude 11,660 feet.
Corona Lake, in Grand County, one-half mile from Corona; altitude 11,185 feet.
Duck Lake, in Boulder County, near Ward; altitude 9,350 feet.
Eagle Lake, in the vicinity of Twin Lakes; altitude about 9,000 feet.
East Lake, in Gilpin County, near Tolland; altitude 10,800 feet.
East Forest Lake, in Gilpin County, four miles west of Tolland; altitude 10,800 feet.
Eldora Lake (*Peterson's Lake*), in Boulder County, three miles north of Tolland; altitude 9,200 feet.
Eldorado Springs, in Boulder County, five miles south of Boulder; altitude 5,700 feet.
Frank Prince Lake, in Boulder County; altitude 5,250 feet.
Ft. Collins, altitude 4,994 feet.
Gas Lake, east of Boulder; altitude 5,200 feet.
Gaynor Lake, in Boulder County, three miles south of Longmont; altitude 5,000 feet.
Goose Lake, in Boulder County; altitude about 10,400 feet.

[1] Prepared by the editor from a rough draft by the author.

Hiram Prince Lake, in Boulder County, about nine miles east of Boulder; altitude about 5,200 feet.

Hot Sulphur Springs, same as Sulphur Springs, in Grand County; altitude 7,800 feet.

Hummock Pool, near Ward, Boulder County, altitude 9,200 feet.

Jenny Lake, in Boulder County, four miles northwest of Tolland; altitude 10,900 feet.

La Junta, in Otero County; altitude about 4,000 feet.

Lily Lake, in Boulder County, about two miles north of Tolland; altitude about 9,100 feet.

Lily Lake, in Boulder County, near Ward, altitude about 10,000 feet.

Long Lake, in Boulder County, four miles west of Ward; altitude 10,550 feet.

Manchester Lake, in Gilpin County, near Rollinsville, about five miles east of Tolland; altitude 8,625 feet.

Manitou, near Colorado Springs; altitude 6,318 feet.

Marshall, in Boulder County, about five miles south of Boulder; altitude about 5,200 feet.

North Forest Lake, in Gilpin County, about four miles west of Tolland; altitude 10,850 feet.

Park Lake, in Gilpin County, at Tolland; altitude 8,880 feet.

Pine Cliff, in Boulder County, about eight miles southwest of Boulder; altitude 8,000 feet.

Pine Glade School, in Boulder County, about eight miles northeast of Tolland.

Redrock Lake, in Boulder County, about two miles west of Ward; altitude 10,100 feet.

Semper Pond, about ten miles north of Denver; altitude 5,400 feet.

Short Creek, Custer County; altitude about 8,000 feet.

Smartweed Lake, in Gilpin County, about one mile north of Rollinsville on the road to Nederland, near Manchester Lake; altitude 8,575 feet.

South Lily Lake, near Ward in Boulder County; altitude about 10,000 feet.

Tank Creek, in "southwestern Colorado"; altitude 10,970 feet.

Teller Lake, in Gilpin County, about two miles southwest of Tolland; altitude 9,575 feet.

Tolland, in Gilpin County, situated on South Boulder Creek in a mountain park (Boulder Park), the seat of the University of Colorado Mountain Laboratory; altitude 8,889 feet.

Twin Lakes, in Lake County; altitude 9,365 feet.

Ula, Custer County; altitude about 7,900 feet.

West Cliff, in Custer County; altitude 7,849 feet.

Wet Mountain Valley, in Custer County; altitude 7,800 to 8,200 feet.

White Rocks, in Boulder County, five miles east of Boulder; altitude 5,000 feet.

Yankee Doodle Lake, in Boulder County, about four miles northwest of Tolland; altitude 10,750 feet.

SUMMARY[1]

The foregoing paper gives the determination of specimens of algae collected in Colorado by members of the biological staff of the University of Colorado, together with records abstracted from the general literature of the subject. In all 143 species of algae are listed, a large part being reported for the first time. Many of the specimens

[1] Prepared by the editor.

examined are from Boulder County—some from the city of Boulder, the seat of the University of Colorado. Other collections here reported upon were made largely in the higher altitudes of Gilpin County in the vicinity of Tolland, where the Mountain Laboratory of the University is located. It appears that there is not thus far sufficient information to discuss the altitudinal distribution of algae in the State. A considerable amount of material is at hand for more detailed study and later report.

SOME DESMIDS FROM ALPINE STATIONS IN COLORADO[1]

By G. H. Wailes

Following is a list of desmids determined by the writer from material submitted by Professor C. H. Edmondson of Washburn College. The collections were made in the summer of 1911 from alpine stations near the Continental Divide west of Denver and Boulder, Colorado. In examining this material I notice that some of the American forms of desmids are slightly different from the British and European; thus *Euastrum verrucosum* var. *reductum* and *E. bidentatum* from these collections are not quite typical. Separate lists are given below for the three collections.

Summit Lake, Clear Creek County, 12,740 Feet

Closterium parvulum Näg.
Hyalotheca dissiliens (Sm.) Bréb.
Penium curtum Bréb. f. minor Wille, (l. 29μ, diam. 14μ).
P. cylindrus (Ehrenb.) Bréb.
Euastrum occidentale West & G. S. West.
E. ansatum Ralfs.
E. verrucosum var. *reductum* Nordst.
E. bidentatum Näg.
Cosmarium pseudobroomei Wolle (medium-sized variety; length about 50μ, width nearly as much).
C. quadratum Ralfs.
C. granatum Bréb.
C. subcrenatum Hantzsch.
C. hammeri Reinsch.
Staurastrum natator var. *crassum* West.

[1] *Publication of the Colorado Biological Survey*, No. 12.

FROM A POINT ON JAMES PEAK AT AN ALTITUDE OF 12,500 FEET (GILPIN COUNTY)

Closterium abruptum West.
Netrium digitus (Ehrenb.) Itzigsh. & Rothe.
Euastrum bidentatum Näg.
Cosmarium hammeri Reinsch.
Tetmemorus laevis (Kütz.) Ralfs.

FROM CORONA, COLORADO (GRAND COUNTY), 11,660 FEET

Closterium braunii Reinsch.
C. intermedium Ralfs.

THE GRASS-FLORA OF TOLLAND, COLORADO, AND VICINITY[1]

By Francis Ramaley and Miss Mary Esther Elder

The Area Studied.[2]—The region covered in the following study has as a center Tolland, a small village situated in Boulder Park, a broad valley in Gilpin County in northern Colorado. The

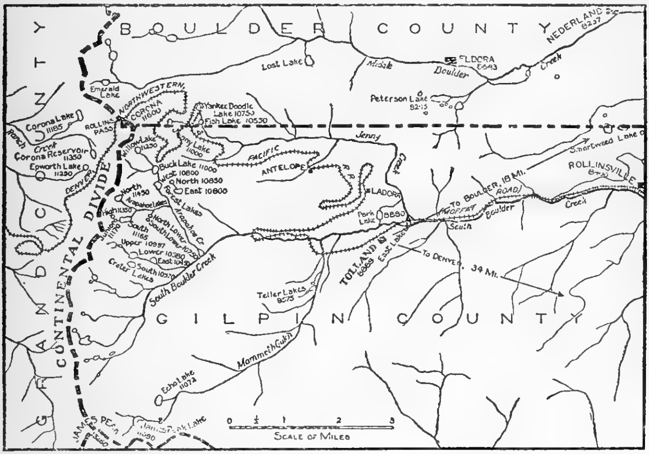


Fig. 1.—Map of Tolland, Colorado, and Vicinity. The area of the present study would be included by lines drawn to connect Eldora, Teller Lake, and Smartweed Lake.

[1] *Publication of the Colorado Biological Survey*, No. 13.

[2] Previous articles in these *Studies* concerned with the botany of Tolland, Colorado, and vicinity are:

Ramaley, Francis, "Remarks on Some Northern Colorado Plant Communities with Special Reference to Boulder Park (Tolland, Colorado)," Vol. VII, pp. 223–236, 1910.

Bruderlin, Katharine, "A Study of the Lodgepole-Pine Forests of Boulder Park (Tolland, Colorado)," Vol. VIII, pp. 265–275, 1911.

Ramaley, Francis, and Mitchell, Louis A., "Ecological Cross-Section of Boulder Park (Tolland, Colorado)," Vol. VIII, pp. 277–287, 1911.

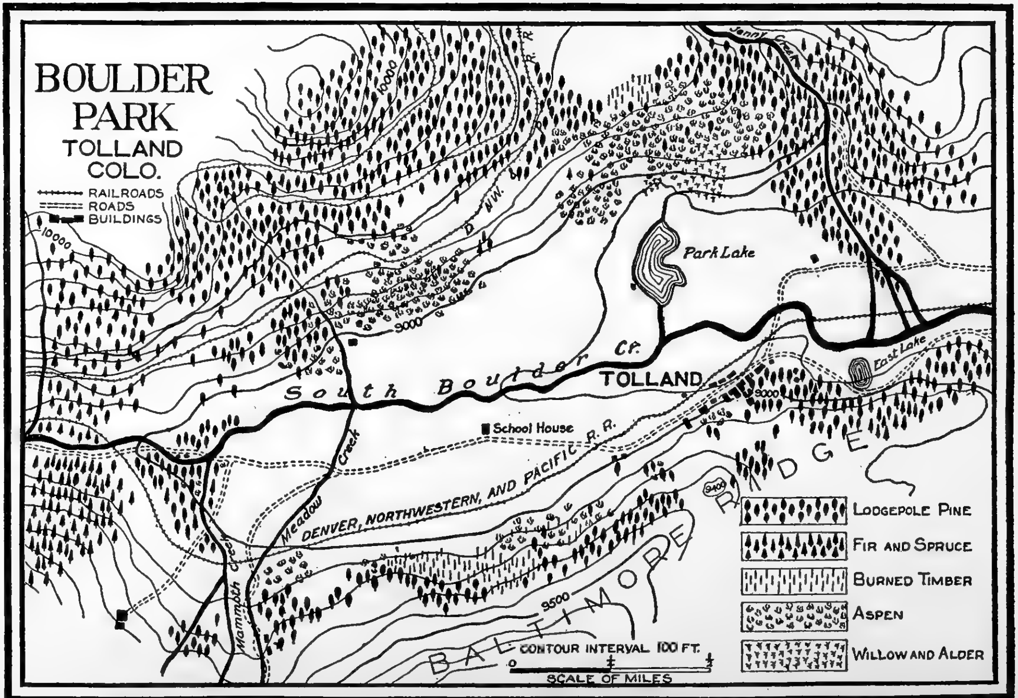


FIG. 2.—Map of Boulder Park, Tolland, Colorado, and immediate environs

mountain laboratory of the University of Colorado[1] is located here and the district has on this account been rather well examined. Tolland is 8,889 feet above sea-level, and the adjacent areas covered in the present study are all of an altitude of 8,500 to 9,500 feet. Following are the localities mentioned in the systematic list:

Tolland.—A small village on South Boulder Creek in Boulder Park, Gilpin County, altitude 8,889 feet.

Boulder Park.—An open valley about two miles long and three-fourths of a mile wide, chiefly grassland surrounded by wooded hills—altitude 8,800–9,100 feet.

East Lake and *Park Lake.*—Small ponds in Boulder Park.

Teller Lakes.—Morainal ponds 1½ miles southwest of Tolland—altitude 9,575 feet.

Mammoth Gulch.—A valley about one mile southwest of Tolland—altitude 9,000–9,500 feet. Plants collected at higher altitudes in the gulch are not included in the present study.

Eldora.—A village on middle Boulder Creek in Boulder County, 4 miles north of Tolland—altitude 8,600 feet.

Eldora Lake (*Peterson's Lake*).—Three and one-half miles north of Tolland in Boulder County—altitude about 9,200 feet.

Rollinsville.—A small village on South Boulder Creek, 5 miles below Tolland in Gilpin County—altitude about 8,500 feet.

Smartweed Lake.—About one mile north of Rollinsville in Gilpin County—altitude 8,600 feet.

The district included in the present study has roughly the form of a triangle with Teller Lake, Smartweed Lake, and Eldora at the apices. About 12 square miles are included in the area. Various ecological habitats are represented, as coniferous forest, aspen forest, streamside and lake-margin areas, dry grassland, talus slope, etc.

The Material Examined.—The material includes 290 numbers, collected entirely by Messrs. Francis Ramaley and W. W. Robbins during the years 1906–1911, inclusive. A few species from Eldora have been admitted to the list from the "Flora of Boulder, Colorado,

[1] For an account of the Mountain Laboratory of the University of Colorado see "A Summer Laboratory for Mountain Botany," by Francis Ramaley and W. W. Robbins in *Plant World*, Vol. XII, pp. 105–110, 1909.

and Vicinity," by Dr. Francis P. Daniels.[1] These specimens have not been seen by the present writers.

Determination of Species.—Many of our specimens have in previous years been submitted to Professor Aven Nelson of the University of Wyoming and the value of his determinations has been very great for the present work. Recently, especially in the genus *Poa*, some critical material has been sent to Professor A. S. Hitchcock, and the authors wish to acknowledge their indebtedness to him. Two years ago Miss Louise Falk (now Mrs. W. W. Robbins, of Fort Collins, Colorado) examined all of the Colorado grasses in the University herbarium and her painstaking study brought to light a number of errors made by our botanical staff in previous determinations. The present writers have gone through all the material here listed, have examined each specimen and have named the plants in the light of all available information.

The nomenclature used is with few exceptions that of Rydberg's *Flora of Colorado.*

Published Works Cited.—Since in any study of the area here examined the student will necessarily make use of certain publications, these have been indicated with the page numbers for every species. The works in the order of publication are: *Flora of Colorado*, by P. A. Rydberg, published by the Experiment Station of the Colorado Agricultural College, Fort Collins, Colo., 1906; *New Manual of Botany of the Central Rocky Mountains*, by John M. Coulter, revised by Aven Nelson, New York, 1909; *Flora of Boulder, Colorado, and Vicinity*, by Francis P. Daniels, issued as a portion of *University of Missouri Studies*, Science Series, Vol. II, No. 2, 1911. The page numbers given for Dr. Daniels' list refer to the reprint, which is repaged.

The Commonest Genera and Species.—In the area under consideration the best represented genera as to number of species are the following: *Poa*, with 15 species, *Agropyron* 10, *Festuca* 5, *Bromus* 5, *Stipa* 5, *Muhlenbergia* 4, *Calamagrostis* 4, *Panicularia* 4.

[1] *University of Missouri Studies*, Science Series, Vol. II, pp. 149–459, 1911. Reprinted with change of paging: i–xii and 1–311.

GENERA OF COLORADO GRASSES AND THE NUMBER OF SPECIES RECORDED IN EACH GENUS

Genus	Colorado (Rydberg)	Boulder and Vicinity (Daniels)	Tolland and Vicinity
ANDROPOGONEAE			
Schizachyrium	1	1	0
Amphilophis	1	0	0
Andropogon	3	2	0
Sorghastrum	1	1	0
Sorghum	1	0	0
ZOYSIEAE			
Hilaria	2	0	0
PANICEAE			
Syntherisma	2	1	0
Panicum	4	4	0
Echinochloa	1	1	0
Chaetochloa	4	3	0
Cenchrus	1	1	0
ORYZEAE			
Homalocenchrus	1	1	0
PHALARIEAE			
Phalaris	3	1	0
Savastana	1	1	1
AGROSTIDEAE			
Aristida	3	2	0
Stipa	12	5	5
Oryzopsis	3	1	0
Eriocoma	2	1	0
Muhlenbergia	17	6	4
Lycurus	1	1	0
Phleum	2	2	2
Alopecurus	2	2	2
Phippsia	1	0	0
Blepharineuron	1	0	1
Sporobolus	8	4	0
Polypogon	1	1	0
Cinna	1	1	1
Agrostis	6	5	3
Calamagrostis	9	2	4
Calamovilfa	1	0	0
AVENEAE			
Deschampsia	4	1	1
Trisetum	3	3	2
Graphephorum	3	0	1
Avena	4	3	2
Merathrepta (*Danthonia*)	4	3	3
CHLORIDEAE			
Spartina	2	1	0
Beckmannia	1	0	0
Schedonardus	1	1	0
Bouteloua	5	2	1
Antheropogon	1	1	0
Leptochloa	1	0	0
Bulbilis	1	1	0

Genus	Colorado (Rydberg)	Boulder and Vicinity (Daniels)	Tolland and Vicinity
FESTUCEAE			
Schleropogon	1	0	0
Phrogmites	1	1	0
Munroa	1	1	0
Triplasis	1	0	0
Dasyochloa	1	0	0
Erioneuron	1	0	0
Tridens	2	0	0
Diplachne	1	0	0
Redfieldia	1	0	0
Koeleria	1	1	1
Eragrostis	3	2	0
Catabrosa	1	0	0
Eatonia	4	3	0
Melica	3	1	1
Dactylis	1	1	1
Briza	1	0	0
Distichlis	1	1	0
Poa	46	24	15
Panicularia	5	4	4
Puccinellia	1	1	0
Festuca	14	8	5
Bromus	14	8	5
HORDEAE			
Agropyron	16	11	10
Hordeum	4	3	2
Sitanion	5	2	2
Elymus	12	8	3
Lolium	1	1	0
	269	147	81

In the open grassland of Boulder Park the genera represented by the greatest number of plants, not of species, are *Poa*, *Festuca*, *Koeleria* and *Muhlenbergia*, while in the forests there are other species of *Poa* and *Festuca* together with representatives of *Bromus* and *Calamagrostis* making up a large part of the grass-flora. In moist situations along streams or near lakes perhaps the most abundant grasses belong to *Agrostis*, *Calamagrostis*, *Deschampsia*, *Alopecurus*, and *Panicularia*.

The senior author has in preparation a paper which will deal with the ecology of the dry grassland of Tolland and adjacent districts and in this a full discussion of the abundance of the different grasses will be given.

Genera Which May Be Found with Further Study.—While the present list is probably as nearly complete as any first-published list is likely to be, yet there are certain genera of which we have no records which it would appear should be represented in the collection. All of the following have been reported either from Idaho Springs or Georgetown which are in the same general area of the state and hence may be expected at Tolland: *Syntherisma* (crab-grass), *Oryzopsis* (mountain-rice), *Munroa* (false buffalo-grass), *Catabrosa* (water whorl-grass), *Puccinellia* (meadow-grass). It is likely also that additional species will be found in the genera already reported.

Extent of the Grass-Flora.—The present writers have examined from the area under consideration specimens having 290 different herbarium numbers which represent 26 genera and 79 species. When the small area of collection is considered and its high altitude (8,500–9,500 feet), together with the extremely cool climate—too cold for "fruit trees" or cereal grains—this seems a rather large number of species and genera. A tabular comparison of our area with that of the entire state of Colorado may be of interest. The Colorado statistics are from Rydberg.

	Colorado	Tolland and Vicinity
Number of genera	69	26
Number of species	269	81

Tribe PHALARIEAE

SAVASTANA L. Holy-grass

Savastana odorata (L.) Scribn.

Rydberg, Flora of Colo., p. 23; Coulter-Nelson Manual, p. 47 (as *Hierochloe odorata*); Daniels, Flora of Boulder Colo., p. 60 (as *Hierochloe odorata*).

Among bushes and on banks from Lab. to Alaska, N.J. and Ariz. Range in Colo. 6,500–9,000 ft.

Collections: Tolland (along Meadow Creek) 6921; Park Lake (among sedges) 7684; East Lake (bistort and potentilla associations) 5704; Smartweed Lake 7654.

Tribe AGROSTIDEAE

STIPA L. Porcupine-grass

Stipa comata Trin. & Rupr.

Rydberg, Flora of Colo., p. 24; Coulter-Nelson Manual, p. 50; Daniels, Flora of Boulder, Colo., p. 60.

On dry plains and hills from Alb. to Alaska, N.Mex. and Calif. Range in Colo. 4,000–9,000 ft.

Collections: Tolland (dry grassland) 8825, 8983; East Lake (dry hillside) 3447; between Tolland and Rollinsville 8728.

Stipa viridula Trin.

Rydberg, Flora of Colo., p. 24; Coulter-Nelson Manual, p. 49; Daniels, Flora of Boulder, Colo., p. 60.

Dry prairies and hills from Sask. to Mont., Kans. and Utah. Range in Colo. 4,000–9,000 ft.

Collection: Tolland (dry grassland) 8927.

Stipa nelsonii Scribn.

Rydberg, Flora of Colo., p. 24; Coulter-Nelson Manual, p. 49; Daniels, Flora of Boulder, Colo., p. 60.

Dry plains and hills from Ass. to Ida. and Colo. Range in Colo. 7,500–10,000 ft.

Collection: Tolland 8883.

Stipa minor (Vasey) Scribn.

Rydberg, Flora of Colo., p. 24; Coulter-Nelson Manual, p. 49 (as *S. columbiana*); not listed in Daniels, Flora of Boulder, Colo.

Dry hillsides and mountain valleys from Mont. to Utah and N.Mex. Range in Colo. 8,000–12,500 ft.

Collections: Tolland 8824; Park Lake 7882; East Lake (Meadow association) 7832, 8701, 8897.

Stipa vaseyi Scribn.

Rydberg, Flora of Colo., p. 24; Coulter-Nelson Manual, p. 49; not listed in Daniels, Flora of Boulder, Colo.

On foothills and mountain sides from Colo. to Ida., Tex. and N.Mex.; also in Mex. Range in Colo. 5,000–9,000 ft.

Collection: Tolland 6918.

MUHLENBERGIA Schreb. Drop-seed-grass

Muhlenbergia richardsonis (Trin.) Rydb.

Rydberg, Flora of Colo., p. 27; Coulter-Nelson Manual, not separately listed; Daniels, Flora of Boulder, Colo., p. 61.

On prairies and in meadows from Anticosti to B.C., N.Mex. and Calif. Range in Colo. 4,000–9,000 ft.

Collections: Tolland 6873, 6877, 8808; East Lake (Campanula society and in the Meadow association) 3438, 8898.

Muhlenbergia simplex (Scribn.) Rydb.

Rydberg, Flora of Colo., p. 27; Coulter-Nelson Manual, p. 55 (as *Sporobolus simplex* Scribn.); Daniels, Flora of Boulder, Colo., p. 62.

In meadows and along brooks from Nebr. to Wyo. and N.Mex. Range in Colo. 8,000–10,000 ft.

Collections: Tolland 8873; Smartweed Lake 7868.

Muhlenbergia gracilis Trin.

Rydberg, Flora of Colo., p. 27; Coulter-Nelson Manual, p. 51; Daniels, Flora of Boulder, Colo., p. 62.

Gravelly or sandy soil in the mountains from Tex. to Colo. and Calif., also Mexico. Range in Colo. 5,000–10,000 ft.

Collection: Tolland (dry grassland) 6930, 8923, 9005.

Muhlenbergia subalpina Vasey.

Rydberg, Flora of Colo., p. 27; Coulter-Nelson Manual, p. 52 (as *M. gracilis breviaristata*); Daniels, Flora of Boulder, Colo., not listed.

On dry hills from Wyo. to N.Mex. Range in Colo. about 9,000–10,000 ft.

Collection: Tolland (dry grassland) 8981.

PHLEUM L. Timothy

Phleum pratense L.

Rydberg, Flora of Colo., p. 28; Coulter-Nelson Manual, p. 53; Daniels, Flora of Boulder, Colo., p. 62.

In meadows and waste places, escaped from cultivation from N.Sc. to B.C., Fla. and Calif. Range in Colo. up to 11,000 ft.

Collections: Tolland (ruderal) 6882, 6935, 8800, 9040.

Phleum alpinum L.

Rydberg, Flora of Colo., p. 28; Coulter-Nelson Manual, p. 53; Daniels, Flora of Boulder, Colo., p. 62.

In mountain meadows from Lab. to Alaska, N.H. and Calif.; also in northern Europe and Asia. Range in Colo. 8,500–12,000 ft.

Collections: Tolland 6879, 8799; Mammoth Gulch 5810, 8831; Eldora 2299; Smartweed Lake 7791.

ALOPECURUS L. Foxtail

Alopecurus aristulatus Michx.

Rydberg, Flora of Colo., p. 28; Coulter-Nelson Manual, p. 53 (as *A. fulvus*); Daniels, Flora of Boulder, Colo., p. 62.

In wet meadows from Me. to Alaska, Pa. and Calif. Range in Colo. 4,000–11,500 ft.

Collections: Tolland 6922, 8866; Boulder Park 6843; Park Lake (Carex association) 7691; East Lake (Carex association) 3368, 5694; Eldora Lake 7819; Eldora 2290; Smartweed Lake 6127.

Alopecurus occidentalis Scribn.

Rydberg, Flora of Colo., p. 28; Coulter-Nelson Manual, p. 54; Daniels, Flora of Boulder, Colo., p. 63.

In wet meadows from Alb. to B.C., Colo. and Utah. Range in Colo. 8,500–11,000 ft.

Collections: Tolland (meadow, streamside) 5226; Park Lake (among sedges, wet meadow) 7682; East Lake (Carex association also scrub formation) 3375, 7707; So. Boulder Canon (Sedge moor) 8691 A.

BLEPHARINEURON Nash

Blepharineuron tricholepis (Torr.) Nash.

Rydberg, Flora of Colo., p. 28; Coulter-Nelson Manual, p. 56; not listed in Daniels, Flora of Boulder, Colo.

Mountain valleys from Colo. to Utah, Tex. and Ariz.; also Mex. Range in Colo. 6,000–12,000 ft.

Collection: Tolland 8960.

CINNA L. Wood Reed-grass

Cinna latifolia (Trev.) Griseb.

Rydberg, Flora of Colo., p. 30; Coulter-Nelson Manual, p. 56; Daniels, Flora of Boulder, Colo., p. 63.

In damp woods from Newf. to B.C., N.C. and Utah. Range in Colo. 4,000–9,000 ft.

Collection: Tolland (moist Coniferous forest) 8887. Reported from Eldora by Daniels.

AGROSTIS L. Bent-grass

Agrostis asperifolia Trin. (*A. exarata* of authors.)

Rydberg, Flora of Colo., p. 30; Coulter-Nelson Manual, p. 57; Daniels, Flora of Boulder, Colo., p. 64.

In wet meadows from Man. to N.Mex. and Calif. Range in Colo. 4,000–10,500 ft.

Collections: Tolland (dry grassland next to meadows) 6884, 8888; near Tolland 3475, 8963A; Mammoth Gulch (streamside, meadow) 8835.

Agrostis hiemalis (Walt.) B.S.P.

Rydberg, Flora of Colo., p. 31; Coulter-Nelson Manual, p. 58; Daniels, Flora of Boulder, Colo., p. 64.

On prairies and hills, both in dry and wet soil, from Lab. to Alaska, Fla. and Calif.; also in Mex. Range in Colo. 4,000–11,000 ft.

Collections: Tolland (dry grassland) 6813, 6885, 8815, 8819, 8870; East Lake (Carex, Potentilla, Campanula associations) 3382, 3427, 3439, 6173, 7831; Mammoth Gulch 8833; Eldora 2394; between Tolland and Rollinsville 8738; Smartweed Lake 7857.

Agrostis tenuiculmis Nash.

Rydberg, Flora of Colo., p. 31, Coulter-Nelson Manual, p. 58 (as *A. idahoensis*); Daniels, Flora of Boulder, Colo., p. 64.

On mountain meadows from Mont. to Wash., Colo. and Calif. Range in Colo. 9,000–11,500 ft.

Collection: East Lake, Tolland (abundant in meadow association and in dry grassland) 7834.

CALAMAGROSTIS Adans. Reed-grass

Calamagrostis purpurascens R. Br.

Rydberg, Flora of Colo., p. 31; Coulter-Nelson Manual, p. 59; Daniels, Flora of Boulder, Colo., p. 64.

On dry, stony hills and alpine table-lands from Greenl. to Alaska, Colo. and Calif. Range in Colo. 6,500–12,500 ft.

Collections: Tolland 8864; East Lake (among trees) 3455; Mammoth Gulch 6695, 8840; Smartweed Lake (dry forest and ridge) 8787.

Calamagrostis canadensis (Michx.) Beauv.

Rydberg, Flora of Colo., p. 32; Coulter-Nelson Manual, p. 58; Daniels, Flora of Boulder, Colo., p. 65.

In wet thickets and open woods; also in meadows from Lab. to B.C., N.C. and Calif. Range in Colo. 4,000–11,000 ft.

Collections: Tolland 6876, 6913, 8957; Boulder Park 6753; East Lake (Shrub association) 3419.

Calamagrostis canadensis acuminata Vasey.

Rydberg, Flora of Colo., p. 32; Coulter-Nelson Manual, p. 59; not listed in Daniels, Flora of Boulder, Colo.

Ravines and thickets Lab. to B.C., N.C. to Calif. Range in Colo. 9,000–10,000 ft.

Collections: Mammoth Gulch 8841; between Tolland and Eldora Lake (streamside) 9102.

Calamagrostis hyperborea elongata Kearney.

Rydberg, Flora of Colo., p. 32; Coulter-Nelson Manual, p. 59; not listed in Daniels, Flora of Boulder, Colo.

In wet meadows and swamps, especially in plains regions, from Ont. to B.C., Colo. and Calif. Range in Colo. 4,000–9,000 ft.

Collections: Tolland (dry grassland) 8888; East Lake (among sedges) 3370; Smartweed Lake (dry grass-land) 8791.

Tribe AVENEAE

DESCHAMPSIA Beauv. Hair-grass

Deschampsia caespitosa (L.) Beauv.

Rydberg, Flora of Colo., p. 33; Coulter-Nelson Manual, p. 60; Daniels, Flora of Boulder, Colo., p. 65.

In wet meadows and swamps from Newf. to Alaska, N.J. and Calif. Range in Colo. 7,500–11,000 ft.

Collections: Tolland (dry grassland) 6920, 6928; Boulder Park 6743; Park Lake 7885; East Lake 3403; Mammoth Gulch (meadow) 5353; Smartweed Lake (Dasiphora association) 7863.

TRISETUM Pers. False Oats

Trisetum subspicatum (L.) Beauv.

Rydberg, Flora of Colo., p. 33; Coulter-Nelson Manual, p. 61; Daniels, Flora of Boulder, Colo., p. 65 (as *T. spicatum*).

On mountains and hillsides from Greenl. to Alaska, N.H., Colo. and Calif.; also northern Europe. Range in Colo. 8,600–13,000 ft.

Collections: Tolland (dry grassland) 6718, 8693, 8804, 8810; Mammoth Gulch (ridge) 5210; Eldora 2269.

Trisetum majus (Vasey) Rydb.

Rydberg, Flora of Colo., p. 34; Coulter-Nelson Manual (included in *T. subspicatum*); Daniels, Flora of Boulder, Colo., p. 65.

In meadows and on hillsides from Mont. to B.C., Colo. and Utah. Range in Colo. 8,000–12,000 ft.

Collections: Tolland (ruderal) 6718, 6875, 9067; Mammoth Gulch 8834; Eldora 2775.

GRAPHEPHORUM Desv.

Graphephorum wolfii Vasey.

Rydberg, Flora of Colo., p. 34; Coulter-Nelson Manual, p. 73; not listed in Daniels, Flora of Boulder, Colo.

In wet places in willow thickets Colo. to Wash. and northward. Range in Colo. 8,500–10,500 ft.

Collections: Tolland 8880; Eldora 2300. Not hitherto reported below 10,500 feet.

AVENA L. Oats

Avena striata Michx.

Rydberg, Flora of Colo., p. 34; Coulter-Nelson Manual, p. 62. Daniels, Flora of Boulder, Colo., p. 65.

In woods from N.B. to B.C., Pa. and Colo. Range in Colo. 7,000–11,000 ft.

Reported from Eldora by Daniels.

Avena americana Scribn.

Rydberg, Flora of Colo., p. 35; Coulter-Nelson Manual, p. 62 (included with *A. mortoniana*); not listed in Daniels, Flora of Boulder, Colo.

On ridges and hillsides from Sask. to Alb., S.D. and Colo. Range in Colo. 8,500–10,000 ft.

Collections: Tolland (dry grassland) 8811, 8845, 8871; Smartweed Lake 7658, 9012. Not hitherto reported below 10,000 ft.

MERATHREPTA Raf. Wild Oat-grass

Merathrepta californica (Bolander) Piper.

Rydberg, Flora of Colo., p. 35 (as *Danthonia californica*); Coulter-Nelson Manual, p. 62 (as *Danthonia*); Daniels, Flora of Boulder, Colo., p. 66.

In wet meadows from Mont. to B.C., Colo. and Calif. Range in Colo. 5,000–10,000 ft.

Collections: Smartweed Lake (dry grassland) 8791, 9013.

Merathrepta intermedia (Vasey) Piper.

Rydberg, Flora of Colo., p. 35 (as *Danthonia intermedia*); Coulter-Nelson Manual, p. 62 (as *Danthonia*); Daniels, Flora of Boulder, Colo., p. 66.

In meadows and on mountain slopes from Alb. to B.C., Colo. and Calif. Range in Colo. 8,600–11,500 ft.

Collections: Tolland (glacial sink, dry grassland, and around glacial sinks, never in the middle) 8924, 8970, 8982. Reported from Eldora (Daniels).

Merathrepta parryi (Scribn.) Piper.

Rydberg, Flora of Colo., p. 35 (as *Danthonia parryi*); Coulter-Nelson Manual,

p. 62 (as *Danthonia*); not listed in Daniels, Flora of Boulder, Colo.

In mountain valleys from Alb. to N.Mex. Range in Colo. 8,500–10,000 ft.

Collections: Tolland (dry grassland, scattered, never in societies) 6931, 8844.

TRIBE CHORIDEAE

BOUTELOUA Lag. GRAMA-GRASS

Bouteloua hirsutata Lag.

Rydberg, Flora of Colo., p. 36; Coulter-Nelson Manual, p. 63; Daniels, Flora of Boulder, Colo., p. 67.

On plains and prairies, especially in sandy soil, from Ill. to Minn., to S.D., Tex. and Ariz. Range in Colo. 4,000–8,500 ft.

Collections: Smartweed Lake 8989. Hitherto not reported above 7,000 ft.

TRIBE FESTUCEAE

KOELERIA Pers. PRAIRIE-GRASS, JUNE-GRASS

Koeleria cristata (L.) Pers.

Rydberg, Flora of Colo., p. 38; Coulter-Nelson Manual, p. 67; Daniels, Flora of Boulder, Colo., p. 68.

On prairies and plains from Ont. to B.C., Pa. and Calif. Range in Colo. 4,000–10,000 ft.

Collections: Tolland (dry grassland) (ruderal) 6883, 8814, 8826, 8973, 9035; East Lake (Potentilla association) 3429; Eldora 2282; Smartweed Lake (dry grassland) 9004.

MELICA L. MELIC-GRASS

Melica spectabilis Scribn.

Rydberg, Flora of Colo., p. 40; Coulter-Nelson Manual, p. 68. Not listed in Daniels, Flora of Boulder, Colo.

In meadows from Mont. to Wash., Colo. and Ore. Range in Colo. 8,000–9,000 ft.

Collection: Above Tolland 8951.

DACTYLIS L. ORCHARD-GRASS

Dactylis glomerata L.

Rydberg, Flora of Colo., p. 40; Coulter-Nelson Manual, p. 68; Daniels, Flora of Boulder, Colo., p. 69.

Cultivated and naturalized from Europe in fields and waste places from N.B. to Wash., Fla. and Calif. Range in Colo. 4,000–9,000 ft.

Collections: Tolland (ruderal) 8801, 9094.

POA L. MEADOW-GRASS[1]

Poa pratensis L.

Rydberg, Flora of Colo., p. 44; Coulter-Nelson Manual, p. 70; Daniels, Flora of Boulder, Colo., p. 69.

[1] In view of the difficult character of this genus all specimens determined by Professor Hitchcock, and hence to be considered authentic, have been indicated by the use of an asterisk (*).

In meadows from Lab. and Alaska to Fla. and Calif.; also native of Europe and Asia. Range in Colo. 4,000–11,500 ft.

Collections: Tolland *6869, *6887, 8694; East Lake 7708, *8900; between Tolland and Rollinsville 8721; Smartweed Lake (meadow) 8706, 8714, *8903.

Poa arctica R. Br.

Rydberg, Flora of Colo., p. 44; Coulter-Nelson Manual, p. 70; not listed in Daniels, Flora of Boulder, Colo.

In wet places in arctic or alpine regions along arctic coasts and Alaska; also in the Canadian Rockies and Colo. Range in Colo. 8,500–14,000 ft.

Collection: Smartweed Lake (meadow) * 8901. Hitherto not reported below 11,000 ft.

Poa reflexa V. & S.

Rydberg, Flora of Colo., p. 44; Coulter-Nelson Manual, p. 71; Daniels, Flora of Boulder, Colo., p. 70.

In wet meadows from Mont. and Alaska to Colo. and Calif. Range in Colo. 8,000–13,000 ft.

Collections: Above Tolland 8955; Mammoth Gulch (damp situations) 8832.

Poa leptocoma Bong.

Rydberg, Flora of Colo., p. 44; not separately listed in Coulter-Nelson Manual; Daniels, Flora of Boulder, Colo., p. 70.

In wet meadows from Mont. and Alaska to Colo. and Calif. Range in Colo. 8500–12,500 ft.

Collections: Above Tolland *8961; Eldora 2316.

Poa platyphylla Nash and Rydb.

Rydberg, Flora of Colo., p. 44; Coulter-Nelson Manual, p. 70; Daniels, Flora of Boulder, Colo., p. 70.

In moist places and along streams in the mountains of Colo. and N.Mex. Range in Colo. 7,000–10,050 ft.

Collection: Tolland (Carex association) 3384.

Poa compressa L.

Rydberg, Flora of Colo., p. 45; Coulter-Nelson Manual, p. 70; Daniels, Flora of Boulder, Colo., p. 70.

In woodlands, among bushes and in cultivated places from N.H. and B.C. to N.C. and Calif. Native of Europe. Range in Colo. up to 9,000 ft.

Collections: Tolland (dry grassland) (ruderal) 8820, *8822, 9030; Smartweed Lake (meadow) 8713, *8904.

Poa serotina Ehr.

Rydberg, Flora of Colo., p. 45; Coulter-Nelson Manual, p. 70 (included in *P. flava*); Daniels, Flora of Boulder, Colo., p. 70 (as *P. triflora*).

In wet meadows and swamps from Newf. and B.C. to N.J. and Calif.; also in Europe. Range in Colo. 4,000–9,500 ft.

Collections: Tolland (streamside and moist forest) (ruderal) 8878, 8886, 9028; above Tolland *8956, *8959; Mammoth Gulch 8838, *8839; So. Boulder Canyon (meadow) 8691; Smartweed Lake 7800. Reported from Eldora by Daniels.

Poa interior Rydb.

Rydberg, Flora of Colo., p. 45; Coulter-Nelson Manual, p. 70; Daniels, Flora of Boulder, Colo., p. 71.

In wet meadows from Canadian Rockies and Wash. to N.Mex. Range in Colo. 5,000–10,000 ft.

Collections: Tolland (dry grassland) 8670, 8778, 8781, 8782, *8812, 8816, 8925; Boulder Park 6752; Mammoth Gulch *8836; between Tolland and Rollinsville 8723.

Poa rupicola Nash.

Rydberg, Flora of Colo, p. 45; Coulter-Nelson Manual, p. 71 (included in *P. pattersonii* Vasey); Daniels, Flora of Boulder, Colo., p. 71.

Dry grassland and forest openings from Mont. and Ore. to Colo. and Utah. Range in Colo. 8,500–13,000 ft.

Collections: Tolland (dry grassland) 6870 (?), 6934 (?), *8813, 8926, 8986 (?); Mammoth Gulch *8829; between Tolland and Rollinsville (dry grassland) 8726; Smartweed Lake (dry grassland) 9014.

Poa alpina L.

Rydberg, Flora of Colo., p. 45; Coulter-Nelson Manual, p. 71; Daniels, Flora of Boulder, Colo. p. 71.

In wet places on mountain tops, along streams and in arctic regions, Greenl. and Alaska to Que., Colo. and Utah. Range in Colo. 8,600–13,000 ft.

Collection: Eldora 2293.

Poa wheeleri Vasey.

Rydberg, Flora of Colo., p. 46; Coulter-Nelson Manual, p. 71; Daniels, Flora of Boulder, Colo., p. 71.

In meadows from Mont. and Ida. to Colo. and Ore. Range in Colo. 6,000–11,000 ft.

Collections: Above Tolland *8952, *8954.

Poa vaseyana Scribn.

Rydberg, Flora of Colo., p. 46; not separately listed in Coulter-Nelson Manual; Daniels, Flora of Boulder, Colo., p. 71.

Mountain meadows of Colo. Range in Colo. 9,000–10,000 ft.

Collection: So. Boulder Canyon (meadow) 8690.

Poa epilis Scribn.

Rydberg, Flora of Colo., p. 46; Coulter-Nelson Manual, p. 72; not listed in Daniels, Flora of Boulder, Colo.

In mountains from Mont. to Colo. and Utah. Range in Colo. 8,500–13,000 ft.

Collections: Tolland (dry grassland) 8671; above Tolland *8962; between Tolland and Rollinsville 8740. Hitherto not reported below 10,000 ft.

Poa fendleriana (Steud.) Vasey.

Rydberg, Flora of Colo., p. 47; Coulter-Nelson Manual, p. 72; not listed in Daniels, Flora of Boulder, Colo.

Dry hills and table-lands from Colo. to N.Mex. and Calif. Range in Colo. 6,000–11,500 ft.

Collections: East Lake 7558; Smartweed Lake 7655.

Poa truncata Rydb.

Rydberg, Flora of Colo., p. 47; not separately listed in Coulter-Nelson Manual; not listed in Daniels, Flora of Boulder, Colo.

In meadows of Colo. Range in Colo. about 5,000–9,000 ft.

Collections: Tolland *8881; Eldora 2318, 2384. Hitherto not reported above 8,000 ft.

PANICULARIA Fabr. Manna-grass

Panicularia nervata (Willd.) Kuntze.

Rydberg, Flora of Colo., p. 48; Coulter-Nelson Manual, p. 74 (as *Glyceria nervata*); Daniels, Flora of Boulder, Colo., p. 72.

In wet meadows and swamps from Lab. to B.C., Fla. and Calif. Range in Colo. 4,000–9,000 ft.

Collection: Tolland 3459.

Panicularia americana (Torr.) MacM.

Rydberg, Flora of Colo., p. 48; Coulter-Nelson Manual, p. 74 (as *Glyceria grandis*); Daniels, Flora of Boulder, Colo., p. 73.

In swamps and along streams from N.B., to Alaska, Tenn. and Nev. Range in Colo. 4,000–9,000 ft.

Collections: Tolland (aspen groves—marshy ground) 8878; Eldora 2288.

Panicularia pauciflora (Presl.) Kuntze.

Rydberg, Flora of Colo., p. 48; Coulter-Nelson Manual, p. 74 (as *Glyceria pauciflora*); not listed in Daniels, Flora of Boulder, Colo.

In wet meadows from Mont. to B.C., Colo. and Calif. Range in Colo. 9,000–10,500 ft.

Collections: Lily Lake near Eldora Lake, 8867; Eldora 2289.

Panicularia borealis Nash.

Rydberg, Flora of Colo., p. 48; Coulter-Nelson Manual, p. 74 (as *Glyceria borealis*); Daniels, Flora of Boulder, Colo., p. 73.

In shallow water from Me. to Alaska, N.Y., Colo. and Calif. Range in Colo. 5,000–8,500 ft.

Collections: Eldora Lake 7816; Smartweed Lake 6119, 7849½.

FESTUCA L. Fescue-grass

Festuca rubra L.

Rydberg, Flora of Colo., p. 50; Coulter-Nelson Manual, p. 76; Daniels, Flora of Boulder, Colo., p. 74.

In meadows from Lab. to Alaska, N.C. and Calif.; also in Europe and Asia. Range in Colo. 5,000–9,000 ft.

Collections: Tolland (ruderal) 6751, 8891, 9029; Eldora 2298; Smartweed Lake 8715.

Festuca minutiflora Rydb.

Rydberg, Flora of Colo., p. 50; Coulter-Nelson Manual, p. 75 (included in *F. brachyphylla*); Daniels, Flora of Boulder, Colo., p. 74.

Alpine peaks of Colorado, 10,000–12,000 ft.

Professor Daniels reports the occurrence of *Festuca minutiflora* Rydb. on "mountain sides at Eldora" but it is possible that these specimens were collected in the subalpine zone and should not be included in our present study.

Festuca pseudovina Hackel.

Rydberg, Flora of Colo., p. 50; Coulter-Nelson Manual, p. 75 (included in *F. ovina*); not listed in Daniels, Flora of Boulder, Colo.

On dry hillsides and mountains from Sask. to B.C., Mich. and Colo. Range in Colo. 8,500–12,500 ft.

Collections: Tolland (dry grassland) 6859, 8692, 8818, 8821, 8828, 8922; Smartweed Lake (dry grassland) 8794, 8905, 9015.

Festuca ingrata (Hack.) Rydb.

Rydberg, Flora of Colo., p. 50; Coulter-Nelson Manual, p. 75 (as *F. ovina ingrata*); Daniels, Flora of Boulder, Colo., p. 74 (var. *nudata*).

On hillsides and in dryer meadows from Mont. to B.C., Colo. and Utah. Range in Colo. 3,000–12,000 ft.

Collections: Tolland (dry grassland) 6859, 8779; East Lake (Potentilla association) 3425; between Tolland and Rollinsville 8737; Smartweed Lake (Potentilla association) 7667, 7798.

Festuca thurberi Vasey.

Rydberg, Flora of Colo., p. 50; Coulter-Nelson Manual, p. 76 (as *F. scabrella*); not listed in Daniels, Flora of Boulder, Colo.

On hillsides in Colo. and southern Wyo. and Utah. Range in Colo. 8,000–12,000 ft.

Collections: Tolland (aspen grove, stream bank and dry grassland) 8784, 8809, 9116; East Lake (shub association and in a Dasiphora clump) 3402, 7833; between Tolland and Rollinsville 8718, 8727; Smartweed Lake 7778.

BROMUS L. Brome-grass

Bromus porteri (Coult.) Nash.

Rydberg, Flora of Colo., p. 52; Coulter-Nelson Manual, p. 78; not listed in Daniels, Flora of Boulder, Colo.

On hillsides and in meadows from Man. to Sask., Alb., Colo. and Ariz. Range in Colo. 7,000–11,000 ft.

Collections: Tolland 6915; East Lake (shrub association) 3415; between Tolland and Rollinsville 8719.

Bromus richardsonii Link.

Rydberg, Flora of Colo., p. 52; Coulter-Nelson Manual, p. 78; Daniels, Flora of Boulder, Colo., p. 75.

In meadows and on hillsides from Sask. to B.C., Colo., Ariz. and Ore. Range in Colo. 6,000–11,000 ft.

Collections: Tolland 6941, 8869, 8876, 8877, 8884; East Lake 3452; Mammoth Gulch 8837; above Tolland 8958; Newcombs, 3 miles west of Tolland, 6786; Eldora 2285.

Bromus pumpellianus Scribn.

Rydberg, Flora of Colo., p. 52; Coulter-Nelson Manual, p. 77; Daniels, Flora of Boulder, Colo., p. 75.

In meadows and on hillsides from Sask. to Alaska and Colo. Range in Colo. 6,000–10,000 ft.

Collections: Tolland (dry grassland) 6874, 8914, 8979, 9034; above Tolland 8963; Newcombs, 3 miles west of Tolland, 6792.

Bromus inermis Leyss.

Rydberg, Flora of Colo., p. 52; Coulter-Nelson Manual, p. 77; not listed in Daniels, Flora of Boulder, Colo.

Escaped occasionally from cultivation from Ohio to Mont. and Colo. Range in Colo. 5,000–9,000 ft.

Collection: Boulder Park 6749. Not hitherto reported in the mountains.

Bromus tectorum L.

Rydberg, Flora of Colo., p. 52; Coulter-Nelson Manual, p. 77; Daniels, Flora of Boulder, Colo., p. 75.

In waste places from Mass. to Wash., Va. and Utah. Introduced from Europe. Range in Colo. 5,000–9,000 ft.

Collections: Mammoth Gulch 8830; Teller Lake, near Tolland (ruderal) 9084. Not hithereto reported from mountain stations in Colorado.

Tribe HORDEAE

AGROPYRON Gaertn. Wheat-grass

Agropyron spicatum (Pursh) Rydb.

Rydberg, Flora of Colo., p. 53; Coulter-Nelson Manual, p. 79; Daniels, Flora of Boulder, Colo., p. 76 (var. *inerme*).

On dry hills and mountains from Mont. to Wash., Ariz. and Calif. Range in Colo. 5,000–9,000 ft.

Collection: Tolland 6872. Not previously reported above 7,000 ft.

Agropyron richardsonii (Trin.) Schrad.

Rydberg, Flora of Colo., p. 54; not listed in Coulter-Nelson Manual; Daniels, Flora of Boulder, Colo., p. 76.

Meadows and dry grassland and among bushes from Minn. and Sask. to B.C., Iowa and Colo. Range in Colo. 7,000–10,000 ft.

Collections: Tolland 6919½; Smartweed Lake (dry grassland) 9010.

Agropyron caninum (L.) Beauv.

Rydberg, Flora of Colo., p. 54; Coulter-Nelson Manual, p. 79; not listed in Daniels, Flora of Boulder, Colo.

In meadows and among bushes from N.Sc. to Ida., N.C. and Colo. Range in Colo. 7,000–9,000 ft.

Collections: Tolland 8894; East Lake (shrub association, Potentilla association and dry hillside) 3401, 3431, 3442½.

Agropyron andinum (S. & S.) Rydb.

Rydberg, Flora of Colo., p. 54; not separated from *A. violaceum* in Coulter-Nelson Manual; Daniels, Flora of Boulder, Colo., p. 76.

Mountains from Mont. to Colo. Range in Colo. about 8,500–9,500 ft.

Reported from Eldora by Daniels.

Agropyron violaceum (Hornem.) Vasey.

Rydberg, Flora of Colo., p. 54; Coulter-Nelson Manual, p. 80; Daniels, Flora of Boulder, Colo., p. 76.

Hillsides and open grassland areas in the mountain from Greenl. to Alaska, N.H. and Utah. Range in Colo. 6,500–12,000 ft.

Collections: Tolland (dry grassland) (ruderal) 6747, 6881, 6919, 8797, 8881, 8882, 8894, 8920, 8984, 8985, 9031.

Agropyron tenerum Vasey.

Rydberg, Flora of Colo., p. 54; Coulter-Nelson Manual, p. 80; Daniels, Flora of Boulder, Colo., p. 76.

On hillsides, and in rolling grassland from Lab. to Alaska, N.H., Mo. and Colo. Range in Colo. 4,000–9,000 ft.

Collections: Tolland (dry grassland) (ruderal) 6886, 8921, 9063; Smartweed Lake (Dasiphora association) 6126.

Agropyron lanceolatum S. & S.

Rydberg, Flora of Colo., p. 54; Coulter-Nelson Manual, p. 81 (apparently included in *A. occidentale*); not listed in Daniels, Flora of Boulder, Colo.

On the plains and in mountain parks from Wyo. to Wash. and Colo. Range in Colo. 5,000–8,500 ft.

Collections: Smartweed Lake (dry forest, dry grassland) 8785, 9016.

Agropyron pseudorepens S. & S.

Rydberg, Flora of Colo., p. 54; Coulter-Nelson Manual, p. 80; Daniels, Flora of Boulder, Colo., p. 76.

In meadows and along roadsides from Iowa to Alb., N.Mex. and Utah. Range in Colo. 4,000–10,000 ft.

Collections: Tolland (ruderal) 8803, 8827, 8892; Eldora 2327; between Tolland and Rollinsville 8722.

Agropyron riparium S. & S.

Rydberg, Flora of Colo., p. 54; not recognized as a separate species in the Coulter-Nelson Manual; Daniels, Flora of Boulder, Colo., p. 77.

On river banks and in meadows from Mont. to Colo. Range in Colo. 7,000–9,000 ft.

Collection: Tolland (dry grassland) 6932.

Agropyron occidentale Scribn.

Rydberg, Flora of Colo., p. 54; Coulter-Nelson Manual, p. 81; Daniels, Flora of Boulder, Colo., p. 77.

Prairies and plains, often along roadsides, Man. and Sask., Ore., Mo., N.Mex. and Ariz. Range in Colo. 4,000–9,500 ft.

Collection: Tolland (ruderal) 9022.

HORDEUM L. Barley

Hordeum jubatum L.

Rydberg, Flora of Colo., p. 55; Coulter-Nelson Manual, p. 82; Daniels, Flora of Boulder, Colo., p. 77.

On prairies and in meadows from Lab. to Alaska, N.J., Tex. and Calif. Range in Colo. 4,000–11,000 ft.

Collections: Tolland (ruderal) 3457½, 6780, 9039; Smartweed Lake 7852.

Hordeum sativum hexastichon (L.) Hack.

Not listed in Rydberg, Flora of Colo.; or Coulter-Nelson Manual; Daniels, Flora of Boulder, Colo., p. 77.

Adventive along roadsides, 5,000–9,000 ft.

Collections: Between Tolland and Rollinsville 8717; Tolland (ruderal) 9065.

SITANION Raf. Bristle-grass

Sitanion longifolium J. G. Smith.

Rydberg, Flora of Colo., p. 55; Coulter-Nelson Manual, p. 83; Daniels, Flora of Boulder, Colo., p. 78.

Dry situations on hillsides and among rocks from Nebr. to Nev., Tex. and Ariz. Range in Colo. 6,500–9,000 ft.

Collections: Tolland (dry grassland) 8823, 8919; Mammoth Gulch 8842.

Sitanion brevifolium J. G. Smith.

Rydberg, Flora of Colo., p. 56; Coulter-Nelson Manual, p. 84; Daniels, Flora of Boulder, Colo., p. 78.

Dry soil on hills and mountain sides from Wyo. to Utah, Colo. and Ariz. Range in Colo. 5,000–10,000 ft.

Collections: Tolland———; Boulder Park 6777; East Lake (dry hillside) 3446; Eldora 2329.

ELYMUS L. Lyme-grass

Elymus canadensis L.

Rydberg, Flora of Colo., p. 56; Coulter-Nelson Manual, p. 82; Daniels, Flora of Boulder, Colo., p. 78.

On stream banks and among bushes; also along hedgerows and roadsides N.S. and Wash. to Ga. and N.Mex. Range in Colo. 4,000–9,000 ft.

Collection: Tolland (ruderal) 9057. Not hitherto reported from the higher mountain districts.

Elymus glaucus Buckley.

Rydberg, Flora of Colo., p. 56; Coulter-Nelson Manual, p. 82; not listed in Daniels, Flora of Boulder, Colo.

In meadows and among bushes from Mich. to Alb., B.C., Colo. and Calif. Range in Colo. 7,000–10,000 ft.

Collection: Tolland 7503.

Elymus condensatus Presl.

Rydberg, Flora of Colo., p. 57; Coulter-Nelson Manual, p. 83; Daniels, Flora of Boulder, Colo., p. 78.

On hills and in dryer valleys from Alb. and B.C. to N.M. and Calif. Range in Colo. 5,000–10,000 ft.

Collection: South Boulder Canyon above Tolland.

Summary

The foregoing pages are a report upon a collection of grasses made by Francis Ramaley and W. W. Robbins in the vicinity of the Mountain Laboratory of the University of Colorado at Tolland, Colo., during the years 1906–1911 inclusive. The district included in the study is about 12 square miles in extent and has an altitude of 8,500 to 9,500 feet above sea-level embracing a varied topography of mountain-park, gulch, stream and lakeside areas. The genera recorded are 26 in number with a total of 81 species. These are distributed as follows: Phalarieae, one genus with one species; Agrostideae, 8 genera with 22 species; Aveneae, 5 genera with 9 species; Chlorideae, one genus with one species; Festuceae, 7 genera with 32 species; Hordeae, 4 genera with 17 species.

Volume IX Number 4

THE UNIVERSITY OF COLORADO STUDIES

FRANCIS RAMALEY
EDITOR

PUBLISHED BY THE
UNIVERSITY OF COLORADO
BOULDER, COLO.

September, 1912

Price, 50 Cents

Four numbers of this publication are issued each college year, the first number in the volume generally appearing in December.

All exchanges should be addressed to the "Library of the University of Colorado, Boulder, Colo."

Educational institutions, libraries, societies and individuals desiring to be placed on the exchange list should make request to the "Secretary of the University of Colorado, Boulder, Colo.," to whom also should be addressed any correspondence in regard to purchase of single copies.

Binding note: Title-page and alphabetical index of Vol. IX will appear in the next number.

VOLUME IX NUMBER 4

THE UNIVERSITY OF COLORADO STUDIES

FRANCIS RAMALEY
EDITOR

PUBLISHED BY THE
UNIVERSITY OF COLORADO
BOULDER, COLO.

SEPTEMBER, 1912

Price, 50 Cents

CONTENTS

THE CONTINUITY OF BERGSON'S THOUGHT

By Melanchthon F. Libby

Henri Louis Bergson is fifty-two years of age and since 1900 has been Professor in the *Collège de France*. He was born in Paris and like so many great thinkers is said to be of Jewish origin. He has written three works of general philosophic import besides numerous essays and a book on *Laughter*. His first work, a Doctor's thesis, dealt with the time-honored problem of free-will, and was written between 1883 and 1887; it was published in 1889. It contains the central thought which gives unity and coherence to all his writings. From this it is clear that a recent critic who speaks of Bergson as a stripling when opposed to Mr. Balfour, who, he says, published over thirty years ago, and another critic who says one of the great events of 1911 (*sic*) was Bergson's "discovery of the soul," have overlooked the fact that he made this contribution public twenty-three years ago, and had his main ideas nearly thirty years ago.

It was Professor James's reference to Bergson as "the Master" which gave him vogue in America; and the wide reading of the *Creative Evolution*, published in 1907, and published in the English translation by Mitchell in 1911, have probably made his name the most widely talked of among recent philosophers.

The book which appeared between these two, *Matter and Memory*, 1896, is more difficult for the lay reader, perhaps, but unfortunately it is just that work in which he comes to the fullest comprehension of the thought on which all his other thoughts depend.

There is at present a very general demand that writings on philosophical subjects shall be clear and not obscure, simple and not needlessly intricate, popular and not too technical. James certainly held this view and met this demand, though it may be doubted whether James's style is really as clear and simple as it looks. Bergson also believes in this view. His mind is of an almost crystalline clearness, and yet any reader, lay or professional, might read many parts of his

Creative Evolution twenty times over with the greatest concentration and yet fail to get his meaning. This is because in his first two books he spends much time and effort on the establishment of certain peculiar meanings for certain common words, such as *time*, *matter*, *extension*, *perception*, *intensity*, *space;* and only those who follow those explanations can clearly comprehend his ideas of creative evolution.

No reader expects to understand the problems of the infinitesimal calculus without reading the mathematics leading to it, and so in other studies a propaedeutic discipline is conceded necessary without question. One purpose of this paper is to show the unity of Bergson's thought, and to make it clear to readers of his last great work that while some pages of it are abstruse, they are not obscure to those who really desire to pay the very moderate price of reading his earlier works with reasonable care and attention.

Well, now, what is it in general that Bergson has done? In his first book, begun when he was twenty-three or twenty-four, he attacks a subject which has baffled the greatest thinkers since Augustine, and slays the dragon of determinism by giving a new idea of what freedom really might mean. If his numerous admirers are to be believed, he has put an end forever to the wide-spreading dry-rot which a materialistic psychology was imposing upon the will of man by identifying the movements of matter in the form of brain-cells with the modifications of thought and feeling which do in some way run parallel to them. Any reader who doubts the importance of this problem should read books like Loeb's *Physiology of the Brain*, where it is repeatedly stated that mental phenomena are absolutely determined by physical and chemical causes. Kuelpe in his *Introduction to Philosophy* advises that in science we hold to determinism, while in law, morals and pedagogy we believe in the freedom of the will. One eminent English moralist thinks we may conquer the realm of ethics without settling the free-will question, leaving it like an impregnable fortress in the rear.

Bergson sees clearly that if the will is not free, if we can really originate nothing, there is no use going farther. We should feel out of touch with our base of supplies. You cannot praise, blame, scold, encourage, inspire or shame a "yeast-ferment," or an eight-day clock. Loeb should never use words like *should* or *ought* or *must.*

If the *mind* or *soul* or *will* is really nothing but the slave of the laws of matter, if "the brain thinks," if the mechanism of associative memory is the final word of psychology, then we must look forward to an education without hopes or fears, to a listless culture scarcely worth an effort. But the will is not to be identified with the instrument but with the player, not with the telephone wire but with the speaker who makes use of it.

The discussion depends largely upon the problem, long familiar to philosophy, as to whether sensations can be measured. Bergson says emphatically, No! Spatial ideas apply to matter but not to mind. If we once admit that mind can be treated spatially we put it under the reign of the laws of matter.

None of his critics have answered his argument. Some have abused the author, some have withdrawn with feeble scorn, some like Mr. Balfour have written able objections to Bergson's view of evolution, but no one has attacked his fundamental position, namely, that the soul "endures" and merely acts upon matter through the brain.

In the second book he attacks the Association Theory. He admits of course that it offers a plausible and correct account of what *has* happened in any given case, but insists that it never touches the real problem of why such things happen. The deep free movements of the enduring soul are the real cause of what we think and feel, and when we envisage life with our whole soul, all that we have endured, and been enriched by, we are truly ourselves, and not the slaves of mere sensations and associations.

A clock does not measure real time (duration), but only time plotted out for utility; because some days are fruitless and unremembered, while other minutes are crowded with life. The true minutes are measured by stirring action, vivid ideas, unforgettable heart-beats. In the world of duration there is freedom, the memory is the record of this duration; and again, not only is time measured by new creative living acts, but this enduring, flowing, evolving sense of time is life itself. Time and life and creation are one. The life-force is a great adventure in which nothing is determined, everything is in the making, thought is free. To limit all this by intellect is to make the worship greater than the god. The intellect is merely the *Ancilla Domini*. It is our greatest counsellor, a veritable genius in promoting our welfare. But the world was wonderful before intellect was known, and may survive any great need of it. Conceptual thought was still in its infancy in the days of Plato and has grown apace ever since. It has accomplished marvels and will yet accomplish more. But the soul is more than intellect, as Shakespeare is greater than Newton. Only in life can we find a true philosophy of life.

Bergson has put a limit to the arrogance of science, especially to its intolerable encroachments upon the realms of art, religion, poetry, character, education and whatever is immediately dependent upon feeling and genius.

In the highest scientific quarters there is already a tendency to limit the authority of science to its proper sphere. It is apparently just the greatest thinkers in the special sciences who most readily assent to Bergson's claims. Of course the small-fry will pose as the defenders of the supreme sway of intellect; it makes their intellects doughty champions. But just as Kant, the greatest intellect of the eighteenth century, set faith and beauty above reasons, so Bergson possibly the deepest and clearest and most learned thinker of our own times puts intuition above intellect which is after all merely saying that Shakespeare knew more about vital matters than Newton; or that Browning knew more about men and women than Wundt; or that wisdom is greater than knowledge; or that for the purposes of a broad philosophy of life, and history, and history in its cosmic sense as biology and geology, imagination and sympathy and genius may carry us farther than reasoning and logical analysis. But no one ranks intellect higher than Bergson or has a greater intellectual gift, as all admit; it is merely that he puts intuition higher still. To put it in popular phrase his God creates by aiming at great things not by attending to the infinite parts into which the intellect may resolve those things after they are made, just as a great poet creates by trying to tell his story and not by scanning his verses and counting his vowels and consonants.

The soul is the enduring thing. As long as we are really living as men naturally live, striving, aspiring, accomplishing, inventing, adventuring, the soul is everything, but in moments of fatigue and detension matter becomes real, and conduct determined, and intellect and the laws of nature usurp the place of life.

I. Time and Free-Will

Can Conscious States Be Measured Scientifically?

In his *Essay on the Immediate Data of Consciousness*, Bergson first deals with his great conception of the *intensity* of conscious states. He takes the most uncompromising attitude toward those who speak of *measuring* the intensity of conscious states. Toward the end of the first chapter, he shows that the Weber-Fechner law of psycho-physics is based entirely upon a misconception of the true nature of intensity; and that not only those who support the law, in any form, but also even those who oppose it, yet continue to speak of magnitudes as applicable to feelings, are proceeding on a false assumption, which, however it may be approved by common-sense, and by science (especially Physics), must inevitably lead to wrong metaphysical conclusions (especially to a denial of free-will). This question as to the applicability of the concept of quantity to conscious states—feelings, sensations, affections—seems to Bergson to be the root of the problem of free-will. If we once admit that sensations are measurable, the whole argument for freedom is abandoned. Sensations differ in quality, but the idea that they differ in quantity always arises from reading the *cause* of the sensation into the effect, the sensation itself.

In the second chapter, he proceeds to speak of the multiplicity of our sensations. He finds that the multiplicity of conscious states is wholly qualitative. Discrete multiplicity is quantitative, but this is precisely because it depends upon the intuition of space: the multiplicity of sensation itself is purely qualitative, and measurement is not predicable of this any more than of *simple* feelings.

This unfolding multiplicity of sensation is duration in the true sense, real time as contrasted to conceptual (common-sense and scientific) time.

Former states can never recur in our consciousness, because a conscious state is an interpenetration of elements so heterogeneous.

The very useful concept of homogeneous time is achieved by spreading a net over duration; and this network is analogous to the divisions of space. We thus treat what is really intensive as if it were extensive, and we get good and useful results in common-sense (punctuality, etc.) and in science (astronomy, etc.).

But if we go away from convention and strip our experience of all utilitarian schemes, we find that time means duration, and duration means the unfolding multiplicity of duration. Real concrete duration and the specific feeling of duration are the ground of Bergson's whole philosophy of experience and of the evolution of the world.

Common-sense, science and the common use of language are in a vast unconscious conspiracy to obscure the truth of philosophy by substituting the useful concept of measurable time for the real primitive grip on duration. Most errors in philosophy arise from this root error.

Applying this teaching in the third chapter to the will, he finds that we take up our stand *after* the act has been performed and apply to it our false, abstract, conceptual network. From the point of view of abstract logic, we cannot be free: the deadness and unreality of logic denies life and freedom to conduct; but viewed not as the débris of the past but as the vital activity of the present and future, our conduct may be free, although, in the very nature of this freedom, indefinable.

In fact, freedom is precisely one of the clearest facts established by observation.

Bergson now proceeds to elaborate this argument.

Quantitative differences are applicable to magnitudes but not to intensities. (For a clear account of the Weber-Fechner law, see Stout's *Manual of Psychology*, pages 199–209; also Sanford, Titchener and others.) When we attempt to measure intensities by objective causes, we study atomic movements, and assume some mathematical relationship between these and the corresponding sensations (tuning-fork and pitch of sound). We fancy that an increase of sensation occurs in the same way as an increase in the stimulus. For example, a candle may be brought nearer, and we assume that just as the light becomes stronger as a stimulus (that is, by continuous increase), so the sensation of light becomes stronger, and may be measured by analogy with the stimulus. (Bergson is not here concerned with the exact relation, as in Weber's logarithmic law.) Bergson denies all this. There are different sensations, but not sensations that change, or increase, or diminish. You cannot subtract one sensation from another because there are no fractions between—the thing is a metaphor and a delusion.

Bergson's argument proceeds to inquire into the reason for the great plausibility, in the writings of Weber, Fechner, Delboeuf and many others, of this idea that measure applies to intensities as well as to extension. He admits that it is acceptable to common-sense; and it is well known that many sneer at the very suggestion that the view may be erroneous.

Bodily States Can Be Measured, but Not Psychic

The author analyzes the idea in relation to deep-seated psychic states, such as desire, hope, joy, sorrow; he goes on to the aesthetic feelings of grace and beauty, and discusses music, poetry and art. Next come the moral feelings, such as pity, conscious states involving physical symptoms, attention, violent emotions, sensations of pitch, heat and cold, light; and in each and every one of these conscious states, he exposes the confusion by which we ascribe the measurable qualities of the outer world to the non-measurable qualities of the inner state: the qualities of the stimulus which causes the state to the state itself, which arises as an effect.

In conclusion, he shows that the grand culmination and scientific glorification of the whole error is the Weber-Fechner law. He attacks this as the most comprehensive and scientific expression of the idea, and concludes, as he began, with the view that conscious states have only intensity, and that only extensive objects can be measured.

Having shown that quantitative differences are *never* applicable to psychic states, but only to magnitudes ultimately spatial in character, the author turns to the idea of duration. In this chapter he shows that *superficial* psychic states *are* invested with the discontinuity of their external, or spatial, causes, but that the true psychic states lie deeper down, that they interpenetrate, and form an organic whole. This is the real soul, and it is the freedom of this soul that must solve the free-will problem.

There are two kinds of multiplicity: that of material objects conceived as discontinuous, and countable in space, and that of psychic states not countable until conceived of metaphorically as occupying positions in space.

We may speak of homogeneous time, and speak of conscious states as a discrete series occupying this time, but in reality this time is not time at all but a spatial metaphor for time: whenever we speak thus of time, we use images borrowed from space.

Probably *man only* conceives of space as an empty homogeneous medium. It is doubtful whether animals perceive the external world quite as we do: animals have been seen to return in a straight line to their old home, pursuing a path hitherto unknown to them, over a distance which may amount to several hundred miles. Directions may be known to animals as shades of feeling, like our own discrimination of right and left. The reality known as sensible qualities is heterogeneous, while that of quantities is homogeneous. Counting, mathematics, abstract thought, and perhaps language, depend on this latter.

"Pure duration is the form which the succession of our conscious states assumes when our *ego* lets itself *live*, when it refrains from separating its present state from its former states." It must then form past and present into an organic whole, as when we recall the notes of a tune melting, so to speak, into one another. Each one of these notes represents the musical phrase.

Pure duration is wholly qualitative; it cannot be measured unless it is represented symbolically in space.

In duration, each increase of stimulation is added to, and taken up in, the preceding stimulations, while in things spatial, each state perishes absolutely as the next arises. Time indeed *seems* to be measurable by clocks, etc., but *if all the measurers went faster at once, the fraud would be discovered only by the soul and its duration. Within* there is succession without any mutual externality; *outside* is mutual externality without succession. The present tick of the clock is radically distinct from the last, which is dead and non-existent *except to memory.*

There is a real space without duration and there is a real duration without space. The meeting of these two gives a symbolical representation of duration in terms of space.

The famous paradox of the Eleatics arises from the confusion of the *trajectory* in space, and the movement, whose basis is psychic and indivisible. To cut the movement would be like cutting an elastic string. Science eliminates duration from time and mobility from motion, in order to deal with them for its purpose. But science does not explain life. Science tells what is true at the beginning and end of an interval, but *we endure* through that interval, and motion endures as we do. If all the intervals in the world were shortened a thousand times, but at the same rate, science would never know the difference.

Our superficial states of mind are so intimately related to objects in space that we regard them as having the numerical and measurable properties of those objects; but below the self with well-defined states, we feel the deeper self, in which succession means a melting together, an organic oneness.

Language cannot describe the deeper self without arresting its mobility. Living in a town, we associate our mental states with houses, streets, etc. But the self goes on and changes, while language returns the same phrase for our experience, so that words are like dead leaves floating on a dark and deep pool of psychic life.

Language and analysis distort real feeling. A poem is conceived as a living idea—it has to die to become expressed in words; but these may stir up life in other minds.

On the surface, our ideas obey the law of association, but deeper down *they interpenetrate, and their selection depends on our deeper selves.* We give reasons for our ideas, but at times these reasons do not touch on the real reason. The victim of suggestion gives plausible reasons for acts that have been determined by the hypnotist. The psychology of association is convenient and conventional, but it contents itself with a superficial linking of what *has taken place*, and is therefore statical in method. But a living and dynamic psychology would dig deeper, and discover *how* the true self selects things *as they take place*, even though it be true that they are linked as the laws of association have asserted.

Physical determinism rests on certain theories of matter. The brain is a series of molecules or atoms, and forms a part of the larger series comprising the whole world. The conservation law forbids one to assume that the mind can originate a series of movements.

But the atomic theory of matter is still at the hypothetical stage: the kinetic explanation of physical facts may discard it. True, the law of conservation of energy would still hold. But is not this law itself based on some psychological process rather than on a genuine proof?

There is no proof of a necessary connection between psychic and cerebral states. In a movement we find the reason for another movement, but not for a conscious state. Even the *connection* between brain and mind is proved only for superficial things and not for the *will*. But determinism extends this to all states, and opposes common-sense, which leaves the will free. The associationist view arises in this way. *Scientific determinism (mechanism) and psychological determinism are predisposed to give over the will to a geometrical scheme of the universe, in which all is theoretically calculable by some supermathematician.* Our sensations really do lend themselves to such plans, but not our deeper psychoses. Still conservationism would claim our movements, and leave us little freedom. Is this law really universal, or are living beings just the exception?

The conservation principle applies only to what can be restored to its first state, and duration escapes from this law.

We may yet discover some new kind of energy, besides kinetic and potential, just as we did find that the atom is not the ultimate corpuscle, though the laws of chemistry remain valid.

Hypnotism versus the Association Theory

Psychological determinism assumes that one state of consciousness *causes* another. In hypnosis, the preceding conscious state is often *taken* for a cause, while the true cause is unknown, except to the hypnotist, yet the association theory appears to be in good working order.

Bergson thinks that we sometimes will for willing's sake, by a kind of *coup d'état*, and that the laws of association are not applicable.

Bergson gives an account of the usual associational analysis of a typical case of choosing—the different complexes struggling for mastery, etc. The self acts as one—as a fusion, not as a juxtaposition of elements. Association is a spatialized psychology: it regards not the living but the dead and dissected psychosis. The soul is not *determined by* love and hate, but the soul *is* love or hate: language and psychology give a pale phantom of the actual soul. The soul is free just because it *is* all these alleged motives. Of course, many of our phases of consciousness *really do* belong to space and sensation, and do not blend with ourself like drops falling into a lake. But then *we are not always entirely free*, but only so far as we express our deeper will and feeling.

What Freedom Really Means

I am free when my whole soul acts, when I envisage a crisis with my whole personality, alert and consenting. But most of my daily acts are not of this sort, and leave me the slave of habit and environment.

Determinism assumes an *ego* (always self-identical), hunted down by feelings, images, etc. This, of course, is absurd, and takes no account of the real, enduring *ego*. It makes the soul resemble a material object.

What are the tests of freedom? It is a quality of the living act. When my act bears the stamp of my personality, I am free. But determinism asks about the past and the future:

"Could I have acted otherwise?"

"Could a supernatural prophet foretell my acts?"

Of course the *will* is the personality, or total character, and freedom does not require that I should have two characters, but merely that I should *fully express the one that I truly am.*

The geometrical diagram of coming to a decision, wherein we see a road with two branches, is entirely spatial and false. There are *not two roads, nor even two tendencies, but a self which keeps on enduring and ultimately wills and acts.* It develops through its very hesitations and painful struggles, until the ripe fruit drops from the tree.

Both determinists and libertarians have erred in speaking of *two* paths. At the time of deciding, there is always *one:* they see it dead, not living.

As for absolute prophecy, Bergson answers that to know completely the antecedent conditions of any action would be to perform that action—nothing short of this would suffice. How can Peter know the intensity of Paul's feelings? The question is meaningless. It is unreal because irrational.

The Same State of Mind Never Recurs

But determinism will make a final stand on the law that "the same antecedents will always produce the same consequent." But the essence of durationism is that *the same states never recur. Life is a real progress—the character changes with every heart-beat, and we are precisely all that we have endured.* The repetition of a feeling makes it different and utterly incalculable: the physicist deals with the same weights over and over, but the deeper feelings are never twice the same. If there is a law of cause and effect, it does not mean the same to the real psychologist as to the physicist, because *a deep feeling acts once and never again.* We cannot tell what a man will do in a *given case*, because the case can never be really *given, nor the man.* Of course, we can make very good guesses, especially where there is little freedom or creative originality.

Will someone now persist, after all, that an act is somehow bound up in its antecedents? It is then necessary to analyze the whole conception of causation, and to see that in no sense in which we use the word to denote the regular successions of science can it be applied to the obscure and incalculable movements of our deeper selves. Therefore, we may justly conclude that *no one who really comprehends the true nature of time, or duration, can doubt the freedom of the will.*

This conclusion, published in 1889, marks the first stage of importance in the history of Bergson's thought. It will appear farther on that all his later views depend upon this conception of time, in a very real and direct connection.

A quarter of a century has elapsed since Bergson in his Doctor's thesis established the "new idealism" and "discovered the soul." There is nothing in his later works that equals the depth and the originality of his first great thought. In this conception of time as the purely spiritual element in the world, he surpasses Kant more completely than Kant "sublated" Locke and Leibniz. It is no longer "time and space," but *time versus space.* His system stands or falls on the strictness of his conception of time as "duration." The seed of his work on "Matter and Memory" has been exhibited in the foregoing pages, but the very last chapter of his illustrious views on "Creative Evolution" is equally based upon the great thought which he expounds in his publication of 1889.

Most of the criticisms (in learned and popular periodicals) of Bergson's philosophy are based upon a misreading of his "Creative Evolution"; but this work cannot be understood or answered without a thorough comprehension of his use of such words as "duration," "will," "memory," "matter," "space"; and when the chaotic discussion of his system has cleared, we shall learn whether his "durationism" can be really subverted.

The preliminary to any future criticism of Bergson should be a few convincing paragraphs as to what he teaches concerning those things which exist in a manner proper to the psychic state. Is it too much to say that none of the able writers who have refuted him have shown that they have quite caught his argument?

II. Matter and Memory

In his second work, Bergson emphasizes the striking truth that "the body is an instrument of action only." This statement is the soul of Pragmatism, and James calls Bergson "the master" many years later. As for memory, "the body retains motor habits capable of acting the past over again"; and "It can resume attitudes in which the past (pure memory) will insert itself." "In no case can the brain store up images." "Neither in perception, nor in memory, nor *a fortiori* in the higher attainments of mind, does the body contribute directly to representation."

"All the difficulties of the problem of materialism and idealism come from considering the physical and mental as duplicates of each other." Perception and memory (the physical and mental) are not mere duplicates of one another.

We Are Not Made to Think but to Live and Act

Neither the realist (materialist) nor the idealist (spiritualist) can bridge the chasm between body and mind.

Kant makes a very unconvincing attempt to make a transition from sense to understanding. Bergson realizes the implications of his great thought. Perception and memory are not pure knowledge, but point to *action*. Both old schools neglect this all-important truth.

It is action that the body prepares. The growing complexity of the nervous system shunts the excitation received on to an ever larger variety of motor mechanisms, and so sketches out an ever-increasing variety of conduct.

Memory (that is our past experiences stored in the psychic world) enables us to select those actions that are most useful, by comparison with previous similar situations.

By allowing us to grasp, in a single intuition, multiple moments of duration, it (memory) frees us from the flow of *things*, that is from the rhythm of (material) necessity.

Our perceptions are not pure, but are largely mixed with our past, that is, our whole previous experience, habits, in a word our own character. Hence though we act in accordance with natural laws, these laws are largely what *we* are, or what we perceive them to be because of our past.

Perception gives us things as they are in themselves: it is not in me but in them, and hence possesses extension as the warp and woof of it. Perception is not to be considered as an inextended spiritual fact.

The vibrations my body receives from things prepare my body to act on these things: it is an image like them. Perception therefore consists in detaching from the totality of objects the possible action of my body upon them. Perception appears then as only a choice. Its function is largely *to neglect* in the total world all that I cannot act upon.

In using the word "images" then, Bergson concedes to idealism a kinship between real things and consciousness. (But materialists have to do this ultimately in a crude epiphenomenalism.)

But our perception does not make or comprise the whole of the world of reality; on the contrary, the purpose of a true science (and a really useful and helpful metaphysics) is to give us more of that real world of which our perception gives us a rude synthesis with most of its links left out.

Our World Comprises Only the Part We Can Act Upon

Perception gives us a second-full of red light which for science contains four hundred billions of vibrations (which it would take two hundred and fifty centuries of our history to count, if we could continue counting so long at the absurdly high rate of five hundred to a second). How can perception make the world if perception only sketches the vaguest outline of the thing as it is in itself? And yet we may freely grant that the world as we know it is the result of the selection made by pure perception of such aspects of reality as we can use in action.

My conscious perception has an entirely practical destination.

My consciousness of matter is not subjective, for it is in things rather than in me. It is not *relative* because the relation between the phenomenon and the thing is not that of appearance to reality, but simply that of the part to the whole, e.g., of the-blotting-paper-to-the-eye-and-ink as compared with the-blotting-paper-to-the-microscope: of the flash of red light as compared with the four hundred billions of waves.

The mistake is to set up homogeneous space as a real or even ideal *medium* prior to extension. Space is a useful conceptual derivative from extension, which is an important factor, the greatest factor, in perception, that is, in *things*.

Space makes the relation of things to mind seem utterly inexplicable if we regard it as logically preceding the perception of things, and Kant's ideal space is no better in this respect than the naïve space of early realism.

The mistake is to regard the world as an external reality which is divided and multiple, and mind as an inextended sensation alien to that external reality.

Concrete extensity is not divided and immediate perception is not inextended.

We must assume an extended continuum and, in this, many centers of interpenetrating bodies, our own being one of these images. We divide this continuum in order to act upon other bodies. Finally this division calls for space and atoms as a conceptual method of dealing with real action.

In explanation of our experience we may say this: that every thing happens *as if* we allowed to filter through us that action of external things (the vibrations of the material world) which is real (the *most* real in the "microscopic" sense), in order to retain that which is *virtual*, that is, *real for our purposes* (of reacting or living in the environment): this virtual action of things upon our body, and of our body upon things, *is* perception.

The brain states correspond to this perception.

The state of the brain is not the cause of perception, nor the effect of perception, nor in any sense its duplicate: it is its continuation; it carries over perception or virtual action into conduct or real action: the cerebral state is action already begun.

But pure perception is not what we actually find in ourselves. In order to explain experience as we have it, we must restore duration (memory) and extension (matter).

Our body is extended and capable of acting upon itself as well as upon other bodies. Into our perception, then, something of our own body must enter. *Our relations with other images are distant and indicate lessening degrees of action: our relation with our body reduces distance to nil, and action becomes not merely possible but real. Pain is an actual effort to set the damaged part to rights. This is the meaning of "affection."* The surface of our body is the common limit within which images and sensations arise together.

The mistake is to think that sensation is inextended because of this interiority. The old epistemology makes of these affective states of our bodily sensations, inextended elements of consciousness, out of which the external world is to be built up by magic in some unthinkable manner; whereas we should start with the external world as given, and these affective states are impurities introduced into this image-world (of which the body is a part) by the ferment caused when the external world and the body react on each other.

But spirit is hardly found in perception and affection. There is a kind of selective process in these. And again "no doubt the material universe is a kind of consciousness." But in it there is a neutralizing balance which hinders any one image from standing out. (Children and animals *accept* the world and themselves.)

"But *to touch the reality of spirit* we must place ourselves at a point where an individual consciousness, *continuing and retaining the past in a present enriched by it, thus escapes the law of necessity*, the law *which ordains that the past shall ever follow itself in a present which merely repeats it in another form, and that all things shall ever be flowing away.*"

Memory is spirit, not a manifestation of matter (as we have conceived matter in perception). "*When we pass from pure perception to memory, we definitely abandon matter for spirit*"; the material for the psychic world.

We cannot prove that perception is not the result (*or the duplicate*) *of* *the cerebral states, because the things which happen would conform to this view; but the same does not hold true of memory, for a memory is a representation of an absent object.*

Does a memory arise from a weakened repetition of a cerebral phenomenon? Is it a weakened perception? Is there only a difference of intensity between a perception and a recollection?

Now if, as our hypothesis supposes, the brain itself in no way begets the image of a present object, but only *continues it into action*, it (the brain) may also prolong and turn into action the memory which we summon up: but it cannot give birth to that recollection.

And again, if perception is something of the present object itself, memory being related to absent objects must be of an opposite nature. There are no intermediate stages (as of weaker and stronger) between presence and absence.

The Brain Only a Contact between Mind and World

So much for the hypothesis; now how do the facts stand? The facts bearing on any hypothesis of accumulated memories in cortical substance are drawn from *localized disorders of memory.* If recollections were deposited in the brain, gaps of memory should somehow correspond to lesions of the brain. But a whole period of the past *may* be obliterated without any precise cerebral lesion; and, on the contrary, in those disorders of memory where cerebral localization is distinct and certain, that is to say, in the different types of aphasia, and in the diseases of visual or auditory recognition, *we do not find that definite recollections are, as it were, torn from their seat, but that it is the whole faculty of remembering that is more or less diminished in vitality,* as if the subject had more or less difficulty in bringing his recollections into contact with the present situation.

The mechanism of this contact was therefore what we had to study in order to ascertain whether the office of the brain is not rather *to insure the working of the contact* than to imprison memory in the cells.

This contact is *recognition.*

Recognition of a present object may be effected in two absolutely different ways, but *in neither case does the brain act as a reservoir of images.*

(*a*) Sometimes the body (by an entirely *passive* recognition, rather acted than thought) responds to a perception that recurs by a movement or attitude that has become automatic. In this case habit accounts for everything, and destruction of mechanism causes lesion of memory.

(*b*) Sometimes recognition is *actively* produced by memory-images which go out to meet the present perceptions: but then it is necessary that these recollections, at the moment they coincide with the perception, should be able to set going in the brain the same machinery that perception ordinarily sets to work in order to produce action. And this is why in all cases where a lesion of the brain attacks a certain category of recollections, the affected recollections do not resemble each other, by all belonging to the same period, or by any logical relationship, but simply in that they are all *auditive*, or *visual*, or *motor*. It is not memory that is damaged, but the *contact* between the psychic and the material worlds.

English idealism makes no difference in *kind* between perception and memory; hence the external world is only "a true hallucination." But *memory is not a faded perception, otherwise faded perceptions would seem memories; but they never do.*

If we had not already the idea of a *past* previously lived, how could we ever assign an experience to it as a memory; and thus classify weak perceptions not as weak perceptions, standing among other perceptions, but as memories of the past. *Memory is not a regression from the present to the past, but an active and forcible invasion of the present by the past.* We place ourselves *in* the past *at a stroke*, and summon recollections to play upon *the inner keyboard of the brain*, so as to modify actions, prepared by the playing on *the outer keyboard of perception.* Memory and perception are contraries. We start from a virtual state of pure memory and pass through several planes of consciousness to action.

The old psychology and metaphysics made perception a disinterested work of mind, and then made memory a state of the same nature; but *perception is for action;* our present is sensory *and* it is motor; it is the state of our body; but our memory is in very truth in the domain of the psychic; our past *acts* no longer, *pure memory is not motor; it can become real only by returning to the field of action; it inserts itself into a present sensation and borrows the vitality of this present state.*

Associationism gives at first *a very plausible account of memory, recognition* and allied topics; but on closer investigation it is full of errors.

The Fallacy in Associationism

The cardinal error of associationism is to have set all recollections on the same plane, to ignore the distance which separates them from the present bodily state: that is, *from action.* It becomes unable to explain (*a*) *how* the recollection clings to the perception which evokes it; (*b*) *why* association is effected by similarity and contiguity, rather than otherwise; and (*c*) by what particular caprice a *particular* recollection is chosen among the thousand others which resemblance or contiguity might *equally well* attach to the present perception.

To complete a recollection by more personal details does not at all consist in mechanically juxtaposing other recollections to this, but in transporting ourselves to a wider plane of consciousness, in going away from *action* in the direction of the *dream.* We go to more distant planes. These planes are not given as ready-made: *they exist virtually, with that existence which is proper to things of the spirit.* The spiritual world is the home of the intellect, which moves between these planes of memory, and creates them anew: it is precisely the function of intellect to connect these planes with action. Action *demands* similar and contiguous cases. *No speculative interest could explain this mystery.* Memory has a certain *tension* which is commensurate with its desire to mingle, or not to mingle, in *action.*

But the great final problem for this book is to show how mind and body come together. *We have made of our body, and all that surrounds it, the pointed end ever moving, ever driven into the future by the weight of our past.* If pure memory is already psychical, and pure perception physical, we ought to be able by placing ourselves at their fusing point, to throw some light on the reciprocal action of mind and matter.

The opposition of mind and matter, in the usual dualism resolves itself into three aspects: (*a*) The extended and the inextended; (*b*) The problem how quantity explains quality; (*c*) How freedom is consistent with necessity. If we are to achieve any success, we must show how our view tones down these seeming hopeless oppositions.

If matter is made up of *innumerable real corpuscles*, and mind of *sensations to which the dimensions of bodies are utterly inapplicable*, then mind and matter are *really* disparate, on the first count. But *is* this the right statement of the problem? *No such corpuscles are given in intuition—they have been produced artificially by the understanding*, struggling with practical needs and scientific problems arising therefrom. What is really *given* is something *between divided extension*, and *pure inextension*.

Extensity is the most salient quality of *perception*. *Abstract space* is *a device for dividing extensity* and *giving us infinitely divisible matter;* but this space and matter are *not given in perception*. We stretch a net over the real, *as a painter blocks out squares* on his canvas. But just as we divide the really given experience into unreal atoms on the material side, so we divide it into atomic sensations on the mental side, and these *refuse to combine* in any such way as would explain the very real images (not at all inextended) which make up our actual world. *There are no such sensations, just as there are no such atoms.* They are purely conceptual *abstractions*, resulting from a disintegration of reality by the intellect. *To get a true philosophy of mind and matter, we must withdraw from conceptualism into the free air of living intuition*, and explain a real experience by real elements.

The second opposition (quality *vs.* quantity) is far less artificial. How can the movement of waves at a certain rate (quantity) spell *red* (quality) to mind? But this problem is not so radical if we abandon the first opposition.

You now *restore perception to the thing perceived; the red is in the object, not in some inextended sensation*. You may say, But the atoms remain, and *they* are not red; we reply that science is already permitting us to discard atoms. But, you persist, there is an apparent homogeneity of movements which does rhyme with the heterogeneity of qualities. Well; but how could such movements, composed as you suppose, of a series of instantaneous positions, fill *an actual duration*, such as we get in intuition—which will you cleave to in this unanswerable dilemma, the infinite instants which make motion impossible, or the actual movements without which life is unthinkable?

It results that:

Concrete movement, capable like consciousness of prolonging its past into its present, capable by repeating itself of engendering sensible qualities, *already possesses* something akin to consciousness, something akin to sensation. *It is the difference of internal tensions which gives the rhythm that fixes the synthesis of the images as we know them; and this tension is itself determined by our need of action.*

And finally our freedom consists in modifying the images of the whole, which is real, by selecting for action the part which concerns us—that which affects us, and which *we* in turn can affect. We do not accept the monotonous duration of nature, but we impose upon this even background the rhythm of our own time-span: *we thicken the waves; we paint our own picture on this great background, and our life and personality are just what we take up and act upon of all that is actually there.*

"Spirit borrows from matter the perceptions on which it feeds, and restores them to matter *in the form of movements which it has stamped with its own freedom.*"

According to this work the brain is no more the seat of memory, than a copper wire is the seat of an ancient telephone conversation. Everybody knows thousands of facts which are not in the momentary field of attention; for example, the general outline of the Career of Napoleon. These facts exist in a psychic world, and are called back when action needs them.

Just as our enduring psychic life makes will and personality in the world of conduct, so this same growth and change may be seen as memory in the world of thought: *and matter signifies* just in proportion as it is given meaning and intensity by what the soul has endured. *Is not the evolution of all creation just precisely analogous?* Only those who master his first works can hope to understand his conception of evolution.

III. Creative Evolution

In the Preface Bergson speaks of his general position—that intellect is only an aspect of life, and (as found in man) not broad enough to explain life, especially as it ignores so much of life in ignoring all the experience of inferior species, which have, so to speak, fallen behind us in the race.

The first chapter begins with a reiteration of Bergson's favorite idea of *duration*. *We endure*, but external objects are always in the last analysis unchangeable. The final elements of things (molecules, atoms, corpuscles) can "return"; *they have no real history* or development; they do not profit by experience, and thus invent new phases, (in contrast to "us"); a "sufficient" scientist could foretell the position of every single atom. Mathematics and physics disregard true duration; their symbol "*t*" always deals with breaks, not intervals. *The universe as a whole endures and creates new and unexpected and even unimaginable things, like the mind itself.* Duration *means* just invention or creation. In the universe we may conceive of two opposite movements, matter descending and life struggling upward: life endures, and imposes its own rhythm upon matter. The universe is a boundless ocean of vibrations, most of which are colorless and nonexistent for the individual: but out of this ocean *the individual selects as much as it may possibly act upon*, and by a synthesis in accordance with his own rhythm, the individual, so to speak, *paints his own world on the larger but neglected background. We cut out our own systems; we see only the plan or design of our own action.* We thus flash out isolated groups which, without our reaction, fade back into the colorless whole. *These groups must be conceived as possessing true duration in the whole of nature, but not in the isolated systems, in which we see them, and which are only snap-shots of reality, constructed to satisfy our practical needs.*

Now the question arises whether a living organism like a lifeless object is also a mere snap-shot devoid of duration. Bergson says, "No." A living body grows old, has a real history, cannot "return" to earlier states, is strictly individual. Of course it is impossible to define the word individual very closely, but a living organism seems to aim at real independence, and to resemble the whole universe in being creative and in enduring. Aging is memory organized; the body is a record of experiences endured: aging cannot be explained by merely mechanical causes, as some have attempted to explain it. Organic growth is absolutely incalculable because it is impossible to gather the data before the growth has actually occurred. Physics and chemistry never touch life and movement. May we not say that life is just continuous creation?

Evolution Theory in General Is Considered as Accepted

Bergson accepts transformism as the most probable account of biological development. He thinks the facts of embryology, paleontology and comparative anatomy establish this hypothesis. But even if species were proved to be discontinuous creations, the classifications of biology would remain, and paleontology would prove that the acts of special creation occurred in the transformed order. Philosophy needs no more for its purposes than this logical or ideal kinship of species. In this sense, evolution certainly occurred *somehow:* either in creative design, or in immanent vitalism or in some other hidden manner which still acted *as if* by the rules of transformism. Life arose at a certain moment in certain points of space: it was a real visible current: it has a continuous progress through the germ-cells of living organisms. Organic evolution is thus in strict analogy with consciousness itself, its past always creating its present, and biting into its future. Physicists and physiologists are sometimes inclined toward mechanism, Bergson says, but histologists, embryogenists and naturalists are slower to believe in vital action as explicable without some psychic factor. Of course, the amoeba is quite mechanical, but then it is not advanced on the phylogenetic scale, and represents the point at which life is just breaking in to the material world: besides, the amoeba itself presents some curious problems to pure mechanism.

La Place, DuBois-Reymond and Huxley hold that a sufficient intellect could describe any future state of the world, *if he had the facts* about atoms, forces, etc., at any one moment. From this point of view, duration really does not exist; time is a name, not a reality.

But duration is the one thing we are truly sure of as our innermost selves, and this proves that radical mechanism deals only with the surface of things.

But teleology is no better: it equally assumes that all is given: it leaves no room for free creation, invention, originality: all must happen according to a rigid plan. Of course finalism is very smooth and plastic, and in one sense even Bergson accepts the truth of it. The idea of a harmonious design of course is absurd: nature is ravenous and quarrelsome, and pessimists make out as good a case for the doctrine of universal opposition and conflict. The vitalistic theories have a use, but so far as they support a harmonizing principle in the *individual* life, they have to explain rebellious cells, such as the phagocytes, as well as to explain how a being which is simply made of a couple of cells (of the parents) can really be called an *individual*.

Both mechanism and teleology have put too much stress on intellect, which is after all only a strand in the rope of life. We must enter into all aspects of life to explain life: the animals and plants and other orders of being that we have overcome and passed in the race of development are also parts of the whole of life, and we shall never explain evolution without examining these and assigning them a place. These aspects of teleology are distasteful, but there is one thing we may accept: the whole creation does show a certain harmony on one side. All the species and forms of life are bound together in a way, and progress side by side like straws in a sheaf. Of course we are the largest and finest straws. Each species, however, works for itself, and much conflict arises from this. But there is a common impetus, and as we go on the conflicting species seem to be in a sense interdependent and complementary. The harmony is behind rather than before us: just as a wind drives down the street all as one, but is dispersed when it strikes a corner.

We cannot speak of a common aspiration. "It would be futile to try to assign an end to life in the human sense." The road is created by the act of traveling. Man is in the making. No, no, all this is futile; but the common impulse is behind and accounts for resemblances in species which could hardly be accounted for otherwise.

Mechanism teaches that a lot of species have evolved accidentally. Well, if this were so in a sense, how is it we find such striking similarities? Why have so many species eyes, and other organs, functioning in much the same way, if it is all the chance of matter and blind forces? But if the original impulse had in a sense a common aim, then these highly divergent species might really be expected to show striking similarities.

None of the Current Explanations of Evolution Sound

From page 55 to page 85 Bergson endeavors to make good his attacks on the current views of evolution. He begins by seeking an example of development which will be fair and typical and which will stand as it were for the whole process. He rejects sex as of uncertain function, and finally settles upon the "eye." He proceeds to examine the accounts of the evolution of the eye from its earliest form as given by a neo-Darwinist, by DeVries, by Eimer and by the neo-Lamarckians. His final conclusion is that the first three, being purely mechanical, are most unsatisfactory, and that Lamarckism has some, but not much, idea of his own view, which is psychological.

The finalists, he says, talk a great deal about the miraculous structure of the eye: but it functions at first as a mere pigment-spot, which may really be accidental. The evolutionists step in to explain how this spot develops until we get the eye of a man or of an eagle.

First come the Darwinists with their "insensible variations," then DeVries with his "sudden mutations." Both favor the purely accidental hypothesis. Next comes Eimer with his idea of a variation controlled directly along a definite line under the immediate influence of external conditions.

According to Darwinians, the eye changed very, very slowly, and whatever was good in this slow and imperceptible change was retained; the rest was eliminated.

According to DeVries, the eye would change all at once by the simultaneous appearance of *several* new characters.

Bergson says as he sees the problem both views may be partly true. But if these variations are *accidents*, neither view tells the whole story. In the case of slow variations, one accidental change at a time would surely *impair* vision, and how could such a change be retained by the principle of the best thing surviving? It would not *wait* for the complementary changes which are supposed to join and complete it.

In some ways, the sudden leap theory is better. If the eye of a mollusc and that of a vertebrate have been evolved by relatively few leaps, there is perhaps less difficulty in understanding the resemblance of this organ in the two: chance, that is, seems less of a magician. But when such sudden changes arise, why does not the animal become blind? How do all the parts of the delicate machinery of vision, suddenly changed, remain co-ordinated so that the eye continues to see?

Of course the "law of correlation" will be invoked. But it doesn't apply. We have not here to do with a collective whole of solidary changes, but with a vast number of *complementary* changes most delicately organized. That all these should occur in such a way as to improve, or even to maintain, vision seems unthinkable under the direction of such a principle as accident. Now what about Eimer's orthogenesis? Molluscs and vertebrates have certainly evolved separately under the influence of light. Can we say that light has caused the development?

We can imagine that light might act upon an organism in such a way as to effect a gradual complication better adapted to the mold of outward circumstances, but how could it affect the increasingly complex structure of the eye itself? In the one case, matter receives a gradual imprint from light, in the other it becomes active and solves a problem (of seeing better). At first, no doubt, the pigment-spot may have been produced physically by the action of light, but when the eye makes use of light *to control locomotion*, the "imprint" explanation fails, because the eye is not now passive but active. The lower down the phylogenetic scale we go, the more matter and the less life: but higher up more life and less matter: the organism is now active, not passive. Is this surprising? It is like an orator who begins by falling in with the mood of his audience, but on waking up to his work sways the audience to his own mood. Surely no one will argue that light makes the whole nervous mechanism, which at last responds to the eye, thus become an active guide of locomotion. This would be to attribute to matter a creative power *sui generis* that would be more spiritual and mysterious than teleology.

But, does someone object, there are facts, well known facts to prove that outer stimuli *do* cause enormous changes: what about the species whose very natures are changed by salt solutions? Well, this seems at first sight to be plausible. But does the salt solution cause the change? What is a cause? There is a real impelling cause as when a cue hits and moves a billiard ball; there is a releasing cause as when a spark ignites a carload of gunpowder; and then there is an unwinding cause as in the spring of a victrola. Are the two latter very real causes? No. But the salt solution is just midway between these. It is an occasion of variation rather than a real cause.

As applied then to the explanation of the development of the eye, Eimer's view is pure finalism. The production of an eye in two widely different species by two entirely different series of infinitely numerous small causes is contrary to the principles of mechanism.

Up to this point, we have talked of the eye of a species, but study of the eye in an individual of a species shows the same reasoning is sound. If a lens is removed, it may be regenerated in the greatest variety of ways.

The result so far is that the pretended mechanism, or accident of natural necessity, is a mere pretense in these three systems, and *every one of them has some inner directing agent*, which it alternately denies and makes use of. The convergence of effects in lines of life so remote, the eye appearing in species so disconnected, and of so various experience, can never be explained by mechanics.

Now what about neo-Lamarckism? Lamarck explained variation by use or disuse of organs, that is, practice and effort, and by transmission of characters thus acquired to descendants. His disciples attribute such variations not to mere mechanism, but to effort, sometimes voluntary effort, at adaptation to environment. This effort *may* be only the mechanical exercise of organs under pressure of circumstances, but it may imply consciousness and will. This seems the only theory of evolution that might account for the building up of identical complex organs on independent lines of development. But does it go deep enough? Effort and exercise will strengthen an organ, and make it grow, but will it develop a pigment-spot to the eye of a vertebrate? And then how about plants? And finally are acquired characters transmissible? Philosophy cannot settle this discussion, but yet must follow it. Bergson doubts whether the soma ever affects the germ-plasm. He thinks the germ may suffer from malnutrition. Or it may be poisoned generally and give rise to deviations. He thinks that children resemble parents in their natural dispositions, and that the results of these resemblances may be attributed to parental *habits* groundlessly. At the most, he thinks transmission the exception and certainly not the rule.

He therefore concludes that neo-Lamarckism is no more able than any other form of evolutionism to solve such a problem as that of the evolution of the eye, with its enormous number of variations all in the same direction even if we grant that it explains how individual efforts could produce them singly.

All Current Theories Partly True

Bergson does not reject any of these views entirely. Each of them being supported by a considerable number of facts must be true in its way. Before proceeding to his own view of creative evolution, Bergson points out just how he regards those four well-known views. He argues with the neo-Darwinians that the variations are *inherent in the germs* and *not caused by experiences, behavior or habits of individuals*. But he differs from them when they regard these differences as *accidental* and *individual*. He says *they are the development of an impulsion which passes from germ to germ across the individual.*

He thinks the mutations of DeVries establish a *tendency* to change which is *anything but accidental.*

Bergson agrees with Eimer that the evolution of the organic world is *largely determined by the pressure of circumstances* acting in a constant direction. But he *does not agree that mere physical and chemical causes can ever account for such results.*

He approves, on the other hand, of the element of psychology in Lamarckism, but says it means nothing in the vegetable kingdom, and besides he *does not believe it shown that acquired characters are transmitted as a general rule.*

Bergson's "Life-Force" Theory

In the remaining ten pages of the chapter, Bergson offers his own theory of evolution, which he calls "Creative Evolution," and which after study of his previous works one might feel inclined to call "Durational Evolution." According to this view, the "*élan vital,*" sustained right along the lines of evolution, among which it gets divided in the shock with matter, is the fundamental cause of variations: at least of those which are passed on to accumulate and create new species. Life is seeking to act upon inert matter: vision is one of the possibilities of this action upon matter, therefore life is trying to see.

The eye has a very complex structure, but a very simple function. It is just this contrast between structure (our analysis), and function (nature's synthesis), which should give us pause. Both mechanism and teleology agree in regarding the eye as a marvelous machine, built as human beings build machines, by assembling parts for a purpose. But life does not proceed by the association and addition of elements. On the very contrary, *life proceeds by dissociation and division.* A very simple object seen from every possible point of view seems endlessly complex. Think how many infinitesimal squares of colored mosaic it would require to reproduce a painting; yet the painter may have made it by a few simple movements. Our eyes and our intellects are such as to lend the greatest complexity to things which in themselves are quite simple. Nature has no more trouble in making an eye than I have in raising my hand—an exceedingly simple movement, though infinitely complex to the anatomist and to the mathematician. It is one thing to be a clever calculating manufacturer, and quite another to be a creator of living organisms; and although science must always stick to the machine theory for practical ends, yet it will never explain the simplest fact of life and motion.

The whole organism corresponds to the whole effort of Nature, but the parts which we see in an organism do not correspond to parts of that effort: just as the movements of certain muscles and nerves do not correspond to parts of my effort in raising my arm. The materiality of *this* (Nature's) machine does not represent a sum of means employed, but a sum of obstacles avoided. Thus vision should attain *by right* an infinity of things, but most of them are in fact not accessible to our eyes. The vision of a living being is limited to objects (vibrations) upon which that being can act. Distant objects are small, others invisible. Thus seeing in general is canalized; and the apparatus of seeing is the canal which *limits the vision in general* of the *élan vital*, or life impulse. A river rushing along its bed is not accounted for by the earth of the banks nor by a drawing of its course, though both are important aspects of its real reason for existence. *Suppose you thrust your hand into a heap of iron filings; now suppose the hand to be invisible. Some will account for the arrangement by studying the arrangement of the filings themselves and the forces that are acting among them. Others will suppose that some definite design and designer was needed to arrange the separate atoms; but in reality the whole thing came from a simple impulse which threw off the mechanism and the design as mere by-products.* Such is the action of the life impulse in its effort to act upon inert matter. The greater the effort of the hand, the farther it will enter the heap of filings, but *at every stage there will be a complete and co-ordinated arrangement and design.* There cannot be a partial co-ordination because the act is simple and whole *at every stage. Thus in the case of the eye, the form of the organ represents the depth to which the visual process has attained* and accordingly the eye is the same in the most differing species if the progress toward vision has gone equally far in both. Not that the *élan vital* has a clear idea of any progress toward vision. *Life is a tendency to act on inert matter, and vision or visual perception proves to be precisely one of the possible modes of such action.*

The Life-Force Divides and We Get Plants and Animals

The *élan vital* encounters inert matter and bends to physical forces.

Finally it leaves this track and develops in numerous directions like straws of a sheaf. Many potential phases of life are abandoned by each actualized tendency. Many end in blind alleys, but it is a real highway that leads through mammals to man. Societies of bees and ants are stereotyped. In human society there is less equilibrium. The general directions come from life, but difficulties met on the way demand adaptation. No general definition perfectly distinguishes the plant from the animal. The group must be defined not by possession of certain characters, but by its tendency to emphasize them. Vegetables are distinguished from animals by their power of creating organic matter out of mineral elements drawn directly from earth, air and water. The movements of animals have greater frequency and variety than those of vegetables. Between mobility and consciousness there is an obvious relationship. Consciousness appears as choice. The nervous system is a mechanism of choice. Consciousness appears as cause and effect of movement. There seems little volition in vegetables; but what corresponds to the will of an animal is in the vegetable the power of bending the energy of the solar radiation, when it uses it to break the connection of carbon with oxygen in carbonic acid. Sensibility may be said to appear faintly in the peculiar impressionability of its chlorophyl light. The same impetus which has led the animal to give itself nerves and nerve-centers must have ended in the plant in the chlorophyllian function.

At the root of life, there is an effort to graft on to the mechanical forces of matter the largest possible degree of indetermination or freedom.

Life, advancing through matter, makes use to this end of all the stored-up energy it finds on its path. The different kingdoms of life store up energy, and each advance depends on this fact. The vegetables find stored-up energy in earth, air and water; the animals in the vegetables; the higher animals in the lower. Vegetables and animals represent the two great divergent paths of the *élan vital.* Yet they both spring from a common root, and each tries to develop one of the good features of that from which both spring.

What constitutes animality is just the faculty of utilizing a releasing mechanism for the conversion of as much stored-up energy as possible into "explosive" actions. At first, the explosion seems rather aimless, but there develops an increasing tendency to act so that movements will result. Some of the food-supply repairs tissue; some gives energy to movement.

The nervous system develops in accordance with the need of action, and finally assumes its supreme place as guide and center of the body. The rest of the body waits upon and supplies this central system, which in turn guides the whole body as a general an army.

A nervous system with neurones placed end to end, so that at the extremity of each many ways are open to choose from, is a veritable reservoir of indetermination.

That the main energy of the *élan vital* has been spent in the creation of apparatus of this kind is, we believe, what a study of the organized world would reveal.

There is much discord in living beings. Life in general is mobility itself, but particular life-expressions lag behind. The impulse is easily exhausted. Like eddies of dust raised by the wind as it passes, the living turn upon themselves, borne up by the great blast of life. They are, through it, relatively stable. The externalization of our life in act is chilled, and dies, and we tend to doubt the sincerity of our own enthusiasms when we see them in their outer shapes. But the dead retain for a while the features of the living. Then at times the invisible breath that bears them is materialized before our eyes, in a brief vision. We have this sudden illumination before certain forms of maternal love, so striking, and in most plants so touching, observable even in the solicitude of the plant for the seed. This love may possibly deliver to us life's secret. It shows us each generation bending over that which follows. We see that life is above all a thoroughfare, and that the essence of life is the movement which passes it onward.

There is in all living beings a certain torpor, a partial sleep, betraying the failure of life to reach its goal. It is like a leaping man who is yet self-preoccupied and cannot give his whole attention to his effort.

Obstacles and exhaustion make his progress a partial failure. In the first development of animals, the freedom of movements met with new perils. We find the soft organisms of the vertebrates surrounded by protective armor. Shells, solid sheaths, scales, etc., protect but hinder, and life and consciousness are retarded. Later, however, agility in flight and attack, and the power of choosing advantages in place and time of flight, tend to free the animal of his early impediments. In man, we at last reach "*a hand*" which is capable of any kind of work. If *success* means aptitude for development, any and everywhere, and against all obstacles, man is undoubtedly the most successful of the efforts of the life-force.

Animal life shows a divergence in progress somewhat like that between vegetables and animals.

The hymenoptera and the vertebrates are very divergent groups each of which reaches a perfection of its own. The ants and bees have followed the line of instinct, while man has developed intellect. These two are not to be regarded as in the same *line* of evolution. The torpor of the vegetable, the instinct of the ant, and the intelligence of man are three separate, distinct and divergent efforts of the *élan vital* to reach freedom and consciousness.

Instinct and Intellect Divide

Instinct and intellect are opposite and complementary. The cultivation of intellect requires an activity contrary to instinct, and yet *there is no intelligence in which traces of instinct are not found.* Instinct and intellect both aim at producing action on inert matter, but by different methods. Man arrives in evolution when tools arrive. No one doubts for an instant that when we get handmade tools and weapons, we have reached the age of human intelligence. And this common-sense judgment is strictly sound. Animals use artificial instruments occasionally, and often recognize them. But human invention completes itself in manufacturing instruments, and this is the defining mark of human intellect.

The invention itself is less important than the new desires and enlarged environment the invention creates.

Now does an animal possess tools and machines? Yes, but the instrument is part of its body. Does the instinct make the organ, or the organ the instinct? We do not know. Either view seems reasonable. Instinct and the organizing work of living matter seem two names for the same thing. The most marvelous instincts of the insect only develop its special structure into movements. Indeed when social life among ants, bees, etc., differentiates function, we find also different structures. Thus in its perfection instinct is a faculty of using and even of constructing *organized* instruments; while intelligence perfected makes unorganized instruments.

Instinct, like intellect, has its own advantages and defects. Instinct finds the appropriate instrument at hand, without taking thought: the instrument repairs itself. It is complex in detail, but very simple in function. It does one thing, and retains one form. A machine made by intelligence is often imperfect, cumbersome and troublesome, but it can vary a great deal, and do all sorts of things in all sorts of places and seasons. It also creates new needs and works profound changes on the society that produces it, while the instinct of ants and of bees keeps them in a narrow circle.

If the life-force were unlimited, it might have developed instinct and intelligence together, and to any extent in the same organisms. But it had to choose one of these two ways, and so it either acts directly through an organized instrument, or indirectly through an unorganized instrument. The two modes diverge more and more as they go on—neither understanding the other—but yet they always have a relation because of the common stem of which they are the branches. The insect shows gleams of intelligence in its *choice* of place, time and materials; and the most intellectual of the human race have the constant great need of relying on their instincts. In the higher vertebrates, we see a tendency to intellect.

Man in the prehistoric world must have been much at the mercy of enemies, but he proceeded along very perilous lines to intelligence, and by this risk achieved remote results of the highest value.

How far is instinct conscious? Plants probably have practically no feeling. It is likely in animals that where action is free and unrestrained there is little feeling just as in our automatic actions and in somnambulism. Action makes consciousness unnecessary. But if the action is checked or thwarted, consciousness awakens. "Consciousness is the light that plays around the zone of possible actions, or potential activity which surrounds the action really performed by the living being" . . . . "where the action is the only action possible, consciousness is reduced to nothing." "The consciousness of a living being may be defined as an arithmetical difference between potential and real activity. It measures the difference between representation and action."

Instinct then points to unconsciousness, and intelligence to consciousness. Compare the manner in which we regard the vasomotor system in pumping blood, and the hands in playing the violin. Deficit is the normal state of intelligence; *laboring under difficulties is its essence.*

Some of the animals perform acts so marvelous that if they were based on learning they would imply the most profound and extensive studies. Everything happens as if under the guidance of skilled entomologists and surgeons. Those who would praise intellect at the expense of instinct must first explain the amazing mechanism which Nature actually presents in the instinct stage.

Whatever is innate knowledge in animals bears on things, while in children it bears on relations. The best example of the latter is the ease with which children take up the meanings of phrases and sentences: intelligence has an innate knowledge of forms just as instinct has a similar knowledge of things. *Instinct is thus far superior to intelligence in the quality of its content, but it is exceedingly narrow. Intelligence, knowing relations, knows thousands of things where instinct knows only one.* "There are things that intelligence alone is able to seek, but which by itself it will never find. These things instinct alone could find; but it will never seek them." *Intellect would be inexplicable in itself, but it is to be thought of as a very remarkably wide extension of practical knowledge: it is a way of knowing the world of matter which enables us to act upon it as instinct never could.* Spencer thinks he explains intellect when he exhibits it as "an impression left on us by the general characters of matter." But this is reversing things;

these general characters of matter are precisely what intellect has added to the world in order to act upon and control it.

"The intellect aims first of all at constructing." This fabrication is exercised exclusively on inert matter, in this sense, that even if it makes use of organized material, it treats it as inert, without troubling about the life which animated it. And of inert matter itself, fabrication deals only with the solid; the rest escapes. Just as the fluid escapes it in inert matter, so the life, the living, escapes it in organized matter. Our intelligence, as it leaves the hands of Nature, has for its chief object the *unorganized solid*. The intellect forms a clear idea of the discontinuous alone; when it attempts to deal with the continuous, or with real motion, or with life, it gives only a sketch and not an adequate account. It deals with states and positions, not with process, interval or progress. It reconstructs a line by a series of short lines or points; it puts immobilities together to make motion; it substitutes states of mind for living mind; it replaces reality with a practical equivalent. Of immobility alone does the intellect form a clear idea. It invents a concept known as homogeneous space, which no one has ever perceived (what we perceive is extension colored, resistant, etc.) in order to exercise its power of analyzing and decomposing and recomposing the stuff of perception.

This kind of knowledge cannot go far without language. Symbols are invented to denote an infinity of things, and these symbols arise out of the need of the intellect and favor the intellectual conception of experience. *Language gives liberty*. A word can stand for a thing, or for the image, recollection or idea, of a thing. The concept is the beginning of power and control. The intellect looks out upon unorganized matter and adopts its ways in principle, in order to direct and control them in fact. It resolves the organized into the unorganized and treats the living like machines. It does not admit the unforeseeable, and it fails wherever it has to do with genuine feeling or originality or human nature. That is why pedagogy is so far from being a guide to character and genius.

The intellect is characterized by a natural inability to comprehend life. Instinct, on the contrary, is molded on the very form of life.

If the consciousness that slumbers in it should awake, if it were wound up into knowledge instead of being wound off into action, it would give up to us the most intimate secrets of life.

Instinct, in extreme cases (bees and ants), coincides with groups instead of individuals, and the individuals are like cells of the group: cannot live without one another.

There are two theories as to origin: (1) the reflex theory (neo-Darwinism), and (2) the "lapsed intelligence" theory.

We find in nature many species in a circle interpreting one theme yet no relation between species.

The *Ammophila hirsuta* gives nine successive strokes to the larva of the rose-beetle, but the *Sphex* and the *Scolia* attack the same theme differently. These marvels result from sympathy, not knowledge. Instinct is sympathy.

And as to knowledge generally, the aesthetic intuition must supersede intellect as organ of a philosophy of *life*. If the intellect were once freed, it might turn and awaken the consciousness that sleeps in instinct.

The third chapter begins with a long review of the author's teachings regarding matter and duration, and is hardly intelligible without a careful study of his earlier works.

He points out once more that his definition of matter, looked at as an undivided whole, makes it a flux rather than a thing. The inert and the living, or organized, matter stand out from this background of vibrations.

In an analogous way, instinct and intellect, though opposed to each other, stand out from a background of what may be called consciousness, or psychic world.

A real evolution must account for a genesis of intellect, but this can never be done merely by showing the progress of mind through animal intelligence and in a comparatively static and given environment. Such a method does not generate or engender intelligence. Spencer's method is no more evolutional than Fichte's. Fichte like many Germans starts with the idea that mind is already "given."

But Spencer equally assumes that natural objects are already "given." Now a real evolution must show how matter evolves, just as mind evolves. There are no "things" in any absolute sense, but the growing mind acts on the flux by selecting as much as it is able to use, to act upon, and just so much it converts gradually into things. The more consciousness is intellectualized, the more matter is spatialized. Really matter is a flux and completely interpenetrative. Every part of matter is active everywhere; but in order to act upon matter we have to select and localize, and just as we assume that matter can be broken in parts and given lines and edges and limits, just so far can we get matter to act upon matter, and thus conquer and subdue it to our own ends.

Metaphysicians like to think that there are a lot of a priori categories of thought, such as cause and effect, in the very original make-up of our experience; but in reality they put these into experience by their intellectualizing of matter, and naturally they find with great exactness what they have themselves unconsciously hidden there.

"Human intelligence is not at all what Plato taught in the allegory of the cave. Its function is not to gaze at passing shadows, nor yet to turn round and contemplate the burning sun." *The task of living, acting, working, this is the business of the mind primarily, and its so-called higher activities have arisen out of this need and must be constantly explained in terms thereof.* But we draw the power to live and act and grow and evolve from the beneficent sea of life itself, in which we are always immersed whether we think of it or not, and *mind consequently is always more than thought and overflows it and makes intellect seem only the center or nucleus of something vaster but less definite.* Philosophy cannot like science rest in this definite center, but must attempt to flow out into the whole and explain science by a real genetic evolution of intelligence.

It will be objected that this is impossible on the face of it, because such an investigation can be accomplished only by means of the very intellect which it suggested we should abandon in the said investigation. But progress is always made by doing what has been declared impossible. *The only way to learn to swim is to plunge in and try,* not to stand back and compare swimming with walking and declare that it takes solid earth to support you; because you will find that water will hold you up if you adapt yourself to it by the proper movements. You must take the kingdom of new truth by storm; "you must thrust your intelligence outside of itself by an act of the will" and thus live again in a state that is instinctive and at last *truly original in the cosmic sense*, and in this manner stand as it were by your own cradle and grasp the creative or genetic principle which lies at the very root of evolution. *What is needed is a real genetic theory of knowledge, and not a mere theory of the already known, however plausible.*

What should be the relation between science and philosophy? What is the province of each?

It has been contended that philosophy is an organization of the results of the exact sciences. Physics and chemistry busy themselves with matter; biology and psychology with life. Philosophy differs from these, it has been said, in relating their results to a complete system which passes in review the totality of their products. Science thus deals with facts and the laws of science, while philosophy deals with the larger laws, or principle common to all science.

But how is it possible for philosophy to accomplish anything by accepting this rôle?

Science rejects all that the intellect cannot deal with after its own way. But we have seen that the intellect is not an adequate instrument for dealing with really living, growing, creative things; it deals only with dead and past things and not with things in the making. It imposes upon philosophy a purely mechanical scheme of reality, and reduces life to a well ordered mechanism, whereas our deepest experience is not of a dead mechanism but of a creative evolution. Science, of course, touches upon life, and is immensely valuable in giving practical control, but it follows the real curve of life only for a short distance, as a tangent follows a curve.

It is therefore the peculiar province of philosophy to deal with just those aspects of reality which science rejects, because of its inability to schematize them. And when we ask what it is that mainly occupies this province, we find that it is that *pure duration* which is the *essence of the soul itself, and of conscious life in general.*

In all the problems of materiality, science is the final arbiter, and this is precisely because matter, in the sense in which science uses that word, is itself the creature and product of the intellect of which science makes use. When the will is free, and all the experience that we have endured crowds itself into the present to act upon the environment, there is no thought of intellect; but *just in proportion as the will is weakened*, the detension is accompanied by an increased grip upon extension, and in this mood it is that we find mathematics and physics the most natural expression of our experience.

Life itself comes before intellect; all the essentials of human experience were established before mathematics and science were dreamed of. "The more we succeed in making ourselves conscious of our progress in pure duration, the more we feel the different parts of our being enter into each other." But when we let ourselves go, we dream, we live in mere sensation, and the material aspect of experience overrides the psychic. It is just here that science is at its best and comes to its own.

The fundamental error of Kant was to throw "time" to the scientists along with "space," and "cause," and other "categories," to which science is rightly entitled. It is *by an inversion of the forward movement* of real time, that we slip back by degrees into spatiality and the geometrical point of view.

The whole end of intellect is to spatialize experience so as to handle it in analytic schemata. Intellect is capable of reading into experience an endless complexity, and then of finding in that same experience the complexity it has ascribed thereto. To make this clear, think of a poet's verses: the poet as a creator is concerned with a simple effort to express his story, and is utterly unconscious of the phrases and syllables and letters he writes. And yet the cold, passionless mood of inattention so lifeless and so far from the real nature of poetry will with perfect correctness discover all these elements in the poem. But *poetry* is not of this nature. *And no more* *is the world in its reality as a great creative evolution of the kind that science discovers.*

If the intellect were really able to support the pretensions of its extreme advocates, one would suppose that just because it *is* intellect it would be particularly at home and successful in dealing with moral problems. *But it is well known that just here it scores nothing but failure.* A true science of conduct would aim at foretelling conduct as astronomy foretells eclipses; but science is perfectly useless in foretelling the conduct of others or even of ourselves. As long as the intellect deals with space and spatialized time, or any experience that will *stay fixed* in a geometrical plan of things, it does marvels. But *let life intervene, and where is it?* "It is duration that puts spikes in its guns." (*C'est la durée qui met des bâtons dans les roues.*)

Deduction and induction are the two essential functions of intellect, and neither of them works except when they are based upon spatial intuition. Induction seems at first sight to be a true logic of events and of living experience, but it really ignores creative life as much as deduction, and prospers by assuming that time works no real changes, and that what happened yesterday will happen again tomorrow.

Bergson now proceeds to inquire into the meaning of "physical laws," and this inquiry leads to the investigation of the meaning of the words "order" and "disorder," "laws and genera" and to suggestions as to what matter must have ultimately meant in evolution. These considerations lead up to his great conception of the real meaning of evolution with which the chapter ends.

In these pages, we find the subtlest and most characteristic of the fundamental thoughts of Bergson's philosophy. Matter stands at one limit of our experience: it is the nearest possible approach to the geometrical, as opposed to the vital or voluntary, ordering of reality. Astronomical phenomena show an admirable order in the regularity of their occurrence; there is an order no less admirable in a symphony by Beethoven, but the one is mechanical and foreseeable, while the other is original and unforeseeable.

All experiences are arrangements between these two ideal points of classification: first, pure mechanism, which comes as near as reality can come to a thoroughly spatialized or geometrical regularity; second, pure duration, which comes as near as reality can come to a thoroughly original creative and spiritual freedom. Actual experiences never coincide with either extreme, and what we call "disorder" is the result of the mingling of the geometrical with the vital order.

In physical nature, seen as the field of natural law, the laws of physics and chemistry, we get a close approximation to absolute geometrical determinism, although the laws of natural science, such as the law of gravitation, the laws of heat and light, etc., are really not absolutely correct statements of the uniformities they profess to generalize; just because nature is, even where inert matter is most dominant, not quite free from growth, change and original and unforeseeable directions. Nature never quite steps out of duration into pure space.

We think of disorder as a negation of order in the absolute sense; but the most confused ideas arise from this blunder. Disorder is not the absence of order, but the confusion of different orders. A room is in disorder not because it has *no* order but because its conventional order has become mixed up with the psychological order of its peculiar occupant. And the room of nature is found disorderly when it fails to coincide with the moral and voluntary conception of order of the human being that confronts it. For example, rock from a cliff may fall in perfect accord with the laws of cohesion and vibration and gravitation, and may cripple and disable or even kill a man walking on the beach, who does not in any reading of the moral or voluntary law of his spiritual nature seem to have incurred the disaster as a penalty of his act. The confusion of these orders would seem to suggest a complete negation of order; but it is not a case of complete absence of order but rather a case of too much order not fully understood or reconciled from any one clear point of view.

Some of the phenomena of nature which we now regard as typical examples of original, creative evolution seemed to the ancients to be perfect types of the static regularity of the world. Animal genera are now regarded as steps in a constant unforeseeable development, yet the generations of animals were so much alike, when seen by any one observer, as to present a remarkable example of the fixed order of the world. Indeed, *the Greeks thought less of natural law than of fixed genera as the expression of general ideas in philosophy.* Things satisfied their modes of thought when they filled those places which the ordinary average observation required as customary. "The stone is not quite stone so long as it is not in its normal place." In modern philosophy, this idea of genera is completely eclipsed by the idea of law. "The laws of Kepler and Galileo have remained for it the ideal and unique type of knowledge." Laws express the facts of growth, change and movement much more closely than dull ideas of types and genera; and yet they do not express the order of real life and mobility.

The main problem of the theory of knowledge is to explain why there is any order in things. But this is much easier when we realize that order is not contingent upon disorder but upon relation to an inverse order. The ultimates of consciousness are space, which is the ideal of detension, and duration, which is the ideal of spirit. All actual experience is arrangeable in a sliding scale between these ultimates. *Chance and necessity seem to be contrary terms, yet in the history of philosophy they are often found to be synonymous. This is because we unconsciously regard phenomena as explicable from the contrasted points of geometry and volition.* The same thing which seems to be chance or the wild and ungovernable, from the point of view of a willed or moral order, is found to be inevitable from the point of view of a mechanical and spatialized regularity. All order is thus contingent and there cannot be a third state of things in which there is no order at all, for this would not be a "state of things" but precisely *no* state of things or a state of nothing.

"This long analysis was necessary to show how the real can pass from tension to extension and from freedom to mechanical necessity by way of inversion." *The geometrical order has no need of explanation, because it is purely and simply the suppression of the inverse order.* In proportion as we attach ourselves to the new, the original, that which has begun to be, we find matter, or the already-made, losing its position—the poem and not the words and letters fill our vision. *Real* *life is felt in our greatest and freest moments to be driving into a future at once unforeseen and unforeseeable. A simple arrest of this movement throws us back upon the dead past, and this arrest is the ideal genesis of matter. The atom bears the relation to reality that the letters bear to the poem. The real universe is not created but constantly being created.*

If energy really belonged to matter in the spatialized sense, we could hardly escape the conclusions of the law of the conservation of energy; but perhaps it is precisely in extraspatial phenomena that energy resides. *God may be seen as having nothing of the already-made.* "*He is unceasing life, action, freedom; creation so conceived is not mystery; we experience it in ourselves when we act freely.*" "Action increases as it goes on; it grows and creates in the measure of its advance, as we learn by watching ourselves in action. Life is a movement; materiality is the inverse movement; when they clash, we get organization."

We must try to see "*no longer with the eyes of the intellect alone, but with the spirit—the faculty of seeing which is immanent in the faculty of acting.*" What we shall see is not a complex intellectual scheme, but a simple process, "an action which is making itself across an action which is unmaking itself like the fiery path which is torn by the last rocket of a fireworks display through the black cinders of the spent rockets which are falling dead."

From this point of view, let us now proceed to inquire what is *essential* in a theory of evolution.

In the beginning is the *élan vital* with its need of creation. But opposed to this upward movement is inert matter forming an obstacle. We thus find the psychic world with its *desire for freedom* checked by the material world with its *opposing necessity.*

The *élan vital* is limited and finite and can conquer necessity only by patience and cunning. In this dualism, Bergson seems to regard matter as thwarting life and freedom, and while this suggests a mediaeval and unscientific attitude, it has the great advantage of agreeing with common experience, where all our wits are exerted in overcoming the nature elements, getting food and shelter and thus freeing us for thought and art.

When we look at the higher animals, we see that freedom resides in the controlling and releasing mechanism of the sensory-motor nervous system, and that the more complex it is the more power of choice in action the animals have, and hence the more indeterminism or freedom. The stomach, lungs and heart give a certain independence to the animal by cleansing, repairing and protecting the nervous elements, but above all they supply the system with power and thus make its decisions and selections effective. We judge from this that evolution means the development, hand in hand, of automatic and voluntary activity. Wherever we turn in the animal kingdom, we find the essentials of life to be energy and guidance: the energy being guided with greater variety and precision as the nerves become more numerous and intricate.

Energy, then, is the supreme essential in evolution. Where does it come from? It comes from food. The supreme function of vegetables turns out to be the storing of solar energy. Directly or indirectly all animal energy comes from this source. The chemistry of this process is, and may remain, a secret. No order of plants or animals stores energy for others, but it falls out that others use the energy they store. Each species acts only for itself, and this produces the clash and discord of the struggle of life.

On our planet, life has followed, it is true, certain chemical lines, but in other worlds, life may have assumed entirely different forms, of which we cannot even conceive. Probably life has resulted from the clash of psychic and material forces in the planets surrounding all the myriad suns of the universe. Life requires only a slow accumulation and a sudden release of energy, and it may exist even before any solid matter occurs, as in our nebula before the condensation of matter.

Reality, as seen by our intelligence and expressed in our languages, can be seen as one or as many. Throughout the whole realm of life, there seems to us to be a balancing of associative and individual tendencies. Thus some attribute the higher organisms to a gradual *assembling* of cells which agree to work together like ants in a colony, while others regard the cells as a result of *dissociation*. But from the author's point of view, neither of these can claim any particular primacy, because *both are natural and both are the usual and fundamental modes of procedure in evolution.* The unity is in the stream of life which would find its way through matter: the division arises from the obstacles that oppose this stream. Supra-consciousness meets matter to act upon it, and the resulting creation is conscious life. In higher animals, everything acts as if the brain produced consciousness, but in reality "brain and consciousness correspond because equally they measure, the one by the complexity of its structure, and the other by the intensity of its awareness, the quantity of choice which the living being has at its disposal." The consciousness of living being is inseparable from its brain, as the sharp knife from its edge. The human brain differs from others in the number of mechanisms it can set up. *Other animals cannot escape from automatism, but the human brain is such that consciousness breaks the chain of merely instinctive actions.* In the great range of its varied actions, it discovers invention, makes tools, causes matter to react upon itself, and thus extends its bodily powers indefinitely. Language is at once the result, and the further cause of advance, of human freedom. Man alone has leaped from the springboard over the rope; all other species have fallen short. But there was no plan beforehand of all this: the *élan vital* simply *did* go farther through the human brain. "It is as if a vague and formless being, whom we may call, as we will, man, or superman, had sought to realize himself, and had succeeded only by abandoning a part of himself on the way."

Man has gone ahead often by making use of his traveling companions, whether friendly, hostile or merely indifferent. Man, having once discovered intellect, had to cleave to this at all costs, even to the crippling of his sympathetic, or intuitive, knowledge. But philosophy must search out the glimmer of intuition which leads it into unknown paths or it will starve in the region where intellect has devoted knowledge entirely to the courting and controlling of material things. Intellect will never bring us true life, or real progress. Only the spirit can carry us onward. *The spiritual life is our true destiny, but the word has been too narrowly conceived. It is really the animal life* *carried in its integrity to higher refinements and potencies. Conscience, personality, a higher soul, immortality are aspects of the spirit, or should be considered heedfully; but science would crush them all to powder by its mechanisms and necessity and fatalism, if we do not rise to a true vision of their real origin in a source deeper than the intellect and prior to science and opposed to matter. The density of consciousness is not bound up with the brain; the psychic world can realize itself in many ways. It is in life alone that we can find a philosophy of life. Such a view genuinely believed and lived would give us a renewed power to act and to live, a new valuation of all we experience. "All the living hold together and all yield to the same tremendous push." "The whole of humanity, in space and in time, is one immense army, galloping beside and before and behind each of us in an overwhelming charge, able to beat down every resistance, and clear the most formidable obstacles, perhaps even death."* This Bergson conceives to be the carrier of the *élan vital* and the meaning of creative evolution.

The History of Philosophy Needs Rewriting

In the last chapter of "Creative Evolution," Bergson shows at considerable length how a philosophy which "sees in duration the very stuff of reality" must regard the principal attempts at metaphysics from Plato and Aristotle to our own day.

How do all these systems explain the origin, creation and development of the world? They are all preoccupied with the question, How could the world have originated out of nothing?

The intellect, as we have often seen, can do nothing with really living things. The mobile must halt for an instant in order to be fixed by law. For practical purposes the intervals are negligible. But when intellect undertakes to speculate about reality, it forgets that these intervals are not real intervals, just as it forgot that disorder is really a confusion of orders. The word "nothing" has been used like the word "disorder" as if it really signified something; but in life, in duration, it has no place: it is only for intellect and practical control that the void is useful. Existence comes to appear as a conquest over non-existence, whereas in fact non-existence has no reality, and is only a useful part of the intellectual hypothesis of mechanism.

Some of the modern European systems have taken the idea that creation arises out of "nothing" seriously. After admitting that in the beginning there is "nothing," they try to reconcile with this void state the idea that all things exist in the *idea* of a possible existence, and proceed to develop out of a mere abstract, logical possibility the reality of an evolving world, at a sacrifice of all common-sense.

But the mistake is in the easy assumption that they really do think back to "nothing."

What are we thinking about, when we speak of "nothing"? Modern psychology demands that the world should correspond in some way to an image, but to an image of what? But a more pretentious philosophy will attempt to show that it corresponds to an *idea* without corresponding to any image. Let us examine "nothing" with reference to each of these views.

On the first count, we finally reach the conclusion that if we imagine a negative we are really imagining that which makes the image negative; and that something still subsists. It even seems probable that in trying to imagine nothing we imagine with unusual vividness both an outer and an inner reality.

On the second count, we find that the "idea" of "nothing" is an idea of substitution; and that in addition this substitution is tinged by a feeling (as of regret or disappointment). "Nothing" is therefore neither an image nor an idea, but a pseudo-idea, a mere word. We cannot be called upon to explain why creation arises out of "nothing," because for duration there simply is not (and cannot be) any true meaning assignable to the word "nothing."

This obsession of practical intelligence about "nothing" is persistent, and the mode of intellect makes it both persistent and natural. All statical processes of thought, however subtle, neglect the real curves of living, mobile reality, treating polygons as circles, assuming that points make lines, and surfaces solids; but these methods do not quite reach the truth about reality: between these states are states of "nothing," but both the states and the "nothings" between them are false to duration. There is really more in the idea of an object conceived as non-existing than in the idea of an object conceived as existing: psychologically.

The old systems assume that affirmation and negation are the hemispheres of reality, but negation is not on the same level as affirmation. They are by no means symmetrical. "Not" is a word which expresses disappointment from a social point of view; it belongs to the merely practical and not to the real. It tells us nothing about things, but only something about our judgments concerning things.

"For a mind following purely and simply the thread of experience, there would be no void, no possible negation. Fact succeeds fact, thing succeeds thing."

But if memory be added to this simplest experience, the mind would begin to notice absences of things once known. Negation thus has a pedagogical and social value, but is not itself a factor in speculation on reality.

We come to think that as we can annihilate anything by the idea of absence we can annihilate *everything en bloc*, but this kind of annihilation is a pseudo-idea, because it would involve the idea of all the real things expelling one another endlessly in a circle, and hence, refute itself.

The world, then, is not painted on a background of "nothing." We say there is "nothing" in a room when we mean no chairs, tables, etc. The idea is based on utility. And just so with the world. What we mark out as useful for our action is real, and we neglect the rest of reality; but this is no true reason for calling it "nothing" in the absolute sense.

By this line of thought, Bergson sends another of the pseudo-problems of philosophy to the scrap heap. If in the light of duration and psychic reality there is no meaning in the word "nothing," if the word has no real content for a living mind, and is just a word and nothing more, then all the profound mysteries that have been regarded as enigmas for so many ages have no meaning, and pragmatism may dismiss them in order to attend to the real problems, that is, problems whose solutions have some bearing upon life and our estimation of the meaning of life.

Bergson is not given to clear enunciations of his proofs. We may suppose that in beginning his last chapter of the "Creative Evolution," he desired to reply to those who might ask, How did the world begin? How could *any* evolution arise out of nothing? He replies that reality has nothing to do with "nothing": there never was and never could be any such idea except as a pseudo-idea, and he does not waste further time on the resulting pseudo-difficulty.

He next proceeds to show how his conception of reality as duration enables him to see *the whole history of philosophy* from the Eleatics to Spencer in a new light. It is all wrong so far as it concerns the real nature of life and its development. Life can be apprehended from the side of instinct and of intuition, but not from that of intellect. It is not that intellectual philosophy has not worked hard and thought profoundly, but that it is on the wrong track entirely. It is only by turning away from its very nature, intellectualism, that it can free itself from hopeless inconsistency. All its vaunted consistency is found within systems based on a fundamental axiomatic error. Life is too much alive to fit into intellectual forms.

The whole criticism which follows may be summed up in one statement. Life is dynamic; all the systems of all the schools, including Spencer and the modern evolutionists, are radically and hopelessly static.

Bergson here returns to his earliest works. Nowhere is the continuity of his thought more startling. But what was at first a criticism of determinism, mechanism, and the associationist psychology, has now grown to be a criticism of all accounts of reality, Greek, Renaissance or Modern, and not only a destructive criticism but a bold and positive contrary hypothesis.

All the schools have treated experience as if it could be pinned down for investigation. Some of them are very crude descriptions, in which becoming is simply ignored or even ridiculed as unthinkable. Others are subtle and even make a pretense of asserting becoming as the real soul of things. But none of them grasps pure duration as life, soul, mind and reality; and contrasts it with form, essence, quality and geometry, which are mere convenient modes of action.

The Greeks had deep respect for reasoning, and even deeper respect for language; yet language is wholly committed to the statical view of life. The *noun* implies that a thing is a fixed thing; the adjective implies that qualities are states, instead of cross-sections of change; even the verb is hardly better than an adjective. Yet all the Greek categories depend very directly upon this linguistic epistemology, so partial to intellect and so contrary to real experience. According to language, a child becomes a man; according to duration, or creative evolution, becoming, or the life-force, passes through experiences which may be ticketed for convenience as infant, child, adolescent, man and countless stages of subdivision.

Here as elsewhere Bergson admits the value of our human intellect, which shows so fully in our language, but he utterly denies that this human specialty is intended or adapted to give us a metaphysics of reality.

The race has put its whole faith in the intellectual process, and the gain has been enormous, but no one will assert that the result has been the solution of the vital problems.

The Intellect Acts Like a Cinematograph

The intellect represents life as a cinematograph represents objects in motion. When it works, it creates an illusion; but even this illusion would be impossible in the machine if there were no real life behind it to run the film, and so science at its best simulates reality, chiefly because it is always guided by genius and intuition.

When Zeno offered his famous puzzles, he really had hit upon the rift between life and science, between experience and words, between movements and trajectories; but he rejected the true and living, and chose the more profitable and practical, and all who followed took the same course. But they left an unconquered fortress in their rear, and it is precisely from that fortress that materialism and mechanism must now be attacked. A single movement is by hypothesis a movement between stops, and no matter how many intermediate stops there may be the hypothesis does not represent a single movement. All is obscure and contradictory when we try to build up with states what is really a living transition. Quality, form, design are the scaffolding of the intellect, but they have no real place in the house of life.

It is not only the metaphysics of Plato and Aristotle, but the whole science of Greece that we find perverted by intellectualism: the physics, the cosmology and even the theology of their world deal with *states* instead of *growth*. What wonder if a genuine philosophy, a creative evolution was postponed for two thousand years?

All Philosophers Have Overrated Intellect

Bergson thus completes his philosophy of creative evolution by a criticism of the whole history of philosophic thought. From his point of view, the great thinkers are Plato, Aristotle and Plotinus in the ancient world; Descartes, Spinoza, Leïbniz, and Kant in the modern period; and Spencer in the most recent times. There have been many reviews of philosophy. Aristotle and Augustine have given reactions on the systems of their predecessors. Hegel's *History of Philosophy* is the first great modern attempt at evaluating the progress of thought from an independent point of view, and nowadays the works of Erdmann, Ueberweg and Windelband are the most generally esteemed accounts of the evolution of philosophy. But Bergson's last fifty pages differ from all these in viewing the whole development from a unique plane. He sets out to show that while these systems are different from one another, and show interesting and wonderful progress, they are all tarred with the same stick of intellectualism, and that none of them freed itself from a slavish conception of reality. He realizes that Kant and Spencer are nearer to a philosophy of durationism than earlier thinkers, but just for this reason he attacks them more fiercely for having turned aside from the true direction of speculative thought. If Bergson is right, all these systems are enslaved by the triumphs of intellectual science, the whole history of philosophy must be rewritten and criticized from a new and different point of view, and the future of philosophy must be marked by the acceptance of intuitionism and durationism as central ideas. *The direction of philosophy must be as distinct from that of* *science as that of science has been from the direction of instinct. Philosophical thought must be regarded as practically useless, except insofar as it gives us a new and invigorating conception of our possibilities, and of the reality of the soul as the one real and important consideration.* Matter and mechanism and the charting of the dead past are the affair of science, and whatever these may contribute to the control of matter and mechanism in the future. But philosophy has discovered the soul and the creative and inventive powers of man, and has as deep and real a grasp of the future and of man and society in the making as science has of the useful and of the delineation of the dead and the past. *Faith and enterprise, sympathy and intuition, adventure and genius, are the true subjects of intuitional philosophy, and these are foreign and contrary to science and intellect.* Not the timeless, static ideas and concepts of the Greeks, not the pseudo-temporal precision of Galileo and Newton, but *the genuine durationism of the living experiencing soul must be the theme of future thinkers in this department.*

Reality is not the unfolding of the given, emanating from a fanciful, conceptual, do-nothing Absolute, but the living, creative, inventive genius of the vital force, which is obsessed by an infinite aspiration for the free and great, without any definite plan or settled intention. We must think like poets, not like scientists, if we would comprehend life.

Conclusion

A common criticism of Bergson is that he gives courage to sentimentalism and fancy as opposed to solid attainments. It is true that this danger may arise. But we must compare concrete cases on the same levels. It is not fair to compare Aristotle, Newton and Darwin with hysterical and sentimental types; but with Homer, Dante, Shakespeare and Goethe. Intellectualism produces a residuum of worthless and narrow pedants and fanatics, and truth may be perverted and obscured by sophistry and stupidity as well as by emotional aberrations.

We do not need less but more severe intellectual effort; and we need all the material advancement that the finest brains can give;

but these are means to an end, and not the end itself. Nothing has any value in itself but only that value which is conferred upon it by the needs of the human spirit in its fierce and splendid evolution.

The greatest intellects have perhaps always felt this and it is only necessary now that they should confess openly, or rather emphatically assert, that the things of the spirit can only be apprehended spiritually.

The reality of the soul, its freedom as the truest mark of our human rank, the subordination of matter to our advance, these are the deep and persistent truths, and we must concern ourselves rather with finding the errors which have made the opposite views possible than with serious doubts about fundamentals.

If science accepts this new philosophy in this spirit, never again shall we see the triumph of materialism and fatalism and pessimism over all that makes life really worth living.

This great anti-intellectualist, as some call him, is the greatest exponent of what a scholarly and logical mind of wonderful caliber can do in the service of a more perfect world. He differs from other dreamers precisely in his unexampled force of intellect. He does not persuade us to believe in the greatest things but by a prodigious effort of intellect challenges us to refute his subtle arguments. Since Kant there has been no such master of the deepest problems as we see revealed in these works.

Only the few will ever be able to comprehend these books as they were meant. But the influence of the few is supreme in forming the life and genius of peoples.

There is sure to be a great onslaught upon this system. It will be some time before the real significance of this beautiful and broad-minded system is generally realized. It is astonishing in the flood of reviews and criticisms to find hardly any who realize the underlying thought of Bergson. We read a great deal about his view of evolution and very little about his conception of time, real time, as equivalent to life, and soul, and will and creation, and as opposed to space and numbers and matter.

The first enthusiasm over the work has subsided; but outside the classes of the universities, the real enthusiasm has hardly begun.

It will take a generation before the lasting influence of this new star is felt as a general force in world-culture.

Bergson has already published a book in the field of aesthetics which has been received with great applause wherever philosophy is studied. Let us hope that this brilliant French professor will some time give us his views upon what from his point of view must be a closely contiguous field, that is to say, ethics. In the meantime it is interesting to speculate as to what he may believe about human conduct and the great social and political questions which are at present agitating the progress of the *élan vital.*

Note.—In a later number will appear a study of *Duration* which has been prepared in the Department of Philosophy; and which aims at gathering together all that Bergson has written on his central idea.

ALPHABETICAL INDEX TO VOLUME IX

THE UNIVERSITY OF COLORADO STUDIES

VOL. X

FRANCIS RAMALEY
EDITOR

PUBLISHED BY THE
UNIVERSITY OF COLORADO
BOULDER, COLO.

FEBRUARY, 1913, TO DECEMBER, 1913

CONTENTS OF VOLUME X

No. 4

VOLUME X NUMBER 1

THE UNIVERSITY OF COLORADO STUDIES

FRANCIS RAMALEY
EDITOR

PUBLISHED BY THE
UNIVERSITY OF COLORADO
BOULDER, COLO.

FEBRUARY, 1913

Price, 50 Cents

Four numbers of this publication are issued each college year, the first number in the volume generally appearing in January.

All exchanges should be addressed to the "Library of the University of Colorado, Boulder, Colo."

Educational institutions, libraries, societies and individuals desiring to be placed on the exchange list should make request to the "Secretary of the University of Colorado, Boulder, Colo.," to whom also should be addressed any correspondence in regard to purchase of single copies.

Binding note: Title-page, contents and alphabetical index of Vol. IX are printed with this number.

Volume X Number 1

THE UNIVERSITY OF COLORADO STUDIES

FRANCIS RAMALEY
EDITOR

PUBLISHED BY THE
UNIVERSITY OF COLORADO
BOULDER, COLO.

February, 1913

Price, 50 Cents

CONTENTS

OUR FACILE MASTERY OF ENGLISH[1]

By F. B. R. Hellems

I

After all, the use of English is largely a matter of words; and what are words that we should worship them? Is there not a fine freedom and fluency in our conversation, our newspapers, our popular magazines and even some of our university publications? Shall we not be the masters? Has not Carroll's Humpty Dumpty proved that we can if we will?

It will be remembered that our globular friend has just established the position that an unbirthday present is much better than a birthday present. You take one birthday from the three hundred and sixty-five days of the year, and that demonstrates there are three hundred and sixty-four days when you might get unbirthday presents.

"Certainly," said Alice.

"And only *one* for birthday presents, you know. There's glory for you!"

"I don't know what you mean by glory," Alice said.

Humpty Dumpty smiled contemptuously.

"Of course you don't—till I tell you. I meant, 'there's a nice knock-down argument for you!'"

"But 'glory' doesn't mean 'a nice knock-down argument,'" Alice objected.

"When I use a word," Humpty Dumpty said in a rather scornful tone, "it means just what I choose it to mean—neither more nor less."

"The question is," said Alice, "whether you *can* make words mean so many different things."

"The question is," said Humpty Dumpty, "which is to be master—that's all."

Alice was too much puzzled to say anything, so after a minute Humpty Dumpty began again. "They've a temper, some of them—particularly verbs, they're the proudest—adjectives you can do anything with, but not verbs—however, *I* can manage the whole lot of them! Impenetrability! That's what *I* say!"

"Would you tell me, please," said Alice, "what that means?"

[1] Reprinted from *The Forum*, Vol. XLVIII, pp. 321–32, September, 1912, by permission of the editor.

"Now you talk like a reasonable child," said Humpty Dumpty, looking very much pleased. "I meant by 'impenetrability' that we've had enough of that subject, and it would be just as well if you'd mention what you mean to do next as I suppose you don't mean to stop here all the rest of your life."

"That's a great deal to make one word mean," Alice said in a thoughtful tone.

"When I make a word do a lot of work like that," said Humpty Dumpty, "I always pay it extra."

"Oh!" said Alice. She was too much puzzled to make any other remark.

"Ah, you should see 'em come round me of a Saturday night," Humpty Dumpty went on, wagging his head gravely from side to side: "for to get their wages, you know."

(Alice didn't venture to ask what he paid them with; and so you see I can't tell *you.*)

"You seem very clever at explaining words, Sir," said Alice. "Would you kindly tell me the meaning of the poem *Jabberwocky?*"

"Let's hear it," said Humpty Dumpty. "I can explain all the poems that ever were invented—and a good many that haven't been invented just yet."

And I, at least, am ready to conclude that herein lies the central explanation of our familiar mastery of words. We make them mean what we want them to mean, quite regardless of their feelings, or family, or natural tendencies or past history. We have acclaimed the declaration made by the president of one of our better known universities that "accuracy is atrophy" and that "a consciousness of etymologies rather impedes than helps the full movement of the mind." With the adoption of these tenets we are free to emulate his announcement that "the good teacher is now a 'pedotrieb' or 'boy-driver,'" or to startle the classicists with original applications of "banausic." Having climbed the Hill of Presumption we pounce on innocent words, strain them and twist them, rack and rive and maul them. It is no wonder that the fledglings strive to purchase force or felicity by verbal innovations or misapplications, as well as by "extravagance of epithet or intemperance of phrase." My readers could quote countless examples; but I venture to instance one sudden coruscation, because the speaker held two degrees from really respectable universities, one of them near the Rockies, the other east of the Alleghanies. The young gentleman was describing the interest taken by one of his friends in a charming southern girl who was spending the summer in our little town, and his bewildering words were these: "So Frank went sifting over to the shack to see if he couldn't start a one-ring fussing fest. But, say, didn't the old dame hand him out some bunch of talk? What? It was Frankie for the tallest timber in the deep, deep woods." For a moment I was staggered by this example of what Walt Whitman calls "an attempt of common humanity to escape from bald literalism and express itself illimitably"; but I subsequently inferred that the mother of the young lady had discouraged a certain tendency to unconventionality manifested by Frank. However, the foregoing is hardly more successful in "snatching a grace beyond the reach of art" than this sentence from the academic authority mentioned above: "If not a polyphrastic philosophy seeking to dignify the occupation of the workshop by a pretentious Volapük of reasons and abstract theories, we have here the pregnant suggestion of a psychological quarry of motives and spirit opened and ready to be worked."

Between these two poles might be found every variety of the abuse of words. We have a veritable language-distorting, phrase-tormenting mania, tumbling out alleged thoughts in a weird jumble. But why should I adduce further instances from the lips of other speakers or the pens of other writers? Truly, "Their words are a very fantastic banquet, just so many strange dishes"; and this capricious fare is rapidly becoming the standard diet.

Occasionally a dull and dreary pedant may put in a plea for a reasonable treatment of words, and even quote Bacon's pertinent dictum: "It were good that men in their innovations would follow the example of time itself, which indeed innovateth greatly, but quietly and by degrees scarce to be perceived." But the popular advocates scoff at him, and plausibly retort that by adhering too closely to the traditions of pure English one makes the language stereotyped, thereby preparing it for fossilization. If they read Bacon, they would strengthen their plea with another sonorous sentence: "A froward retention of custom is as turbulent a thing as an innovation; and they that reverence too much old times are but a scorn to the new." Then in their zeal to save the language from even the remotest danger of fossilization they force it fantastically into all sorts of abnormal growths such as we have instanced above; and, as Dr. Johnson might have said, "the measure of their success is the extent of their departure from rectitude."

Now, this doubtless represents a successful twentieth-century method of encouraging life and elasticity in our great mother-tongue; but for antiquated people living in an "old and iterative world" the policy must seem dangerously drastic. A few survivors still believe that rational adaptability is one of the supreme merits of our lovable language; that with its utilization of Saxon, Greek and Latin elements it is not less capable of prompt and unlimited expansion than of leisurely and beautiful growth; and that its finest development can come only by treating it with such noble homage and devotion as it has received from the leaders of English literature in all periods. Great writers have never hesitated to give old words a new application or enrich them with enlarged connotation; nor have they withheld their pens from coining fresh words that were needed to make current a new conception, a deep thought, a brilliant witticism or a gleam of fanciful humor. But through all their modifying and innovating they have proceeded with a fine august submission to fundamental fitness.

And words are really wonderful things. We begin by such humble steps as learning to spell them, and pronounce them, and by getting their primary meanings. Then as the years roll round we find how great minds have empowered them to disengage spirit from matter and have dowered even a single word with such a wealth of import that it brings the light of joy to our eyes or moves our heart to bitter tears, that it carries us to the dreary house of death or unspheres the harmony of heaven. And I suppose that most of us must stop at this point; but I do not question that the great artist in words, like the great master in music, may go far beyond us in his love and appreciation. Extreme forms of this belief might be found among the French symbolists; but we need seek no further than one of their admirers, Lafcadio Hearn, whom we may almost claim as an

American, although on final examination he proves to be a cosmopolitan. In one of his Japanese letters that genuine artist pays the following tribute to words, a tribute which I believe to be absolutely sincere on his part, even if it does seem extravagant to us:

> The readers do not feel as you do about words. They can't be supposed to know that you think the letter *A* is blushing crimson, and the letter *E* pale sky-blue. They can't be supposed to know that you think *KH* wears a beard and a turban; and initial *X* is a mature Greek with wrinkles;—or that "no" has an innocent, lovable, and childlike aspect.

To these objections Hearn makes rejoinder:

> All this is true from the critic's standpoint. But from ours, the standpoint of:
>
> The dreamer of dreams
> To whom what is and what seems
> Is often one and the same—
>
> To us the idea is thus:
>
> Because people cannot see the color of words, the tints of words, the secret ghostly motion of words:
>
> Because they cannot hear the whispering of words, the rustling of the procession of letters, the dream-flutes and the dream-drums which are thinly and weirdly played by words:
>
> Because they cannot perceive the pouting of words, the frowning and fuming of words, the weeping, the raging and racketing and rioting of words:
>
> Because they are insensible to the phosphorescing of words, the fragrance of words, the noisomeness of words, the tenderness or hardness, the dryness or juiciness of words—the interchange of values in the gold, the silver, the brass and the copper of words:
>
> Is that any reason why we should not try to make them hear, to make them see, to make them feel? Surely one who has never heard Wagner, cannot appreciate Wagner without study!

And in conclusion:

> I write for beloved friends who can see color in words, can smell the perfume of syllables in blossom, can be shocked with the fine elfish electricity of words. And in the eternal order of things, words will eventually have their rights recognized by the people.

Now I for one, with my dull ear and dim eye, cannot realize all of these superb possibilities, but I do accept his closing thought that "in the eternal order of things, words will eventually have their rights recognized by the people"; even if there will always be a few Humpty Dumpties on the wall.

And in assigning their rights we must not forget that they still raise the individual from mere animal existence to human life, even as they have led the race in its weary clambering up the steeps of the ages. With reference to their part in personal development we could do no better than quote the felicitous judgment rendered by Edmund Gosse in the most intimate of his writings, *Father and Son:*

When I read Shakespeare and came upon the passage in which Prospero tells Caliban that he had no thoughts till his master taught him words, I remember starting with amazement at the poet's penetration, for such a Caliban had I been:

I pitied thee,
Took pains to make thee speak, taught thee each hour,
One thing or other: when thou didst not, savage,
Know thine own meaning, but wouldst gabble, like
A thing most brutish, I endow'd thy purposes
With words that made them known.

For my Prospero I sought vaguely in such books as I had access to, and I was conscious that as the inevitable word seized hold of me, with it out of the darkness into strong light came the image and the idea.

Passing from the unit to the race we find an almost miraculous bond between speech and thought, as every thinker has recognized. On this point the cold evolutionary naturalist is at one with the dreaming mystic or glowing symbolist. Haeckel, for instance, who may be taken as a perfect representative of the contemporary investigator interested in ideas rather than in words, pays reasoned and unemotional tribute to articulate conceptual speech and insists that "the higher grade of development of ideas, of intellect and reason, which raises man so much above the brute, is intimately connected with the rise of language." But his conclusion is only a scientific restatement of the feeling in the heart of the theologizing eastern seer of olden days who put forth the following phantasy:

I dreamed that God became a myriad words, infusing into each something of His own essence, that men should no longer be as the beasts of the field, but should rise to a knowledge of the divine. Thereby it was brought to pass that the race of man became even as gods, having dominion over all things upon the earth, yea, even over the powers of life and death.

In one striking sense, the word has been God.

II

But whatever we believe about the rights, services and possibilities of words, we may readily agree with the delightful Frenchman as to the ease of composition: "After you have your words, all you have to do, in order to write effective prose, is to arrange them one beside another." What could be simpler, for instance, than the following description of the life and lot of the citizens of Burgdale from the pen of William Morris?

> Thus then lived this folk, in much plenty and ease of life, though not delicately nor desiring things out of measure. They wrought with their hands and wearied themselves; and they rested from their toil and feasted and were merry: tomorrow was not a burden to them, nor yesterday a thing which they would fain forget: life shamed them not, nor did death make them afraid.

Or what could be easier to write than this assertion about America?

> For a century past she has drawn to herself, by an irresistible attraction, the boldest, the most masterful, the most practically intelligent of Europe; just as, by the same law, she has repelled the sensitive, the contemplative and the devout. Unconsciously, by the mere fact of her existence, she has sifted the nations; the children of the Spirit have slipped through the iron net of her destinies, but the children of the World she has gathered into her granaries. She has thus become, in a sense peculiar and unique, the type and exemplar of the Western world. Over her unencumbered plains the Genius of Industry ranges unchallenged, naked, unashamed.

Now if William Morris, or Mr. Dickinson or any other of the greater prose stylists can make the heart beat by such an easy and unstudied passage, and if their long years of practice generally result in some such facile simplicity, why should the rest of us not adopt, or rather indulge, a natural spontaneous style from the beginning? The conclusion is inescapable.

On the other hand, many literary men, as well as eminent scientists and other scrupulous thinkers, have really felt that there was difficulty in writing English, but that the effort was worth while. Huxley, for instance, made the following admission some twenty years ago, when he was the busiest man in England: "The fact is that I have a great love and respect for my native tongue, and take great pains to use it properly. Sometimes I write essays half-a-dozen times before

I can get them into proper shape, and I believe I become more fastidious as I grow older." And it often turns out that the writer whose pen seems to move most easily is the veriest slave of his skill. The stock example for many years to come will be Stevenson. We all remember the confident and youthful critic who once said that Stevenson obviously wrote with perfect ease, at a high rate of speed, in a style that was essentially innate. But the comment about his unstudied innate style becomes deliciously humorous, when we listen to his own explicit account of the long and tedious process whereby he acquired his power. No writer has more freely and forcefully avowed his willingness to tread in nobler footprints than his own. "This, like it or not, is the way to learn to write." And his letters tell us how slowly and painfully he worked toward the final form of his pages, even at that stage of maturity when he could be said to have won his greatest mastery over words and phrases. Similarly, we have heard Emerson quoted as an example of a writer who framed his sentences without effort; but the authentic records of his career show he would work and hunt, not merely days but weeks, to find the felicitous turn of a sentence. And many enthusiasts assert that something of the same sort is true of every great writer in every language. They even include Lincoln and Franklin. If ever there was a vigorous, incisive, conclusive style that seemed to spring spontaneously from an untutored pen, that style certainly belongs to our great statesman, whom the English poet describes so happily as "he of tragic doom, the later born, he of the short plain word that thrilled the world and set the bondman free." Yet there seems to be evidence to prove that even Lincoln was as patient and wonderful in learning to express himself as he was in everything else; and when our young lawyers and budding statesmen are willing to take several months out of their lives and work at Euclid, not for his geometry, but primarily to learn the effective presentation of an argument from premises to conclusion, we shall no longer have to complain of so many speeches that are utterly jejune on the one hand or bombastic on the other. Even more pertinent is the example offered by Benjamin Franklin, another American who was great in action as well as effective in presentation; and he tells us how he fashioned his style on *The Spectator*, reading the papers, making summaries of them, rewriting them and even turning them into verse to be reconverted into prose. But the question is whether the experience of such men as Huxley, Stevenson, Lincoln and Franklin is really pertinent in this precocious period.

Furthermore, it is undeniable that after traversing the long and laborious path advocated by the antiquarians a man may still have no real message for his fellows. No "imprisoned splendor" can escape to the world without, unless the splendor has some way or other come to exist within. And so often the great masters have attained to their treasure of wisdom and sympathy by treading some *via dolorosa*, that we think of their sufferings as imparting eloquence directly to their lips rather than developing the greatness of soul and kindness of heart which ultimately find expression for our strengthening or solace. Accordingly, the progressive members of the younger generation, realizing the tremendous formative power of suffering and other emotions, have not failed to throw themselves in the way of all possible experiences. But the easy sacrifice does not always seem to produce the superhuman result of which the devotee had dreamed, until one begins to question how far it is possible to make merit by immolation on any other altar than that of human duty and daily service. The experience-hunter and the emotion-monger pay a terrible price in the health of the soul, and with it they purchase the shadow of a dream.

Even before Horace penned his graceful precepts or Plato set forth his profound doctrines, it was true that a man must have something to say if he was to be heard. But withal, when we insist that a writer's message is the great factor, we do not escape the fact that he is judged largely by his success in delivering it; and it often happens that the form of the message is a part of the message.

III

Our facile mastery of English on the side of appreciation as distinguished from expression must be dismissed with a few words. It will be recalled that Humpty Dumpty not only made words mean whatever he wanted them to mean, he also undertook to explain "all the poems that ever were invented—and a great many that hadn't been invented just yet." And the average opponent of hard and close work in literature is just as confident as Humpty Dumpty.

This is no place for a panegyric on that inexhaustible mirror of life held up to us in English literature. But we may record our thanks that the immortals have been infinitely generous in bestowing our heritage of prose and poetry. From Chaucer to Swinburne, from "Sir John Mandeville" to Cardinal Newman, not to speak of the living, we have a line of glorious masters by whose help our magic mirror enables us to see what is noblest and best and most enduring, or to drift away from our daily dulness on a sea of gladdening recreation. And it is perfectly clear that we could all understand these authors with absolute ease, if we cared to leaf them over. We only read the little masters, the toying rhymesters, the salacious novelists—in short, the popular literature of the day, because we wish to keep *au courant*. We could just as readily appreciate Shakespeare with his "boundless cloudless view," if we would, or enjoy Shelley's "flush of rose on peaks divine"; but we prefer what we prefer. Let no pedant suggest that this preference has anything to do with a lack of wide and serious reading, of adequate training in the Bible or of familiarity with the commonplaces of classical mythology and literature. Yet a gentle disputant might imagine that the appreciation of Milton's "calm translunar music" would be hampered if one had to consult a concordance to allay a haunting suspicion that Beelzebub was one of the apostles. And I fancy the reader of almost any standard author may have puzzled moments if he thinks that the Amazons were a Gallic tribe conquered by Julius Caesar, that Penelope was a desert island in the North Sea or that Orpheus was a New York gentleman of Hebrew extraction who founded the Orpheum circuit.

However, I may not follow my irresponsible pen into further vagaries. It is apparent that any critic would be utterly unfair if he should even hint that there is neither a deep-seated enthusiasm for great writers on the part of most people, nor a genuine capacity for enjoying their works; while Ruskin's famous conclusion that the kings of thought will have us dig deep and painfully for their gold is only another example of his antiquarian sentimentality. But withal, I do sometimes fear that the very easiness and assurance of our mastery may turn out to be another phase of the lawlessness, the slackness, the laziness of mind and the stultifying self-complacence that arise so easily when a nation is prosperous without being disciplined, and literate without being educated.

IV

It is often hard to distinguish between a deplorable *pseudodoxia epidemica* and a genuine aesthetic impulse begotten by the changing manifestations of the Spirit of the World; and eventually there may be a complete triumph for the countless good Americans who unconsciously or deliberately disdain orderliness of language and belittle the sacred heights of Parnassus. But, whatever be the outcome, it is well to have a considerable remnant that shall contend for the old-time religion.

The ancient Greeks made purity of language an absolute *sine qua non* for admission to the sacred mysteries that taught the way of immortal life. Into the final significance of the requirement I may not examine; but its rigorous application to our present thought would clearly exclude from heaven any American that did not speak good English. Now it is an invidious task to lay down terms for passing the blissful gates. Some of us will have a pretty hard scurry at the best. But it would seem reasonable to suggest that the guardian should insist on a simple examination of all applicants who profess to be educated, and might turn back all those who cannot spell correctly, write and speak grammatically and enjoy a dainty bit of prose or poetry. And all teachers who have labored in love to spread the gospel shall sit among the blessed; whereas in the great cold interspaces of the universe shall be heard the despairing wail of all those who have advocated laxity and superficiality and learned the truth only when it was too late.

THE EARLY DAYS OF THE UNIVERSITY OF COLORADO

By James F. Willard

The University of Colorado, situated at Boulder, owes its origin to an act of the first territorial legislature of Colorado. On October 26, 1861, Mr. Wilhite introduced into the legislature a bill for an act to establish the University of Colorado in the city of Denver.[1] The bill was referred to the committee of the whole which struck out the words "city of Denver" and the first list of incorporators.[2] On October 31 the measure was again taken up and a vote taken upon the location of the university.[3] It took but three roll-calls to settle this question, Boulder finally receiving eight votes and becoming the site chosen.[4] Immediately nominations were made for the members of the board of trustees. This task did not receive the serious consideration that it deserved from the members of the House, some even taking it in a jesting mood. Jerome B. Chaffee, for example, nominated General Lewis Cass and Jefferson Davis. When the House proceeded to vote on the nominations it put all on the list, facetious and otherwise,[5] and the bill then passed by a vote of 7 to 6.[6] The Council took up the proposed act on November 1 and referred it to the Committee on Education.[7] It was amended on November 6 by striking out a number of the names of the incorporators and by adding the names of T. J. Jones and M. Goss.[8] The bill as amended passed the Council on the same afternoon;[9] these amendments were agreed to by

[1] *House Journal*, 1st session, p. 254. This was House Bill No. 150. The story told in the *History of Clear Creek and Boulder Valleys* (Baskin & Co.), p. 407, of the introduction of the bill by Charles F. Holly of Gold Hill seems to have no basis in fact.

[2] *Ibid.*, p. 281. [3] *Ibid.*, p. 298.

[4] The following cities were voted for on the first roll-call: Georgia Gulch, Silver City, Golden City, Denver, Mill City, Bradford, Platte City, McNulty, Pueblo, Conejos, Boulder.

[5] *House Journal*, 1st session, p. 303. [6] *Ibid.*, p. 304.

[7] *Council Journal*, 1st session, pp. 144, 151.

[8] *Ibid.*, p. 176. The names struck out were Lewis Cass, D. M. Vance, Jeff. Davis, F. J. Stanton, M. Riddlebarger, Wm. N. Byers, O. A. Whittemore, Thomas Gibson, C. C. Carpenter, Mr. Partridge, John Howard.

[9] *Ibid.*, p. 182.

the House on the same date,[1] and became a law through the signature of Governor Gilpin on November 7, 1861.[2]

The "Act to establish the University of Colorado,"[3] states that it was "designated to promote and encourage the diffusion of knowledge, in all the branches of learning, including the scientific, literary, theological, legal and medical departments of instruction." For this purpose a Seminary Fund was created, to "consist of all moneys arising from the sale of all lands which may be donated by the Congress of the United States for seminary purposes, and all moneys which may be donated for that purpose from any and all sources." This fund was to be under the control of a commission composed of the governor, the secretary of the territory and the district attorney. The government of the university was to be in the hands of a board of trustees,[4] which should have the power to hold property, elect officers, fill vacancies, locate the university, appoint its officers and prescribe the course of study. The university was located at Boulder City, as the present Boulder was then called.

For years this act of the legislature remained a dead letter. The first board of trustees never met, no site for a university was selected and, except in name, the University of Colorado did not exist. These were the troubled days of the Territory of Colorado, the days of the waning of the first mining enthusiasm and of the distress caused by the Civil War. The university project suffered in the midst of the general depression. On the eve of the meeting of the eighth session of the territorial legislature an attempt was made to assemble the people of Boulder for the purpose of taking measures to secure a meeting of the incorporators of the university.[5] This meeting was held on December 26, 1869, but was very poorly attended.[6] A committee was appointed to ascertain the necessary steps to be taken. Of this committee nothing further is heard.

[1] *House Journal*, 1st session, p. 373.

[2] *Ibid.*, p. 387.

[3] *General Laws*, 1st session, pp. 144–46.

[4] The names of the incorporators follow: D. P. Wallingford, J. Feld, A. O. Patterson, A. A. Bradford, Wm. Gilpin, Edwin Scudder, C. Dominguez, Byron M. Sanford, William Hamind, J. B. Chaffee, Chief Justice B. F. Hall, Amos Steck, Jesus M. Barela, G. F. Crocker, J. S. Jones, M. Goss.

[5] *Boulder News*, December 21, 1869.

[6] *Ibid.*, December 28, 1869.

Boulder County was represented in the territorial House during its eighth session by J. H. Wells, of Burlington; Boulder and Gilpin counties by Thomas J. Graham, of Boulder. Burlington was at that time a thriving young city of the plains, later absorbed by Longmont near which it was located. On January 7, 1870, Thomas J. Graham introduced into the House a bill for an act to amend the act of November 7, 1861.[1] The measure was referred to the committee on incorporations of which J. H. Wells was chairman.[2] The committee in its report recommended that the name Boulder City should be struck out and that of Burlington inserted as the site of the university.[3] A minority report of the committee, signed by T. J. Campbell and T. J. Graham, protested against this change of location.[4] Against it they argued the better location of Boulder at the base of the mountains, its superior advantages from a material point of view with special reference to its stone quarries and timber and, they add, "that the citizens of Boulder and vicinity have agreed to contribute the sum of ten thousand dollars in money and in land in aid of said university."[5] The citizens of both Boulder and Burlington sent delegations to Denver in an endeavor to have the university located in their respective towns and Boulder won. On January 18 Mr. Graham's bill, unamended, passed the House by a vote of 19 to 6, Mr. Wells voting in the negative.[6] It went to the Council and received the unanimous vote of that body.[7] It was approved by the governor on January 25, 1870.[8] This, the second university act, reconstructed the board of trustees, adding the names of John H. Wells, G. Gerkley, Thomas J. Graham, Amos Widner and James M. Smith, of Larimer County. Messrs. Berkley, Graham and Widner were residents of Boulder.

Under the impetus of the new act the university question at once showed signs of life. On January 29, 1870, the board of trustees held

[1] *House Journal*, 8th session, p. 18. This was House Bill No. 2. According to Mr. Eugene Wilder, of Boulder, Mr. Graham had been elected because of his intense interest in the university proposition.

[2] *Ibid.*, p. 27. [3] *Ibid.*, p. 28. [4] *Ibid.*, pp. 51–52.

[5] I have not been able to trace these subscriptions. The *Boulder News* on January 18, 1870, refers to subscriptions "to the amount of thousands of dollars."

[6] *House Journal*, 8th session, p. 55.

[7] *Council Journal*, 8th session, p. 130.

[8] For the act, see *General Laws*, 8th session, pp. 110–11.

its first meeting at the Court House in Boulder.[1] William Gilpin was selected as the temporary president of the board and T. J. Graham its temporary secretary.[2] Permanent officials were immediately elected: Granville Berkley, president, Thomas J. Graham, secretary, and Edwin Scudder, treasurer. The question of a site for the university was discussed but a settlement was postponed until a meeting to be held in April. On April 4 the second meeting was held, and the university located on land donated by Messrs. Berkley and Widner, both members of the board.[3] This land lay to the east of the city of Boulder and consisted of 15 acres donated by Mr. Berkley and 5 acres donated by Mr. Widner.[4] A committee was appointed to see to the surveying of the land, to obtain the conveyance of the gifts of land and to "contract for and procure a good permanent fence around said Ground of good posts and poles suitable to keep out stock of all kinds permitted to run at large and to make such other and further improvements thereon as they may think advisable." During the months of April and May, 1870, under the direction of the committee, work was begun on the improvement of the site.[5] It was surveyed, ploughed and harrowed so as to prepare it for grass and trees; contracts were let for planting trees and for fencing the plot; and then the work came to an end. In all $178.50 was spent upon the improvements. The trees were not planted, however, and the fence was not put up. Once again the movement to establish a university in Boulder died down.

For almost two years little is heard of the university. There was an act to establish a university, there was a board of trustees, there was a site agreed upon and slightly improved; but the board of trustees did not meet during the period April 4, 1870—January, 1872, the deeds to the land were not transferred and there was no money

[1] The records of the meetings of the trustees are found in its minute book, hereafter to be referred to under that title. This book is, at present, in the possession of G. A. Andrews of Boulder, with whom it was left by Amos Widner.

[2] *Minute Book*, pp. 3–5. Cf. *Boulder News*, February 1, 1870, March 29, 1870. There were present Messrs. Gilpin, Scudder, Sanford, Graham, J. M. Smith, Berkley and Widner.

[3] *Minute Book*, pp. 6–7. Cf. *Boulder News*, April 5 and April 13, 1870.

[4] The technical description of the site is, "on the south half of the northeast quarter of section thirty in township no. one north, range seventy west."

[5] *Minute Book*, pp. 14–21.

to erect a single building. The latter seems to have been the chief obstacle in the way of further progress, so the movement halted until the next meeting of the legislature.[1] Mr. Graham, as ever indefatigable, got the subscribers to the university fund to meet at the Court House on May 2, 1871, so that more work could be done.[2] This plan had no result. Evidently, however, someone, who it was is not known, was soliciting subscriptions, for on October 27, 1871, another meeting of the subscribers was held and it was estimated that about $3,000 was then offered for the university fund.[3] The *Boulder News* protested against the delay again and again,[4] and then, changing, became optimistic in October and hoped that the university would be opened during the coming January.

The ninth session of the territorial legislature opened January 1, 1872. As a preparation for this the board of trustees held, on January 1, its first meeting since April 4, 1870.[5] The board promptly reconstructed its membership. Some of the early members of the board had died, others had left the territory, while still others were not known to the members of the board; consequently their names were dropped and others put in their places.[6] The secretary was requested to report to the board on the lands offered to the university. He reported eight offers totaling 159 acres. He also reported donations in money or work under the date of January, 1870, to the amount of $2,160 and miscellaneous donations since then, the largest being that of Ira Austin of $4,000 or 40 acres of land as he might elect. After these reports were made it was voted to receive bids of land for a relocation of the university. The old site had proved to be unsuitable and, what is more, the donors had not deeded the land to the trustees. On

[1] Compare A. Widner's brief sketch of the history of the University in the *Governor's Message and Departmental Reports* submitted to the 1st General Assembly (1876), "Report Univ. of Colorado."

[2] *Boulder News*, April 29, 1871, May 6, 1871. [3] *Ibid.*, October 27, 1871.

[4] *Ibid.*, August 12, August 19, November 3, November 10, November 17, 1871.

[5] *Minute Book*, pp. 8–37. Comment in *Boulder News*, January 5, January 12, 1872. There were present Messrs. Berkley, Gilpin, Widner, Sanford, Scudder and Graham. The meeting lasted from January 1 to January 8, inclusive.

[6] George F. Crocker and James M. Smith were dead; B. F. Hall and D. P. Wallingford had removed from Colorado; J. Feld, William Hammond and M. Goss "are not known" as citizens of the territory. The new members were Nathan Thompson, George C. Corning, Jacob F. L. Schirmer, N. K. Yont, Ira Austin, Henry C. Thatcher, John F. Topping.

January 2, 1872, three sites were offered: one to the west of the city made by F. A. Squires, James B. Tourtellot, Marlah Tourtellot, George H. Tourtellot, Jonas Anderson, Wm. Brierly; a second to the south made by G. A. Andrews, M. G. Smith and A. Arnett; a third to the east, the old site, made by G. Berkley and Amos Widner. These sites were visited and after several ballots the Andrews-Arnett-Smith tract was selected on January 6, 1872.[1] It consisted of 51.3 acres situated on the heights to the south of the city. This is the present site of the University of Colorado. The warranty deeds to this land were made on January 8 and recorded on January 9, 1872.[2] An additional donation was made by A. Arnett, on January 10, of 80 acres to the north of the city.[3]

The board of trustees, having possession of what was then an extensive site, proceeded to move in two directions to gain the necessary funds for the erection of buildings. On the one hand an attempt was made to gain subscriptions from the townspeople, on the other to gain an appropriation from the legislature which was about to meet. A committee of seven, two trustees and five townsmen, was appointed on January 5 to solicit donations "to aid in the building of the university and improving the grounds." The members of this committee reported on January 8 that $1,135 had been subscribed in labor or cash and that ten shares of the stock of the Anderson Ditch Company had been transferred to the university by M. G. Smith and Jonas Anderson. Another meeting of the board was held on January 22. The soliciting committee reported additional donations of $135 in money or labor. Another committee was appointed to "invite volunteers to a Bee to remove the surface stones from the university grounds." Messrs. Berkley and Widner were also appointed to draft a memorial to the legislature asking for a $15,000 appropriation. The task of gaining this appropriation was taken up by J. P. Maxwell, the member of the House from Boulder. On January 25, 1872, he

[1] *Minute Book*, p. 34.

[2] *Deed Record* (Boulder County), Book O; Andrews grant, pp. 494–95, Arnett grant, pp. 496–97, Smith grant, pp. 497–98. Andrews gave 21.98 acres, Arnett, 3.83, Smith, 25.49 acres.

[3] *Ibid.*, pp. 449–500. According to the testimony of Mr. Frank Tyler, of Boulder, this land was later transferred to his father, C. M. Tyler, in exchange for four horses.

introduced a bill for an act appropriating $15,000 to the university.[1] This measure was defeated on February 6.[2] The defeat is said to have been due to the fact that the Republican members of the legislature had agreed in caucus to vote against any but the most necessary appropriations.[3] It may also have been due to the opposition of the mining districts.[4]

The failure of the appropriation bill and the seeming impossibility of raising the necessary funds in Boulder at that time put an end for another two years to the development of the university. It was seen that without legislative assistance little real progress could be made. As a result, from January 22, 1872, until January 5, 1874, though several meetings were held, the board of trustees transacted no business.[5] The university site remaining rather bare, the *Boulder News* proposed on July 4, 1873, that the townspeople should beautify the grounds "as a token of their appreciation of the advantage and honor conferred by the location of the State University at Boulder."[6] So far as is known nothing came of this proposal.

The board of trustees resumed its activity on January 6, 1874. The business in hand was to prepare for the tenth session of the territorial legislature, which had then convened. A committee was appointed to prepare a petition to the legislature asking for a $30,000 appropriation. Edwin Scudder having died, Ephraim Pound was elected to fill the vacancy and George C. Corning was elected treasurer in his place.[7] The legislative petition was approved of by the board on January 13.[8] J. P. Maxwell and D. H. Nichols had been elected to the territorial House in September, 1873,[9] and upon them devolved the duty of gaining the appropriation from the legislature. They were successful in this undertaking, On February 6, 1874, the governor signed an act appropriating $15,000 to the university, this

[1] *House Journal*, 9th session, 104. Cf. pp. 92, 108, 172.

[2] *Ibid.*, p. 177.

[3] *Boulder News*, September 5, 1873.

[4] This is Mr. Maxwell's explanation of the rejection of his bill.

[5] Meetings with or without a quorum were held on March 4 and April 1, 1872, July 7, 1873.

[6] *Boulder News*, July 4, 1873. Cf. *ibid.*, March 7, 1873.

[7] *Minute Book*, pp. 43–44. Cf. *Boulder News*, January 16, 1874.

[8] *Ibid.*, p. 46.

[9] *Boulder News*, September 19, 1873.

sum to be paid in two instalments of \$10,000 and \$5,000 when the trustees should raise "by subscription, donation or otherwise" like amounts.[1] In return for this grant the act provided (section 5): "Each County shall be entitled to send one pupil under the age of sixteen years to said University, tuition free, said pupil to be selected by competitive examination before the County Superintendent of such County, and given to the highest scholarship." The editor of the *Boulder News* grew very indignant over this conditional plan of appropriation,[2] but the board of trustees accepted the inevitable and started in at once to try to raise the necessary \$15,000.

Within sight at last of its cherished goal, the university board began a new movement to solicit subscriptions. Its first plan was barren of results. On February 13 the ministers of the Presbyterian and Protestant Episcopal churches, J. E. Anderson and Henry M. Baum, were authorized to solicit donations in the East.[3] Mr. Baum went to the eastern states during the summer to raise money for his church,[4] and, probably, to seek donations for the university, but no results appear. After the February meeting the board was unable to get a quorum until July 7.[5] The importance of the problem before it led the board finally to take extreme measures. At the meeting held on July 7 a committee submitted rules and by-laws for the government of the board. These were adopted. Under the rules a new election was necessary and Nathan Thompson, the minister of the Congregational Church, was elected president of the board, Amos Widner, its secretary, and George C. Corning continued as its treasurer.[6] A committee was appointed to devise ways and means of raising the \$15,000 required by the legislature. This committee reported at a meeting held on July 18, through George C. Corning, its chairman. It suggested: "1st, That subscription papers be circulated through the county; 2d, That donations be solicited from the

[1] *General Laws*, 10th session, pp. 307–8. Cf. *Boulder News*, February 6, 1874, February 13, 1874.

[2] *Boulder News*, February 20, 1874.

[3] *Minute Book*, pp. 46.

[4] *Boulder News*, June 12, 1874.

[5] *Minute Book*, pp. 48–49. No quorum present April 17, May 1, May 19, May 28. Cf. comment in *Boulder News*, March 20, 1874.

[6] *Minute Book*, pp. 50–51; *Governor's Message and Departmental Reports* (1876), "Univ. of Colorado Report," p. 4.

People; 3d, That a loan be negotiated." This report having been adopted Mr. Thompson was selected to solicit donations and Mr. Corning appointed "to visit Denver to see if arrangements could not be made to secure a loan of money for four or six months."[1]

The plan of raising the $15,000 required by the legislature by means of a loan was the cause of considerable criticism. Mr. Corning reported to the board on July 28 that he had succeeded in the negotiation of a loan of the above amount for four months at one and a half per cent a month.[2] This loan was authorized on the first of August.[3] The cash was in the treasurer's hands before August 4.[4] Mr. Corning's bond for $30,000 having been submitted to the board on July 31, the following day he, with Messrs. Thompson and Widner, journeyed to Denver to get an order from the territorial auditor on the treasurer for the legislative appropriation.[5] When they arrived there it was found that Mr. Corning had left his bond in Boulder. On August 5 they made a second trip to Denver and presented to L. C. Charles, the auditor, an affidavit signed by Nathan Thompson that the sum of $15,000 had been raised and was in the treasurer's hands "in cash, subscribed and actually paid in for the uses and purposes of the said university." Mr. Charles refused to give the order requested, stating the grounds of his refusal in a letter to Mr. Corning dated August 8. This letter was presented to the board on the tenth.[6] His objections were that he had no evidence that the board was properly organized or that the money had been raised in compliance with the act of 1874. Judge Leonard was authorized to answer these objections and did so without, however, moving the auditor.[7] The Denver newspapers then got hold of the story and promptly charged the board with attempted fraud.[8] The board, on October 13, finally resolved upon drastic measures. A demand was to be made for a

[1] *Minute Book*, p. 52. [2] *Ibid.*, p. 54. [3] *Ibid.*, pp. 55–56.

[4] *Ibid.*, p. 56. At the meeting on August 4 Judge Ira E. Leonard was appointed attorney to the board and Mr. Graham was instructed to submit a design for a seal to be used by the board. The seal was adopted August 22, 1874.—*Minute Book*, p. 59.

[5] *Boulder News*, October 2, 1874.

[6] *Minute Book*, pp. 57–58. [7] *Ibid.*, pp. 60–62.

[8] Quotations are given in the *Boulder News*, September 18 and October 2, 1874, from the *News* and *Times*.

warrant upon the treasury, "and on the event of the said auditor's refusal to sign and deliver said warrant the said attorney [Judge Leonard] is authorized to take legal steps to compel the said auditor to execute the same."[1] Mr. Charles persisted in his refusal and the board was compelled to take up more seriously the problem of raising the $15,000 by subscription.

The campaign to raise funds for the university was taken up vigorously in November, 1874. At the meeting of the board on November 13 a committee was appointed "to draft and report at the next meeting the necessary forms of notes or obligations to be circulated with a view of soliciting further aid to the university fund."[2] The report of this committee was accepted on the 20th and the president was instructed to have 500 copies of these papers printed for circulation. On the 27th George C. Corning was appointed to head a committee to procure subscriptions. This committee conducted a vigorous campaign during the winter of 1874 and the early spring of 1875.[3] They were evidently successful for, on May 1, 1875, a committee was appointed "to negotiate for funds upon the basis of the notes and obligations which had been procured by way of Donations and Subscriptions for the Purpose of Building the University."[4] The cash was raised, according to a story told at that time, in the following manner: "George C. Corning, of the Boulder Bank, a wide-awake citizen, and withal a gentleman of means, took these notes at their face, advancing money on them."[5] On May 15 the subscription committee reported "that it had succeeded in raising fifteen thousand

[1] *Minute Book*, p. 63. At the same meeting the places of A. K. Yont and A. A. Bradford were declared vacant, and C. M. Tyler and I. E. Leonard elected to membership. A letter was received from George C. Corning resigning as treasurer. It was not accepted. He had been appointed territorial treasurer.—*Boulder News*, September 11, 1874. On Judge Leonard's election to the board, see *Boulder News*, October 16, 1874.

[2] *Minute Book*, p. 64.

[3] *Minute Book*, pp. 65–67. Meetings were held December 5, 1874, January 5, April 5, 1875. On January 5 the seat of C. Dominguez was declared vacant and Hugh C. McCammon elected to fill his place. On April 5 Captain Ira Austin resigned. His place was filled on May 29 by the election of William Martin of Caribou.

[4] *Minute Book*, p. 69. Cf. the resolution of April 12: "*Resolved*, That the President is hereby authorised to call a public meeting at his discression [sic] to obtain contracts for money or obligations for Building the University of Colorado."—*Minute Book*, p. 68.

[5] *Boulder News*, February 18, 1876, quoting from a letter to the *Fairplay Sentinel* of January 25, 1876. On April 14, 1876, there appeared a notice in the *Boulder News:* "All notes in aid of the university are now due and must be paid by the 18th or they will be placed in hands of an attorney for suit without further notice. Geo. C. Corning." Evidently the story is true.

dollars in cash and that said funds were at the disposal of the Trustees of the University of Colorado."[1] On the 19th the committee handed in a further report, the total amount of the subscriptions then being $16,806.66.[2] The *Boulder News*, under date of May 28, sums up the situation as follows:

> In a few days the officials of the State University Board go to Denver to receive the Territorial appropriation of fifteen thousand dollars. The additional fifteen thousand, to be raised in this town, made a condition of the act, is all subscribed, and the cash is in the hands of the treasurer of the Board. The construction of the first university building is to begin immediately. Plans and specifications are ready. It is the purpose to have two departments go into operation the first of January.

The first instalment of the territorial appropriation was paid on June 7 and the remainder quickly followed.[3]

After over five years of struggle and worry the board of trustees had at last sufficient money in its treasury or in sight to begin the long-delayed construction of the university building. This task occupied its attention almost exclusively during the next year. On the day following the first payment made by the territorial treasurer June 8, the board resolved "that the secretary consult with architects and see upon what terms they will submit to the inspection of the Board plans for University Building."[4] Plans were submitted on June 21 by four firms and on the following day Mr. Dimick, of Boulder, was elected the university architect, "provided he will accede to such terms as may appear to us suitable."[5] A building committee was appointed at the same meeting with Mr. Leonard as its chairman. Mr. Dimick accepted the terms of the board and the secretary was directed to advertise for bids on the construction of the university building.[6]

[1] *Minute Book*, p. 70.

[2] *Ibid.*, p. 71. The names and the amounts subscribed were to have been inserted in the *Minute Book* but the pages are blank. These facts are to be found in the *Boulder News*, June 18, 1875, where the total is stated to be $16,656.66. This list is also to be found in the *History of Clear Creek and Boulder Valleys* (Baskin & Co.), pp. 408–9. Mr. Corning reports the total amount in the treasury on July 17, 1875, from "notes given to the university" as $15,000.—*Boulder News*, July 23, 1875.

[3] *Boulder News*, June 4, June 11, and July 23, 1875. Mr. Corning's report, as treasurer, is given in the issue of July 23.

[4] *Minute Book*, p. 74.

[5] *Ibid.*, pp. 75–77.

[6] *Ibid.*, p. 77. June 23.

The board, at the meeting held on July 6, received its first gift of an academic nature. Ex-Governor William Gilpin presented the first and second volumes of his work entitled, *The Mission of the North American People.*[1] The *Boulder News* remarked that this gift formed "the nucleus of the University library."[2]

On July 17 the board was thoroughly organized, a standing committee on finance and an executive committee being elected.[3] At the following meeting, on July 22, thirty-five bids varying from $28,700 to $42,000 were received for the erection of the university building.[4] The president made his first annual report at the same meeting of the board.[5] Late in July the contract was let to McPhee & Keating, of Denver, for $28,700 and the ground was broken for the foundation on July 27, 1875.[6]

With the building started the board began to think of equipment and the course of study. It decided to profit by the experience of other universities. On August 2 Nathan Thompson stated to the board "that he had secured passes on the K. P. Railroad to Lawrence, Kansas, and back for two members of the Board, and suggested that the Board authorize two of its members to visit the University of Kansas located at that place," with a view to inquiring into its history and management and inspecting its buildings.[7] Messrs. Thompson and Leonard, appointed to make the visit, left for Lawrence on August 10, and returned home on the 20th. In addition to a thorough investigation of the University of Kansas, they made a hurried side trip to St. Louis where they visited Washington University.

[1] *Minute Book*, p. 78.

[2] *Boulder News*, July 9, 1875.

[3] *Minute Book*, p. 79. The places of Granville Berkley and Jesus M. Barela were declared vacant, for non-attendance, at this meeting. In the *Boulder News*, July 23, 1875, the reports of the president, treasurer and finance committee are given in full. They are not contained in the minutes.

[4] *Minute Book*, p. 80.

[5] *Boulder News*, July 23, 1875. The president states that 54 meetings, regular and adjourned, had been held during the past year. He states that J. M. Barela, J. B. Chaffee, J. S. Jones, A. O. Patterson, Henry C. Thatcher, John F. Topping, John H. Wells, members of the board, had not been present at any meeting. Of the resident members Nathan Thompson had been present 47 times, A. Widner 44 times, E. Pound 43 times, T. J. Graham 31 times.

[6] *Boulder News*, July 30, 1875; *Minute Book*, p. 82. The *News* gives the name of the sub-contractors: Sam Milner, stone work; Martin & Co., cut-stone work; Caldwell & Parsons, brick work.

[7] *Minute Book*, p. 82. A full report of this visit is given in the *Boulder News*, August 27, 1875. Cf. *Minute Book*, p. 83.

By the 4th of September the work on the foundation had sufficiently progressed for arrangements to be made for the laying of the corner-stone on Monday, September 20.[1] Due notice of the exercises was given by the committee on arrangements in the *Boulder News* on September 17.[2] On the same day the Grand Lodge of the Masons of Colorado, Columbia Lodge, Number 14, of the same order, and the Phoenix Hook and Ladder Company Number 1, gave notice to their members to be present at the ceremony. September 20 was the stormiest day of the season. A combination of rain and snow prevented any of the imposing ceremonies arranged for and the citizens of Boulder were greatly disappointed.[3] Shortly after the noon hour the officers of the Grand Lodge, five trustees, the architect, the contractors and a few others went to the university grounds and performed the ceremony of laying the corner-stone. The ceremonies were concluded in Union Hall with addresses made by Judge Belford, Dr. Lord, Nathan Thompson and others.

After the laying of the corner-stone the work on the building went on rapidly.[4] Superintendent of Public Instruction Hale in his report dated December 20, 1875, states that "the building will be ready for occupancy in the spring."[5] On January 15, 1876, the members of the legislature came to Boulder and, at the dinner given to them in the Boulder House, Judge Leonard and others made speeches in which they set before them the needs of the university.[6] After the dinner the visitors inspected the grounds and building. A description of the building appeared in the *Fairplay Sentinel* shortly after their visit: "The University, a handsome edifice of brick, four stories high, with

[1] *Minute Book*, p. 84.

[2] In addition to naming some of the speakers, the committee offered suggestions as to what should be placed in the "tin box." A list of the deposits is given in the *Boulder News*, September 24, 1875.

[3] A full account of the exercises is given in the *Boulder News*, September 24, 1875. The addresses of the speakers are given: of Judge Belford, September 24; of the Master of the Grand Lodge, of Dr. Lord and of Nathan Thompson, October 1; of H. M. Hale, October 8. Nathan Thompson resigned his pastorate in October, 1875, and left Boulder shortly afterward. This fact will account for the omission of his name after the laying of the corner-stone.

[4] See the bills allowed by the board October 6, 18, 30, November 13, December 2.—*Minute Book*, pp. 88–90.

[5] *Third Biennial Report*, Supt. Public Instruction, p. 10.

[6] *Boulder News*, January 21, 1876. Cf. January 14, 1876. See also *History of Clear Creek and Boulder Valleys*, p. 408.

a cut-stone basement, costing $30,000, is the ornament of the city." The tower of the building blew down in February[1] and, in consequence, the plans had to be changed.[2] During the same month the territorial legislature passed an act, approved February 11, "To provide a Fund for the support and completion of the University of Colorado and the management of the same."[3] The sum of $15,000 was appropriated, to be applied in the following order: heating apparatus; gas-fixtures and pipes; water pipes laid from the town to the university; out-buildings and sewerage; service of architect and superintendent; fencing the grounds, salaries, library, etc. The trustees were not to create any indebtedness beyond the sum in the treasury. They were allowed to charge a reasonable tuition fee for all pupils.

On the 18th of April the building committee reported that the building was completed "except the front steps and painting." They called attention to the condition of the floors, plastering and other details as needing attention.[4] This report was accepted and $1,000 was withheld from the contractors until the repairs should be made. On the 8th of July a committee of three was appointed "to take steps to open the University this fall." On the 22d the building committee made its final report that the work of the contractors was completed and that it had received the building.[5] The committee was then discharged and McPhee & Keating were paid the balance due them. On the same day another committee reported that the fencing of the grounds had been completed and that trees had been planted. With the exception of furniture and apparatus the material side of the university was about completed.

Already the trustees were prepared to step aside in favor of the regents who were, under the new constitution of the state, to govern the university. Their meetings were no longer of the same impor-

[1] *Boulder News*, February 18, 1876. See also the quotation from the *Denver Tribune* given in the *Boulder News*, January 28, 1876.

[2] *Minute Book*, p. 94.

[3] *General Laws*, 11th session, pp. 183–84. This money was to be paid as follows: $3,500, April 1, 1876; $4,000, July 1, 1876; $3,500, January 1, 1877; $4,000, July 1, 1877. Cf. comment on the appropriation in the *Boulder News*, February 18, 1876.

[4] *Minute Book*, pp. 97–99. Mr. Widner states as to the building: "It was completed and accepted on the 18th day of last April."—*Governor's Message and Departmental Reports* (1876), p. 4.

[5] *Minute Book*, pp. 103–4.

tance and it was found difficult to assemble a quorum.[1] Various bills were allowed on the 6th and 30th of October. The latter was the last full meeting of the board.[2] There were present E. Pound, C. F. Buckingham, George C. Corning and the two survivors of the original board, Amos Widner and Thomas J. Graham. They adjourned to meet on November 6, in the evening. The minutes of the board close with this entry, in the handwriting of Amos Widner: "Boulder, Nov. 6th, 1876. Board failed to meet this evening as per adjournment. Amos Widner, Sec."[3]

While the board of trustees was making its struggle to complete the university building, Colorado was in the throes of attaining statehood and of perfecting its new organization. The enabling act was approved by the president of the United States on March 3, 1875. In it seventy-two sections of land were "set apart and reserved for the use and support of a State University."[4] The constitutional convention, authorized by this act, met in Denver, December 20, 1875, and adjourned March 15, 1876.[5] In its proceedings little of interest concerning the university is to be found. Some of the recommendations of the committee on education are, however, worthy of record. In its first report on public education the committee proposed that the regents of the university should be elected in the judicial districts and that they should be given control, if the legislature so desired, of the Agricultural College and the School of Mines as branches of the university.[6] The president of the university was to be, *ex officio*, a member of the board, but without the privilege of voting. Both of these provisions were changed to their later constitutional form on February 19.[7] In the constitution as finally adopted by the convention on March 14, 1876, the university received the attention it merited. With several other institutions the University of Colorado became a state institution.[8] It was provided that it should be governed by

[1] On August 5, August 13, September 9, October 3, 1876, a quorum was lacking.—*Minute Book*, pp. 104–8.

[2] *Minute Book*, p. 108.

[3] *Ibid.*

[4] *Mill's Annotated Statutes*, edition 1908.

[5] *Proceedings of the Constitutional Convention.* Hereafter this volume will be referred to as *Proceedings.*

[6] *Proceedings*, p. 187. January 29, 1876.

[7] *Ibid.*, p. 358.

[8] Constitution, Article VIII, Sec. 5.

a board of regents to be elected at large by the people for six years. This board was to select a president of the university who should be, *ex officio*, a member of the board, who should preside over its meetings, but who should have no power of voting except in the case of a tie. He was to be the principal executive officer of the university and a member of its faculty.[1] The constitution was accepted by the people on July 1, 1876, and on August 1, 1876, President Grant proclaimed Colorado a member of the Union.[2]

Upon the board of regents, provided for in the constitution and elected in the autumn of the year 1876, now devolved the task of equipping the university and of selecting its faculty. The six men elected were George Tritch, Frederick J. Ebert, Junius Berkley, Levi W. Dolloff, C. Valdez and W. H. Van Grieson.[3] At the first meeting of the new board held on December 23, 1876, in the governor's office in Denver, F. J. Ebert was chosen temporary chairman and J. Berkley, temporary secretary.[4] The next meeting was held in Denver, again in the governor's office, for the purpose of taking under consideration the bill then in the General Assembly which was to regulate the state university. At the same meeting a demand was made upon the board of trustees that they transfer all university property to the board of regents.[5] The bill that had been carefully scrutinized by the regents became a law on March 15, 1877. It made ample provision for the government of the University and gave it a financial basis by a grant of a one-fifth mill tax for its support.[6]

The new law made it possible for the board of regents to organize and begin work. The meeting of March 27, 1877, was held at Boulder in the university building.[7] Permanent officers were elected: Levi W. Dolloff, president; Junius Berkley, secretary; Thomas M. Field, treasurer. Mr. Field declined the office and Job A. Cooper was

[1] Constitution, Article IX, Secs. 12, 13, 14.

[2] *Iowa Journal of History and Politics*, Vol. II, pp. 271–72.

[3] *History of Clear Creek and Boulder Valleys*, pp. 409. Messrs. Dolloff and Berkley were residents of Boulder.

[4] *Regents' Minutes*, pp. 1–2.

[5] *Ibid.*, pp. 2–4. February 2, 1877.

[6] *Mill's Annotated Statutes*, edition 1891, chap. 128. Governor Routt's message to the legislature is interesting on the status of the university late in 1876.

[7] *Regents' Minutes*, pp. 4–8.

elected on April 29. At the same meeting it was voted to open the university with preparatory and normal departments on September 5, 1877. On the 28th Dr. Joseph A. Sewall, of Normal, Ill., was elected president of the university at a salary of $3,000, and Professor Justin E. Dow, of Boulder, was elected professor of Greek and Latin at a salary of $2,000.[1] President Sewall had been professor of chemistry at the Illinois Normal University and Professor Dow, principal of the public schools of Boulder. These were the only faculty appointments made by the regents before the opening of the university.

The *Boulder News* on August 31, 1877, gave notice of the inaugural exercises to be held on Wednesday, September 5, and added: "The Regents have been wise in their selection of a President and Professor. . . . . One hundred and seventeen seats have arrived and are being placed; the blackboards are painted; the rooms are cleared and cleaned; the ventilation and water for buildings arranged; the grounds graded, rubbish removed, and roads made. President Sewall's family have arrived and are furnished with pleasant rooms in the building which they make their home." September 5 was a perfect day in contrast to the stormy 20th of 1875, when the corner-stone was laid.[2] The exercises began with a parade headed by Gilman's band. "The University bell heralded the approach of the procession to the grounds. The bell occupied the place of humility—on the steps of the temple of learning, but in due time will be elevated to the summit."[3] The Rev. A. J. Chittenden opened the exercises at the building with the invocation. The choir sang. President Dolloff, for the regents, made a few introductory remarks and was followed by the speaker of the day, President Sewall. Other addresses were made and the university anthem, "We hail thee! great Fountain of learning and light," was sung.

With such formalities the University of Colorado was at last opened.

[1] *Regents' Minutes*, p. 7; *Boulder News*, March 30, 1877. A brief account of Mr. Sewall's life is given in the *Boulder News*, April 20, 1877.

[2] A full account of the exercises is given in the *Boulder News*, September 7, 1877.

[3] *Boulder News*, September 7, 1877.

VOLUME X NUMBER 2

THE UNIVERSITY OF COLORADO STUDIES

The Amphibia and Reptilia of Colorado

MAX M. ELLIS AND
JUNIUS HENDERSON

PUBLISHED BY THE
UNIVERSITY OF COLORADO
BOULDER, COLO.

MAY, 1913

Price, 50 Cents

This publication is issued four times a year, the first number in each volume usually appearing in January.

Educational institutions, libraries, societies and individuals desiring to be placed on the exchange list should make request to the "Secretary of the University of Colorado, Boulder, Colo.," to whom also should be addressed any correspondence in regard to purchase of single copies.

All exchanges should be addressed to the "Library of the University of Colorado, Boulder, Colo."

VOLUME X NUMBER 2

THE UNIVERSITY OF COLORADO STUDIES

FRANCIS RAMALEY
EDITOR

PUBLISHED BY THE
UNIVERSITY OF COLORADO
BOULDER, COLO.

MAY, 1913

Price, 50 Cents

CONTENTS

THE AMPHIBIA AND REPTILIA OF COLORADO PART I[1]

BY MAX M. ELLIS AND JUNIUS HENDERSON

Comparatively little has been published concerning the reptiles and amphibians of Colorado. The limited literature consists of records of species scattered through a number of publications, some of which are inaccessible to the general public. Considerable unrecorded material having accumulated, it seems opportune to publish this present report in order to place in the hands of naturalists and the general public such information as we have, bringing together into compact form the records heretofore published, and adding to them the unpublished material, so far as the same has come to our attention.

Environmental Conditions.—Colorado has an area of about 103,500 square miles, a latitudinal extent of about 276 miles and a longitudinal extent of about 375 miles. It is traversed from north to south, irregularly, by the continental divide—the "backbone of the continent"—its waters draining into two oceans. Its rock formations represent all the geological systems except possibly the Silurian. Though its average altitude is only approximately 6,800 feet, it varies in altitude from less than 3,500 feet to over 14,000 feet above sea-level, with consequent differences in climatic and other environmental conditions.[2] The mean annual rainfall varies in a general way with altitude and topography, from less than 10 inches to 30 inches or more. Data as to temperatures in the larger and higher masses of mountains are as yet very meager, but it may be said that the temperature at elevations of from 13,000 to 14,000 feet drops to a point below freezing nightly even in summer time, while the mean temperature for the warmest months in some of the lower portions of the state is nearly eighty degrees. On the whole, the state is a cool one. The diurnal range of temperature is great over the entire state.

[1] *Publication of the Colorado Biological Survey*, No. 14.

[2] ROBBINS, W. W., "Climatology and Vegetation in Colorado," *Botanical Gazette*, Vol. XLIX, pp. 256–280, 1910, with maps, diagrams, tables and general discussion.

From east to west the state may be divided roughly into three topographical areas. (1) The eastern two-fifths (approximately) is included in the western portion of the Central Great Plains of North America. It is a region of flat or rolling prairies, semi-arid and treeless, except along the borders of the few streams, and where artificial irrigation has been adopted. (2) At their western edge the plains abruptly give way to the steep and high foothills which flank the great mass of mountains occupying the central area and extending from the northern border of the state clear across to the southern boundary, enclosing several open areas called "parks," of which the principal ones are North Park, Middle Park, and South Park. (3) The western portion of the state, beyond the higher ranges of mountains, is an area of mesas and dissected plateaus. The foothills and mountains are to a great extent heavily forested, chiefly by coniferous trees, up to an altitude of from 10,500 to 11,500 feet. The higher portions of the western mesa region are also forested, chiefly with pinyon pine and cedar.

Living Faunas and Floras.—In such a region, with its great differences of altitude, temperature, moisture and soil, a large fauna and flora would be expected, and in case of the flora and some of the zoölogical groups this expectation is fully realized. On the other hand, however, the reptilian and amphibian faunas are not very large, because of certain limiting factors, though there are probably more species found than is popularly supposed. The present paper records altogether 45 species of reptiles and 11 species of amphibians.

The class Reptilia includes crocodiles, alligators, turtles, tortoises, lizards and snakes, of which the first two are not found in our area. The class Amphibia (or Batrachia) includes frogs, toads, newts and salamanders. Both classes are included among the so-called cold-blooded animals. Birds and mammals, whose blood is always warm and does not vary much in temperature with changes in the temperature of the surrounding atmosphere, are called warm-blooded animals, and ordinarily to them a change of a few degrees in blood temperature means death. Reptiles, amphibians and fishes are commonly called cold-blooded animals, not because their blood is always cold, but because it varies, within certain limits, as the temperature of the surrounding medium—water or air—varies. They can withstand considerable fluctuation in blood temperature without fatal consequences. Nevertheless, such changes have a marked influence upon the activity of these lower vertebrates, especially the reptiles. They are sluggish during cool weather and active during warm weather. Though large portions of Colorado never suffer from extreme cold, and the direct rays of the summer sun are often quite hot at midday over a considerable part of the state, yet on the whole the climate is cool, and even in the warmer areas the diurnal changes are great. The climate of the mountains, which occupy so much of the state, is especially cool, and above the 9,000-foot contour frost is apt to occur every month in the year. Hence a portion of the state is wholly unadapted to reptiles, much of it unfavorable, and little of it especially favorable. Lizards, which are so well represented, both in species and in individuals, in the states to the south and southwest, are represented by fewer species in Colorado and entirely unknown in large areas, though the small swifts and horned lizards are rather abundant in favorable localities. Aridity seems favorable to lizards, but most species of reptiles and amphibians are confined to the vicinity of perennial streams, ponds, marshes and lakes. A large portion of Colorado being semi-arid, this is another limiting factor, though some species of snakes, such as the prairie rattlesnake and hog-nosed snake, are common on the dry plains. In some portions of the world forests harbor many reptiles and amphibians, but the forest areas of Colorado are confined to the mountains and high mesas, which are otherwise unfavorable to a large reptilian and amphibian fauna.

Poisonous Species.—There is a widespread fear of snakes, lizards and salamanders, which is often said to be instinctive. It may well be doubted whether this fear is really instinctive. In many communities children are purposely taught to fear these animals, because some species are dangerous and they are unable to discriminate. In other instances children imbibe their fear from others, in the absence of conscious effort to teach them. Such fear, instilled into the minds of children, is very difficult to eradicate in later years. An astonishing belief, which is also widespread, is that snakes and lizards are "slimy," which is exactly contrary to the fact.

Some of our Colorado amphibians are supplied with secretions which are poisonous when taken internally, which accounts for the fact that dogs, etc., will not usually molest toads. Their "bite," however, need not be feared.

In this region the bites of most reptiles and all amphibians are practically harmless. The spotted salamander, so much dreaded by most people, is not poisonous. None of our Colorado lizards are poisonous. Only one type of snake thus far found in the state is dangerous—the rattlesnake. It is true, some species can inflict a slight wound, which may become infected and thus cause trouble which would naturally, though erroneously, be attributed to snake poison. A scratch or bruise of any kind may become infected. The hog-nosed snake has a very bad reputation in eastern Colorado, but is in fact quite harmless, and students of snakes have no hesitation about handling it, despite the stories told of its venomous character. Considerable of the misconception concerning the dangerous character of various species is likely due to misidentification of species. Thus in some instances the hog-nosed snake and the copperhead have been confused, and the bullsnake, rattlesnake and hog-nosed snake are easily confused by persons who are not very familiar with them, or not close observers, or who get excited when they encounter a snake. Of course, in view of all the facts, it is as well for the layman, unless he knows the species, to avoid handling snakes, or at least to avoid their bites.

The danger of being bitten by even the venomous species is comparatively slight. It is said that in 1872 one western expedition killed not less than 2,000 prairie rattlesnakes, and not a man or animal was bitten.[1]

The venom of snakes is in a measure proportioned to the size of the reptile. Hence our small Colorado species are by no means so dangerous as the large species of the South. Still, our Colorado rattlesnake is to be reckoned as a dangerous species, especially to

[1] STEJNEGER, LEONHARD, "Poisonous Snakes of North America," *Ann. Rept. U.S. Nat. Mus.* for 1893, . 444.

young children, and even to an adult if the venom is introduced directly into the circulation, which can very seldom happen. Under ordinary circumstances the bite is not apt to be fatal to an adult. Out of a considerable number of cases which have come to our knowledge, we have thus far but one report of death in Colorado as a result of snake bite—a four-year-old boy at Marshall, Boulder County—though there may be others. This is said, not with the idea of making people less vigilant in avoiding the reptiles or less prompt in seeking relief from their bites, but to allay, in a measure, the fear of fatal results and the excitement following a bite, which combine to render wise treatment and recovery more difficult.

The great works of Mitchell and Reichert on the venom of serpents[1] are not likely to be available to the general reader, but these and many other publications have been summarized by Stejneger.[2] Men who have studied the subject with great care are quite emphatic and almost unanimous in condemning the practice of using large quantities of alcohol in case of snake bite. Many cases of death following snake bite appear from the symptoms to have been the direct result of alcoholic poisoning, the alcohol being often administered in such quantities as to produce convulsions, under the mistaken notion that it is an antidote for the snake venom and that under such circumstances large quantities may be administered with impunity. It is not an antidote, and may have just the effect not desired. The strychnia treatment can of course be safely administered only under the watchful eye of a skilled physician. In a sparsely settled community getting a patient to a physician involves delay. In such an emergency, probably Dr. Stejneger's suggestion would meet the approval of most authorities, though they might differ somewhat as to minor details. His suggestion is as follows:

> As for the preliminary treatment before medical assistance can be obtained or rational remedies applied, but little can be added to the old methods employed.

[1] MITCHELL, S. WEIR, "Researches upon the Venom of the Rattlesnake," *Smithsonian Contributions to Knowledge*, Vol. XII, No. 135, 1860; MITCHELL, S. WEIR, and REICHERT, EDWARD T., "Researches upon the Venom of Poisonous Serpents," *Smithsonian Contributions to Knowledge*, 1886.

[2] STEJNEGER, LEONHARD, "The Poisonous Snakes of North America," *Ann. Rept. U.S. Nat. Mus.* for 1893, pp. 337–487, 1895. See especially pp. 457–475 as to the poison; pp. 475–478 as to treatment; pp. 478–480 as to preventive inoculation, immunity and serum treatment.

The first thing to be done is to tie a strong ligature or two, a string or a handkerchief, between the wound and the heart, whenever practicable; next, cutting deeply into the punctures, so as to make the blood flow freely; sucking out of the blood from the wound, a procedure perfectly harmless, unless the person doing it has an open wound in the mouth; next, careful loosening of the ligature so as to admit a small quantity of the fresh blood to the ligated member in order to prevent mortification; next, administration of a stimulant; if at hand, small doses of an alcoholic liquor being given internally at frequent intervals; if alcohol is not at hand, and a stimulant appears imperative, a small dose of ammonia might be given, but *only* very shortly after the bite, not on a later stage, when it will certainly do harm, at least in cases of poisoning by rattlesnake, copperhead or water moccasin; if the patient has to wait for the arrival of a doctor, now is the time to try all reliable means to produce a profuse perspiration.

We may add that the wound and incisions may be washed with a solution of potassium permanganate, made by dropping enough of the crystals into water to give a rich wine color. If a hypodermic syringe be at hand, some of the solution can be injected in the neighborhood of the wound, but care must be taken not to strike an artery or vein with the solution, as that might prove speedily fatal.

Dr. W. J. Baird, of Boulder, has told us that a 1:60 solution of calcium chlorate in water may be injected in and about the wound with good effect, this compound acting upon the snake poison.

Some recent authors have condemned the practice of sucking the wound as a procedure both dangerous and useless. If one be reasonably sure that the mouth is free from wounds or sores and the teeth sound, there can be little danger, and some good must come from extracting a portion of the poison.

An outfit with full directions for the treatment of snake bites, including all necessary instruments and materials, with the Pasteur anti-venom serum, is now on the market.[1]

Economic Relations.—Most people feel that it is a solemn duty to kill snakes and salamanders at sight. This is a mistaken policy, but so firmly established that it seems almost useless to protest. Most (perhaps we should say all) reptiles and amphibians are distinctly useful under natural conditions, where natural enemies keep them in

[1] The addresses of firms handling these supplies may be obtained by writing to the Museum of the University of Colorado.

check. Some species may become harmful under artificial conditions, when the balance of nature has been disturbed by the destruction of their enemies,[1] but even under artificial conditions the checks upon increase are usually sufficient to make them useful, rather than harmful. Frogs are harmless and are used for food. Toads help to keep insects in check about the house and garden. Lizards serve a similar purpose in other places. Snakes subsist largely upon insects, mice and other pests. Even the rattlesnake does much good in that way, and, before the settlement of Colorado, served to keep the prairie-dogs in check, congregating about the colonies of the latter during the breeding season and subsisting on the young "dogs." On the other hand, snakes do destroy some eggs and young birds of useful species, though the harm they thus do is greatly outweighed by the good. Except perhaps around poultry yards it would be better to destroy only the rattlesnake.

Extinct Reptilian Faunas.—The great amphibians of Carboniferous age do not seem to be represented in the rocks of Colorado, but the gigantic lizard-like reptiles of Jurassic and Cretaceous times are well represented, their fossil remains showing that some of them were to be numbered among the largest, if not the largest, animals which ever lived on the earth. These great lizards are often all referred to as dinosaurs, although they include several distinct groups. Their scattered bones occur in many parts of the state, but the most important remains have been found near Cañon City and Morrison. They survived but a short while the retreat of the sea at the close of Cretaceous time, and are now wholly extinct everywhere.[2] During Tertiary time large land tortoises lived in northeastern Colorado, and their remains are found in the rocks of that age, especially in the neighborhood of Pawnee Buttes.[3]

[1] Fisher, A. K., "The Economic Value of Predaceous Birds and Mammals," *Yearbook of U.S. Dept. Agric.* for 1908, pp. 191–192, 1909.

[2] See Marsh, Othniel C., "Vertebrate Fossils," *Geology of the Denver Basin in Colorado, U.S. Geol. Surv., Monog.*, Vol. XXVII, pp. 473–527, 1886; "The Dinosaurs of North America," *16th Ann. Rept. U.S. Geol. Surv.*, Part I, pp. 133–414, 1896; Hatcher, John B., "The Ceratopsia," *U.S. Geol. Surv., Monog.*, Vol. XLIX, 1907; Case, E. C., "A Revision of the Cotylosauria of North America," *Carnegie Inst. Wash., Pub.* No. 145, 1911.

[3] See Hay, Oliver P., "The Fossil Turtles of North America," *Carnegie Inst. Wash., Pub.* No. 75, 1908.

Collecting and Preserving Specimens.—There are large areas in the state from which no amphibians or reptiles are recorded, and no areas represented by large collections. In order to better understand the distribution of species, and to ascertain what unrecorded species may inhabit the state, it is desirable to obtain as much material as possible from every portion of Colorado. Specimens may be sent to the University Museum, at Boulder, at its expense, where they will be identified and returned to the sender, if desired, at his expense; otherwise they will be placed in the museum collection. If sufficient material can be accumulated, it is hoped some time to supply the principal high schools of the state with collections illustrating the herpetology of Colorado.

In collecting specimens care should be taken not to mutilate them, especially the head. If killed with a stick or other instrument the stroke should be back of the head, not on the head, and just sufficient to kill without mutilating. If it is convenient to confine the specimen in a closed vessel, it can of course be easily killed with ether or chloroform. It can then be preserved in grain alcohol, denatured, if not obtainable in natural condition, or 5 per cent solution of formaldehyde. Punctures, or in case of large specimens short slits, should be made in the abdomen, the incision extending just through the skin, in order to allow the alcohol or formaldehyde rapidly to penetrate all portions. In shipping, the solution may be poured off after the specimens have stood in it for two or three days, and the specimen wrapped in cloth or some other absorbent soaked in the solution.

The Literature.—The greater part of the literature of Colorado herpetology is based upon collections made many years ago, chiefly by the various expeditions and surveys sent out by the United States government. In the early reports many of the localities were indefinite, and a great deal of carelessness in subsequently reprinting the records has added to the confusion. Some labels read simply "Republican River," which river traverses portions of three states; or "Platte River," yet there are two distinct rivers of that name, one in Missouri and one in Nebraska, with branches in Colorado and Wyoming. "South Fork" may or may not refer to the South Platte in some cases.

Fort Laramie, Wyo., and Laramie, Wyo., have certainly been confused in some instances. Nebraska in the early reports may mean any portion of the territory formerly included under that name, thus requiring an extensive knowledge of both western geography and western history to avoid mistakes. Some Fort Bridger, Wyo., records have been inadvertently placed in Utah, and some Fort Garland, Colo., records have been ascribed to New Mexico. We have tried to avoid all records where there is a real doubt as to the locality, or have indicated the doubt. In the accompanying bibliography we have included all the publications which have reached our attention directly bearing upon Colorado herpetology, several which are limited to neighboring states, some works of general reference and several on fossil forms.

In citing the published records we have given the names used by the authors cited, so that the reader may determine for himself whether, in the light of present-day knowledge or future investigation, such references are justifiable. As in all other branches of natural science, nomenclature is rapidly changing.

Material.—The classification and description of the Colorado species has been based, as far as possible, on specimens actually examined by us. No records have been included in this report which were not based on captured specimens. When specimens were merely seen, although the identification may have been quite correct, we deemed the chance of error great enough to list them only as "reported specimens." The material used by us is for the most part that in the Museum of the University of Colorado. Through the kindness of the officials of the Colorado State Historical and Natural History Museum, the Colorado Museum of Natural History, the Agricultural College, and the Teachers' College Museum, we have been permitted to examine their specimens of Amphibia and Reptilia and include the records in this report. In addition to the various specimens collected in Colorado, we have made free use of the numerous specimens of Colorado species, collected in adjoining states, in the University Museum.

We wish to express our thanks to the following persons in particular, through whose kindness the work has been materially advanced: Professor L. A. Adams, Professor A. E. Beardsley, Professor E. Bethel,

Professor T. D. A. Cockerell, and Messrs. W. L. Burnett, L. J. Hersey, J. C. Smiley, H. G. Smith and A. G. Vestal.

Systematic Account

By means of the following key any of the forms found in Colorado belonging to the classes Amphibia and Reptilia may be separated readily, although considering these classes as a whole, there are forms which it does not cover. The detailed zoölogical definitions of these classes are given under the class headings, which descriptions cover all forms.

A. Body smooth, without scales or other epidermal structures on the body; frogs, toads, salamanders and tree frogs. Class *AMPHIBIA* (page 48).

AA. Body with scales or epidermal plates of some sort (excepting the soft-shelled turtles, which may be recognized by their dorsal and ventral shields); snakes, lizards and turtles. Class *REPTILIA* (page 61).

Class AMPHIBIA

Poikilothermous vertebrates with two occipital condyles, most species with functional gills in the early stages; skin without scales (except in the Gymnophiona); embryo without amnion and allantois, usually passing through a "tadpole" stage.

A. Tail present throughout life.
Order *CAUDATA*, the Salamanders and Newts (page 48).

AA. Tail not present in the adult stage.
Order *SALIENTIA*, the Toads and Frogs (page 50).

Order *CAUDATA*

This group of Amphibians, although fairly large, is represented by but a single species in Colorado.

Family Ambystomidae

Four limbs present and well developed; eyes with eyelids; side of the head without a spiracle in the adult. This family of Salamanders is represented in North America, South America, Asia and Japan, although the majority of the species are found in the new world.

Genus **AMBYSTOMA** Tschudi

Ambystoma Tschudi, *Classification der Batrachier*, p. 92, 1838.

Ambystoma tigrinum (Green)

TIGER SALAMANDER

Salamandra tigrina Green, *Journ. Acad. Nat. Sci. Phila.*, Vol. V, p. 116, 1825.

Amblystoma mavortium—YARROW, *Wheeler Survey*, Vol. V, pp. 516–519, 1875 (Denver, San Luis Valley).

Amblystoma trisruptum—YARROW, *U.S.N.M. Bull. 24*, p. 150, 1882 (South Park, Colo.).

Amblystoma tigrinum—COPE, *U.S.N.M. Bull. 34*, p. 85, 1889 (South Park, Colo.); ELROD, *The Museum*, Vol. I, p. 263, 1895 (Pike's Peak, Colo.); COCKERELL, *Univ. Colo. Studies*, Vol. VII, p. 131, 1910 (Meeker, Colo.); PROSSER, *Univ. Colo. Studies*, Vol. VIII, pp. 257–263, 1911 (Tolland, Colo.); CARY, *N. Am. Fauna*, No. 33, pp. 22 and 40, 1911 (Loveland and Estes Park, Colo.).

Head longer than wide, its width equal to or slightly less than that of the body; body stout and somewhat depressed, with 12 costal grooves; tail compressed and long, its length usually about equal to that of the body and head; digits, 4–5, not webbed; sole of the foot with two tubercles; size medium, length up to twelve inches.

Ground color brown, blue-black or black, of a waxy luster, with numerous irregular spots and bars of yellow which are often so united as to cover a greater area than the ground color; ventral parts yellow, or blackish overlaid with yellow; throat bright yellow.

The larvae of this species are a rather uniform dark brown and may be recognized by the large bright red tufts, the external gills, on each side of the throat.

A. tigrinum ranges from Maine to California and south well into Mexico, a range greater than any other North American species of the Caudata. In the southern part of its range the larvae often become sexually mature and reproduce without transforming into adult salamanders, a condition which may be brought about artificially by confining the larvae to the water and keeping it warm enough. These sexually mature larvae are known as Axolotls and are quite abundant in the lakes and ponds in Mexico. They are highly prized by the natives for food. The eggs are laid in the early spring. They are attached to plants or débris in the water near the shore. If conditions are favorable the salamanders mature in a single season, the adults leaving the water late in August. This salamander feeds on insects, insect larvae, worms and small Mollusca. Although popularly believed very dangerous, this species is quite harmless.

Colorado specimens.—*University Museum:* Meeker, August 16, 1909 (135 mm.), A. H. Felger, No. 64; Ohio City, July 4, 1911 (125 mm.), F. Rohwer, No. 133; Boulder, March 28, 1912 (222 mm.), E. Miller, No. 177; Tolland, July 27, 1911 (6 specimens, 120–200 mm.), F. Ramaley, No. 178; *Colorado State Historical and Natural History Museum:* Denver, September 10, 1892 (5 specimens, 100–150 mm.), H. G. Smith; Denver, August 9, 1900 (220 mm.), W. C. Ferril; Denver, August 10, 1900 (160 mm.), W. C. Ferril; Denver, August 18, 1900 (140 mm.), W. C. Ferril; Denver, July 18, 1902 (120 mm.), W. C. Ferril; Denver, July 24, 1904 (255 mm.), David Bellrose; Denver, August 31, 1904 (250 mm.), Mrs. N. P. Nelson; Denver, October 3, 1905 (110 mm.), Guy Bradbury; Denver, October 24, 1905 (180 mm.), F. A. Richardson; Broomfield, December 13, 1905 (270 mm.), William Ireland; Denver, October 24, 1907 (150 mm.), Richard Johnston; *State Teachers' College Museum:* Trinidad, A. E. Beardsley; Cache la Poudre, A. E. Beardsley; Alexander Lakes above Delta, and Durango, A. E. Beardsley; *reported* by Cockerell from Boulder, October 7, 1907, by Ramaley from Redrock Lake, near Ward, and from Beaver Reservoir, Boulder County. General reports show this species to be very abundant over the state.

Order *SALIENTIA*

Four of the five families of this group known from North America are represented in Colorado. The following key will distinguish them.

A. Parotoid glands present, usually large and prominent; terrestrial.
- B. Pupil of the eye vertical; upper jaw with teeth; parotoids not prominent in some species. Family *Pelobatidae*, the Burrowing Toads (page 51).
- BB. Pupil of the eye round or horizontal; skin with large warts; jaws toothless. . . . Family *Bufonidae*, the true Toads (page 52).

AA. Parotoid glands wanting; most of the species semi-aquatic.
- C. Tips of the digits more or less expanded into adhesive disks for climbing; size rather small. Family *Hylidae*, the Tree Frogs (page 56).
- CC. Tips of the digits not expanded into adhesive disks; size medium to large. . . . . . . Family *Ranidae*, the Frogs (page 59).

Family Pelobatidae

The Western Spade-foot Toad is the only member of this family found in Colorado.

Genus **SCAPHIOPUS** Holbrook

Scaphiopus Holbrook, *N. Am. Herpt.*, Vol. II, p. 85, 1842.

Tympanic membrane present and external, although often quite obscured; hind foot with an elevated tubercle near the heel. The single species, *S. hammondii* Baird, has been reported from Colorado.

Scaphiopus hammondii Baird

Western Spade-Foot Toad

Scaphiopus hammondii Baird, *Rept. Pac. R.R. Survey*, Vol. IV, Reptiles, pl. 28, fig. 2, 1859.

Scaphiopus hammondi—Cary, *N. Am. Fauna*, No. 33, p. 27, 1911 (Morris, Colo.).

Scaphiopus hammondi bombifrons—Dickerson, *Frog Book*, pl. ix, 1907 (Denver, Colo.).

Characterized at once by the vertical pupil of the eye; parotoid glands and tympanum quite obscure; length of the hind limb equal to or slightly greater than the length of the head and body; distance between the eyes equal to or slightly greater than the width of the eye; size medium to small, length less than three inches.

Dorsal color yellowish brown, greenish brown or gray; with or without two or more lighter stripes dorsally; usually with a dark stripe back of each eye; tubercles red or yellow, or tipped with red or yellow; under parts whitish with a bluish or a reddish cast; throat black in the male.

Two subspecies of this toad may be recognized.

a. Muzzle high, rather abruptly truncate; skin rather rough; west of the range . . . . *S. h. hammondi* Baird.

aa. Muzzle rounded; skin quite smooth; east of the range. *S. h. bombifrons* (Cope).

The Spade-foot Toads are of particular interest because of their peculiar appearance and habits. They lead a rather solitary life in burrows of their own construction. Because of this habit they are rarely seen except in the spring when they come to water to lay their eggs. At this time they are among the noisiest of amphibians. All observers agree as to the remarkable power of the voice of these toads. Professor A. E. Beardsley tells us that this toad is very abundant near Greeley every spring.

The Western Spade-foot Toad ranges through the Rocky Mountain and Great Basin region.

Colorado specimens.—*State Teachers' College Museum:* Greeley and near Greeley, A. E. Beardsley.

Family Bufonidae

Genus **BUFO** Laurenti

Bufo Laurenti, *Synopsis Reptilium,* p. 25, 1768.

A large genus of cosmopolitan distribution. Tongue free posteriorly and fastened to the floor of the mouth anteriorly; pupil of the eye horizontal; digits, 4–5, toes webbed. The toads are of large economic importance because of their feeding habits. It has been shown by various observers that the number of insects destroyed by a single toad is remarkable. Since toads are absolutely harmless and are quite inoffensive, they should be protected. Five forms are recorded from Colorado.

a. Top of the head without bony crests.
- *b.* Ventral parts spotted; parotoids rounded; webbing between the digits deeply indented . . . . *B. boreas* Baird and Girard.
- *bb.* Ventral parts unspotted; parotoids elongate, wider posteriorly; webs short. . . . . *B. debilis* Baird.

aa. Top of the head with elevated bony crests.
- *c.* Median crests parallel, joining the lateral crests at right angles; no diagonal crests. . . . . *B. woodhousei* Girard.
- *cc.* Median crests diverging posteriorly.
  - d. A short, diagonal crest, directed mesially from the angle at the junction of the median and lateral crests on each side. *B. americanus* LeConte.
  - dd. No diagonal crest; median crests diverging widely posteriorly. *B. cognatus* Say.

Bufo boreas Baird and Girard

MOUNTAIN TOAD; COLUMBIAN TOAD

Bufo boreas Baird and Girard, *Proc. Acad. Nat. Sci. Phila.*, p. 174, 1852.

Bufo microscaphus—YARROW, *Wheeler Survey*, Vol. V, p. 523, 1875 (South Park, Colo.); YARROW, *U.S.N.M. Bull. 24*, p. 162, 1882 (South Park, Colo.).

Bufo columbiensis—COPE, *U.S.N.M. Bull. 34*, p. 271, 1889 (South Park Colo.); YOUNG, *Proc. Acad. Nat. Sci. Phila.*, p. 298, 1909 (east slopes of Arapahoe Peaks, Boulder Co., Colo.).

Head short, widest just back of the eyes, its length 4 or a little more in the total length; muzzle long and sloping; fore-arm longer than the hand; glands on the tibia; size medium, length up to five inches.

General color brownish or greenish gray; sides with numerous irregular light colored blotches; usually a light colored area near the posterior angle of the mouth; ventral parts yellowish, whitish or even greenish, much mottled with black; tubercles of the feet black; tips of the digits dark brown.

Range, Colorado north and west to Puget Sound. In this state found only in the mountains.

Colorado specimens.—*University Museum:* Redrock Lake, above Ward, July 21, 1907 (75 mm.), G. S. Dodds, No. 179; Copeland Park, Boulder County, September 5, 1907 (3 specimens, 45–90 mm.), S. A. Rohwer, No. 180; Park Lake, Tolland, July, 1909 (2 specimens, 85 and 90 mm.), F. Ramaley, No. 181; Black Canyon, Tolland, August 29, 1912 (60 mm.), A. G. Vestal, No. 182; *Colorado State Historical and Natural History Museum:* Cumbres Pass, August 1, 1902 (75 mm.), W. C. Ferril; *State Teachers' College Museum:* Chamber's Lake and Grand Mesa, A. E. Beardsley.

Bufo debilis Girard

SONORAN TOAD

Bufo debilis Girard, *Proc. Acad. Nat. Sci. Phila.*, p. 87, 1854.

Head short, its length about 4.5 in the total length; muzzle truncate; hind leg short, its length equal to that of the head and body; parotoid glands large, widening posteriorly so as to be roughly triangular in outline; size small, rarely exceeding two inches in length.

General color brownish to ashy gray; small tubercles black; legs more or less banded with black; under parts whitish or yellowish, or even dusky, but unspotted.

Range, Colorado south into Chihuahua.

Colorado specimen.—*State Teachers' College Museum:* Las Animas County, near Trinidad, 1883, A. E. Beardsley (det. A. E. Beardsley).

Bufo woodhousei Girard

Woodhouse's Toad

Bufo woodhousei Girard, *Proc. Acad. Nat. Sci. Phila.*, p. 86, 1854.

Bufo woodhousei—Baird, *Pac. R.R. Surv.*, Vol. X, v, p. 20, 1859 (upper Arkansas); Cope, *U.S.N.M. Bull. 34*, p. 284, 1889 (Colorado Springs, Colo.).

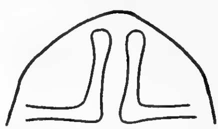
Bufo lentiginosus frontosus—Yarrow, *Wheeler Survey*, Vol. V, p. 520, 1875 (Twin Lakes, Colorado Springs and Pueblo, Colo.).

Bufo lentiginosus woodhousei—Yarrow, *Wheeler Survey*, Vol. V, p. 521, 1875 (between Pueblo and Ft. Garland); Cary, *N. Am. Fauna*, No. 33, p. 27, 1911 (Rangeley and Rifle, Colo.).

Head very short, almost twice as wide as long, its length about 5 in the total length; muzzle quite abrupt, somewhat rounded at the tip; parotoids long and oval; size large, males three to four inches in length, females four to six inches.

General color dull gray or dark brown, yellowish laterally; often quite distinctly marked with blackish spots; a light mid-dorsal stripe; ventral parts yellowish or whitish with small dark spots near the fore limbs; throat black in the male.

Range, Rocky Mountain region. This species is regarded by many authors as but a well-defined variety of *Bufo lentiginosus* Shaw.



Bufo woodhousei.—Diagram of Bony Crests

Colorado specimens.—*University Museum:* North of Boulder, June 1, 1910 (80 mm.), J. Henderson, No. 119; Grand Junction, August 8, 1912 (7 specimens, 32–90 mm.), J. Henderson and M. M. Ellis, No. 183; Montrose, August 9, 1912 (18 mm.), J. Henderson, No. 184; Rio Florida, near Durango, August 11, 1912

(95 mm.), J. Henderson and M. M. Ellis, No. 185; *Colorado State Historical and Natural History Museum:* Denver, July 27, 1900 (85 mm.), W. C. Ferril; Denver, August 6, 1900 (100 mm.), W. C. Ferril; Lamar, June 12, 1904 (40 mm.), H. G. Smith; *State Teachers' College Museum:* Greeley, A. E. Beardsley; *reported* common at Greeley by Beardsley.

Bufo americanus LeConte

AMERICAN TOAD (*Figure 2, Plate I*)

Bufo americanus LeConte, in Holbrook, *N. Am. Herpetology,* Vol. V, p. 5, 1842.

Bufo lentiginosus lentiginosus—YARROW, *U.S.N.M. Bull. 24,* p. 164, 1882 (Ft. Garland, Colo.).

Bufo lentiginosus americanus—YARROW, *U.S.N.M. Bull. 24,* p. 167, 1882 (South Platte River and Central Park).

Head short, its length 4 to 4.5 in the total length; muzzle rather abrupt; parotoids large and oval; size medium, males two to three inches, female three to four inches in length.

General color variable, yellow, brown, dark brown, gray or even greenish; usually much spotted with a color lighter than the ground color; a pale mid-dorsal stripe usually apparent; warts dull or marked with red or yellow; ventral parts light; throat of the male black.

Range, southern Canada south into Mexico, rather general in the United States. This species is regarded by many authors as merely a well-defined variety of *Bufo lentiginosus* Shaw, the common toad.

Bufo americanus.—Diagram of Bony Crests

Colorado specimens.—*University Museum:* Boulder, September 10, 1909 (85 mm.), J. Henderson, No. 186; Julesburg, July 19, 1912 (28 specimens, 10–105 mm.), J. Henderson and M. M. Ellis, No. 187; Brighton, July 26, 1912 (9 specimens, 20–40 mm.), J. Henderson, No. 188; *Colorado State Historical and Natural History Museum:* Denver, July 27, 1900 (70 mm.), H. G. Smith; Julesburg, August 31, 1905 (3 specimens, 40–45 mm.), H. G. Smith; Denver, August 6, 1900 (2 specimens, 40 and 50 mm.), W. C. Ferril.

Bufo cognatus Say

SAY'S TOAD; WESTERN TOAD (*Figure 1, Plate I*)

Bufo cognatus Say, *Long's Exped. Rocky Mts.*, Vol. II, p. 190, 1823.

Bufo lentiginosus cognatus—YARROW, *Wheeler Survey*, Vol. V, p. 521, 1875 (Ft. Garland, Colo.); YARROW, *U.S.N.M. Bull. 24*, p. 165, 1882 (Ft. Garland, Colo.).

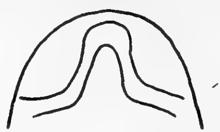
Bufo lentiginosus frontosus—YARROW, *U.S.N.M. Bull. 24*, p. 165, 1882 (Colorado Springs, Colo.).

Bufo cognatus—COPE, *U.S.N.M. Bull. 34*, p. 277, 1889 (Ft. Garland, Colo.); DICKERSON, *Frog Book*, pl. xxxii, fig. 90, 1907 (Denver, Colo.); COCKERELL, *Univ. Colo. Studies*, Vol. VII, p. 130, 1910 (Medano Ranch, Costilla Co., Colo.).

Head quite short, much wider than long, its length about 5 in the total length; parotoids large and oval; size large, length three to six inches.

General color yellowish brown, gray or greenish; dorsal pattern of large blotches of a rather bright dark brown or black, giving the toad a very conspicuous marking, these spots often more or less confluent; a distinct pale, mid-dorsal stripe; ventral parts yellowish.

A Western plains species, coming into the foothills region.



Bufo Cognatus.—Diagram of Bony Crests

Colorado specimens.—*University Museum:* Medano Ranch, Costilla County, July 2, 1909 (2 specimens, 50 and 55 mm.), E. R. Warren, No. 189; Julesburg, July 19, 1912 (100 mm.), J. Henderson, No. 190; Brighton, July 26, 1912 (9 specimens, 20–35 mm.), J. Henderson, No. 191; *Colorado State Historical and Natural History Museum:* Wray, June 15, 1902 (100 mm.), H. G. Smith; *State Teachers' College Museum:* Greeley, A. E. Beardsley.

Family HYLIDAE

The tree frogs are small amphibians, which, although they still lay their eggs in the water, have become more or less arboreal as adults. This habit has been made possible by the development of adhesive disks at the tips of the digits. At the same time quite a number of species of this family have suffered a more or less complete loss of the webbing between the digits. Some species are neither arboreal nor aquatic but are rather terrestrial in habit. Tree frogs are found in many parts of the world but the majority of species are natives of the tropics of the New World. Two species belonging to genera restricted to North America are found in Colorado.

a. Fingers and toes almost free, webbing greatly reduced; skin smooth. *Chorophilus* Baird.

aa. Toes rather completely webbed; skin rough.

b. Terminal digital disks very small . . *Acris* Duméril et Bibron.

bb. Terminal digital disks quite prominent. . . *Hyla* Laurenti.

Genus **CHOROPHILUS** Baird

Chorophilus Baird, *Proc. Acad. Nat. Sci. Phila.*, p. 59, 1854.

A single species of this genus is known from the state.

Chorophilus triseriatus (Wied)

Three-Lined Tree Frog

Hyla triseriata Maximilian, Prinz zu Wied, *Reise Nord-Amerika*, Vol. I, p. 249, 1865.

Chorophilus triseriatus triseriatus—Yarrow, *Wheeler Survey*, Vol. V, pp. 523 and 524, 1875 (Ft. Garland, Fairplay and Pagosa, Colo.); Yarrow, *U.S.N.M. Bull. 24*, p. 170, 1882 (Fairplay and Pagosa, Colo.).

Chorophilus triseriatus—Cope, *U.S.N.M. Bull. 34*, pp. 343, 347, 1889 (Laramie River; Fairplay and Pagosa, Colo.); Cary, *N. Am. Fauna*, No. 33, p. 27, 1911 (Rangeley and ten miles east of Slater, Colo.).

Head much depressed, somewhat pointed anteriorly, rather long, its width about 3 in the total length; length of the hind leg to the heel reaching forward to the ear; total length of the head and body about 1.5 in the total length of the hind limb; size small, length less than 1.5 inches; males with a gular sac.

Color quite variable, gray, green, brown, or even reddish; usually with three dark stripes, or at least the indications of three stripes, one in the mid-dorsal region, and one on each side beginning at the posterior margin of the eye and running parallel to the mid-dorsal stripe; ventral parts whitish, yellowish or greenish.

This species is almost always found on the ground, where it hides away under loose stones or fallen timber. Its generic name signifies "chorus-loving," and refers to the habit of the species of singing more or less in concert in the early spring. The loud voice of the male is the result of the reinforcing resonance given by the expanded gular sac.

Range, United States generally, abundant in the West and Rocky Mountain region. This species is recognized by some authors as but a variety of *C. nigritus* (LeConte).

Colorado specimens.—*University Museum:* Stapp's Lake, Boulder County, August 19, 1905 (18 mm.), G. S. Dodds, No. 192; Copeland Park, Boulder County, September 6, 1907 (2 specimens, 18 and 22 mm.), S. A. Rohwer, No. 193; Bluebird Mine, Boulder County, August 5, 1908 (32 mm.), T. A. McHarg, No. 194; Kremmling, August 5, 1911 (7 specimens, 18–20 mm.), J. Henderson, No. 131; Boulder, April 26, 1913, (2 specimens, 25–30 mm.), Robert Plimpton; *Colorado State Historical and Natural History Museum:* Denver, August 7, 1889 (2 specimens, 25 and 40 mm.), H. G. Smith; *State Teachers' College Museum:* Greeley and Grand Mesa, A. E. Beardsley.

Genus **ACRIS** Duméril et Bibron

Acris Duméril et Bibron, *Erpêtologie Générale,* Vol. VIII, p. 506, 1841.

Acris gryllus (LeConte)

Cricket Frog

Rana gryllus LeConte, *Ann. Lyceum New York,* Vol. I, p. 282, 1825.

Head depressed and pointed, its length about 3 in the head and body; length of the hind leg to the heel reaching forward to the snout or beyond; male with a gular sac; size small, length under 1.5 inches.

Color variable and changeable; generally brownish, greenish or reddish, and somewhat clouded with dusky; a triangular dark blotch on the top of the head between the eyes; a dark line on each side from the posterior margin of the eyes.

This frog, although a true tree frog, lives on the ground. In the spring it is very noisy, its voice being very powerful because of the gular sac.

Range, eastern and southern United States, west through Nebraska into the Northwest.

Colorado specimens.—*University Museum:* Wray, October 26, 1912 (2 specimens, 18–20 mm.), M. M. Ellis, No. 195.

Genus **HYLA** Laurenti

Hyla Laurenti, *Synopsis Reptilium*, p. 32, 1768.

This genus embraces more than half of the species of *Hylidae* and is represented in all of the large faunal divisions. Most of the species known are from Australia and the New World. The single species *Hyla arenicolor* Cope is found in Colorado.

Hyla arenicolor Cope

ARIZONA TREE FROG; SAND-COLORED TREE FROG

Hyla arenicolor Cope, *Journ. Acad. Nat. Sci. Phila.*, p. 61, 1866.

Head depressed and rounded anteriorly, its length about 3.5 in the total length; length of the hind leg to the heel reaching forward to the eye; first finger distinctly shorter than the second; male with a gular sac; size medium, length two inches or less.

Color variable and changeable; generally brownish gray to greenish, with numerous small rather round blotches of black (these spots sometimes in two irregular rows); hind legs crossed by three poorly defined dark bars; ventral parts roughened; throat dusky; belly whitish; often with a light spot below each eye.

Range, Utah and Colorado south into Mexico and west into California.

Colorado specimen.—*State Teachers' College Museum:* Mesa de Maya, Las Animas County, 1886, A. E. Beardsley (det. A. E. Beardsley).

Family RANIDAE

Genus **RANA** Linnaeus

Rana Linnaeus, *Syst. Nat.*, ed. X, p. 354, 1758.

Tongue free posteriorly, fastened anteriorly to the floor of the mouth; upper jaw with teeth; fingers free, toes webbed. A genus of cosmopolitan distribution, being the only one of this family found in the United States. Of the many species of this genus but a single species, *Rana pipiens*, is found in Colorado.

Rana pipiens Schreber

LEOPARD FROG

Rana pipiens Schreber, *Naturforscher*, Vol. XVIII, p. 185, pl. iv, 1782.

Rana halecina berlandieri—YARROW, *Wheeler Survey*, Vol. V, pp. 526–527, 1875 (Denver and San Luis Valley, Colo.); YARROW, *U.S.N.M. Bull. 24*, p. 181, 1882 (Ft. Garland, Colo.).

Rana virescens brachycephala Cope—COPE, *U.S.N.M. Bull. 34*, p. 405, 1889 (Medicine Bow Creek—possibly Colorado; Ft. Garland, Colo.).

Rana pipiens—COCKERELL, *Univ. Colo. Studies*, Vol. VII, p. 130, 1910 (Meeker, seven miles northeast of Meeker, Buford, and five miles above Buford, Colorado; Medano Ranch, Costilla Co., Colo.); CARY, *N. Am. Fauna*, No. 33, p. 24, 1911 (Vermillion Creek, near Ladore, Colo.).

A lateral longitudinal fold along each margin of the dorsal surface, and several other, usually four, smaller longitudinal folds in the skin between the lateral folds, these smaller folds often much interrupted; head short, 3 to 3.5 in the total length; length of the hind leg reaching forward to the snout or beyond; size medium, length three to four inches.

General color variable, gray, brownish or usually green; dorsal pattern usually of two or more rows of large, rounded, black spots, margined with yellowish; spots across the dorsal surface of the legs forming rather distinct bars; ventral parts uniform white or yellowish.

Range, southern Canada south into Mexico, United States generally. Several subspecies of this species have been described but they all intergrade more or less.

Colorado specimens.—*University Museum:* Boulder, August 8, 1907 (35 mm.), F. Rohwer, No. 196; near Pine Glade School, southwest of Magnolia, August 22, 1907 (2 specimens, 65 and 70 mm.), F. Ramaley, No. 197; Louisville Junction, September 14, 1907 (3 specimens, 40–45 mm.), M. H. Perkins, No. 198; Bluebird Mine, Boulder County, August 5, 1908 (35 mm.), T. A. McHarg, No. 199; Meeker, August 6, 1909 (45 mm.), A. H. Felger, No. 52; seven miles northeast of Meeker, August 12, 1909 (9 specimens, 30–80 mm.), A. H. Felger and J. Henderson, No. 59; Julesburg, July 19, 1912 (17 specimens, 20–80 mm.), J. Henderson and M. M. Ellis, No. 200; Alamosa, July 27, 1912 (60 mm.), M. M.

Ellis, No. 201; Montrose, August 9, 1912 (75 mm.), J. Henderson, No. 202; Rio Florida, near Durango, August 11, 1912 (7 specimens, 60–80 mm.), J. Henderson and M. M. Ellis, No. 203; Grand Junction, August 8, 1912 (5 specimens, 40–50 mm.), J. Henderson and M. M. Ellis, No. 204; *Colorado State Historical and Natural History Museum:* Denver, July 31, 1890 (3 specimens, 30–65 mm.), H. G. Smith; Aurora Lake, near Denver, September 3, 1900 (5 specimens, 40–68 mm.), W. C. Ferril; Denver, September 3, 1900 (55 mm.), W. C. Ferril; Julesburg, September 22, 1900 (2 specimens, 60 and 70 mm.), H. G. Smith; Wray, September 17, 1903 (4 specimens, 30–80 mm.), H. G. Smith; Durango, September 27, 1905 (50 mm.), H. G. Smith; Holly, May 24, 1907 (5 specimens, 40–100 mm.), H. G. Smith; *Agricultural College Museum:* Ft. Collins, May 10, 1894 (3 specimens, 45–50 mm.), L. C. Bragg; *State Teachers' College Museum:* Greeley, A. E. Beardsley; *reported* common in all parts of the state along watercourses.

Class REPTILIA

Poikilothermous, air-breathing Vertebrates, with functional lung or lungs, without functional gills, and with a single occipital condyle. Embryo with amnion and allantois.

A. Body covered with epidermal plates or scales. Order *SQUAMATA*.

B. Bones of the lower jaw firmly united by a bony suture; mouth not dilatable; four limbs present (except in a few forms not represented in the Colorado fauna).
Suborder *Sauria*, the Lizards (page 61).

BB. Bones of the lower jaw united by ligaments so that the mouth may be greatly dilated; limbs wanting or represented by rudiments.
Suborder *Serpentes*, the Snakes (page 81).

AA. Body covered by two shields, a dorsal and a ventral, of bony or cartilaginous plates. Order *TESTUDINATA*, the Turtles (page 111).

AAA. Body covered with a heavy leathery epidermis; size large; body elongate (not found in Colorado). Order *CROCODILIA*, the Crocodiles.

Suborder *SAURIA*

The Lizards

Three of the four families of Lizards recorded from the United States are represented in Colorado. These three may be separated by the following key.

A. Scales on dorsal parts dull, usually keeled; ventral parts covered with scales somewhat larger than the dorsal scales; tongue smooth or covered

with very fine papillae which give it a velvety appearance; tongue thick and only free from the floor of the mouth at the tip.
Family *Iguanidae* (page 62).

AA. Scales on dorsal parts very small and granular; ventral parts with large plates; anterior portion of the tongue free from the floor of the mouth; considerable of the surface of the tongue covered with scalelike papillae; tip of the tongue deeply forked. . . Family *Teiidae* (page 76).

AAA. Scales on both dorsal and ventral parts smooth, polished and highly lustrous; anterior portion and sides of the tongue free from the floor of the mouth; considerable portion of the surface of the tongue covered with scalelike papillae; tip of the tongue only slightly notched.
Family *Scincidae* (page 78).

Family Iguanidae

The Iguanas and the Iguana-like Lizards

A very large family of lizards, particularly abundant in tropical and subtropical America, although the family is represented in the East Indies. Seven genera of this family have been reported from Colorado and five of these are known to be more or less abundant in the state. The other two stand on uncertain records.

A. Body elongate, its width always much less than the length of the tail; posterior margin of the head without bony "horns"; lateral margins of the body without rows of large, pointed, elevated scales.

b. A median dorsal row of large, strongly keeled scales, elevated into a dorsal crest. . . . . . *Dipsosaurus* Hallowell (page 63).

bb. No such row of elevated scales in the mid-dorsal region.

c. Ear opening exposed.

d. A gular fold.

e. Occipital plate larger than either nasal plate, separated from the rostral region by not more than ten plates; plates on the top of the head large and irregular.
Uta Baird and Girard (page 64).

ee. Occipital plate equal to or smaller than either nasal plate, separated from the rostral region by at least twelve plates; plates on the top of the head small, and much alike in size and shape. . . . *Crotaphytus* Holbrook (page 65).

dd. No gular fold. . . . *Sceloporus* Wiegmann (page 67).

cc. Ear opening covered. . . *Holbrookia* Girard (page 70).

AA. Body depressed and robust, length of the tail equal to or usually less than the maximum width of the body; head with bony "horns" in the occipital and temporal regions; body with one or two rows of elevated, large pointed scales on each lateral margin.

f. Ear opening exposed. . . *Phrynosoma* Wiegmann (page 71).

ff. Ear opening covered with scales. . . *Anota* Hallowell (page 75).

Genus **DIPSOSAURUS** Hallowell

Dipsosaurus Hallowell, *Proc. Acad. Nat. Sci. Phila.*, Vol. VII, p. 92, 1854.

But a single species of this genus is known, *Dipsosaurus dorsalis* (Baird and Girard).

Dipsosaurus dorsalis (Baird and Girard)

Desert Iguana or Keel-Backed Lizard

Crotaphytus dorsalis Baird and Girard, *Proc. Acad. Nat. Sci. Phila.*, p. 126, 1852.

Dipsosaurus dorsalis—Yarrow, *U.S.N.M. Bull. 24*, p. 54, 1882 (Colorado); Cope, *Rept. U.S.N.M.*, p. 245, 1898 (Colorado).

Gular fold present; head small, about equal to the hind foot in length; femoral pores present; nostrils terminal, beyond the end of the canthus rostratus; a mid-dorsal row of large, elevated, strongly keeled scales; size moderately large; length ten to twelve inches.

Color pale brown to brownish gray, shading into yellowish brown in the caudal region; dorsal pattern of several narrow, irregular, longitudinal, dark brown or black stripes; tail with dark cross bands; ventral parts whitish or yellowish, without markings.

This lizard feeds on plants, particularly flower heads. It is most closely related to the tropical Iguanas of any of the North American species. We have not examined specimens of this species from Colorado, and the two records of it from this state are uncertain. If found in Colorado it will probably be in the southwestern part of the state, as this lizard ranges from Southern California to Arizona. Professor A. E. Beardsley states that a large lizard answering the description of *Dipsosaurus dorsalis* has been reported to him several times from Lamar, Rocky Ford and Canon City, although he has never secured specimens of it.

This lizard is a desert species.

Genus **UTA** Baird and Girard

Uta Baird and Girard, *Stansbury's Exped. Great Salt Lake*, p. 344, 1852.

Gular fold present, marked by larger scales; tail longer than the body; ear openings not covered, rather large and prominent; femoral pores present; occipital plate large and somewhat rounded.

A genus of rather small lizards confined to southwestern United States and northern Mexico.

Key to the Colorado Species of Uta

a. Five or six rows of scales in the mid-dorsal region distinctly larger than the adjoining scales; the central rows of this series smaller than the edge series . . . . *U. ornata* Baird and Girard.

aa. Scales along the mid-dorsal region very slightly if at all larger than the adjoining scales; the mid-dorsal scales grading insensibly into the lateral scales . . . . *U. stansburiana* Baird and Girard.

Uta ornata Baird and Girard

Ornate Swift (*Figures 5 and 6*)

Uta ornata Baird and Girard, *Proc. Acad. Nat. Sci. Phila.*, Vol. VI, p. 126, 1852.

Uta ornata—Yarrow, *Wheeler Survey*, Vol. V, p. 568, 1875 (Twin Lakes, Colo.); Cope, *Rept. U.S.N.M.*, p. 317, 1898 (Plateau Creek near Eagalite, Colo.); Cary, *N. Am. Fauna*, No. 33, p. 26, 1911 (Plateau Creek, Mesa Verde, Spruce Tree Ruins, Coventry, Colo.).

Head depressed and broad; five or six rows of enlarged scales in the mid-dorsal region forming a longitudinal band of scales abruptly larger than the adjoining scales, the center of this band with smaller scales; a row of slightly elevated, conical scales on each side of the back near the lateral margin; other dorsal scales small and closely set; ventral scales larger than the dorsal scales; length from tip of snout to vent about 1.5 in the length of the tail; total length up to eight inches.

General color gray to blackish gray or brownish gray; of a more or less mottled pattern with irregular black cross bands, quite distinct on the sides but interrupted dorsally; a dark area on each side of the neck; ventral parts whitish to greenish; throat greenish or yellowish;

males with a large area of bright blue or greenish blue on each side of the anterior portion of the abdomen.

Range, New Mexico and Colorado west into California.

Colorado specimens.—*University Museum:* Rifle, July 2, 1908 (128 mm.), S. A. Rohwer, No. 205; four miles west of Meeker, August 11, 1909 (120 mm.), J. Henderson, No. 206; *Colorado State Historical and Natural History Museum:* Grand Junction, September 17, 1904 (2 specimens, 70 and 116 mm.), H. G. Smith; *reported* by Cary, *l.c.*, Sindbad Valley, McElmo and Arboles.

Uta stansburiana Baird and Girard

STANSBURY'S SWIFT

Uta stansburiana Baird and Girard, *Proc. Acad. Nat. Sci. Phila.*, Vol. VI, p. 69, 1852.

Uta stansburiana—CARY, *N. Am. Fauna*, No. 33, p. 26, 1911 (Mack, Plateau Creek and DeBeque, Colo.).

Head depressed; scales of the back small and of a rather uniform size, closely set and weakly keeled; no mid-dorsal rows of enlarged scales; scales on the tail spiny and larger than those of the back; length from tip of snout to vent about 1.5 in the length of the tail; size small, total length usually less than five inches.

General color dark gray to dark grayish green; dorsal pattern of two irregular rows of dark, more or less crescentic blotches, surrounded by smaller, scattered spots of blue and black; one or two pale stripes, somewhat interrupted, along each side; a dusky area back of each fore limb, often surrounded by yellowish; ventral parts greenish or yellowish white; under parts of the jaw, bluish.

A species of the Great Basin, ranging north into Oregon and south into Texas.

Colorado specimens.—*Reported* by Cary, *l.c.*, from Desert north of Mack, Plateau Creek, Coventry, Paradox Valley, Salt Canyon, Dolores River Canyon and McElmo, Colo.

Genus **CROTAPHYTUS** Holbrook

Crotaphytus Holbrook, *N. Am. Herpetology*, Vol. II, p. 79, 1842.

Scales small; gular fold present; tail much longer than the body, slender and cylindrical; ear openings not covered; femoral pores present; occipital plate small.

Moderately large lizards found in southwestern United States and northern Mexico. The food of these lizards consists of insects, small toads and lizards and often small individuals of their own species. They will also eat small flower heads. As regards food, they stand between the strictly herbivorous *Dipsosaurus* and the insectivorous *Sceloporus*. One species is known from Colorado.

Crotaphytus collaris (Say)

COLLARED LIZARD

Agama collaris Say, *Long's Exped. Rocky Mts.*, Vol. II, p. 252, 1823.

Two subspecies of this lizard are described. They may be distinguished by the following key.

a. Interorbital plates in a single row. . . . . . *C. c. collaris* (Say).
aa. Interorbital plates in at least two rows. . . . *C. c. baileyi* (Stejneger).

At present only the subspecies *baileyi* is known from Colorado. However, as the true *collaris* is recorded from points near Colorado, that variety should be looked for in southern Colorado.

Crotaphytus collaris baileyi (Stejneger) (*Figures 3 and 4*)

Crotaphytus baileyi Stejneger, *N. Am. Fauna*, No. 3, p. 103, 1890.

Crotaphytus collaris baileyi Cockerell, *Univ. Colo. Studies*, Vol. VII, p. 131, 1910 (Rifle Gap, Garfield Co., Colo.); CARY, *N. Am. Fauna*, No. 33, p. 25, 1911 (McElmo, Coventry and Sindbad Valley, Colo.).

Head depressed, very broad in the region just back of the eyes, pointed anteriorly and narrowed posteriorly, length a little less than that of the hind foot; scales small, ventral scales larger than the dorsal scales; length from the tip of the snout to the vent about 2 in the length of the tail; maximum total length about fifteen inches.

General color grayish yellow, yellowish brown, grayish green or green; a double collar of two black bands, very heavy at the sides and interrupted dorsally, separated by a band of white or yellow and bordered with the same color; ventral parts yellowish or greenish; throat yellow or orange; under parts of the jaw bluish; dorsally with numerous small light spots; sides of the abdomen and the tops of the hind limbs with small dark red spots; inside of the back of the mouth black. Markings vary from quite obscure to distinct, and both colors and markings are more vivid at the breeding season.

Mr. H. G. Smith of the State Historical and Natural History Museum informs us that this species is commonly known as the "Boomer" in western Colorado. It is extremely active and when disturbed often runs on its hind legs. Like most of our *Iguanidae*, the Collared Lizard is oviparous. One specimen reported by Ditmars[1] laid twenty-one eggs early in August.

Crotaphytus collaris ranges from Idaho south into Mexico, west into California and east into Arkansas.

Colorado specimens.—*University Museum:* Rifle Gap, August 5, 1909 (245 mm.), A. H. Felger, No. 55; *State Historical and Natural History Museum:* Grand Junction, August 13, 1905 (255 mm.), Ora Keithley; Grand Junction, May 17, 1906 (260 mm.), W. C. Ferril; *Colorado Museum of Natural History:* Trinidad, May 2, 1911 (300 mm.), L. J. Hersey; Trinidad, June 7, 1911 (340 mm.), L. J. Hersey; Trinidad, August 5, 1911 (60 mm.), L. J. Hersey; Trinidad, September 5, 1911 (5 specimens, 250–300 mm.), L. J. Hersey; *State Teachers' College Museum:* Trinidad and Delta, A. E. Beardsley; *reported* common at Trinidad, by L. J. Hersey.

Genus **SCELOPORUS** Wiegmann

Sceloporus Wiegmann, *Isis*, p. 369, 1828.

Scales moderately large, keeled dorsally, with the keeled portion often produced into a sharp point; no gular fold; tail a little longer than the body; ear openings not covered; femoral pores present; supraorbital plates prominent.

The Spiny Swifts, *Sceloporus*, are small to moderately large lizards, including some of the most abundant species found in the United States. Species of this genus are found from Central America to Canada, and over the whole of the United States. They feed largely upon small insects and insect larvae. In general color they are gray or brown, lighter below, and the males have a blotch of blue on each side of the abdomen. Two species are recorded from Colorado.

Key to the Colorado Species of Sceloporus

a. Supraorbital plates in four rows; inside row of small plates, second row of large plates, third and fourth rows of small plates.

S. consobrinus Baird and Girard.

[1] Ditmars, *Reptile Book*, p. 115, 1907.

aa. Supraorbital plates in five rows; inside row of small plates, second and third rows of larger, subequal plates, fourth and fifth rows of small plates and more or less irregular. . . . *S. graciosus* Baird and Girard.

Sceloporus consobrinus Baird and Girard

YELLOW-BANDED SWIFT (*Figures 10 and 11*)

Sceloporus consobrinus Baird and Girard, in Marcy, *Rept. Red River Reptiles*, p. 237, 1853.

Sceloporus consobrinus—YARROW, *Wheeler Survey*, Vol. V, p. 574, 1875 (Pagosa, Colo.); CARY, *N. Am. Fauna*, No. 33, p. 26, 1911 (Douglass Spring, Escalante Hills, LaVeta and Arboles, Colo.).

Sceloporus undulatus—ELROD, *The Museum*, Vol. I, p. 137, 1895 (Garden of the Gods, Colo.); COCKERELL, *Univ. Colo. Studies*, Vol. VII, p. 131, 1910 (Meeker, Colo., and four miles west of Meeker, Colo.).

Sceloporus elongatus—CARY, *N. Am. Fauna*, No. 33, p. 26, 1911 (Arkins, Escalante Hills, Meeker, Rangeley, Plateau Creek and McElmo, Colo.).

Head somewhat pointed anteriorly, widest in the region of the eyes and very slightly narrower behind the eyes, length of the head about 1.5 in the length of the hind foot, profile sloping; supraorbital plates in four rows, the inside row of small plates, a second row of large plates, the two outside rows of small plates; a pit on each side of the neck near the ear opening, guarded by large scales and lined with very small scales; length from tip of snout to the vent not more than 1.5 in the length of the tail; total length six to eight inches.

General color yellowish or greenish gray; two stripes of yellow or a yellowish gray lighter than the ground color, on each side; the upper of these stripes the brighter, covering two or three rows of scales; the lower separated from the upper by seven to nine rows of scales, and covering three or four rows of scales, quite suffuse along its ventral margin; between the two light stripes, the ground color may be slightly darker than the general ground color, producing a dark stripe; dorsally with many very fine cross bands of black, these bands often being less than a half of a millimetre wide but so dark as to be quite distinct; ventral parts whitish or yellowish, rarely greenish, with quite a few small black or dark brown dots; throat of the male with a bright peacock blue band, traces of which may appear in the female; sides of the abdomen of the male with large greenish blue blotches.

This species is quite common through the Rocky Mountain region, ranging south into Mexico. By some zoölogists it is considered as but a variety of the common swift of the east, *S. undulatus* (Latreille). *S. consobrinus*, however, is a species of the elevated arid portion of the United States.

Colorado specimens.—*University Museum:* Boulder, May 18, 1907 (171 mm.), F. Rohwer, No. 207; Little Fossil Mountain, near Rifle, July 2, 1908 (160 mm.), S. A. Rohwer, No. 209; Perry Park, July 25, 1908 (146 mm.), Albert Dakan, No. 212; Box Elder Creek, foothills, northwest of Ft. Collins, August 13, 1908, J. Henderson, No. 68; four miles west of Meeker, August 11, 1909 (2 specimens, 110 and 150 mm.), J. Henderson and T. Duce, No. 208; Boulder, October 9, 1911 (157 mm.), Ben Rowland, No. 146; two miles east of Durango toward Rio Florida, August 11, 1912 (144 mm.), J. Henderson and M. M. Ellis, No. 210; near Chautauqua, Boulder, September 21, 1912 (56 mm., vent to snout, with regenerating tail), N. deW. Betts, No. 211; Wray, October 27, 1912 (2 specimens, 70 and 75 mm.), M. M. Ellis and A. G. Vestal, No. 213; *Colorado State Historical and Natural History Museum:* Estabrook, July 4, 1903 (2 specimens, 120 and 130 mm.), H. B. McCurdy; Estabrook, July 11, 1903 (120 mm.), E. A. Dugan; Durango, August 27, 1903 (3 specimens, 110 to 125 mm.), H. G. Smith; Buffalo Park, September 7, 1903 (150 mm.), W. C. Ferril; Wray, September 17, 1903 (150 mm.), H. G. Smith; Pagosa, August 8, 1904 (2 specimens, 105 and 115 mm.), H. G. Smith; Grand Junction, September 16, 1904 (40 mm.), H. G. Smith; Grand Junction, September 17, 1904 (3 specimens, 130–145 mm.), H. G. Smith; Wray, May 31, 1905 (90 mm.), H. G. Smith; Grand Junction, August 13, 1905 (6 specimens, 100–125 mm.), H. G. Smith; Basalt, August 16, 1905 (120 mm.), H. G. Smith; *Colorado Museum of Natural History:* Trinidad, August 5, 1909 (3 specimens, 60–120 mm.), L. J. Hersey; Ponia, near Trinidad, August, 1910 (120 mm.), L. J. Hersey; *Agricultural College Museum:* Larimer County, May 11, 1902 (180 mm.), W. L. Burnett; *private collection* of A. G. Vestal, Wray: October 27, 1912 (50 mm.), A. G. Vestal; *State Teachers' College Museum:* Trinidad, A. E. Beardsley.

Sceloporus graciosus Baird and Girard

SAGE-BRUSH SWIFT

Sceloporus graciosus Baird and Girard, *Proc. Acad. Nat. Sci. Phila.*, Vol. VI, p. 69, 1852.

Sceloporus graciosus—CARY, *N. Am. Fauna*, No. 33, p. 24, 1911 (Bear River Bluffs near Maybell, Colo., and twenty miles west of Baggs Crossing, Colo.).

This swift is quite similar to *S. consobrinus*, from which it differs in the arrangement of the supraocular plates. These are in five rows, an inside row of small plates, followed by two rows of medium-sized plates, with two outside rows of small plates. In coloration it is also much the same as *S. consobrinus*. There are two yellowish stripes on each side separated by a dusky area covering from seven to nine rows of scales. In this dusky area, however, there is a row of more or less crescent-shaped spots of dark brown or black. There are also two rows of these same spots dorsally between the two upper light stripes. *S. graciosus* is a species of the Great Basin, ranging from Oregon south into Mexico.

Reported by Cary, *l.c.*, from Escalante Hills, valleys of Texas and Evacuation Creeks; Rio Blanco Co.; Grand Valley, north of Mack, Colo.; Rifle, Coventry and McElmo, Colo.

Genus **HOLBROOKIA** Girard

Holbrookia Girard, *Proc. A.A.A. Sci.*, Vol. IV, p. 201, 1851.

Scales small and smooth; throat with a gular fold; tail shorter or longer than the body; ear openings covered; femoral pores present; body depressed; size small.

The Spotted Lizards, *Holbrookia*, range from Wyoming and Utah south into Mexico, from Kansas into California.

Holbrookia maculata Girard

SPOTTED LIZARD (*Figures 7, 8 and 9*)

Holbrookia maculata Girard, *Proc. Am. Asso. Adv. Sci.*, Vol. IV, p. 201, 1851.

Holbrookia maculata—COPE, *Rept. U.S.N.M.*, p. 297, 1898 (Colorado Springs, Colo.).

Holbrookia maculata maculata—YARROW, *Wheeler Survey*, Vol. V, p. 563, 1875 (Denver and Colorado Springs, Colo.).

Holbrookia maculata propinqua—YARROW, *Wheeler Survey*, Vol. V, p. 564, 1875 (Twin Lakes, Colo.).

Head somewhat rounded anteriorly, widest in the region of the eyes, not well marked off from the neck, 1.00 to 1.25 in the length of the hind foot, profile rather abruptly sloping; length of the tail less than the length of the body from the tip of the snout to the vent; size small, total length less than six inches.

General color gray or greenish gray to brownish yellow; two rows of about twenty dark, irregular spots on each side of the back, these spots more or less confluent on the tail; many small light spots dorsally; ventral parts whitish; two or three dark blue or black spots on each side of the abdomen just back of the fore-limb.

Range, that of the genus.

Colorado specimens.—*University Museum:* Denver, May 14, 1905 (90 mm.), H. Markman, No. 214; LaJunta, July, 1905 (4 specimens, 95–110 mm.), G. S. Dodds, No. 215; Boulder, September, 1907 (150 mm.), F. Rohwer, No. 216; eight miles east of Platteville, June 18, 1912 (9 specimens, 85–95 mm.), J. Henderson and R. M. Butters, No. 217; *Colorado State Historical and Natural History Museum:* Denver, 1872 (75 mm.), J. W. LaMunyon; Denver, 1878 (2 specimens, 80 and 90 mm.), H. G. Smith; Denver, 1900 (2 specimens, 70 and 80 mm.), W. C. Ferril; Denver, 1903 (2 specimens, 80 and 85 mm.), W. C. Ferril; Wray, September 23, 1903 (100 mm.), H. G. Smith; Barr, June 13, 1906 (105 mm.), A. H. Felger; *State Teachers' College Museum:* Trinidad, A. E. Beardsley; *reported* common all along the foothills from Trinidad to the Wyoming line by Beardsley.

Genus **PHRYNOSOMA** Wiegmann

Phrynosoma Wiegmann, *Isis*, p. 367, 1828.

Body stout, depressed, and somewhat arched in the mid-dorsal region; head bearing several bony processes or "horns," particularly in the temporal and occipital regions; lateral margins of the body with one or two rows of large, elevated scales; scales of the back irregular in size and shape, many pointed, keeled and elevated; scales of the ventral surface smaller and more regular; a distinct gular fold; femoral pores present; no abdominal ribs; viviparous or oviparous.

To this genus and the following one, *Anota*, belong the "Horned Toads" of North America. This term is, however, incorrect, as these queer little animals are true lizards and should be known as Horned Lizards. In spite of their peculiar and rather offensive appearance they are quite harmless. When disturbed they often swell up and assume a defensive attitude. If sufficiently irritated they will squirt several drops of blood from just above the eyes.[1] This blood may be driven a distance of almost a foot. Because of this peculiar habit many strange stories are told of these animals and they are commonly

[1] *Proc. U.S. Nat. Mus.*, Vol. XV, pp. 375–378, 1892.

regarded as very dangerous by the Negroes in the southwest. They depend upon their general appearance for protection, as they move rather slowly. Their cephalic horns are very effective as protective structures in rendering them difficult to swallow. Cope[1] records finding a rattlesnake, which had died from attempting to swallow a *Phrynosoma*, with the occipital horns forced through its skin. Strecker[2] found a hawk dead from the same cause.

Horned Lizards are found from Washington to Southern Mexico. They range as far east as Missouri and Arkansas, being restricted to the arid and semi-arid regions.

The two species of this genus found in Colorado may be distinguished by the following key.

a. One row of elevated, pointed scales along each lateral margin of the body; horns short . . . . *P. hernandesi* (Girard).

aa. Two rows of elevated, pointed scales along each lateral margin of the body; horns long and prominent . . . . . *P. cornutum* (Harlan).

Phrynosoma hernandesi (Girard)

HERNANDEZ'S HORNED TOAD OR LIZARD (*Figures 12 and 14*)

Tapaya hernandesi Girard, *Wilkes U.S. Expl. Exped., Herpt.*, p. 395, 1858.

Phrynosoma douglassii douglassii—YARROW, *Wheeler Survey*, Vol. V, pp. 580 and 581, 1875 (Ft. Garland, Colorado Springs and Pagosa, Colo.).

Phrynosoma douglassii hernandesi—COPE, *Rept. U.S.N.M.*, p. 414, 1898 (Pagosa and Colorado Springs, Colo.).

Phrynosoma hernandesi—COCKERELL, *Univ. Colo. Studies*, Vol. VII, p. 131, 1910 (Meeker, Colo., and two miles southeast of Meeker, Colo.).

Horns short, not exceeding the diameter of the eye in length; one rather prominent horn projecting backward from the posterior end of each canthus rostratus; three directed outward and backward from the lateral angles of the head in the temporal region; a short horn on each side of the occipital region, pointing backward and upward, and a very small median occipital horn.

One row of elevated, pointed scales on each lateral margin of the body; dorsal scales irregular in size and shape, many elevated, pointed

[1] *Rept. U.S.N.M.*, p. 404, 1898.

[2] *Proc. Biol. Soc. Wash.*, Vol. XXI, p. 168, 1908.

and keeled; ventral scales smooth, closely set and of rather uniform size and shape; nasal openings on the canthi rostrati; gular fold prominent.

Length of the head 2 to 3 in the maximum width of the body, 1 to 1.25 in the maximum width of the head; tail short, 1.20 to 1.75 in the maximum width of the body.

Color grayish to blackish, varying toward brown; a lighter mid-dorsal streak; under parts whitish.

Average specimens, about 100 mm.

The specimen from Monarch contained 14 tenebrionid beetles, *Eleodes* sp. and a large number of ants.

This species is viviparous. The young, which usually number less than twelve, are born in the middle or late summer.

Range, Oregon to Arizona, east to Kansas.

Two forms of this species may be recognized, a plains form and an upland form, scarcely entitled to recognition as subspecies.

a. Occipital spine more nearly vertical than the last temporal spine when the head is viewed from the side; tail shorter than the hind limb; plains form. *P. h. ornatissimum* (Girard).

aa. Occipital spine and the last temporal spine directed backward at about the same angle when seen from the side; tail equal to or longer than the hind limb; upland form . . . . *P. h. hernandesi* (Girard).

Colorado specimens.—*University Museum:* Boulder, September 7, 1907 (45 mm.), W. H. Foster, No. 218; Boulder, August 28, 1908 (95 mm.), A. L. Goodrich, No. 219; Owens Lake, Boulder County, August, 1908 (78 mm.), F. Rohwer, No. 220; Boulder, August, 1908 (90 mm.), F. Rohwer, No. 221; two miles southeast of Meeker, August 8, 1909 (72 mm.), W. W. Robbins, No. 59; four miles east of Wellington, June 13, 1911 (100 mm.), J. Henderson, No. 222; Cottonwood Springs, north of Ft. Morgan, June 22, 1912 (95 mm.), J. Henderson, No. 223; *Colorado State Historical and Natural History Museum:* Denver, July, 1873 (90 mm.), Mary G. Smith; Denver, August 2, 1900 (120 mm.), W. C. Ferril; Denver, May 20, 1903 (2 specimens, 95 and 100 mm.), W. C. Ferril; Denver, Capitol Grounds, August 14, 1903 (9 specimens, 80–120 mm.), W. C. Ferril; LaVeta Pass, August 21, 1903 (60 mm.), C. E. Langerr; Antonito, August 22, 1903 (90 mm.), H. G. Smith; Hugo, June 9, 1906 (110 mm.), W. C. Ferril; *Colorado Museum of Natural History:* Trinidad, August, 1909 (26 specimens, about 25 mm.), L. J. Hersey; *Agricultural College Museum:* Cortez, August 13, 1903 (120 mm.), S. A. Johnson; *private collection* of A. G. Vestal, Monarch, Boulder County, May 17, 1912 (115 mm.), A. G. Vestal; *State Teachers' College Museum:*

Trinidad and Greeley, A. E. Beardsley; *reported* by Cary, *l.c.*, from both sides of the range as *Phrynosoma ornatissimum.*

Phrynosoma cornutum (Harlan)

TEXAS HORNED TOAD (*Figure 13*)

Agama cornuta Harlan, *Journ. Acad. Nat. Sci. Phila.*, Vol. IV, p. 299, 1825.
Phrynosoma cornutum—COPE, *Rept. U.S.N.M.*, p. 435, 1898 (Pagosa and Colorado Springs, Colo.).

Horns long, the longest more than twice the diameter of the eye in length; one short stout horn directed backward and outward from the posterior end of each canthus rostratus; three from the temporal region on each side pointing outward and backward, of these the anterior is the shortest, the middle one the longest and the posterior one just equal to or usually slightly shorter than the middle one; two large occipital horns, one on each side, directed upward and somewhat backward, these being the largest of the horns; a small, median occipital horn.

Two rows of elevated pointed scales on each lateral margin of the body; dorsal scales of various sizes, many large, flattened, keeled and elevated; scales on ventral parts more or less distinctly keeled.

Nasal openings between the canthi rostrati; gular folds prominent and covered with keeled scales.

Length of the head 1.25 to 1.75 in the width of the head, almost 3 in the maximum width of the body; tail long, about equal to the maximum width of the body in length.

Color grayish brown to blackish brown, subject to much variation; usually twelve, more or less distinct spots of a slightly darker color than the ground color may be seen on the dorsal surface; below whitish; tail irregularly marked above; a median dorsal stripe lighter than the ground color.

Size moderately large, average specimens 125 mm. or larger.

This species, unlike the other members of this genus, is oviparous. Strecker,[1] who has studied the egg-laying habits of this lizard, finds that it lays about two dozen eggs in a burrow some six or seven inches

[1] *Proc. Biol. Soc. Wash.*, Vol. XXI, pp. 165–168, 1908.

deep. These burrows are usually constructed on sloping ground. The eggs are placed in layers, each layer being carefully covered with packed dirt. The breeding season is from April to the last of July.

Range, north to Colorado, east to Missouri, south into Mexico. Abundant in Texas.

Colorado specimens.—*University Museum:* Boulder, June 23, 1911 (135 mm.), E. Bethel, No. 124. As a specimen of this species escaped from captivity near the University campus about this time it is thought that this specimen does not represent a true record for this species. *Colorado State Historical and Natural History Museum:* Denver, 1872 (4 specimens, 80–105 mm.), J. W. LaMunyon, locality uncertain; *State Teachers' College Museum:* Trinidad, A. E. Beardsley.

Genus **ANOTA** Hallowell

Anota Hallowell, *Proc. Acad. Nat. Sci. Phila.*, p. 182, 1852.

Characters of the genus the same as those of *Phrynosoma* excepting the covered ear opening.

Anota modesta (Girard)

Little Horned Toad

Phrynosoma modestum Girard, *Stansb. Exped. Great Salt Lake*, p. 361, 1852.

We have no specimens of this species in our collection. Professor T. D. A. Cockerell reports this species from the Wet Mountain country in Custer Co., Colo. The specimen which he collected there some years ago was sent to Washington and the identification of *Phrynosoma modestum* (Girard) returned. The specimen is lost and we are unable to ascertain by whom it was determined. This species is included in this report only as a species likely to be found in southern Colorado, since it is found in northern New Mexico. We quote Cope's description, as we have not examined specimens of it.

Smallest of the species. Head broadly rounded; muzzle very obtuse, profile descending steeply from a tranverse angle above the nostrils. Temporal regions expanded, supporting a series of acuminate tubercles from below the front of the orbit, of which the posterior only is distinctly a horn. It is directed posteriorly, having usually the same direction and length of the occipital. One short acute occipital horn on each side; no interoccipital. Posterior superciliary plate angular, but not prominent. Infralabials increasing regularly in size to the posterior, which are not very prominent. Gular scales equal. A strong prehumeral fold, in front of which is a fossa, and in front of this a semicircular fold convex backward with a few larger tubercles on its border. . . . . In life the color of this species is a light yellowish brown, sometimes with a shade of pink. A blackish spot begins on each side of the nape and extends round to a point anterior to the humerus. There is sometimes a sooty shade on each side from the middle to the groin. A small blackish spot behind the vent on the middle line, and frequently a similar spot on each side of the anterior border of the vent. There are no dorsal spots or cross bars, but the tail is indistinctly annulate with blackish. Under surface pale yellowish, immaculate, except the gular region, which is generally indistinctly dusky spotted.—*Rept. U.S.N.M.*, pp. 437 and 438, 1898.

Family Teiidae

The Striped Lizards

This family of lizards, which contains a fairly large number of species, is found only in the New World. Only a single genus is found in the United States, *Cnemidophorus*.

Genus **CNEMIDOPHORUS** Wagler

Cnemidophorus Wagler, *Syst. Amph.*, p. 154, 1830.

Dorsal scales rather small, ventrals large; gular fold present, double; head plates large and regular; ear openings exposed; femoral pores present; scaled portion of the tongue heart-shaped or V-shaped posteriorly; body elongate; size medium, length up to twenty inches, of which the small, elongate tail makes up over half; range, United States generally, south into South America. Three species have been taken in Colorado.

a. Under part of the throat with a band of scales distinctly and abruptly larger than the adjoining scales.

b. Femoral pores, 15 to 17; posterior margin of the frontal plate just reaching the junction of the second and third supraocular plates, so that the suture between second and third supraocular plates appears continuous with that separating the frontal and fronto-parietal plates; head tapering rather uniformly to the snout; no large, post-antebrachial plates; size small. . . . . . *C. sexlineatus* (Linnaeus).

bb. Femoral pores, 18 to 25; posterior margin of the frontal plate passing the junction of the second and third supraocular plates; head rather suddenly pointed beyond the eyes; large post-antebrachial plates present; size medium. . . . . . *C. gularis* Baird and Girard.

aa. Under part of the throat without a band of large scales; size moderately large. . . . . *C. tessellatus* (Say).

The color pattern of these three species is so similar and so subject to the same type of variation that a comparative description will perhaps be more effective than individual descriptions of each.

The typical pattern as shown by the young of all three species is composed of a series of four to eight longitudinal stripes of yellow on a ground color of dark brown or olive. In *C. sexlineatus* these stripes remain prominent throughout life on the body and the anterior portion of the tail. On the posterior portion of the tail they break up and disappear. The spaces between the light stripes are darker than the general ground color.

The next type of pattern is that of the adult *C. gularis*. The young of this species are marked much like the adult of *C. sexlineatus*, although the two dorsal light stripes show a tendency to be less distinct. The adult, however, has irregular rows of light spots in the dark area between the longitudinal stripes, and the stripes themselves tend to break down into spots. In some specimens this is completed so that they resemble typical individuals of *C. tessellatus*.

In the adult *C. tessellatus* the breaking up of the longitudinal stripes is usually complete, so that the typical pattern of this lizard is one of spots, the spots being those between the longitudinal stripes and the remains of the longitudinal stripes. The light spots may even become so prominent as to appear to form the background, thus giving a yellowish background with dark spots. The young of this species are marked much like the adult *C. sexlineatus*. Cope[1] gives a series of figures showing the parallel variation of the dorsal pattern of *C. gularis* and *C. tessellatus*.

The ventral parts of all three species are whitish, yellowish or even greenish and the dorsal ground color is subject to the same variation in shades of color that is found in other lizards. The tail when complete (most specimens will have lost portions of the tail if they are of

[1] Cope, *Rept. U.S.N.M.*, pl. 5, 1898.

any size) is more than twice the length of the body and is covered with larger, coarser scales.

Cnemidophorus sexlineatus (Linnaeus)

Race Runner; Six-Lined Lizard

Lacerta sexlineata Linnaeus, *Syst. Nat.*, 12th ed., Vol. I, p. 364, 1766.

Cnemidophorus sexlineatus—Cope, *Rept. U.S.N.M.*, p. 597, 1898 (Plateau Creek, near Eagalite, Colo.).

Colorado specimens.—*Colorado State Historical and Natural History Museum:* Denver, May 21, 1900 (160 mm.), H. G. Smith; Grand Junction, September 16, 1904 (4 specimens, 105–130 mm.), H. G. Smith; Wray, May 31, 1905 (175 mm.), H. G. Smith; *Colorado Museum of Natural History:* Ponia, near Trinidad, August, 1910 (2 specimens, 90 and 120 mm.), L. J. Hersey; *State Teachers' College Museum:* Corrizo Creek, Las Animas County, and Greeley, A. E. Beardsley.

Cnemidophorus gularis Baird and Girard

Spotted Race Runner

Cnemidophorus gularis Baird and Girard, *Proc. Acad. Nat. Sci. Phila.*, p. 128, 1852.

Cnemidophorus gularis—Cary, *N. Am. Fauna*, No. 33, p. 27, 1911 (Grand Valley, McElmo and Hotchkiss, Colo.).

Colorado specimens.—*Reported* by Cary, *l.c.*, from Golden, Colo.

Cnemidophorus tessellatus (Say)

Tessellated Lizard

Ameiva tessellata Say, *Long's Exped. Rocky Mts.*, Vol. II, p. 50, 1823 (Canyon of Arkansas, Colo.).

Cnemidophorus tigris—Cary, *N. Am. Fauna*, No. 33, p. 26, 1911 (Plateau Creek and McElmo, Colo.).

Colorado specimens.—*Colorado State Historical and Natural History Museum:* Grand Junction, May 17, 1906 (2 specimens, 260 and 270 mm.), W. C. Ferril.

Family Scincidae

The Skinks

A very large family of lizards of cosmopolitan distribution. Two genera are known from the United States, one of which, *Eumeces,* is represented in the Colorado fauna.

Genus **EUMECES** Wiegmann

Eumeces Wiegmann, *Herpt. Mex.*, p. 36, 1834.

Scales smooth and polished, very closely and firmly set, moderately large; no gular fold; ear openings not covered; no femoral pores; size small to moderately large.

A genus of wide distribution, species of *Eumeces* being known from North America, Africa and Asia. Four species are recorded from Colorado and a fifth will doubtless be found when the collections are made more complete. This fifth species, *Eumeces quinquelineatus* (Linnaeus), is accordingly included in the key, since it is reported from some of the adjoining states.

a. Fifth hind toe longer than the second; scales in 28 to 32 rows; head 4.5 in the length without the tail. . . . *E. quinquelineatus* (Linnaeus).

aa. Fifth hind toe shorter than the second.
- *b.* Scales in 28 to 30 rows.
  - c. Free portion of the fifth hind toe more than half the length of the head. . . . . *E. guttulatus* (Hallowell).
  - cc. Free portion of the fifth hind toe less than half the length of the head. . . . . *E. obsoletus* (Baird and Girard).
- *bb.* Scales in 26 rows. . . . . . . *E. leptogrammus* (Baird).
- *bbb.* Scales in 24 rows. . . . . . *E. multivirgatus* (Hallowell).

This key is adapted from Cope, as specimens of all of these species were not at hand for examination.

Eumeces obsoletus (Baird and Girard)

SONORAN SKINK (*Figures 15 and 16*)

Plestiodon obsoletum Baird and Girard, *Proc. Acad. Nat. Sci. Phila.*, p. 129, 1852.

Head somewhat pointed anterior to the eyes; profiles sloping evenly; length of the head about 5 in the length of the head and body; size rather large; length up to 12 inches.

Color variable in the different stages; color of the adult, yellowish, greenish or olive brown, head with a reddish cast, tail lighter and often rather blue; five rather indistinct, longitudinal yellowish stripes;

medium-sized individuals with the yellowish stripes quite distinct; young specimens much darker than the adults, with the stripes very indistinct.

This lizard, like the other species of the genus, has the power to break off its tail when it is seized by that part. The escaping tail-less lizard regenerates a new tail. Specimens are often taken with a small half-formed tail, showing the loss of a former tail.

This skink ranges from Utah and Wyoming south into Mexico, east into Kansas and Nebraska.

Colorado specimens.—*University Museum:* four miles east of Wellington, June 13, 1911 (108 mm.), J. Henderson and R. M. Butters, No. 224; Greasewood Lake southeast of Osgood, June 23, 1912 (90 mm.), J. Henderson, No. 225; *State Teachers' College Museum:* near Greeley, A. E. Beardsley.

Eumeces guttulatus (Hallowell)

BLUE-SPOTTED SKINK

Lamprosaurus guttulatus Hallowell, *Proc. Acad. Nat. Sci. Phila.*, p. 206, 1852.

Dorsal stripes wanting; a row of bluish spots over each eye and on the chin; dorsal parts uniformly blackish in the young, becoming olive green in the adult; tail of the young bluish; size small, length less than five inches. Range, Colorado south to Mexico.

Colorado specimen.—*State Teachers' College Museum:* Corrizo Creek, Las Animas County, A. E. Beardsley.

Eumeces leptogrammus (Baird)

HAYDEN'S SKINK

Plestiodon leptogrammus Baird, *Proc. Acad. Nat. Sci. Phila.*, p. 256, 1858.

General color dark green above, bluish to dark blue below; five dorsal stripes of greenish white dots, the mid-dorsal stripe being the widest and most prominent. Range, Nebraska, Wyoming south to Texas.

Colorado specimen.—*State Teachers' College Museum:* Big Bend, Weld County, A. E. Beardsley.

Eumeces multivirgatus (Hallowell)

MANY-LINED SKINK

Plestiodon multivirgatum Hallowell, *Proc. Acad. Nat. Sci. Phila.*, p. 251, 1857.

General color grayish green to olive green; ventral parts greenish; mid-dorsal region dark green bordered on each side by four or usually five stripes of brown which alternate with stripes of the ground color.

Range, Nebraska, Colorado and Kansas south into Texas.

Colorado specimen.—*State Teachers' College Museum:* near Greeley, A. E. Beardsley.

Suborder *SERPENTES*

The Snakes

KEY TO THE FAMILIES AND GENERA OF THE COLORADO SNAKES

A. No pits on the sides of the head. . . . . . . *COLUBRIDAE*

B. Maxillary teeth without grooves (all of the Colorado *Colubridae* excepting one small, reddish snake with a black head, belong here).

C. Anal plate entire.

D. Scales in 17 to 25 rows.

E. Scales keeled; 17 to 21 rows.

Thamnophis Fitzinger (page 82).

EE. Scales smooth; 19 to 25 rows.

Ophibolus Baird and Girard (page 90).

DD. Scales in 29 to 35 rows.

Pityophis Holbrook (page 92).

CC. Anal plate divided.

F. Scales distinctly keeled.

G. Rostral plate projecting and recurved, producing a "snout." . . . *Heterodon* Latreille (page 95).

GG. Rostral plate not projecting as above.

H. Loreal plate present.

Tropidonotus Kuhl (page 96).

HH. Loreal plate absent.

Storeria Baird and Girard (page 98).

FF. Scales smooth or very faintly keeled.

I. Nasal plates, one on each side; size small.

J. Dorsal parts uniform bright green.

Liopeltis Cope (page 99).

JJ. Dorsal parts not green; general color gray, brownish or reddish. . . *Chionactis* Cope (page 100).

II. Nasal plates, two on each side.

K. Maxillary teeth subequal; scales smooth; size small; dorsal parts uniform ashy brown to bluish black; with or without yellowish red collar; ventral parts orange or red.

Diadophis Baird and Girard (page 101).

KK. Posterior maxillary teeth longer than those in front; scales smooth or faintly keeled; size large; young specimens striped and spotted dorsally.

Zamenis Wagler (page 103).

BB. Posterior maxillary teeth with grooves; anal plate divided; loreal plate absent; scales smooth.

Tantilla Baird and Girard (page 106).

AA. Head with a pit on each side between the eye and nostril; fangs present, large, hollow, and erectable; species venomous. . . *CROTALIDAE.*

L. Top of head covered with closely set, small scales, excepting the large supraocular plate above each eye.

Crotalus Linnaeus (page 107).

LL. Top of the head covered by nine large plates.

Sistrurus Garman (page 110).

Family Colubridae

To this family belong the majority of species of snakes. The family as a whole is known as one of harmless snakes.

Genus **THAMNOPHIS** Fitzinger

Thamnophis Fitzinger, *Syst. Rept.*, p. 26, 1843.
Eutainia Baird and Girard, *Cat. N. Am. Reptiles*, Pt. I, p. 24, 1853.
Eutaenia Cope, *Proc. Am. Phil. Soc.*, p. 495, 1886.

Anal plate entire (we have an exceptional specimen from Meeker, Colo., of *Thamnophis elegans*, with the anal plate divided); scales in 17 to 23 rows, all distinctly keeled excepting those of the first row on each side, which are also usually more or less keeled; superior labials, usually 7 or 8, sometimes 6 or 9; preoculars, 1, sometimes 2, rarely 3; posterior maxillary teeth, especially the last two or three, longer than those in front; small to medium sized snakes; general color pattern of three stripes, a dorsal and two laterals, on a darker ground color.

The Garter Snakes, genus *Thamnophis*, are the most abundant and most variable group of North American snakes. The color pattern, and the number of scale rows, labials and other plates are subject to great variation, almost every combination within the limits of the genus being known. As a result some sixty-five forms of *Thamnophis* have been described, which have been variously ranked by different zoölogists as species, varieties and synonyms. The garter snakes are usually semi-aquatic in habit. Few species are found far from water. All species are viviparous and produce large numbers of young. When pursued the garter snakes will try to escape but when captured they attempt to bite vigorously and usually emit a substance from the anal glands which gives off a sweet, sickening odor. These snakes are quite harmless.

Range, from Central America over most of North America as far north as Canada.

Key to the Colorado Species of Thamnophis

It is to be noted that the species of this genus vary in such a way as to produce a seeming intergradation of all forms. Several types are distinct, however, and of these four are found in this state. In the identification of Garter Snakes particular attention should be paid to the locality from which the specimen was collected.

a. Lateral stripe on the *third* and *fourth* rows of scales.
- *b.* Superior labials, seven; plains species; in Colorado east of the main range. . . . . *Th. radix* (Baird and Girard).
- *bb.* Superior labials, eight; southern Colorado. *Th. megalops* (Kennicott).

aa. Lateral stripe on the *second* and *third* rows of scales.
- *c.* Superior labials, seven; dorsal scales in nineteen rows; postgenial a fourth to a half longer than the genial; sides of the body above the lateral stripe with spots of brick red color; Colorado, general. *Th. parietalis* (Say).
- *cc.* Superior labials, eight; dorsal scales in twenty-one rows; genials and postgenials subequal; Colorado, general except in the eastern plains. *Th. elegans* (Baird and Girard).

Thamnophis radix (Baird and Girard)

Plains Garter Snake (*Figures 17, 18 and 20*)

Eutainia radix Baird and Girard, *Cat. N. Am. Reptiles*, Pt. I, p. 34, 1853.

Eutaenia marciana—Yarrow, *Wheeler Survey*, Vol. V, p. 555, 1875 (Pueblo, Colo.); Yarrow, *U.S.N.M. Bull. 24*, p. 118, 1882 (Pueblo, Colo.).

Eutaenia radix—Cope, *Rept. U.S.N.M.*, p. 1028, 1898 (Pueblo, Colo.); Ruthven, *U.S.N.M. Bull. 61*, p. 77, 1908 (Pueblo, Greeley, Ft. Collins, Colo.).

Dorsal scales typically in 21 rows, in 19 or 21 rows just back of the head, and in 19 or rarely 17 rows over the posterior portion of the body; first row of scales faintly, if at all, keeled, others distinctly keeled, especially those in the mid-dorsal region. Superior labials, usually 7, 1st, 2d, 3d and 7th subequal, 4th, 5th and 6th larger, the 5th being the largest; inferior labials, usually 10, 1st longest, directed mesially and posteriorly, so as to meet the 1st from the opposite side in the mid-ventral line, 2d smallest, 6th largest and widest. Ventrals, about 150, 140–180. Tail one-fifth to one-fourth of the total length.

General color brown or olive, darker dorsally; ventral parts pale yellow, yellowish green or greenish blue. A mid-dorsal stripe, varying in color from a pale lemon yellow to a rich orange red or orange brown, usually orange, beginning in the posterior angle of the parietal plates and continuing to the tip of the tail, covering only one row of scales at its origin, widening over three or four rows just back of the head, narrowing again so as to cover only a single mid-dorsal row and half or more of the adjacent row on each side, from the anal region on, covering only parts of two rows. A lateral stripe of pale yellow, blue or green, somewhat interrupted by black spots from above and below, covering more or less completely the *third* and *fourth* rows of scales on each side, beginning just back of the angle of the jaw and continuing to the base of the tail or beyond. Space between the dorsal and lateral stripes dark and in general of a checkerboard pattern, which is formed by two or three rows of black or dark green spots, each covering about three scales, alternating with the lighter ground color. Below the lateral stripe an irregular row of dark spots alternating with patches of the bluish or yellowish ground color. Two small pale yellow spots, often more or less confluent, on the parietals near or on their mesial edges. Top of the head dark brown to almost black, lighter in the rostral region; labials and postorbitals yellowish or bluish, the labials rather completely crossed at their junctions by black bars. Each ventral with a dark spot on its anterior margin at or just below its junction with the first row of scales, the remainder of each ventral usually of a uniform color, although not infrequently with small black dots or clouds of color.

This description will cover only average specimens. The variation in color is considerable, so that the various elements of the pattern may be either accentuated or obscured.

The food of this active species has been reported by numerous observers. The smaller individuals feed upon earthworms, insect larvae and small tadpoles. As the snake grows, larger food is taken, frogs, large tadpoles, fish, in addition to insects of various sorts. They are particularly fond of grasshoppers. Ruthven[1] has observed this species feeding upon the tree frog, *Chorophilus nigritus*. In habit *Thamnophis radix* is almost amphibious, being found most abundantly in the sloughs and high grass near streams. When disturbed it will go into the water, where it swims and dives actively. It is rarely taken more than a mile from water and the swampy zone along streams is to be regarded as its habitat. It is a viviparous species and produces from fifteen to forty young at one time. These are born in the latter part of the summer, although a specimen taken at Boulder, Colo., in early July, 1912, contained twenty well-developed embryos.

Thamnophis radix is strictly a species of the plains region. It ranges from western Indiana to the foothills of the Rocky Mountains, north into Canada and south to Oklahoma.

Colorado specimens.—*University Museum:* Boulder, April 29, 1906 (4 specimens, 430–710 mm.), No. 227; University Campus, Boulder, October, 1906 (2 specimens, 500 and 580 mm.), No. 228; Niwot, August 31, 1911 (725 mm.), F. Rohwer, No. 226; near Boulder, July 7, 1912 (190 mm.), M. M. Ellis, No. 230; Julesburg, July 17, 1912 (660 mm.), J. Henderson, No. 229; Boulder, October 29, 1912 (240 mm.), M. M. Ellis, No. 231; *Colorado State Historical and Natural History Museum:* Denver, June 27, 1890 (540 mm.), H. G. Smith; Denver, July 31, 1890 (460 mm.), H. G. Smith; Denver, August 15, 1900 (960 mm.), W. C.

[1] *U.S.N.M. Bull. 61*, p. 75, 1908.

Ferril; Aurora Lake, Denver, September 3, 1900 (2 specimens, 475 and 710 mm.), W. C. Ferril; Highline Ditch, Denver, September 3, 1900 (690 mm.), W. C. Ferril; Denver, June 10, 1901 (860 mm.), C. F. Leach; Denver, June 27, 1903 (850 mm.), Mrs. H. B. McCurdy; Yuma, June 6, 1905 (600 mm.), H. G. Smith; Julesburg, August 25, 1905 (230 mm.), H. G. Smith; Boulder, December 12, 1911 (470 mm.), L. C. Bragg; *State Teachers' College Museum:* Las Animas, Baca and Weld counties, A. E. Beardsley; *reported* by Henderson from Goodrich, Colo., June 22, 1912.

Thamnophis megalops (Kennicott)

Arizona Garter Snake

Eutaenia megalops Kennicott, *Proc. Acad. Nat. Sci. Phila.*, p. 330, 1860.

Eutaenia macrostemma megalops—Yarrow, *U.S.N.M. Bull. 24*, p. 117, 1882 (Rio Grande, Colo.).

This species differs from *Thamnophis radix* (Baird and Girard), particularly in the number of superior labials, the usual number being 8, or occasionally 9. The spots between the dorsal and lateral stripes do not give such a pronounced checkerboard pattern and the snake as a whole is of a duller, lighter color.

This species is included in the fauna of Colorado on the record of a specimen taken by H. W. Henshaw, June, 1873, at Rio Grande, Colo. It ranges over the whole of the Mexican plateau and into northern Arizona and New Mexico. It is then to be expected in Conejos, Archuleta, LaPlata and Montezuma counties of Colorado.

Thamnophis parietalis (Say)

Red Barred Garter Snake (*Figure 19*)

Coluber parietalis Say, *Long's Exped. Rocky Mts.*, Vol. I, p. 186, 1823.

Eutaenia sirtalis dorsalis—Yarrow, *Wheeler Survey*, Vol. V, p. 554, 1875 (Rio Grande, Colo.).

Eutaenia sirtalis obscura—Yarrow, *U.S.N.M. Bull. 24*, p. 126, 1882 (southern Platte; between the Arkansas and Cimarron, N.Mex.).

Thamnophis sirtalis parietalis—Ruthven, *U.S.N.M. Bull. 61*, p. 167, 1908 (Ft. Collins, Denver, Greeley, Colo.); Cockerell, *Univ. Colo. Studies*, Vol. VII, p. 131, 1910 (Meeker and Buford, Colo.).

Dorsal scales in 19 rows, in 17 rows over the posterior portion of the body; all scales keeled, those of the first row weakly so. Superior labials, usually 7, 1st, 2d, 3d, and the 4th and 7th, subequal, 5th largest; inferior labials, 10 or sometimes 9. Ventrals, about 160, 145–180. Genials 1.25 to 1.5 in the postgenials. Tail one-fifth to one-third of the total length.

General color olive brown, red brown or almost black; ventral parts grayish yellow, greenish or bluish. A mid-dorsal stripe, varying from lemon yellow to light green or blue in color, beginning in or just posterior to the angle of the parietal plates and continuing to the tip of the tail, covering more or less completely the three mid-dorsal rows of scales in the anterior and middle portion of the body and narrowing so as to cover only parts of two rows in the tail region. A lateral stripe of pale yellow, blue or green, covering completely or in part the *second* and *third* rows of scales, beginning rather indistinctly just back of the angle of the jaw and continuing to the anal region or beyond, in the tail region covering but a single row of scales or a single row and a part of another. Space between the dorsal and lateral stripes dark, pattern indistinctly made up of two rows of black or dark green spots, the upper series of which is usually fused into a dark stripe along each side of the dorsal stripe, lower series quite distinct, the spots alternating with smaller areas of the brick red ground color. First row of scales and the upper edges of the ventrals dusky or even dark, usually giving the lower edge of the lateral stripe sharp definition. Two small pale spots often confluent, on the parietals near or on their mesial edges. Top of the head brownish or blackish, lighter in the rostral region.

The food of this species is probably much the same as that of *Thamnophis radix.* It is known to eat earthworms, insects, frogs and toads. These animals are the common types of food offered in the swampy places frequented by this snake. It is, however, occasionally taken some distance from water. Little is known concerning the breeding habits of this species. Ruthven[1] records a large female from Iowa giving birth to seventy-three young late in September.

Thamnophis parietalis ranges from the Mississippi River to the Pacific Ocean, south to Oklahoma and north into Canada. It is most abundant in the western half of its range.

[1] *U.S.N.M. Bull. 61*, p. 167, 1908.

Colorado specimens.—*University Museum:* Boulder, May 20, 1905 (500 mm.), No. 232; *Colorado State Historical and Natural History Museum:* Denver, June 3, 1901 (1200 mm.), H. G. Smith; Julesburg, May 2, 1906 (860 mm.), W. C. Ferril; *Agricultural College Museum:* Ft. Collins, April 30, 1892 (3 specimens, 150–300 mm.); *State Teachers' College Museum:* Greeley, A. E. Beardsley.

Thamnophis elegans (Baird and Girard)

WESTERN GARTER SNAKE

Eutainia elegans Baird and Girard, *Cat. N. Am. Reptiles*, Pt. I, p. 34, 1853.

Eutaenia marciana—YARROW, *U.S.N.M. Bull. 24*, p. 118, 1882 (Ft. Garland, New Mexico = Colorado).

Eutaenia vagrans vagrans—YARROW, *Wheeler Survey*, Vol. V, pp. 551–553, 1875 (Twin Lakes, Conejos, Pagosa and San Luis Valley, Colo.); YARROW, *U.S.N.M. Bull. 24*, pp. 119–120, 1882 (Cache la Poudre River, San Luis Valley, Conejos, Twin Lakes, Pagosa, and French Creek, Colo.).

Tropidonotus vagrans—BOULENGER, *Cat. Snakes British Mus.*, Vol. I, p. 203, 1893 (Wales Canyon, Pueblo County, Colo.).

Eutaenia elegans vagrans—COPE, *Rept. U.S.N.M.*, p. 1041, 1898 (Pagosa, Twin Lakes, Conejos, San Luis Valley, Cache la Poudre River, Colo.).

Thamnophis ordinoides elegans—RUTHVEN, *U.S.N.M. Bull. 61*, p. 140, 1907 (Conejos, San Luis Valley, Rio Grande, Durango, Pagosa, Boulder County, Gypsum, Grand Junction, Twin Lakes, Hayden, Colo.).

Thamnophis elegans—COCKERELL, *Univ. Colo. Studies*, Vol. VII, p. 131, 1910 (Meeker and Buford, Colo.).

Thamnophis elegans vagrans—CARY, *N. Am. Fauna*, No. 33, pp. 27, 40, 45, 1911 (Meeker; Higho and Pearl, North Park; Snake River, Slater, Routt County, Colo.).

Dorsal scales in 21 rows, in 19 or 21 rows just back of the head, and in 19 or 17 rows in the posterior portion of the body; first row faintly keeled, others distinctly so. Superior labials, usually 8, first four subequal, 6th the largest; inferior labials, usually 10 (sometimes 9 or 11). Ventrals, about 170, 150–185; tail one-fifth to a little more than one-fourth of the total length. Genials and postgenials subequal.

Ground color brown, brownish green or greenish buff; ventral parts greenish or grayish. A mid-dorsal yellowish stripe, lighter than the ground color, rather indistinct, covering the mid-dorsal row of scales and parts of the adjoining row on each side, interrupted by the dark spots from each side, and often almost obliterated by the darker ground color, in some specimens so interrupted as to cease to be a stripe at all. A lateral stripe of yellowish or bluish color, covering the *second* and *third* rows of scales, often very indistinct and so interrupted as to be scarcely recognizable. Between the dorsal and lateral stripes two rows of black spots, which by alternation with patches of the ground color produce a tessellated pattern. These spots may be quite prominent and the pattern very distinct or they may be scarcely distinguishable from the general ground color. Two small pale yellow spots near or on the mesial margin of the parietal plates more or less surrounded by a cloud of black. Top of the head dark, labials green. Ventrals greenish varying from yellow to gray, each with a dark bar or cloud at its junction with the first row of scales, mesial portion often clouded with black or blue.

The form of this highly variable species found most abundantly in Colorado is that of greenish color and indistinct pattern called variety *vagrans*. The food and habits of *Thamnophis elegans* are much the same as described for the other Colorado garter snakes. Mr. H. G. Smith, of the State Historical and Natural History Museum, told us that the 640 mm. female of this species which he collected at Dolores, Colo., June 27, 1890, gave birth to ten young shortly after her capture. The smallest of these was 190 mm. in length. One of the specimens, No. 61, disgorged a frog, *Rana pipiens*, when captured.

The range of this species is from the foothills on the east side of the Rocky Mountains to the western slope of the Sierra Nevada and Cascade mountains, north to Canada and south into New Mexico and Arizona. It is a species of the high plateau and mountain regions.

Colorado specimens.—*University Museum:* Buford, August 23, 1904 (2 specimens, 570 and 620 mm.), J. Henderson, No. 48; Copeland Park, Boulder County, September 5, 1907 (2 specimens, 580 and 600 mm.), F. Rohwer, No. 237; Allen's Park, Boulder County, September 6, 1907 (690 mm.), S. A. Rohwer, No. 242; Meeker, August 9, 1909 (500 mm.), A. H. Felger, No. 65; Curtis Reservoir, seven miles northeast of Meeker, August 12, 1909 (2 specimens, 270 and 640 mm.), A. H. Felger, No. 61; three miles south of Axial, August 14, 1909 (300 mm.), A. H. Felger, No. 60; Snake Slough, three miles above Meeker, August 17, 1909 (400 mm.), J. Henderson and T. Duce, No. 62; Buford, August 20, 1909 (280 mm.), T. Duce, No. 47; Buford, August 23, 1909 (825 mm.), A. H. Felger, No. 46;

Boulder, May 22, 1910 (280 mm.), S. Searcy, No. 245; Lake Eldora, near Eldora, July, 1910 (2 specimens, 410 and 780 mm.), J. E. Gutberlet, No. 233; Park Lake, Tolland, July, 1910 (3 specimens, 360–470 mm.), W. W. Robbins, No. 240; Mammoth Creek, Tolland, July 28, 1910 (570 mm.), No. 244; Tolland, July 24, 1910 (670 mm.), F. Ramaley, No. 235; four miles northeast of Ohio City, August 22, 1911 (2 specimens, 420 and 550 mm.), A. Daugherty, No. 234; ten miles northeast of Ohio City, July 16, 1911 (570 mm.), F. Rohwer, No. 236; one mile northeast of Ward, near Jim Creek, September 4, 1911 (250 mm.), N. deW. Betts, No. 239; twenty-five miles northwest of Kremmling, July 11, 1911 (230 mm.), J. Henderson, No. 238; four miles northeast of Ohio City, July 14, 1911 (580 mm.), A. Daugherty, No. 6; Muddy Creek, twenty-five miles northwest of Kremmling, July 12, 1911 (410 mm.), J. Henderson, No. 246; East Lake near Tolland, July 12, 1912 (560 mm.), G. S. Dodds, No. 241; west of Nederland, August 30, 1912 (850 mm.), J. Henderson, No. 243; *Colorado State Historical and Natural History Museum:* Dolores, June 27, 1890 (13 specimens, 190–640 mm.), H. G. Smith; Cumbres Pass Lake, August 1, 1900 (480 mm.), H. G. Smith; Buffalo, June 29, 1903 (900 mm.), W. C. Ferril; Estabrook, July 9, 1903 (700 mm.), H. G. Smith; Cumbres Pass, August 24, 1903 (4 specimens, 415–640 mm.), H. G. Smith; Grand Junction, September 16, 1904 (315 mm.), H. G. Smith; *State Teachers' College Museum:* Estes Park, Big Thompson River and upper Cache la Poudre, A. E. Beardsley.

Genus **OPHIBOLUS** Baird and Girard

Ophibolus Baird and Girard, *Cat. N. Am. Reptiles*, Pt. I, p. 82, 1853.

Anal plate entire; scales smooth, in 19 to 25 rows; superior labials, 7 or 8; preoculars, 1; posterior maxillary teeth slightly longer than those in front; moderately large to small snakes; colors bright, pattern usually made up of rings or bands.

The snakes of the genus *Ophibolus* are called King Snakes or less frequently, as the result of the absurd belief that they can milk cows, Milk Snakes. They are of distinct economic importance because of their feeding habits. Their food consists for the most part of small mammals, lizards and other snakes, members of their own species often being included in the last item. They are terrestrial and enter the burrows of rodents and other snakes in their search for food. They feed on poisonous and harmless snakes alike, as they are quite immune to the bite of the former. When killing their prey they often constrict it.

The species of this genus, of which there are some ten or twelve, are confined to North and Central America. They are oviparous.

Ophibolus doliatus (Linnaeus)

WESTERN MILK SNAKE, RED KING SNAKE, OR RINGED KING SNAKE
(*Figure 23*)

Coluber doliatus Linnaeus, *Syst. Nat.*, ed. XII, p. 379, 1766.

Five distinct subspecies of this variable species may be distinguished. The Colorado specimens examined by us were all referable to *O. d. gentilis*, although it is probable that the subspecies *O. d. doliatus* may be found in southeastern Colorado.

a. No oblique black bar back of the eye.
  b. Black bands forming distinct rings entirely around the body; black spots opposite the dorsal bands of the ventral color.
  O. d. gentilis (Baird and Girard).
  bb. Black bands not forming rings around the body.
  O. d. doliatus (Linnaeus).

Ophibolus doliatus gentilis (Baird and Girard)

Ophibolus gentilis Baird and Girard, *Cat. N. Am. Rept.*, Pt. I, p. 90, 1853.

Ophibolus doliatus gentilis Cope, *Check-list N. Amer. Batr. and Rept.*, p. 36, 1875.

Ophibolus triangulus gentilis—GARMAN, *Mem. Mus. Comp. Zoöl.*, Vol. VIII, No. 3, p. 66, 1883 (Colorado and Utah); COCKERELL, *Univ. Colo. Studies*, Vol. VII, p. 131, 1910 (Boulder, Colo.).

Dorsal scales smooth, in 21 or rarely 23 rows; ventrals, 160 to 220; tail one-fifth to one-eighth of the total length.

Predominant color varying from slate brown, through brick red to scarlet; ventral parts light gray to bright yellow; dorsal pattern of twenty to forty irregular blotches of the predominating color, separated by narrower bands of the ventral color, which come up from below, leaving the dorsal blotches as saddles; dorsal blotches strongly margined with narrow black bands (which in two subspecies form complete rings around the body); ventral parts with or without black spots opposite the dorsal bands of the ventral color; top of the head usually with a patch of the predominating color, margined with black, and surrounded by the ventral color. Size medium; length up to three feet.

Range of *O. doliatus*, United States generally, and northern Mexico; of *O. d. doliatus*, Florida north to Maryland and west into Oklahoma and Texas; of *O. d. gentilis*, Nebraska and Colorado, south into Mexico, west of the Mississippi River.

This harmless and useful snake is often mistaken for the poisonous Harlequin Snake, *Elaps fulvius* (Linnaeus), since their color patterns are of the same type and made up of the same color units. We have no records of the Harlequin Snake in Colorado, although it is known from northern and western Texas. The poisonous *Elaps* may be recognized by the order of the colors, as the red band is bordered on each side by a yellow band while in the harmless *Ophibolus* the red band is bordered on each side by a black band.

Colorado specimens.—*University Museum:* Boulder, July 22, 1904 (190 mm.), V. E. Metcalf, No. 128; Boulder, August, 1911 (245 mm.), No. 130; *Colorado State Historical and Natural History Museum:* Yuma, June 6, 1905 (2 specimens, 570 and 630 mm.), Mrs. D. H. Boyes; Orchard, July 12, 1910 (skin only, 340 mm. to lower jaw), Mrs. E. M. Fowle; *Colorado Museum of Natural History:* Clear Creek, near Golden, June, 1912 (450 mm.), alive at the museum when examined by us; *Agricultural College Museum:* Beulah (210 mm.), H. F. Wilson; *State Teachers' College Museum;* Weld, Larimer and Baca counties, A. E. Beardsley.

Genus **PITYOPHIS** Holbrook

Pityophis Holbrook, *N. Am. Herpetology*, Vol. IV, p. 7, 1842.

Anal entire; scales keeled, in 27 to 35 rows; preoculars, 1 or 2; maxillary teeth equal; rostral plate large and recurved between the internasals; a cartilaginous epiglottis which may be elevated vertically in front of the glottis, producing a loud hissing sound when the breath is expelled; large, heavy snakes.

The Bull Snakes, genus *Pityophis*, are the largest of the North American harmless snakes, often reaching the length of eight feet. They are generally believed to be quite dangerous. This is perhaps due to their bold disposition and angry behavior when disturbed. At this time they produce a loud hissing sound which may be heard twenty feet or more and is terrifying enough to the person unfamiliar with this type of snake. The Bull Snakes are oviparous and lay eggs almost as large as hen's eggs. They range over the United States and Mexico. Their food consists largely of small mammals and birds. Because of the large number of rodents eaten by these snakes they are to be regarded as not only harmless snakes, but as beneficial snakes.

Pityophis catenifer (Blainville)

BULL SNAKE (*Figures 24, 25, 26, 35 and 36*)

Coluber catenifer Blainville, *Nouv. Ann. du Mus.*, Vol. IV, p. 290, 1835.

Three subspecies of this snake are recognized, two of which occur in Colorado. These are distinguished particularly by their range and less exactly by the size of the rostral plate.

a. Range, Canada to northern Mexico, west of the Mississippi River and east of the Rocky Mountains; rostral plate separating the internasal plates for two-thirds or more of their length. . . . . . *P. c. sayi* (Schlegel).

aa. Range, west of the Rocky Mountains.

b. Range, Great Basin from Utah and Nevada south to Arizona and New Mexico, east to Colorado and west to the Sierra Nevada Mountains; rostral plate separating the internasal plates for not more than one-third of their length. . . . *P. c. bellona* (Baird and Girard).

bb. Range, west of the Sierra Nevada Mountains; rostral plate just reaching the internasals. . . . . . . *P. c. catenifer* (Blainville).

Pityophis catenifer sayi (Schlegel)

Coluber sayi Schlegel, *Ess. Physionomie des Serpentes*, p. 157, 1837.

Pityophis catenifer sayi Brown, *Proc. Acad. Nat. Sci. Phila.*, Vol. LIII, p. 55, 1901.

Pityophis elegans—YARROW, *U.S.N.M. Bull. 24*, p. 108, 1882 (between the Arkansas and Cimarron, N.Mex.).

Pityophis sayi sayi—YARROW, *U.S.N.M. Bull. 24*, p. 105, 1882 (Pagosa, Colo.); CARY, *N. Am. Fauna*, No. 33, p. 27, 1911 (eight miles west of Naturita, Colo.).

Dorsal scales keeled, excepting the first three or four rows on each side (sometimes as many as 11 rows are smooth on each side), in 27 to 35 rows; superior labials, 8 or 9; inferior labials, 12; postoculars, 3 to 5; nasal opening large and prominent, directed posteriorly; rostral plate large and recurved; ventrals, 200 to 250; tail less than one-fourth of the total length; size large, body heavy, length often eight feet (specimens exceeding nine feet in length have been recorded).

Ground color yellowish gray, or yellowish or reddish brown, often bright yellow or even orange yellow; ventral parts lighter, with an irregular row of dark blotches near the lateral margins of the ventrals; dorsal pattern consisting of a row of rather large, somewhat rectangular, brown, reddish brown or black spots, occupying the mid-dorsal region, these spots often more or less confluent near the head, forming a dark mid-dorsal stripe in which are small spots of the yellowish ground color; between the dorsal row of spots and the ventrals on each side a row of smaller more indistinct spots of a lighter shade than the dorsal spots; head yellowish, with or without a dark stripe from the eye to the posterior angle of the mouth. Mr. L. J. Hersey reports this species from Barr, Colo., as eating the eggs of the Pin Tail Duck, in the summer of 1906.

Colorado specimens.—*University Museum:* Boulder, May 10, 1911 (700 mm.), No. 77; Boulder, October 9, 1911 (410 mm.), B. Rowland, No. 145; *Colorado State Historical and Natural History Museum:* Denver, May 14, 1903 (635 mm.), W. C. Ferril; Colorado, 1896 (1550 mm.); Denver, June 12, 1903 (970 mm.), H. G. Smith; Wray, May 31, 1905 (1130 mm.), H. G. Smith; Julesburg, May 1, 1906 (1040 mm.), W. C. Ferril; *Agricultural College Museum:* Ft. Collins, July, 1892 (1280 mm.), C. P. Gillette; *State Teachers' College Museum:* Las Animas and Baca counties, A. E. Beardsley; *reported* by Henderson from foothills five miles south of Box Elder, Larimer County, 1905; from Osgood, June 23, 1912; from Wild Cat Creek, northeast of Ft. Morgan; by Cockerell, from Boulder, May 22, 1907, as variety, *P. c. sayi.*

Pityophis catenifer bellona (Baird and Girard)

Pituophis bellona Baird and Girard, *Cat. N. Am. Rept.*, Pt. I, p. 66, 1853.

Pityophis catenifer bellona Brown, *Proc. Acad. Nat. Sci. Phila.*, Vol. LIII, p. 54. 1901.

Pityophis sayi bellona—Yarrow, *Wheeler Survey,* Vol. V, pp. 515 and 541, 1875 (Pagosa, Colo.); Yarrow, *U.S.N.M. Bull. 24*, pp. 106–107, 1882 (Pagosa, Cal., probably an error for Col.); Cope, *Rept. U.S.N.M.*, p. 876, 1898 (Pagosa, Colo.).

Colorado specimen.—*State Teachers' College Museum:* Fruita, A. E. Beardsley.

Genus **HETERODON** Latreille

Heterodon Latreille, *Hist. Nat. Reptiles*, Vol. IV, p. 32, 1799.

Anal plate divided; scales keeled, in 23 or 25 rows; rostral plate large, produced, upturned and recurved, producing a "snout" at the end of the head; a ring of scales around each eye, of which three or four are in front of the eye; posterior maxillary teeth much longer than those in front; large, thick-bodied snakes.

The snakes of this genus are known as the Hog-nosed Snakes, and incorrectly as "Spreading Vipers and Adders." The last two names are the result of the ability of these snakes to expand the anterior portion of the body when disturbed so as to resemble somewhat the Asiatic Cobra. They are, however, harmless. When disturbed the Hog-nosed Snakes make a very elaborate show of fight. The snake expands the body just back of the head and strikes vigorously and viciously, although it rarely bites even if opportunity be offered. If these demonstrations are not sufficient the snake may feign death, suddenly, by dropping over on its back. Hog-nosed Snakes are often confused with rattlesnakes by those unfamiliar with them. They feed for the most part on toads and frogs.

The three species of this genus are found only in North America. They are oviparous.

Heterodon nasicus Baird and Girard

WESTERN HOG-NOSED SNAKE (*Figures 28, 29, 30 and 31*)

Heterodon nasicus Baird and Girard, *Cat. N. Am. Reptiles*, Pt. I, p. 61, 1853.

Heterodon nasicus—BAIRD, *Pacific R.R. Survey*, Vol. X, Pt. V, No. 3, p. 19, 1857 (No. 1263, Rocky Mountains).

Heterodon simus nasicus—YARROW, *Wheeler Survey*, Vol. V, pp. 555–556, 1875 (Denver and Pueblo, Colo.); YARROW, *U.S.N.M., Bull. 24*, p. 141, 1882 (Ft. Lyon, Colo.).

Heterodon nasicus nasicus—COPE, *Rept. U.S.N.M.*, p. 777, 1898 (Ft. Lyon, Colo.).

Dorsal scales keeled, in 23 rows; superior labials, 8; inferior labials, 10; 10 or 11 scales around the eye; several small scales between the prefrontals and the internasals; ventrals, 125 to 150; tail one-eighth to one-fourth of the total length; average specimens under three feet; body stout and heavy.

Ground color grayish, to grayish yellow or grayish brown; ventral parts whitish, mottled with irregular dark blotches and with a wide dark area down the center; dorsal pattern of a central row of large, rather rounded, brownish or blackish spots, separated by spaces of about the same size of the ground color; the sides with two rows of dark spots smaller in size, placed one above the other opposite the spaces between the dorsal spots; another set of more suffuse spots showing rather indistinctly between the successive pairs of lateral spots; under parts of the head whitish; top of the head with a narrow light stripe crossing it in the region of the eyes; a dark, oblique band extending from the posterior portion of the supraocular plate to the posterior angle of the mouth, including all or part of the last two superior labials; a second, larger, oblique band, just back of, and separated by a single row of scales from the first dark band.

Range, Montana and Dakota south into Mexico, east to Arkansas. A plains species.

Colorado specimens.—*University Museum:* LaJunta, July, 1905 (425 mm.), G. S. Dodds, No. 247; Hudson, August, 1905 (255 mm.), H. Markman, No. 248; five miles east of Grover, June 26, 1906 (170 mm.), J. Henderson, No. 249; Lodgepole Creek, near Ovid, July 17, 1912 (190 mm.), J. Henderson, No. 250; near Julesburg, July 17, 1912 (525 mm.), J. Henderson and M. M. Ellis, No. 251; three miles east of Osgood, June 22, 1912 (550 mm.), J. Henderson, No. 252; *Colorado State Historical and Natural History Museum:* Denver, August 13, 1902 (460 mm.), C. Murray; Denver, June 2, 1903 (430 mm.), H. G. Smith; Lamar, June 20, 1904 (790 mm.), H. G. Smith; Lamar, June 8, 1904 (750 mm.), H. G. Smith; Denver, June 1, 1905 (480 mm.), E. Bethel; *Agricultural College Museum:* Ft. Collins, July, 1892 (2 specimens, 220 and 310 mm.), C. F. Baker; *State Teachers' College Museum:* Greeley and Trinidad, A. E. Beardsley; *reported* by Henderson from Goodrich, near Crow Creek, June 22, 1912; from Foston, June 25, 1912; from ten miles north of Sterling, July 23, 1912.

Genus **TROPIDONOTUS** Kuhl

Tropidonotus Kuhl, *Isis von Oken*, p. 205, 1826.
Natrix Laurenti, *Synopsis Reptilium*, p. 73, 1768.

Anal plate divided; scales keeled, in 17 to 23 rows; posterior maxillary teeth longer than those in front; rather large snakes.

To this genus belong the Water Snakes. They are found in all parts of the world along streams and in swamps. They lead a semi-aquatic life, feeding upon fish, tadpoles, frogs and other aquatic animals. The many species of this genus are viviparous, producing many young.

Tropidonotus sipedon (Linnaeus)

WATER SNAKE (*Figure 27*)

Coluber sipedon Linnaeus, *Syst. Nat.*, ed. X, p. 219, 1758.

Tropidonotus sipedon—COCKERELL, *Univ. Colo. Studies*, Vol. VII, p. 131, 1910 (Boulder, Colo.).

Dorsal scales keeled, dull and lusterless, in 23 or 25 rows; superior labials, 8 (rarely 9); inferior labials, 9; ventrals, 125 to 150; tail one-fourth or less of the total length.

General color yellowish brown or red brown. Body crossed by fifty or more dark brown or almost black irregular bands, which reach to the ventrals on each side. These bands are most distinct on the sides of the body, dorsally they may be more or less completely broken up into large spots; between these bands or spots are irregular, somewhat triangular patches of the lighter yellowish or reddish ground color, on the sides of the body the ground color often bright red. These markings are usually much obscured in large or old specimens. Ventral parts yellowish or brownish, rather heavily and irregularly blotched, especially back of the anal, with black, gray, brown and red. In the variety *transversus* the ventrals are without markings. Labials pale yellow, their junctions with each other marked with black. Color pattern rather variable, even a green form of this species being known from Florida.

As its name implies, this snake spends the greater part of its life either in the water or very near it. It is often found coiled under loose wet stones on the stream bank. It is quite active and delights to climb into the branches of bushes overhanging the water. The belief is current in many parts of the country that this snake is the dangerous "Water Moccasin." Although sometimes incorrectly called the Moccasin, this snake is one of the harmless species. When given a chance it retires at once if disturbed, but when escape is impossible it makes a bold fight, striking and biting vigorously. At the same time it emits a disagreeable odor from the anal glands.

It feeds on fishes, of which it is particularly fond, frogs, tadpoles and salamanders. This species is viviparous and bears according to Ditmars[1] as many as forty-four young. The average number of young is about twenty-five.

The Water Snake, which is one of the large snakes, reaching the length of four feet, ranges over the most of the United States east of the Rocky Mountains. Three subspecies of this snake may be recognized by their color patterns.

a. Body crossed dorsally by dark bands throughout its length; ventrals spotted. . . . . *T. s. fasciatus.*

aa. Body crossed dorsally by dark bands in the anterior half only; bands giving place to spots in the posterior half; ventrals spotted. *T. s. sipedon.*

aaa. Body marked dorsally with spots only; ventrals without spots. *T. s. transversus.*

Colorado specimens.—*University Museum:* Boulder, 1909 (220 mm.), S. Searcy, No. 67; *Colorado State Historical and Natural History Museum:* Denver, June 27, 1890 (265 mm.), H. G. Smith; Wray, September 18, 1903 (385 mm.), W. C. Ferril; Wray, May 20, 1904 (2 specimens, 650 and 750 mm.), H. G. Smith; Wray, June 15, 1906 (2 specimens, 450 and 1200 mm.), H. G. Smith; *State Teachers' College Museum:* Greeley, Baca, Las Animas and Weld counties, A. E. Beardsley.

Genus **STORERIA** Baird and Girard

Storeria Baird and Girard, *Serpents of North America,* p. 135, 1853.

Anal plate divided; scales heavily keeled, in 15 or 17 rows; loreal plate absent; small snakes; genus restricted to North America.

The genus *Storeria* is represented in Colorado by the species *Storeria dekayi* (Holbrook).

Storeria dekayi (Holbrook)

DeKay's Snake

Tropidonotus dekayi Holbrook, *N. Am. Herpt.,* Vol. III, p. 53, 1842.

Dorsal scales keeled heavily, in 17 rows; superior labials, 7; nasals, 2, with nostril between; ventrals, 120 to 150; caudals, 40 to

[1] Ditmars, *Reptile Book,* p. 353, 1907.

60; tail short, 6 to 9 in the total length; size small, less than 16 inches.

General color above brownish, varying to olive or reddish brown; a pale mid-dorsal stripe, about four scales wide; on each side of the mid-dorsal stripe a row of dark spots, the spots being about two rows of scales apart; below these rows of spots on each side other spots may be present; all of the spots subject to variation; head brown, often with small black dots, and sometimes with a spot under each eye and across the side of the head; ventral parts pinkish to salmon red; ends of the ventrals usually with brown spots.

This small snake is one of the most abundant snakes of eastern United States. It hides under stones and fallen timber and is rarely seen except when sought for. Its food consists of earthworms, slugs and insects. It is viviparous, bearing as many as eighteen young (Ditmars).[1] Some discussion has arisen as to whether this species is aquatic or not. Branson[2] states that all of the Kansas specimens examined by him were either from the water or near the water. On the other hand, this snake has been taken in non-aquatic environments. It is probable that it lives in both habitats.

Range, eastern United States generally, west to the Rocky Mountains and south into Mexico.

Colorado specimen.—*State Teachers' College Museum:* Las Animas County, A. E. Beardsley.

Genus **LIOPELTIS** Cope

Liopeltis Cope, *Proc. Acad. Nat. Sci. Phila.*, p. 559, 1860.

This genus is represented in the North American fauna by but a single species, *L. vernalis* (DeKay). The other species are found in eastern Asia.

Liopeltis vernalis (DeKay)

SMOOTH GREEN SNAKE; GRASS SNAKE; LITTLE GREEN SNAKE

Coluber vernalis DeKay, in Harlan, *Journ. Acad. Nat. Sci. Phila.*, Vol. V, p. 361, 1827.

Liopeltis vernalis—CARY, *N. Am. Fauna*, No. 33, p. 40, 1911 (Rio Pinos, near Vallecito, Colo.).

[1] *Reptile Book*, p. 269. [2] *Kans. Univ. Sci. Bull.*, Vol. II, No. 13, p. 395, 1904.

Dorsal scales in 15 rows, smooth and with a velvety luster; superior labials, 7; inferior labials, 8; ventrals, 120–140; tail about one-third of the total length.

Dorsal parts bright green to olive to the lower edge of the first row of scales (turning bright blue in alcohol); head darker; ventral parts and labials pale yellowish green or yellowish white.

This snake is probably entirely insectivorous. Smooth green caterpillars are its favorite food. It lives among the low underbrush and tall grasses. When disturbed it darts away and quickly conceals itself in the grasses and leaves. It is often found on bushes and briars where its green color makes it very difficult to see unless it is moving. This snake lays from eight to ten eggs. Ditmars[1] gives a very interesting account of finding a nest of this species under a stone in a hollow of moss and lichens. He states that the young were four and five-eighths inches in length when first hatched, olive in color above and greenish white below.

This species ranges over most of the United States east of the Rocky Mountains.

Colorado specimens.—*University Museum:* Boulder, August 11, 1911 (305 mm.), G. A. Smith, No. 127; *Colorado State Historical and Natural History Museum:* Palmer Lake, September 14, 1900 (380 mm.), W. C. Ferril; *reported* by Henderson at Boulder, September 5, 1912.

Genus **CHIONACTIS** Cope

Chionactis Cope, *Proc. Acad. Nat. Sci. Phila.*, p. 303, 1861.

Anal plate divided; scales smooth; scales in 13 to 17 rows; superior labials, 7; size small to medium. Of the several species of this genus but one is known from Colorado.

Chionactis episcopus (Kennicott)

GROUND SNAKE

Lamprosoma episcopum Kennicott, *U.S. Mex. Bound. Survey*, Vol. II, p. 22, 1859.

a. Back crossed by 18 to 25 black bands . . . *C. e. isozonus* Cope.
aa. Back without cross-bands . . . . . *C. e. episcopus* (Kennicott).

[1] DITMARS, *Reptile Book*, p. 326, 1907.

Chionactis episcopus isozonus Cope

BLACK-BANDED GROUND SNAKE

Contia isozona Cope, *Proc. Acad. Nat. Sci. Phila.*, p. 304, 1866.
Chionactis episcopus isozonus Cope, *Rept. U.S. Nat. Mus.*, p. 939, 1898.

Dorsal scales smooth, in 15 rows; superior labials, 7; ventrals, 140 to 160; loreal small; tail about one-fifth of the total length; size small to medium, length under 18 inches. .

General color brownish or grayish with a reddish cast to quite red; back crossed by about 20 black bands separated by equal bands of the ground color, these bands completely encircling the tail, but not quite reaching the ventrals over the body; ventral parts pinkish.

Range, Colorado and Utah south into Mexico.

Colorado specimen.—*State Teachers' College Museum:* Las Animas County, Corrizo Canyon, A. E. Beardsley.

Genus **DIADOPHIS** Baird and Girard

Diadophis Baird and Girard, *Cat. N. Am. Reptiles,* Pt. I, p. 112, 1853.

Anal plate divided; scales smooth, in 15 or 17 rows; superior labials, 7 or 8; inferior labials, 7 or 8; preoculars, 2, rarely 1; maxillary teeth equal; color uniform brownish black, gray or blue above, red or yellow below, usually with a yellow collar; size small, length under two feet.

The Ring-necked Snakes, as those of this genus are called, are small active snakes, which because of their habit of hiding away under stones and bark are not often seen. Their food consists of the small animals which they find in these places, insects, salamanders, earthworms and other smaller snakes. They are oviparous or ovoviviparous.

The four species of this genus and their varieties are restricted to North America and the Bahama Islands.

Diadophis regalis Baird and Girard

SONORAN RING-NECKED SNAKE (*Figures 21 and 22*)

Diadophis regalis Baird and Girard, *Cat. N. Am. Reptiles,* Pt. I, p. 115, 1853.
Diadophis regalis arnyi—COPE, *Rept. U.S.N.M.*, p. 746, 1898 (mouth of Cache Creek, Colo.).

Dorsal scales smooth, with a satin luster or slightly polished, in 17 rows; superior labials, 7; inferior labials, 7; ventrals, 170–250. Body narrowing rather suddenly back of the anal.

Dorsal parts slate brown to brownish or bluish black. Top of the head black or greenish black, smooth and polished. Some specimens with a collar of salmon yellow shading to pale yellow below, two or three scales wide, outlined with black, not completely encircling the body, broken in the mid-dorsal line by one to three rows of scales. This collar may be completely developed as just described or may be represented by but small areas of yellow, or may be entirely wanting. Labials yellow, except as the black of the top of the head covers the upper margins of the superior set and is continued down over those of both sets at the angle of the jaw. Ventrals pale yellow just back of the head, shading to bright red near the anal, bearing two irregular rows of black dots on each side and occasional spots in their mesial portions. Under parts of the tail bright red and without spots except near the anal. Mental region pale yellow and spotted.

Diadophis regalis is a rather active species feeding upon insects, smaller snakes, and such other small creatures as it can find under bark, stones, and in similar places. When cornered and disturbed it has the habit of elevating and wriggling its tail. The forms closely related to this species are oviparous. No observations are recorded concerning the breeding habits of this species.

The range of this snake is from the Mississippi River to Colorado and Arizona; it has been taken in Illinois, although it is rare east of the Mississippi.

The Western Ring-necked Snake, *Diadophis amabilis* Baird and Girard, may be found in Colorado. This snake, which closely resembles *Diadophis regalis* Baird and Girard, may be recognized by the number of scale rows, it having fifteen rows instead of seventeen rows.

The figures given of *Diadophis regalis*, No. 253, are from a specimen taken at Abilene, Kan., by Dr. H. P. Mera.

Colorado specimen.—*State Teachers' College Museum:* Trinidad, A. E. Beardsley.

Genus **ZAMENIS** Wagler

Zamenis Wagler, *Syst. Amph.*, p. 188, 1830.
Bascanion Baird and Girard, *Cat. N. Am. Reptiles*, Pt. I, p. 93, 1853.

Anal plate divided; scales smooth, in 15, 17 or sometimes 19 rows; superior labials, 7 or 8; posterior maxillary teeth successively longer than those in front; preoculars, 2, the lower much the smaller; long and rather slender snakes.

Snakes of this genus are popularly known as Black Snakes, Racers and Coachwhip Snakes. They are generally believed to constrict their prey, which is not the case. For food they take particularly small rodents, insects, and birds and eggs when they can get them. All of the North American species are oviparous, laying from eight to twenty-four eggs. Species of this genus are found in Central and North America, Europe and Asia.

Young specimens of the species of this genus are marked with numerous cross bands of dark brown on a ground color of lighter brown. As they grow older this pattern is either obscured or entirely obliterated by the darker ground color of the adult. Specimens of all species of this genus may be found in which these bands are fairly distinct even in the adult. This is especially true of *Z. taeniatus*.

Key to the Colorado Species of Zamenis

a. Scales in 15 rows (rarely 17); adult with 2 to 5 narrow stripes on each side; belly yellowish and more or less spotted; upper labials, 8. *Z. taeniatus* (Hallowell).

aa. Scales in 17 rows (rarely 19); adult without lateral stripes; upper labials, 7 or 8.
- *b.* Upper labials, 7. . . . . *Z. constrictor* (Linnaeus).
- *bb.* Upper labials, 8. . . . . *Z. flagellum* (Shaw).

Zamenis constrictor (Linnaeus)

Black Snake; Blue Racer

Coluber constrictor Linnaeus, *Syst. Nat.*, ed. X, p. 216, 1758.

Bascanium constrictor vetustum—Yarrow, *Wheeler Survey*, Vol. V, pp. 541–542, 1875 (Pueblo, Colo.).

Bascanium constrictor—Yarrow, *U.S.N.M.*, *Bull. 24*, p. 108, 1882 (Pueblo, Colo.).

Zamenis constrictor—Cope, *Rept. U.S.N.M.*, pp. 796–797, 1898 (Pueblo and Denver, Colo.).

Dorsal scales smooth, in 17 or rarely 19 rows; superior labials, 7; ventrals, 160 to 200; tail, one-fifth to one-third of the total length; long, rather slender species, length up to six feet.

Two subspecies of this snake, separated by their color and to some extent by their range, are known. Both occur in Colorado.

Z. constrictor constrictor (Linnaeus).—Dorsally, dark blue black to shiny black; under parts whitish to slate gray. Range, United States east of the Rocky Mountains, and northern Mexico; quite rare in the western part of its range, where it is almost completely replaced by the following variety.

Z. constrictor flaviventris (Say).—Dorsally, bright, dark green to olive green; ventral parts bright yellow to greenish yellow. Range, United States west of the Mississippi River, south into Mexico.

Colorado specimens.—*Colorado State Historical and Natural History Museum:* Denver, June 5, 1902 (750 mm.), H. G. Smith; Lamar, June 20, 1904 (2 specimens, 325 and 1520 mm.), H. G. Smith; Yuma, June 12, 1906 (385 mm.), H. G. Smith; *Agricultural College Museum:* Ft. Collins, 1906 (310 mm.), S. A. Johnson; *State Teachers' College Museum:* Baca, Las Animas, and Weld counties, A. E. Beardsley; *reported* by Cockerell from Boulder.

Zamenis flagellum (Shaw)

Coachwhip Snake (*Figures 32 and 33*)

Coluber flagellum Shaw, *Gen. Zoöl.*, Vol. II, Pt. II, p. 475, 1802.

Bascanium flagelliforme testaceum—Yarrow, *Wheeler Survey*, Vol. V, p. 542, 1875 (Pueblo, Colo.); Yarrow, *U.S.N.M., Bull. 24*, p. 112, 1882 (Pueblo, Colo.).

Zamenis flagellum flagellum—Cope, *Rept. U.S.N.M.*, p. 803, 1898 (Pueblo, Colo.).

Coluber testaceus—Say, *Long's Exped. Rocky Mts.*, p. 48, 1823 (probably near the junction of Fountain Creek and the Arkansas River).

Dorsal scales in 17, rarely 19, rows; superior labials, 8; ventrals, 170 to 220; tail one-fifth to one-third of the total length; slender species, length up to eight feet.

Anterior portion of the body dark brown to almost black, gradually shading into light brown in the caudal region; ventral parts white, yellow or slightly pink, somewhat clouded in the anterior regions; sometimes with very indistinct cross bands in the caudal region. The general color of this species varies from dark brown to gray or red brown in the different portions of its range.

The name Coachwhip Snake is quite descriptive of the posterior half of the body where the scales are so arranged as to give the appearance of the plaited cord of a whip.

This very active species ranges from Florida to California, south into Mexico and north into Kansas, Colorado and Utah.

Colorado specimens.—*University Museum:* Boulder, May 23, 1905 (295 mm.), No. 254; Altona, July 14, 1912 (340 mm.), N. deW. Betts, No. 255; *Colorado State Historical and Natural History Museum:* Yuma, June 7, 1905 (750 mm.), H. G. Smith; *State Teachers' College Museum:* Las Animas and Baca counties, A. E. Beardsley.

Zamenis taeniatus (Hallowell)

STRIPED RACER

Leptophis taeniata Hallowell, *Proc. Acad. Nat. Sci. Phila.*, Vol. VI, p. 181, 1852.

Bascanium taeniatum taeniatum—YARROW, *U.S.N.M.*, *Bull. 24*, p. 112, 1882 (Canyon Creek, Colo.).[1]

Zamenis taeniatus—COPE, *Rept. U.S.N.M.*, p. 817, 1898 (Canyon Creek, Colo.).

Bascanion taeniatus—CARY, *N. Am. Fauna*, No. 33, p. 27, 1911 (Plateau Creek, Morris, Colo.).

Dorsal scales in 15, rarely 17, rows; superior labials, 8; ventrals, 180 to 220; tail one-fourth to one-third of the total length; average specimens three or four feet in length.

Dorsally pale brown to dark brown, gradually becoming lighter toward the tail; ventral parts yellowish, usually somewhat spotted, especially near the head; a yellowish stripe along the junction of the ventrals with the first row of dorsal scales and a second yellowish stripe on the third and fourth rows of scales (variety *ornatus*); or a narrow black stripe on each of the first four or five rows of scales and at the junction of the ventrals and the first row, with lighter areas between (variety *taeniatus*).

[1] There is a Canyon Creek in La Plata County and another in Ouray County.

Specimens of this species tend to retain the cross bands of the young color pattern even as adults. Range, western Texas to California, south well into Mexico and north into Colorado and Utah.

Genus **TANTILLA** Baird and Girard

Tantilla Baird and Girard, *Cat. N. Am. Reptiles*, Pt. I, p. 131, 1853.
Homalocranium Duméril et Bibron, *Mem. Acad. Sci.*, XXIII, 490, 1853.

Anal plate divided; scales smooth and polished, in 15 rows; posterior maxillary teeth grooved and separated from the others by an interspace; size small; color reddish or brownish.

These snakes are found in North, Central and South America and the West Indies.

Tantilla nigriceps Kennicott

TEXAS BLACK-HEADED SNAKE (*Figure 34*)

Tantilla nigriceps Kennicott, *Proc. Acad. Nat. Sci. Phila.*, p. 328, 1860.

Size small, not exceeding twenty inches.

Dorsal scales smooth and polished, in 15 rows; upper labials, 7; inferior labials, 6; ventrals, about 155.

Uniform yellowish, red brown or drab color above, shading to white, pale yellow or pink below; top of the head blackish brown to almost black, the dark color extending to the level of the eyes on each side and back of the head for about three rows of scales; posterior margin of the colored area V-shaped. Rostral region lighter.

These seem to be the first records for this little snake in Colorado, and Yuma is the most northern point from which it has been taken. Cope[1] does not list it north of Wichita River, Tex., although Branson[2] finds it as a rare snake in southern Kansas.

It is a very retiring snake, and burrows for its food. This consists of insect larvae and earthworms.

This species ranges through Texas, where it is quite abundant, north to Colorado and Kansas and west to Arizona.

Colorado specimens.—*University Museum:* LaJunta, July, 1905 (220 mm.), G. S. Dodds, No. 256; *Colorado State Historical and Natural History Museum:* Yuma, near Dry Willow Creek, July 7, 1905 (340 mm.), H. G. Smith.

[1] COPE, *Rept. U.S.N.M.*, p. 1114, 1898. [2] BRANSON, *Kans. Univ. Sci. Bull.*, Vol. II, p. 415, 1902.

Family Crotalidae

Pit Vipers

This family of snakes is distinguished at once by the peculiar pit on each side of the front of the head below the nostril. This structure although well enervated is of unknown function. The *Crotalidae* have large movable fangs in the front part of the upper jaw. These fangs, which are hollow, are connected with poison sacks and so arranged that the opening of the mouth elevates the fang. These snakes are venomous, the bite of several species often proving fatal in spite of medical attention. Four species are recorded from Colorado.

Genus **CROTALUS** Linnaeus

Crotalus Linnaeus, *Syst. Nat.*, ed. X, p. 214, 1758.

Anal plate entire; subcaudal plates entire; genials large; scales heavily keeled, excepting the first two or three rows on each side, in 23 to 31 rows; labials, 12 or more, subequal; tail terminating in a jointed rattle.

The rattlesnakes, of which there are sixteen or more species, range from Canada to Brazil. They are of a specialized and distinctive type. All the species of this genus are viviparous. The young when first born have only the button on the end of the tail and the rattles appear after the subsequent sheddings of the skin. More than a single rattle may be produced in a single year so that the general belief that the age of the snake may be determined by the number of its rattles is without foundation. For food the rattlesnakes generally take warm-blooded prey, birds and small mammals.

Key to the Colorado Species of Crotalus

a. Supraocular plate produced and elevated into a distinct "horn" above each eye; size small, length of adults usually less than three feet.
C. cerastes Hallowell.

aa. Supraocular plate not elevated into a "horn" above each eye; size large.

b. Tail whitish or yellowish, crossed with three or four distinct, black rings; back with numerous diamond-shaped areas of blackish.
C. atrox Baird and Girard.

bb. Tail without distinct black rings; colored areas on the back rounded.
C. confluentus Say.

Crotalus cerastes Hallowell

Horned Rattlesnake or Sidewinder

Crotalus cerastes Hallowell, *Proc. Acad. Nat. Sci. Phila.*, p. 95, 1854.

Crotalus cerastes—Cope, *Rept. U.S.N.M.*, p. 1199, 1898 (Colorado River, Colo.).

Dorsal scales in 21 rows, all excepting the first two or three rows on each side heavily keeled; superior labials, 11 or 12; inferior labials, 12 or 13; supraocular plates elevated into a distinct "horn" on each side; ventrals, 130 to 150; tail one-eighth to one-sixth of the total length; size small, under three feet in length.

Ground color yellowish, brownish or pinkish; ventral parts yellowish; dorsal pattern of thirty or more rounded blotches of dark brown, separated and somewhat surrounded by grayish white; caudal blotches forming rather distinct bands; a dark bar extending some distance back of the eye; labial region light.

This peculiar little rattlesnake is included in the Colorado fauna on a very uncertain record. The true Colorado River does not flow through Colorado although its headwaters are found in this state. If "Colorado River, Colo.," refers to some of these headwaters this record is valid, although it may be only an error. This snake should be looked for, however, in the extreme southwestern portion of the state. The name "Sidewinder" is given this little reptile because of the peculiar sideways movements it often makes. It ranges through Arizona, Nevada and southern Utah into California.

Crotalus atrox Baird and Girard

Western Diamond Rattlesnake

Crotalus atrox Baird and Girard, *Cat. N. Am. Reptiles*, Pt. I, p. 5, 1855.

Dorsal scales in 25 or 27 rows, all excepting the first and second rows on each side, strongly keeled; superior labials, 16; inferior labials, 15; ventrals, 170 to 190; top of the head flat; tail about one-sixth of the total length.

Ground color yellowish, brownish, gray or even slightly pink; ventral parts yellowish, often somewhat clouded with gray or black, especially near the lateral margins of the ventrals; dorsal pattern of thirty to forty or more, hexagonal to diamond-shaped blotches of black or dark brown, each blotch emarginate with ashy white and with more or less of the ground color in its center; tail ashy white, crossed by three to six black or very dark brown rings which are open ventrally; head without the vertical white stripe under the nostril which is present in *C. adamanteus* (Beauvais), the eastern Diamond-Back Rattlesnake.

Length, up to seven feet. This rattlesnake ranges from the middle of Texas west to Arizona. In southern California it is represented by a red subspecies, *C. atrox ruber* Cope.

Colorado Specimen.—We include this rattlesnake in the fauna of Colorado on the record kindly given us by Mr. L. J. Hersey of the Colorado Museum of Natural History in Denver. This specimen, determined by Mr. Hersey, was five and one-half feet in length and was collected at Trinidad, Colo., by William Wilson, August 17, 1912.

Crotalus confluentus Say

PRAIRIE RATTLESNAKE (*Figures 38, 39 and 40*)

Crotalus confluentus Say, *Long's Exped. Rocky Mts.*, Vol. II, p. 48, 1823 (probably near junction of Fountain Creek and the Arkansas River).

Crotalus confluentus confluentus—YARROW, *U.S.N.M. Bull. 24*, p. 77, 1882 (Cache la Poudre River); COPE, *Rept. U.S.N.M.*, p. 1172, 1898 (Cache la Poudre River).

Dorsal scales in 27 or 29 rows, all strongly keeled, excepting those of the first two or three rows on each side; superior labials, 15 or 16; inferior labials, 16 to 18; ventrals, 170 to 190; top of the head flat or very slightly concave; tail about one-sixth of the total length.

Ground color greenish yellow, gray or brown; ventral parts yellowish; dorsal pattern of thirty or more rounded blotches of dark brown, distinctly darker around the edges and outlined with yellowish white; pattern more obscure toward the tail; a dark bar extending from just below the middle of the eye to the posterior angle of the mouth, bordered on each side by a yellow stripe one row of scales wide; two dark spots in the occipital region; two more or less distinct yellowish stripes on each supraocular plate; an irregular row of spots, often rather indistinct, down each side of the body.

C. confluentus is the common rattlesnake of the state. It is one of the medium-sized rattlesnakes, average specimens being between three and four feet in length. It ranges from southern Canada south almost to Mexico, east into Kansas and Nebraska, and west into Idaho, Utah and Arizona.

Colorado specimens.—*University Museum:* Colorado (580 mm., 5 rattles), No. 78; LaJunta, July, 1905 (620 mm., 8 rattles), G. S. Dodds, No. 257; Wray, October 27, 1912 (shed skin, 650 mm.), M. M. Ellis; *Colorado State Historical and Natural History Museum:* Denver, August 10, 1903 (370 mm., 4 rattles), H. Davies; Denver, October 1, 1904 (2 specimens, 210 and 230 mm.), A. T. Allen; Watervale, August 7, 1906 (780 mm., 9 rattles), H. G. Smith; *State Teachers' College Museum:* top of Pole Hill near Loveland, Greeley and Las Animas County, A. E. Beardsley; *reported* by Henderson from Crow Creek near Cornish, 1904; from Osgood, 1911; from foothills northeast of Lyons, the mountains north of Lyons and Owl Canyon, west of Ft. Collins; from Boulder, near Sanitarium, October 13, 1912; common just south of the northern state line from the Union Pacific Railway to Pawnee Butte, and one northeast of Ault; by Sam Service from Estes Park, September 18, 1908; by Cockerell, from Boulder, 1911.

Genus **SISTRURUS** Garman

Sistrurus Garman, *N. Am. Reptiles,* p. 110, 1883.

Tail with a rattle; head with nine plates instead of the small scales found in *Crotalus;* other characters much the same as *Crotalus.* The snakes of this genus because of their small size are known as Pigmy Rattlesnakes. It is to be remembered, however, that although they are small they are dangerous. One species is recorded from Colorado.

Sistrurus catenatus (Rafinesque)

The Massasauga

Crotalinus catenatus Rafinesque, *Am. Monthly Mag.*, Vol. IV, p. 41, 1818.

Two subspecies of this little rattlesnake are known. They may be little more than geographical varieties.

a. Scales in 23 rows; colors light; range, southwestern United States. *S. c. edwardsii* (Baird and Girard).

aa. Scales in 25 rows; colors dark; range, eastern and northern United States east of the Rocky Mountains . . . . *S. c. catenatus* (Rafinesque).

Sistrurus catenatus edwardsii (Baird and Girard)

EDWARDS' MASSASAUGA

Crotalophorus edwardsii Baird and Girard, *Cat. N. Am. Rept.*, Pt. I, p. 15, 1850.

Sistrurus catenatus edwardsii Cope, *Rept. U.S. Nat. Mus.*, p. 1144, 1898.

General color and pattern much the same as *Crotalus confluentus*. Range, Colorado south into Mexico.

Colorado specimen.—*State Teachers' College Museum:* Baca County, A. E. Beardsley.

Order *TESTUDINATA*

The Turtles

Four families of Turtles are known from Colorado, although but six species have been reported. The families may be distinguished by the following key.

a. Body much depressed; carapace and plastron poorly ossified and covered with a thick leathery skin; snout long and tubular.
Family *Trionychidae* (page 111).

aa. Body elevated at least in the mid-dorsal region; carapace and plastron well ossified.

b. Tail long, with a mid-dorsal series of elevated bony tubercles; plastron small, with 9 plates. . . . . Family *Chelydridae* (page 113).

bb. Tail short, without a mid-dorsal row of tubercles; plastron large.

c. Plastron with 7, 9 or 11 plates; 23 marginal plates on the carapace.
Family *Kinosternidae* (page 114).

cc. Plastron with 12 plates; 25 marginal plates.
Family *Testudinidae* (page 115).

Family TRIONYCHIDAE

The Soft-Shelled Turtles

Turtles of this family are found in the fresh waters of America, Asia, including Japan, and Africa. They may be recognized at once by their greatly depressed bodies and the leathery covering of the carapace which takes the place of external plates in the other turtles. Most of the species are of small or moderate size, but the Southern Snapper, found in southern United States, *T. ferox*, is known to reach a weight of thirty pounds or more. The soft-shelled turtles are vigorous, active animals and when disturbed snap much like the true snapping turtles. A single genus of this family is represented in Colorado.

Genus **TRIONYX** Geoffroy

Trionyx Geoffroy, *Annales Mus. Paris*, p. 84, 1809.

Plastron poorly developed posteriorly; hind limbs and tail free; digits, 5–5; claws, 3–3; range, that of the family. One species known from Colorado.

Trionyx spiniferus LeSueur

Spiny Soft-Shelled Turtle

Trionyx spiniferus LeSueur, *Mém. Mus. Hist. Nat. Paris*, p. 258, 1827.

Dorsal surface covered with tiny elevations; anterior margin of the carapace, especially that of adult females, with numerous small conical tubercles (these are usually wanting or very small in young specimens); nostrils at the tip of the elongate snout, crescent-shaped and each with a small papilla projecting into it from the septum; tail of the female scarcely projecting beyond the margin of the carapace, that of the male projecting beyond the carapace almost the length of the head; digits, 5–5; claws, 3–3; size medium, length of the carapace up to fifteen inches.

Dorsal color olive, green or brownish, with a margin of lighter color separated from the rest of the ground color by a narrow black line; young specimens with twenty or more rounded spots of dark color, margined with black, these spots becoming more indistinct as the animal grows older; ventral parts white or yellowish; under parts of the legs and the ventral margin of the carapace more or less mottled with black.

The flesh of this turtle is of very good quality and the turtle is much sought after in regions where it is at all abundant. It ranges from Maine to the Rocky Mountains, and south to Mexico. It is most abundant in the north central states.

Colorado specimens.—*University Museum:* Evans, July 4, 1908 (about 250 mm.), J. Henderson; *State Teachers' College Museum:* Cache la Poudre, South Platte River and Greeley, A. E. Beardsley.

Family CHELYDRIDAE

The Snapping Turtles

Snapping Turtles are found in North and South America, and in Asia. They are powerful, heavy, freshwater turtles, found usually in sluggish streams. A single species of snapper is known from Colorado.

Genus **CHELYDRA** Schweigger

Chelydra Schweigger, *Prodromus Monographiae Chelonorum*, p. 23, 1814.

Chelydra serpentina (Linnaeus)

SNAPPER, OR SNAPPING TURTLE (*Figure 37*)

Testudo serpentina Linnaeus, *Syst. Nat.*, ed. X, p. 199, 1758.

Carapace broad, elevated anteriorly and notched posteriorly; costals, 4 on each side; neurals, 5; nuchal, 1; marginals, 23; plastron small and cross-shaped, of 9 plates; 2 or 3 inframarginals at the outer margin of the bridge; tail long, equal to the length of the plastron, cylindrical and tapering, with a row of bony tubercles on its mid-dorsal surface and a few smaller tubercles on the sides, with two rows of plates on its ventral surface; head large, much depressed and pointed; digits, 5–5, webbed to the claws; claws, 5–4; size large, specimens weighing as much as forty pounds having been reported.

General color brown, blackish brown or olive above; ventral parts whitish or yellowish.

This turtle takes its common name from its behavior when attacked. At this time it jumps suddenly and snaps with great vigor. With its powerful curved jaws it can easily snap a fair-sized stick in two, and average-sized specimens are dangerous if carelessly handled. It feeds on all sorts of small aquatic animals, including water birds. The habit of snappers, of swimming under water birds and dragging them down, is well known. They will on occasion take floating carcasses. The eggs, about fifty in number, are laid in moist sand in June.

This species is of considerable importance as a food for man.

Large numbers of these turtles are marketed every year. *C. serpentina* ranges over the United States and southern Canada east of the Rocky Mountains, and south into Ecuador.

Colorado specimens.—*University Museum:* White Rocks, near Boulder, September 17, 1910 (310 mm.), F. Rohwer and J. Rowland, No. 258; Wray, October 27, 1912 (125 mm.), M. M. Ellis, No. 259; *Colorado State Historical and Natural History Museum:* Wray, May 21, 1904 (180 mm.), H. G. Smith; *reported* by D. M. Andrews from Boulder Valley, several times during the past ten years; by F. Rohwer, a dead specimen at the same time and place the one above recorded was caught; by N. deWitt Betts, Base-line Reservoir, southeast of Boulder, 1911; common at Greeley by Beardsley.

Family Kinosternidae

The Mud Turtles

Rather small, strictly aquatic turtles, characterized by the much elevated carapace and the narrow body, resulting in a somewhat compressed appearance for the animal as a whole. A family of a few species confined to the Americas. Of the two North American genera one is represented in Colorado by a single species.

Genus **KINOSTERNON** Spix

Kinosternon Spix, *Species Novae Testudinum*, p. 17, 1824.

Kinosternon flavescens (Agassiz)

Yellow-Necked Mud Turtle

Platythyra flavescens Agassiz, *Contrib. Nat. Hist. U.S.*, Vol. I, p. 430, 1857.

Carapace narrow and much elevated in the median line, smooth or in young specimens with a very indistinct dorsal keel, very slightly if at all notched on the anterior margin, general outline elliptical; costals, 4 on each side; neurals, 5; marginals, 23; plastron large, covering most of the ventral surface, lobes movable so that they may be drawn against the margin of the carapace and enclose the head and feet; plastral plates, 11 or 9; feet rather broadly webbed; digits, 5–5, claws, 5–4; size small, length of the carapace up to six inches.

General color yellowish brown or greenish brown above; plates somewhat outlined with black; ventral parts yellow; head greenish above and yellowish below; neck bright yellow.

Range, Arkansas to Rocky Mountains, north into Colorado.

Colorado specimens.—*Colorado State Historical and Natural History Museum:* Lamar, June 20, 1904 (140 mm.), H. G. Smith; *State Teachers' College Museum:* Baca County, A. E. Beardsley.

Family TESTUDINIDAE

Pond Turtles and Box Turtles

This is a large family of turtles of cosmopolitan distribution. The two genera found in Colorado may be distinguished by the structure of the plastron.

a. Plastron firm throughout; carapace rather depressed; aquatic. *Chrysemys* Gray.

aa. Plastron with its anterior portion hinged and movable; carapace elevated and rounded; terrestrial. . . . . *Terrapene* Merrem.

Genus **CHRYSEMYS** Gray

Chrysemys Gray, *Cat. Tortoises*, p. 27, 1844.

We have examined specimens belonging to two species of this genus which were reported as collected in Colorado. Of these two species one, *C. belli* (Gray), is known to be quite abundant in the ponds and lakes of eastern Colorado. The other stands on the record of one specimen, 240 mm., University of Colorado Museum, labeled, "Denver, Colo.," and referable to the species *C. elegans* (Wied). This species we include only in our key, although since it is known from the Yellowstone region and from Kansas, it is probably found in this state.

a. Upper jaw with a small tooth on each side of the median notch. *C. belli* (Gray).

aa. Upper jaw without a small tooth on each side of the median notch. *C. elegans* (Wied).

Chrysemys belli (Gray)

BELL'S PAINTED TURTLE

Emys belli Gray, *Synopsis Reptilium*, p. 31, 1831.

Carapace broad, rather depressed, widest in the posterior portion; costals, 4 on each side; neurals, 5; marginals, 25, those in the posterior region somewhat extended into a shelf beyond the general curvature of the carapace; plastron wide, of 12 plates; feet well webbed; digits, 5–5; claws, 5–5; size medium, large specimens about twelve inches in length.

Dorsal color olive green or brown, usually with a reddish or bronze cast; plates often distinctly margined with black; plastron yellowish, with two dark brown or black longitudinal blotches, extending across each plate excepting the first two, separated by a narrower area of the ground color (although they may be confluent), and irregularly joined to those of the next plate, forming two more or less well-defined concentric ellipses; other parts of the plastron often blurred with blackish; marginal region below, greenish, crossed by numerous small light streaks, some of which may be red but most of which are orange or yellow; under parts of the head with numerous longitudinal stripes; feet greenish above, with a bright yellow mid-dorsal stripe, breaking up and sending a branch down each digit, below yellowish.

This turtle ranges from the Mississippi River west to the Rocky Mountains and north into British Columbia. It has also been taken in Illinois and northern Michigan.

Colorado specimens.—*University Museum:* Boulder, June 24, 1911 (160 mm.), No. 125; Wray, October 27, 1912 (120 mm.), M. M. Ellis, No. 260; Castle Rock, June 9, 1912 (175 mm.), M. M. Ellis, No. 261; Ft. Morgan (165 mm.), H. W. Clatworthy, No. 263; east of Boulder (125 mm.); *Colorado State Historical and Natural History Museum:* Denver, July 31, 1900 (165 mm.), H. G. Smith; Denver, August 25, 1900 (150 mm.), H. G. Smith; *State Teachers' College Museum:* Cache la Poudre, Platte River at Greeley and Lakes near Greeley, A. E. Beardsley; *reported* by J. Henderson, Platteville, June, 1912; as abundant in some of the lakes east of Boulder.

Genus **TERRAPENE** Merrem

Terrapene Merrem, *Versuch Syst. Amphibien,* p. 27, 1820.

The Colorado species of this genus are two.

a. Four digits on the hind foot . . . . . . *T. ornata* (Agassiz).
aa. Three digits on the hind foot . . . . . . *T. triunguis* (Agassiz).

Terrapene ornata (Agassiz)

PAINTED BOX TURTLE

Cistudo ornata Agassiz, *Contrib. Nat. Hist. U.S.*, Vol. I, p. 445, 1857.

Carapace much elevated and rounded, compressed in the mid-dorsal region; marginals, 25; plastron broad, of twelve plates, the two halves on a common hinge so that the plastron may be closed against the margin of the carapace; size up to ten inches.

General color above and below yellowish or yellowish brown, with numerous rather bright yellow stripes and bars, varying to quite pale brown with indistinct markings.

Range, Illinois to the Rocky Mountains, south into Texas.

Colorado specimens.—*University Museum:* Wray, October 27, 1912 (120 mm.), M. M. Ellis, No. 262; *Colorado State Historical and Natural History Museum:* Wray, May 20, 1904 (140 mm.), W. C. Ferril; Lamar, June 20, 1904 (140 mm.), H. G. Smith; Kit Carson, September 6, 1907 (150 mm.), W. C. Ferril; *private collection* of E. Bethel, Denver (2 carapaces, 125 and 150 mm.), E. Bethel; *State Teachers' College Museum:* Ft. Morgan and Box Elder, A. E. Beardsley; *reported* by Cockerell from near Boulder.

Terrapene triunguis (Agassiz)

THREE-TOED BOX TORTOISE, OR BOX TURTLE

Cistudo triunguis Agassiz, *Contrib. Nat. Hist. U.S.*, Vol. I, p. 445, 1857.

This tortoise differs little in general appearance from the preceding one, aside from the difference in the number of toes. In color it is greenish brown with very indistinct lighter markings.

Range, west of the Mississippi, north into Kansas and Colorado.

Colorado specimen.—*Colorado State Historical and Natural History Museum:* Wray, May 20, 1904 (130 mm.), H. G. Smith.

DISTRIBUTION

The discussion of the distribution of our herpetological fauna may be divided into two parts, the general or geographic distribution, and the altitudinal distribution.

Tables 1, 2, 3 and 4 give the data for the geographic distribution. It is to be noted that the absence of a record does not exclude the species, for in many cases it is apparent that a given species very probably occurs in a given area judging from its known distribution. In Table 1 it may be seen that ten species of Colorado Amphibians are species of wide range, since they are found on both sides of the mountains and in several or all of the adjoining states. One species deserves particular attention, *Bufo boreas.* As may be seen from Tables 2, 3 and 4, the other species of our fauna have come in from the south. This toad, however, is not found south of Colorado and in the state is found only in the mountains in the montane zone. It ranges north into Oregon where it is abundant. It must be considered as either our only species of northern origin or a species left here in the montane zone as the climate has become warmer since the retreat of the glaciers. It may be noted that the terrestrial molluscan fauna of Colorado is on the whole more closely related to the northern than to the southern fauna.

The snakes and lizards (Tables 2 and 3) are evidently species which have come into the state from the south. That this migration is still going on to some extent is shown by the addition to our fauna in this report of four snakes, one turtle, one toad, one frog and one lizard from the south. Three groups of reptiles exclusive of the turtles may be noted: the first of seven lizards and five snakes which are found on both sides of the range; a second of twelve snakes and seven lizards found only east of the range; and a third of four snakes and three lizards found only on the west side of the range. The last two restricted classes are of course in general species of the Great Basin Plains and of the Mississippi Basin.

We have no records of turtles from the west side of the range in Colorado (Table 4). It is probable that *Kinosternon flavescens,* reported from Utah, and other Great Basin species will be found in western Colorado. The relatively small number of species of this group in our fauna is due largely to the lack of permanent sluggish streams. Most of our streams are either too high and rapid in the spring or too low in the summer for turtles.

Of the adjoining states New Mexico has a greater proportion of our fauna than any other, 47 of our 56 species occurring in that state.

TABLE 1

DISTRIBUTION OF THE COLORADO AMPHIBIA WITH REFERENCE TO THE MAIN RANGE AND THE ADJOINING STATES

	Colorado East of Range	Colorado West of Range	New Mexico	Kansas	Nebraska	Wyoming	Utah
Ambystoma tigrinum	*x*	*x*	*x*	*x*	*x*	*x*	*x*
Scaphiopus hammondii	*x*	*x*	*x*	..	*x*	*x*	*x*
Bufo boreas	*x*	*x*	..	..	..	..	*x*
——*woodhousei*	*x*	*x*	*x*	..	*x*	*x*	*x*
——*americanus*	*x*	*x*	*x*	*x*	*x*	*x*	*x*
——*cognatus*	*x*	*x*	..	*x*	*x*	..	..
——*debilis*	*x*	..	..	*x*	..	..	..
Chorophilus triseriatus	*x*	*x*	*x*	*x*	..	..	*x*
Acris gryllus	*x*	..	..	*x*	*x*	..	..
Hyla arenicolor	*x*	*	*x*	..	..	..	*x*
Rana pipiens	*x*	*x*	*x*	*x*	*x*	*x*	*x*
Total.............11	11	8	7	7	7	5	8

x = printed record or specimen record for area so marked.
* = probable distribution.

TABLE 2

DISTRIBUTION OF THE COLORADO LIZARDS

	Colorado East of Range	Colorado West of Range	New Mexico	Kansas	Nebraska	Wyoming	Utah
Dipsosaurus dorsalis	*x*	..	*x*	*x*	..	..	..
Uta ornata	*x*	*x*	*x*	..	..	..	*x*
——*stansburiana*	..	*x*	*x*	..	..	..	*x*
Crotaphytus collaris baileyi	*x*	*x*	*x*	..	..	..	*x*
Sceloporus consobrinus	*x*	*x*	*x*	..	*x*	..	*x*
——*graciosus*	..	*x*	*x*	..	..	..	*x*
Holbrookia maculata	*x*	*	*x*	..	*x*	*x*	*x*
Phrynosoma cornutum	*x*	*x*	*x*	*x*	..	..	*x*
——*hernandesi*	*x*	*x*	*x*	..	..	*x*	*x*
Anota modestum	*x*	..	*x*	..	..	..	..
Cnemidophorus sexlineatus	*x*	*x*	*x*	*x*	*x*	..	..
——*tessellatus*	*x*	*x*	*x*	..	..	..	..
——*gularis*	..	*x*	*x*	..	..	..	..
Eumeces obsoletus	*x*	..	*x*	*x*	*x*	..	*x*
——*guttulatus*	*x*	..	*x*	..	..	..	..
——*multivirgatus*	*x*	..	..	*x*	*x*	..	..
——*leptogrammus*	*x*	..	..	..	*x*	*x*	..
Total.............17	14	10	15	5	6	3	9

x = printed record or specimen record for area so marked.
* = probable distribution.

TABLE 3

DISTRIBUTION OF THE COLORADO SNAKES

	Colorado East of Range	Colorado West of Range	New Mexico	Kansas	Nebraska	Wyoming	Utah
Thamnophis elegans	*x*	*x*	*x*	..	..	*x*	*x*
——*radix*	*x*	..	*x*	*x*	*x*	*x*	..
——*megalops*	..	*x*	*x*	..	..	..	..
——*parietalis*	*x*	*x*	*x*	*x*	*x*	*x*	*x*
Ophibolus doliatus	*x*	..	*x*	*x*	..	..	..
Pityophis catenifer sayi	*x*	*x*	*x*	*x*	*x*	..	*x*
——*catenifer bellona*	..	*x*	*x*	..	*x*	..	*x*
Heterodon nasicus	*x*	..	*x*	*x*	*x*	..	..
Tropidonotus sipedon	*x*	..	..	*x*	*x*	..	..
Storeria dekayi	*x*	..	..	*x*	..	..	..
Liopeltis vernalis	*x*	*x*	*x*	*x*	..	*x*	..
Chionactis episcopus isozonus	*x*	..	*x*	*x*	..	..	*x*
Diadophis regalis	*x*	..	*x*	*x*	..	..	..
Zamenis constrictor constrictor	*x*	..	*x*	*x*	*x*	*x*	..
——*constrictor flaviventris*	*x*	*	*x*	*x*	*x*	*x*	*x*
——*flagellum*	*x*	*	*x*	*x*	*x*	..	*x*
——*taeniatus*	..	*x*	*x*	..	..	..	*x*
Tantilla nigriceps	*x*	..	*x*	*x*	..	..	..
Crotalus atrox	*x*	..	*x*	..	..	..	..
——*cerastes*	..	*x*	*x*	..	..	..	*x*
——*confluentus*	*x*	*x*	*x*	*x*	*x*	*x*	*x*
Sistrurus catenatus edwardsii	*x*	..	*x*	*x*	..	..	..
Total.............22	18	9	20	16	10	7	10

x = printed record or specimen record for the area so marked.
* = probable distribution.

TABLE 4

DISTRIBUTION OF COLORADO TURTLES

	Colorado East of Range	Colorado West of Range	New Mexico	Kansas	Nebraska	Wyoming	Utah
Trionyx spiniferus	*x*	..	*x*	*x*	*x*	*x*	..
Chelydra serpentina	*x*	..	..	*x*	*x*	..	..
Kinosternon flavescens	*x*	*	*x*	*x*	*x*	..	*x*
Chrysemys belli	*x*	..	*x*	*x*	..	..	..
Terrapene ornata	*x*	..	*x*	*x*	*x*	*x*	..
——*triunguis*	*x*	..	*x*	*x*	..	..	..
Total..................6	6	0	5	6	4	2	1

x = printed record or specimen record for the area so marked.
* = probable distribution.

TABLE 5

ALTITUDINAL DISTRIBUTION OF COLORADO AMPHIBIA

	3,000 4,000	4,000 5,000	5,000 6,000	6,000 7,000	7,000 8,000	8,000 9,000	Above 9,000
Ambystoma tigrinum........	*	x	x	x	x	x	x
Scaphiopus hammondii.....	*	x	x	..	..	..	..
Bufo boreas..............	..	..	..	..	x	x	x
——*woodhousei*...........	x	x	x	x	?	?	x
——*americanus*...........	x	x	x	x	x	..	..
——*cognatus*.............	x	x	x	x	x	..	..
——*debilis*..............	*	*	x	..	..	..	..
Chorophilus triseriatus......	..	x	x	x	x	x	x
Acris gryllus..............	x	..	..	..	..	..	..
Hyla arenicolor............	*	x	..	..	..	..	..
Rana pipiens..............	x	x	x	x	x	x	x
Total.............11	5	8	8	6	6	4	5

x = printed record or specimen record for zone so marked.
* = known from the zone so marked in some of the states adjoining Colorado.
? = probable distribution.

TABLE 6

ALTITUDINAL DISTRIBUTION OF COLORADO LIZARDS

	3,000 4,000	4,000 5,000	5,000 6,000	6,000 7,000	7,000 8,000	8,000 9,000	Above 9,000
Dipsosaurus dorsalis........	*	..	..	..	..	..	..
Uta ornata................	*	x	x	x	?	?	x
——*stansburiana*..........	*	x	..	..	..	..	..
Crotaphytus collaris baileyi...	*	x	x	..	..	..	..
Sceloporus consobrinus......	x	x	x	x	x	..	..
——*graciosus*.............	*	x	x	..	..	..	..
Holbrookia maculata........	x	x	x	?	?	?	x
Phrynosoma cornutum......	*	*	x	x	x	..	..
——*hernandesi*...........	*	x	x	x	x	..	..
Anota modestum...........	*	x	..	..	..	..	..
Cnemidophorus sexlineatus...	x	x	x	..	..	..	..
——*gularis*..............	*	x	x	..	..	..	..
——*tessellatus*............	*	x	x	..	..	..	..
Eumeces obsoletus..........	*	x	..	..	..	..	..
——*guttulatus*............	*	x	..	..	..	..	..
——*multivirgatus*..........	*	x	..	..	..	..	..
——*leptogrammus*..........	*	x	..	..	..	..	..
Total.............17	3	15	10	4	3	..	2

x = printed record or specimen record for the zone so marked.
* = known from the zone so marked in some of the states adjoining Colorado.
? = probable distribution.

TABLE 7

ALTITUDINAL DISTRIBUTION OF THE COLORADO SNAKES

	3,000 4,000	4,000 5,000	5,000 6,000	6,000 7,000	7,000 8,000	8,000 9,000	Above 9,000
Thamnophis elegans	..	*x*	*x*	*x*	*x*	*x*	*x*
——*radix*	*x*	*x*	*x*	..	..	..	..
——*megalops*	*	*x*	..	..	..	..	..
——*parietalis*	*	*x*	*x*	*x*	..	..	..
Ophibolus doliatus	*x*	*x*	*x*	..	..	..	..
Pityophis catenifer sayi	*x*	*x*	*x*	*x*	*x*	..	..
——*catenifer bellona*	*	*x*	?	?	*x*	..	..
Heterodon nasicus	*x*	*x*	*x*	..	..	..	..
Tropidonotus sipedon	*x*	*x*	*x*	..	..	..	..
Storeria dekayi	*	*x*	..	..	..	..	..
Liopeltis vernalis	*	*	*x*	*x*	*x*	..	..
Chionactis episcopus isozonus	*	*x*	..	..	..	..	..
Diadophis regalis	*	*	*x*	*x*	..	..	..
Zamenis constrictor constrictor	..	*x*	..	..	..	..	..
——*constrictor flaviventris*	*x*	*x*	*x*	..	..	..	..
——*flagellum*	*x*	*x*	*x*	..	..	..	..
——*taeniatus*	*	*	*x*	..	..	..	..
Tantilla nigriceps	*x*	*x*	..	..	..	..	..
Crotalus atrox	*	*	*x*	..	..	..	..
——*cersates*	*	*x*	..	..	..	..	..
——*confluentus*	*x*	*x*	*x*	*x*	*x*	..	..
Sistrurus catenatus edwardsii	*	*x*	..	..	..	..	..
Total.............22	9	18	14	6	5	1	1

x=printed record or specimen record for the zone so marked.
*=known from the zone so marked in some of the states adjoining Colorado.
?=probable distribution.

TABLE 8

ALTITUDINAL DISTRIBUTION OF COLORADO TURTLES

	3,000 4,000	4,000 5,000	5,000 6,000	6,000 7,000	7,000 8,000	8,000 9,000	Above 9,000
Trionyx spiniferus	*	*x*	*x*	..	..	..	..
Chelydra serpentina	*x*	*x*	*x*	..	..	..	..
Kinosternon flavescens	*	*x*	..	..	..	..	..
Chrysemys belli	*x*	*x*	*x*	*x*	..	..	..
Terrapene ornata	*x*	*x*	*x*	..	..	..	..
——*triunguis*	*	*	*x*	..	..	..	..
Total..............6	3	5	5	1	..	..	..

x=printed record or specimen record for the zone so marked.
*=known from the zone so marked in some of the states adjoining Colorado.

Kansas has much the same snake fauna and Utah the same lizard fauna as Colorado, both of these states having, however, many additional species of these two groups not found in Colorado.

Tables 5, 6, 7 and 8 give the data collected on the altitudinal distribution of our species. The amphibians (Table 5) seem the least influenced by altitude of any of the groups. Seven of the eleven species have been taken above the 6,000-foot contour line. The 7,000-foot contour is passed by but five of the snakes and five of the lizards, and it is not reached by any of the turtles. Three species, a snake, *Thamnophis elegans*, a toad, *Bufo boreas*, and the salamander *Ambystoma tigrinum* have been taken above the 10,000-foot contour.

GLOSSARY

Acuminate. With a sharp point at the end.

Allantois. An embryonic membrane which serves as an organ of respiration.

Amnion. An embryonic membrane which completely envelopes the developing embryo.

Amphibious. Living in the water and on the land interchangeably at one and the same time of life.

Anal gland. A glandular diverticulum of the rectum, from which an odoriferous substance is discharged. It is well developed in some snakes.

Anal plate. The large ventral plate just in front of the vent, in snakes and lizards.

Annulations. Bands of color around the body or the appendages.

Bridge. A bony connection, at the sides of the body, between the carapace and plastron of turtles.

Canthus rostratus. A marginal elevation, marking the junction of the top of the head with the sides of the head.

Carapace. The bony or cartilaginous dorsal shield of a turtle.

Cephalic. Pertaining to the head.

Compressed. Flattened, as by pressure from the sides.

Costals. A row of large plates on each side of the central row of plates of the carapace of turtles. See Fig. 37, No. 2.

Costal grooves. A series of horizontal grooves on the sides of the abdomen of salamanders.

Depressed. Flattened as by pressure from above and below.

Epiglottis. A cartilaginous flap just in front of the upper end of the trachea.

Fangs. The long hollow or grooved teeth of the venomous reptiles.

Femoral pores. Small openings usually arranged in a single row, on the upper half of the hind legs of many lizards.

Frontal plate. A large plate near the middle of the top of the head. See Fig. 36, Nos. 7 and 11.

Fronto-parietal plate. A small plate lying between the frontal and the parietal plates on either side.

Genial. The anterior pair of the four plates lying near the middle of the mental region. See Fig. 18, No. 1.

Glottis. The upper end of the trachea.

Gular fold. A fold of skin across the under side of the throat.

Gular sac. A sac on the throat of the males of many amphibians which when expanded acts as a resonator for the voice.

Immaculate. Without markings.

Infralabials. Also called inferior labials. A row of scales along the margin of the lower jaw. See Fig. 35, No. 3.

Inframarginals. Small plates just ventral to the marginals of the carapace of turtles.

Internasals. Plates on the top of the head of snakes and lizards, between the nasals. See Figs. 35 and 36, No. 8.

Interoculars. Plates on the top of the head between the eyes.

Interorbitals. Same as interoculars.
Keeled. With a distinct elevated ridge.
Labials. Scales margining the jaws. Superior labials, Fig. 35, No. 5; inferior labials, Fig. 35, No. 3.
Loreal plate. Small plate between the preoculars and the nasals.
Marginal plates. The outside row of plates of the carapace of a turtle. See Fig. 37, No. 3.
Mental plates. Plates in the chin region.
Mesial. Pertaining to the middle.
Muzzle. The elevated portion of the snout.
Neurals. The plates along the middle of the carapace of a turtle. See Fig. 37, No. 1.
Nape. The back of the neck.
Nasal plates. The plate or plates carrying the nasal opening. See Fig. 35, Nos. 9 and 10.
Nuchal plate. A small median marginal plate of the carapace of turtles, just back of the head. See Fig. 37, No. 4.
Occipital. Pertaining to the top of the back of the head.
Occipital condyle. A process on the occipital bone forming the major articulation of the skull with the backbone.
Occipital plate. A plate in the occipital region.
Oviparous. Egg-laying.
Ovoviviparous. Retaining the egg until hatched, or until the time of hatching.
Parotoid glands. Large glands on the sides of the head of many amphibians, in the region of the ear.
Parietals. Plates on the top of the head. See Fig. 36, No. 13.
Plastron. The ventral bony or cartilaginous shield of turtles.
Poikilothermous. Having a body temperature approximately the same as that of the surrounding medium. Popularly called "Cold-Blooded."
Postgenials. The second pair of four large plates lying near the middle of the mental region.
Postorbitals. Scales just back of the eye. See Fig. 35, No. 4.
Prefrontals. A pair of plates just in front of the frontal. See Fig. 36, No. 14.
Preoculars. Scales just in front of the eye. See Fig. 35, No. 2.
Rostral. A plate forming the anterior end of the head. See Figs. 35 and 36, No. 1.
Subcaudals. The large plates on the ventral surface of the tail of a snake.
Superciliary. Plates just above the eye on the margin of the head.
Supraocular. Plates just above the eye, forming the roof of the orbit. See Fig. 35, No. 6, and Fig. 36, No. 12.
Temporal. The posterior portion of the side of the head.
Tessellated. With a spotted or checkerboard pattern.
Tympanic membrane. That covering the ear opening.
Vent. The posterior opening of the alimentary canal.
Ventrals. Large plates on the ventral surface of snakes.
Viviparous. Bearing living young.

BIBLIOGRAPHY

BAIRD, S. F. "Report on Reptiles Collected on the Survey." *Rept. U.S. Explor. and Surv. to Ascertain the Most Practicable and Economical Route for a Railroad from the Mississippi River to the Pacific Ocean*, Vol. X, Part V, No. 3, 1859. (Cited as *Pac. R.R. Surv. Rept.*)

BAIRD, S. F., and GIRARD, CHAS. *Catalogue of North American Reptiles.* Part I, Serpents. In Smithsonian Misc. Collec., Vol. II, 1853.

BRANSON, EDWIN B. "Snakes of Kansas." *Kansas Univ. Sci. Bull.*, Vol. II, pp. 353–430, 1904. With bibliography.

CASE, E. C. *A Revision of the Cotylosauria of North America.* Carnegie Inst. Wash., Pub. No. 145, 1911.

COCKERELL, T. D. A. "Reptiles and Amphibians of the University of Colorado Expedition of 1909." *Univ. Colo. Studies*, Vol. VII, pp. 130–131, 1910.

COPE, EDWARD D. *Check-List of North American Batrachia and Reptilia; with a Systematic List of the Higher Groups, and an Essay on Geographical Distribution.* U.S. Nat. Mus., Bull. 1, 1875.

———. *The Batrachia of North America.* U.S. Nat. Mus., Bull. 34, 1889.

———. "The Crocodilians, Lizards and Snakes of North America." *Ann. Rept. U.S. Nat. Mus. for 1898*, pp. 153–1270, 1900.

CRAGIN, F. W. "Herpetological Notes from Kansas and Texas." *Colo. College Studies*, 5th Ann. Pub., pp. 37–39, 1894.

DICKERSON, MARY C. *The Frog Book.* Doubleday, Page & Co. 1907.

DITMARS, RAYMOND L. *The Reptile Book.* Doubleday, Page & Co. 1907.

———. *Reptiles of the World.* Sturgis, Walton & Co. 1910.

ELROD, M. J. "Among the Rockies." *The Museum*, Vol. I, pp. 133–138, 165–170, 261–266, 1895.

GADOW, HANS. *Amphibia and Reptilia.* The Cambridge Natural History, Vol. VIII. Macmillan & Co., Ltd., London. 1901.

GARMAN, SAMUEL. "North American Reptiles: Part I, Ophidia—Serpents." *Mém. Mus. Comp. Zoöl.* (Harvard), Vol. VIII, No. 3, 1883.

GIRARD, CHAS. *See* BAIRD and GIRARD.

HAY, O. P. "The Batrachians and Reptiles of Indiana." *17th Ann. Rept. Ind. Dept. Geol. and Nat. Res.*, pp. 410–602, 1892.

———. "On the Ejection of Blood from the Eyes of Horned Toads." *Proc. U.S. Nat. Mus.*, Vol. XV, pp. 375–378, 1892.

———. *The Fossil Turtles of North America.* Carnegie Inst. Wash., Pub. No. 75, 1908.

HATCHER, JOHN B. *The Ceratopsia.* U.S. Geol. Surv., Monog., Vol. XLIX, 1907.

HERRICK, C. L., TERRY, JOHN, and HERRICK, N. H. "Notes on a Collection of Lizards from New Mexico." *Univ. N. Mex., Bull. No. 1*, pp. 117–148, 1899. (Reprinted from *Bull. Sci. Lab. Denison Univ.*, Vol. XI.)

HERSEY, L. J. "A Naturalist's Notes on Birds and Snakes." *Outdoor Life*, November, 1907, pp. 481–483.

JAMES, EDWIN. *Account of an Expedition from Pittsburgh to the Rocky Mountains, performed in the Years 1819–1820.* (Long's Expedition.) Philadelphia, 1823. Compiled from notes of various members of the expedition, and includes Say's notes on reptiles.

MARSH, O. C. "Vertebrate Fossils." *Geology of the Denver Basin in Colorado*, U.S. Geol. Surv., Monog., Vol. XXVII, pp. 473–527, 1896.

———. "The Dinosaurs of North America." *16th Ann. Rept. U.S. Geol. Surv.*, Part I, pp. 133–414, 1896.

MITCHELL, S. WEIR. "Researches upon the Venom of the Rattlesnake." *Smithsonian Contrib. to Knowl.*, Vol. XII, No. 135, 1860.

MITCHELL, S. WEIR, and REICHERT, EDWARD T. "Researches upon the Venom of Poisonous Serpents." *Smithsonian Contrib. to Knowl.*, Vol. XXVI, 1886.

PROSSER, DEAN T. "Habits of *Amblystoma tigrinum* at Tolland, Colo." *Univ. Colo. Studies*, Vol. VIII, pp. 257–263, 1911.

REICHERT, EDWARD T. *See* MITCHELL and REICHERT.

ROBBINS, W. W. "Climatology and Vegetation in Colorado." *Bot. Gaz.*, Vol. XLIX, pp. 256–280, 1910.

RUTHVEN, ALEXANDER G. *Variations and Genetic Relationships of the Garter-snakes.* U.S. Nat. Mus., Bull. 61, 1908.

———. "A Collection of Reptiles and Amphibians from Southern New Mexico and Arizona." *Amer. Mus. Nat. Hist., Bull.*, Vol. XXIII, pp. 483–604, 1907.

SAY, THOMAS. *See* JAMES (Long's Expedition).

STEJNEGER, LEONHARD. "Poisonous Snakes of North America." *Ann. Rept. U.S. Nat. Mus. for 1893*, pp. 337–487, 1895.

TAYLOR, W. E. "The Box Tortoises of North America." *Proc. U.S. Nat. Mus.*, Vol. XVII, pp. 573–588, 1895.

YARROW, H. C. "Report upon the Collections of Batrachians and Reptiles Made in Portions of Nevada, Utah, California, Colorado, New Mexico and Arizona, during the Years 1871, 1872, 1873 and 1874." *U.S. Geog. and Geol. Expl. and Surv. W. of 100th Mer.* (Wheeler Survey), Vol. V, pp. 509–584, 1875.

———. *Check-List of North American Reptilia and Batrachia, with Catalogue of Specimens in U.S. National Museum.* U.S. Nat. Mus., Bull. No. 34, 1882.

SPECIES INDEX

PLATE I

AMPHIBIA AND REPTILIA OF COLORADO

FIG. 1.—*Bufo cognatus.* Western Toad (page 56).

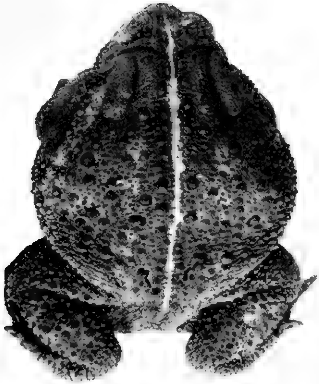


FIG. 2.—*Bufo americanus.* American Toad (page 55)

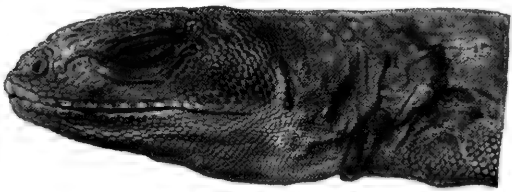


FIG. 3.—*Crotaphytus collaris baileyi.* Bailey's Collared Lizard (page 66).

IG. 4.—*Crotaphytus collaris baileyi.* Bailey's Collared Lizard (page 66).

FIG. 5.—*Uta ornata.* Ornate Swift (page 64).

PLATE II

AMPHIBIA AND REPTILIA OF COLORADO

FIG. 6.—*Uta ornata*. Ornate Swift (page 64).

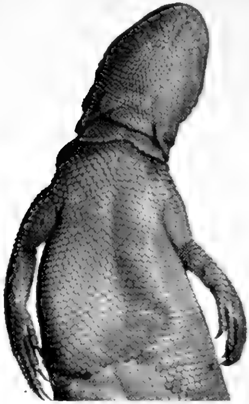


FIG. 7.—*Holbrookia maculata*. Spotted Lizard (page 70).

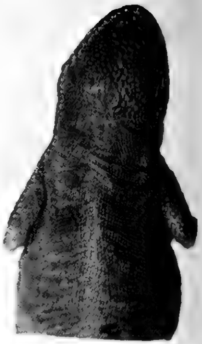


FIG. 8.—*Holbrookia maculata*. Spotted Lizard (page 70).

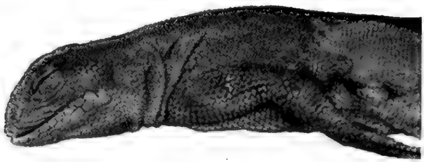


FIG. 9.—*Holbrookia maculata*. Spotted Lizard (page 70).

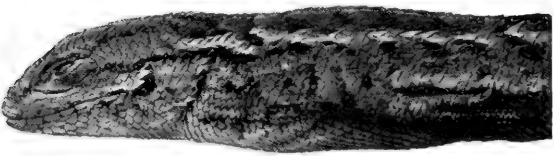


FIG. 10.—*Sceloporus consobrinus*. Yellow-banded Swift (page 68).

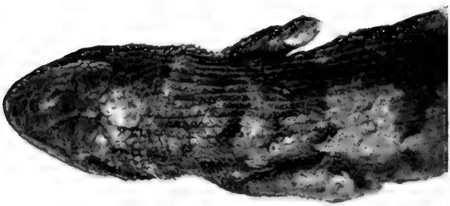


FIG. 11.—*Sceloporus consobrinus*. Yellow-banded Swift (page 68).

PLATE III

AMPHIBIA AND REPTILIA OF COLORADO

FIG. 12.—*Phrynosoma hernandesi.* Hernandez's Horned Toad (page 72).

FIG. 13.—*Phrynosoma cornutum.* Texas Horned Toad (page 74).

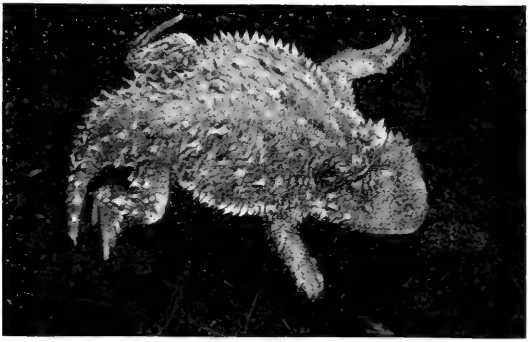


FIG. 14.—*Phrynosoma hernandesi.* Hernandez's Toad (page 72).

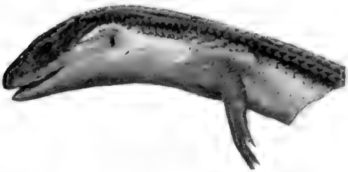


FIG. 15.—*Eumeces obsoletus.* Sonoran Skink (page 79).

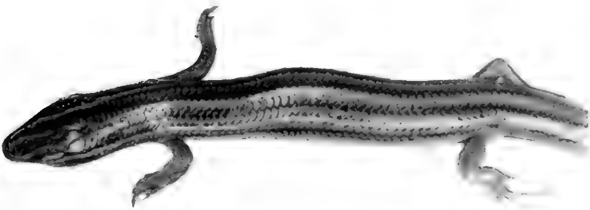


FIG. 16.—*Eumeces obsoletus.* Sonoran Skink (page 79).

PLATE IV

Amphibia and Reptilia of Colorado

Fig. 17.—*Thamnophis radix.* Plains Garter Snake (page 88).

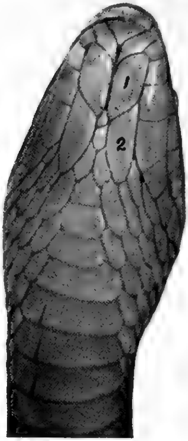


Fig. 18.—*Thamnophis radix.* Plains Garter Snake: 1, Genial; 2, Postgenial (page 88).

Fig. 19.—*Thamnophis parietalis.* Red-barred Garter Snake (page 86).

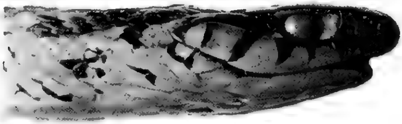


Fig. 20.—*Thamnophis radix.* Plains Garter Snake (page 88).

Fig. 21.—*Diadophis regalis.* Sonoran Ring-necked Snake (page 101).

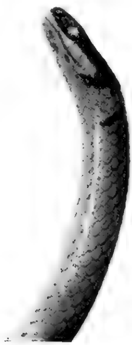


Fig. 22.—*Diadophis regalis.* Sonoran Ring-necked Snake (page 101).

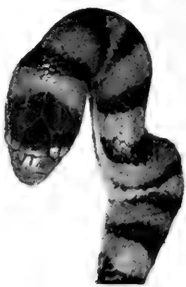


Fig. 23.—*Ophibolus doliatus gentilis.* Red King Snake (page 91).

PLATE V

Amphibia and Reptilia of Colorado

Fig. 24.—*Pityophis catenifer sayi.* Bull Snake (page 93).

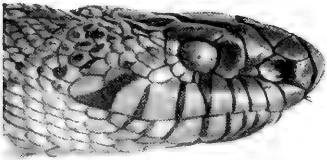


Fig. 25.—*Pityophis catenifer sayi.* Bull Snake (page 93).

Fig. 26.—*Pityophis catenifer sayi.* Bull Snake (page 93).

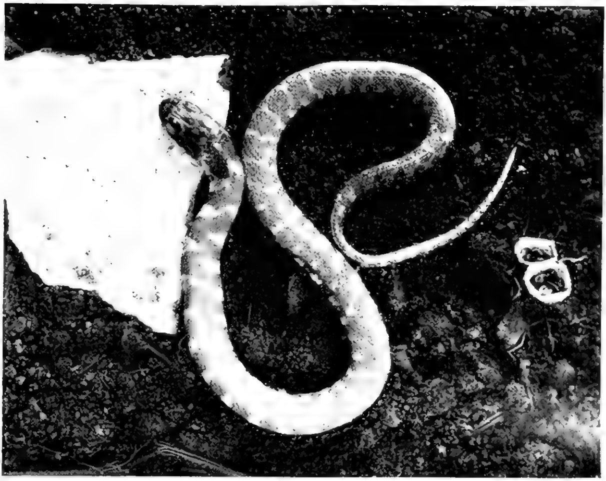


Fig. 27.—*Tropidonotus sipedon.* Water Snake (page 97).

PLATE VI

AMPHIBIA AND REPTILIA OF COLORADO

28

29

30

31

FIGS. 28, 29, 30 and 31.—*Heterodon nasicus.* Western Hog-Nose Snake (page 95).

PLATE VII

AMPHIBIA AND REPTILIA OF COLORADO

FIG. 32.—*Zamenis flagellum.* Coachwhip Snake (page 103).

FIG. 33.—*Zamenis flagellum.* Coachwhip Snake (page 104).

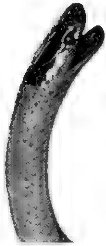
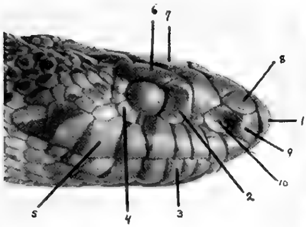
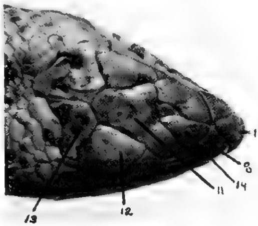


FIG. 34.—*Tantilla nigriceps.* Texas Black-headed Snake (page 106).



35



36

FIGS. 35 and 36.—*Pityophis catenifer sayi.* Bull Snake: 1, rostral; 2, preocular; 3, infralabial; 4, postorbital; 5, supralabial; 6 and 12, supraocular; 7 and 11, frontal; 8, supranasal; 9 and 10, nasals; 13, parietal (page 93).

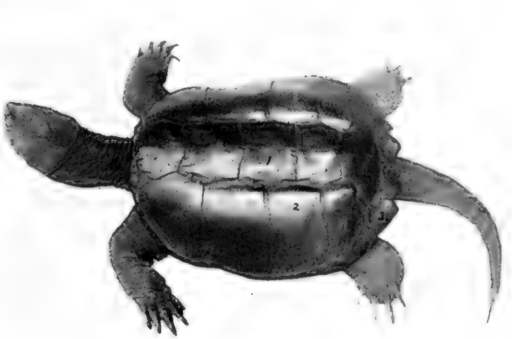


FIG. 37.—*Chelydra serpentina.* Snapping Turtle: 1, neural; 2, costal; 3, marginal; 4, nuchal (page 113).

PLATE VIII
Amphibia and Reptilia of Colorado

Fig. 38.—*Crotalus confluentus.* Prairie Rattlesnake (page 109).

Fig. 39.—*Crotalus confluentus.* Prairie Rattlesnake. Skull showing fangs (page 109).

Fig. 40.—*Crotalus confluentus.* Prairie Rattlesnake. Showing fangsheaths (page 109).

VOLUME X NUMBER 3

THE UNIVERSITY OF COLORADO STUDIES

FRANCIS RAMALEY
EDITOR

PUBLISHED BY THE
UNIVERSITY OF COLORADO
BOULDER, COLO.

NOVEMBER, 1913

Price, 50 Cents

This publication is issued four times a year, the first number in each volume appearing in January or February.

Educational institutions, libraries, societies and individuals desiring to be placed on the exchange list should make request to the "Secretary of the University of Colorado, Boulder, Colo.," to whom also should be addressed any correspondence in regard to purchase of single copies.

All exchanges should be addressed to the "Library of the University of Colorado, Boulder, Colo."

VOLUME X NUMBER 3

THE UNIVERSITY OF COLORADO STUDIES

FRANCIS RAMALEY
EDITOR

PUBLISHED BY THE
UNIVERSITY OF COLORADO
BOULDER, COLO.

NOVEMBER, 1913

Price, 50 Cents

CONTENTS

WOMEN IN THE GERMANIC HERO-SAGAS[1]

By Grace Fleming van Sweringen

In about a quarter of the Germanic hero-sagas there are no women characters. These are stories of men, and there is no suggestion of a woman in them, much less a real feminine rôle. In several others women are mentioned, but without their taking any active part in the story. King Hrôthgâr's wife, Wealhtheów,[2] appears at the banquet a time or two, the typical Germanic hostess. She presents the gifts of the Danes to Beowulf in a few appropriate words, and bids him be happy in the using of them. Hygd,[3] the wife of Hygelâc, has even less to do in the story than Wealhtheów. But her wisdom, far beyond her years, and her generous hand, which spared not the costly jewels, are held up to us in contrast to the unenviable disposition of Thrŷtho.[4] All we know about Thrŷtho, too, is that no man dared so much as raise his eyes in her haughty presence but he paid for his boldness with his head.

In the Ingeld Saga, Freáwaru[5] was married to Ingeld to settle a feud between the Heathobards and the Danes. When the feud broke out again, Freáwaru was cast aside by her husband, not from any guilt of her own, but merely because she chanced to be her father's daughter. Vǿlundr, the magic smith, wreaks a diabolical vengeance upon the innocent Bǫðvildr[6] for the same reason. In this group might also be mentioned the two innocent victims of a husband's jealousy, Wolfdietrich's mother,[7] and Swanhilde,[8] the beautiful young wife of Eormanric. Both of them are, like Desdemona, made to suffer through jealousy aroused by the poisonous whisperings of an evil counsellor. Unlike Desdemona, neither of them has

[1] Reprinted from *Journal of English and Germanic Philology*, Vol. VIII, pp. 501–512, with permission of the editor. Footnotes and list of sources added.

[2] *Beowulf*, ll. 613 ff.; 1163 ff.

[3] *Ibid.*, ll. 1927 ff.

[4] *Ibid.*, ll. 1932 ff.

[5] *Ibid.*, ll. 2023 ff.

[6] "Vǿlundarkviþa," *Edda*, p. 211.

[7] "Wolfdietrich A," *Deutsches Heldenbuch*, B. 3.

[8] "Guþrúnarhvǫt," *Edda*, p. 443; "Hamþismǫ́l," *Edda*, p. 451; *Saxonis*, Lib. 8, pp. 280 ff.; *Jordanis*, XXIV.

an active part to play in the story. The banishment of Wolfdietrich's mother is of interest to us only because of its bearing upon the career of her son, the real hero of the saga. Swanhilde also has nothing to do, heroic or otherwise. The false Bikki invents a story about her, the king believes it, and she is led to her terrible fate. Swanhilde is, however, a telling figure without any effort on her part. She was so lovely and her sunbright eyes so dazzling that even the wild horses which were to trample her to death were held spellbound, and refused to do their work until these eyes had been hidden from them.[1]

Midway between these passive women and the real heroines are the characters that have a small part to play, but an individual part, nevertheless, which has a material bearing upon the movement of the story. They are the minor characters of whom nothing more is required than a clear head, presence of mind, and quick wit at a critical moment; or, perhaps, a willingness to endure hardship, and a certain degree of intelligence in carrying out the plans of another person.

Signý[2] in the Halfdan Saga, for instance, had nothing to do with planning or executing the vengeance for her father's death, but her quick wit and ready act did save the life of her two brothers, and thus preserve them, for the work of vengeance. The boys had come in disguise into the banqueting hall of King Fróthi, the slayer of their father, and their own deadly enemy. Fróthi, suspecting their nearness, sent for a *Vǫlva* or seeress, promising her great rewards if she could tell him where the boys were. The *Vǫlva*, obedient to the king, opened her mouth and spoke:

Two are inside.
I trust neither,
Those who from fire
Somewhat far sit.

[1] Other well-known women characters of this class are Hildeburh, mourning for her slaughtered kinsmen, in the Finn Saga; Siegelinde, the mother of Siegfried, and Gerutha, the mother of Hamlet. Queen Helche, the wife of Attila, the Hun, is mentioned very often in the sagas, and always as "the good Queen Helche," "the beautiful Helche," whom everyone loved. The Evil Counsellor is represented among the women by Skulde, Hrolf's half-sister, in the story of Hrolf and Wøgg, and by Niþuþr's Queen in the Vǿlundr Saga. There are also two women, whose names we do not know, the princess of Jerusalem, wooed by Orendel, and the maiden who was the object of the feud between the brothers, Helgi and Hethinn.

[2] "Saga Hrolfs Konungs Kraka," *Fornaldarsǿgur*, Vol. 1, pp. 3 ff.

And when she had told just enough to whet the king's curiosity, but not enough to help him at all, Signý, the sister, who had been watching her chance, tossed a golden armlet into the lap of the prophetess. The woman broke off suddenly, dazzled by the unexpected gift, and declared what she had said to be a lie. The boys had had their warning, and, in the tumult which followed, made good their escape from the hall.

The princess[1] of Constantinople, whom King Rother wooed and won, was a famous beauty. We are told that she shone among her people brightly as the stars in heaven. Among other women was she as gold among silks. She was entirely fit for a gentleman, or even for a king. It is the traditional feminine curiosity which brings her into the story first. She had heard of the wonderful warrior who called himself Dietrich, encamped with his men just outside of the city. So great was his fame that she was seized by a desire to see him, and find out what manner of man he was. She therefore sent her maid, Herlint, secretly, to beg him to come to her. Dietrich did not go to the princess, but sent her a present instead. He had his smith make for him a pair of golden slippers and a pair of silver ones. He sent two of the shoes to the princess, but both for the same foot. As soon as she observed the mismated shoes, she sent her maid back with one of them. And Dietrich, with an escort of two knights, himself went with Herlint to carry the proper shoe to the princess. Once in her presence, he immediately threw off his disguise, and announced himself as King Rother, whose messengers for her hand had been cast into prison. The princess did not know whether to believe this story or not, and she lay awake all that night devising a plan to get the men out of prison, and prove the identity of Rother. Her plan worked out, everything went well and, thanks to her own cleverness, she sailed away to the western sea with the great King Rother, whom she had long ago made up her mind to marry in spite of her father.

Another young woman who knew what she wished to do, and the best way to do it, is the princess[2] in the Herbort Saga. Dietrich

[1] "König Rother".

[2] Þiðriks Saga, 322[3].

of Berne sent Herbort to woo for him a certain princess named Hilde, whose father did not encourage wooers. Herbort, by a fantastic device of his own, finally gained admission to the maiden, and stated his errand to her. "How does Dietrich of Berne look?" inquired Hilde. "Draw me a picture of him." Herbort drew on the wall a very ugly, frightful looking face. "Heaven forbid," exclaimed the princess, "that I should be married to such a monster!" And then she added, "But why do you woo me for Dietrich of Berne, and not for yourself?"—a question which has the familiar ring of Priscilla's "Why don't you speak for yourself, John?"

The Walther Saga gives us an important secondary character in the person of Hildigunde.[1] It was her wise co-operation in the plans of Walther which made possible their escape from the court of the Huns. The two were hostages at Attila's court. They had been betrothed by their parents, while they were still in the cradle, and fate seemed to favor the arrangement. For, though Attila had often wished to give Walther a Hunnish wife, and thus bind him the more closely to his adopted land, the youth always declined the honor on one pretense or another, and Attila finally ceased to trouble him. Walther planned the flight very carefully, how he was to give a banquet to Attila and his men, and ply them with wine until they should sleep over into the next day. Hildigunde, who carried the keys to the queen's treasures, was to fill two chests with gold, and have ready the four pairs of shoes for Walther, and the iron hooks to catch fish and birds by the way. On the journey, Hildigunde kept guard while Walther slept. And after the fight she bound up the wounds, and poured out the wine for the men who survived. Hildigunde's part is that of the loyal, clever, ready young woman who helps to make things move, not by her own ingenuity, but by faithfully doing what she is told.

The wife of Ortnit,[2] on the other hand, has the elements of the real heroine, though she does not chance to be the central figure in her story. When Ortnit set out to kill the dragon, he demanded from his wife a promise that, if he never returned, she would give her

[1] *Waltharius.*

[2] "Ortnit," *Deutsches Heldenbuch,* B. 3; "Wolfdietrich," *Deutsches Heldenbuch,* B. 3, 4.

hand to no one but the avenger of his death. Ortnit did not kill the dragon, but himself fell a victim to it. His wife was left alone, and his land without a ruler. Many suitors came for the hand of the queen, but she refused them all, in accordance with her vow to wait for the man who should wield the avenging sword, and bring back to her the proofs of his conquest. Years passed. The queen clung to her vow, and her people one by one fell away from her, because her land was being plundered, and she refused to give them a new master. At last she was deprived of her kingdoms and her gold, and she lived with her women in sorrow day and night. But the avenger appeared at last. A stranger in search of adventure came riding by and heard her lamentations in the darkness. He immediately set out against the dragon, slew it after a fierce fight, and came back to claim his reward in the hand of the faithful woman.

Ingibjǫrg[1] represents the type of woman who, through no fault of her own, is the cause of a deadly feud between two men. She was the most beautiful and gifted maiden in all the Scandinavian lands. And two men wished to marry her. Her father, unwilling to offend either one of them, left the choice to Ingibjǫrg. She chose Hjalmarr, a man of great honor in her own land, rather than Angantýr, who was a Berserkr, and one of whom no one spoke aught but ill. Angantýr immediately challenged Hjalmarr to single combat, and the next midsummer they met. Hjalmarr killed his opponent, but himself received a deadly wound, and never came back to Ingibjǫrg. The maiden who was the innocent cause of the strife soon followed her lover in death.

The loyalty of one woman to another, though not the main motif of any saga, appears several times as an incidental motif. When Signi,[2] in the Hagbart Saga, announces her intention to share the death of her lover, the maidens in her following declare their willingness to go with her. And they all die together at the given signal. The generous affection of Gûdrûn's[3] faithful companion, Hildiburg, who stood by her through all her troubles, reminds us of Celia's friendship for Rosalind. And the mild Ortrûn, Gûdrûn's

[1] "Hervarar Saga," *Fornaldar Søgur* I, p. 411.

[2] *Saxonis*, Lib. VII.

[3] *Kudrun*.

one friend in the house of her tormentor, is rewarded at the end of the story for her bit of human sympathy, by having her life spared, and that of her maidens, from the avenging hand of the warrior Wate.

The warlike maiden is also represented among the minor characters. Hervǫr,[1] the sister of Hlǫdr and Angantýr, goes out in armor, like Joan of Arc, and commands an army as her brothers do.

The cruel, heartless woman of the traditional stepmother type is Hartmut's mother, who undertakes to break the pride of the haughty Gûdrûn. The Middle High German poet, who tells the story, is by no means choice or chary of the unpleasant epithets which he applies to her.[2]

Turning now to the major characters. As we have seen, the feminine types represented by the minor characters in the sagas are somewhat varied. The real heroines, on the other hand, are confined to two types, just as the prevailing motifs in the sagas are two—vengeance and fidelity. Inborn in every Germanic warrior was the idea of absolute and unswerving fidelity to an oath—the oath of a vassal to his lord, or the oaths exchanged by lovers. Equally strong in his mind was the idea that the death of a kinsman must be avenged by the surviving members of the family. This was naturally the work of a man, but in the absence of a male relative the woman at hand assumed the burden, and, in more than one case, proved her ability to plan a great thing, and carry it out regardless of results, to face death with all the courage and equanimity of her warrior husband or brother. Life and womanhood itself were none too dear a price to pay for her fidelity to her purpose. The Avenging Woman, and the Faithful Maiden, true to her lover even unto death, are the two types of saga heroine.

Brynhilde[3] and Kriemhilde[3] are perhaps the best known, though not the noblest of the avenging women. Brynhilde's vengeance,

[1] "Das Lied von der Hunnenschlacht," *Eddica Minora*, p. 1; "Das Hervorlied," *Eddica Minora*, p. 13.

[2] The supernatural element in the character of Hilde excludes her from this list of purely human saga women.

[3] Grípisspǫ́, Reginsmǫ́l, Fáfnismǫ́l, Sigrdrifumǫ́l, Brot af Sigurþarkviþu, Guþrúnarkviþa, Sigurþarkviþa en skamma, Helreiþ Brynhildar, Dráp Niflunga, Guþrúnarkviþa II, Guþrúnarkviþa III, Oddrúnargrátr, Atlakviþa, Atlamǫ́l, Guþrúnarhvǫt, *Edda*, pp. 276–450. *Nibelungenlied*, *Vǫlsungasaga*, *Þiþriks Saga*, *Das Lied vom Hürnen Seyfrid.*

which demanded the death of Siegfried, was for a stain upon her own honor. She had been tricked into breaking her vow to marry no one but the hero who should ride through the flames to win her. This motive seems trivial by the side of Signý[1] the Waelsung daughter's great sacrifice for the sake of her father and brothers. Kriemhilde's vengeance for the death of Siegfried is, in the *Nibelungenlied*, sullied by treachery, and by an indifference to bloodshed, which is unnatural to any woman. In the northern version of the story the vengeance is directed, not against her own kinsmen, but against Attila, and is ennobled by its being a punishment for the treacherous invitation, which, in this case, was sent by Attila, and not by Kriemhilde herself.

There is still a bit of the personal element in the vengeance of Rosamunda,[2] the Gepid princess. Although she was fulfilling the first and highest duty of a Teuton, when she avenged the death of her father, it was an insult offered to herself, as well as to the memory of her father, which goaded her to decisive action in the matter. Rosamunda's father was killed by Alboin, king of the Lombards, and Rosamunda herself was a prisoner of war, whom Alboin afterward married. One evening as they sat at the banquet, Alboin, excited by wine and victory, offered to his wife a drinking vessel, which he had had made from the skull of his father-in-law, bidding her drink and be merry with her father. From that moment Rosamunda had but one thought—to avenge the death of her father by the death of her husband. This was not easy to accomplish. The king was a brave man, and no one was willing to assume the responsibility of his death. Finally, as the result of strategy, and by the sacrifice of herself, Rosamunda gained an accomplice in Peredeo, Alboin's bravest and most faithful courtier. At midday when all was still in the palace, and Alboin safely asleep, Rosamunda had all his arms removed except the sword, which he wore at his side. This she had bound firmly to the head of the bed, so that it could not be unsheathed. The hand of Peredeo completed the work, and Alboin fell, with no chance to fight for his life. The cost had been great, but Rosamunda's revenge was accomplished.

[1] *Vǫlsunga S.*, II–VIII.

[2] Pauli, Lib. II, 28.

The towering figure in this group, one unsurpassed, indeed, in all the sagas for tragic effect, is Signý, the Waelsung daughter. Married by her father to a man whom she hated and mistrusted from the first moment, she never once lost courage, but was always master of the situation, and superior to her surroundings. Signý is a real hero, but a woman, too, from first to last. She makes her entrance as an actor in the story on the day after her wedding-day. As she bids her father farewell, she says to him, "I did not wish to be wedded to Siggeir, nor does my heart go out to him. I have a foreboding, too, that much ill will come to us from this union." Then they separated, and Signý went home with Siggeir. We next see her three months later, standing at nightfall on the shore of Siggeir's land, imploring her father and brothers not to set foot in her husband's territory. "Do not run into danger, I beg you, for there will be no way of escaping. Siggeir, the king, has collected a great army, and means to fall upon you without mercy." But her warning was unheeded, the men refusing to run away from an enemy, and Signý left her kinsmen to their fate, and went home weeping bitterly. The next morning a battle took place, and King Waelsung fell with all his following, except his ten sons. These were taken prisoners, but, at Signý's request, were set in the stocks instead of being put to death at once. With the aid of a trusty servant, Signý saved the life of one of them, Sigmund, and he made his escape to live in the woods until the time of vengeance should come. One at a time, when they were ten winters old, Signý sent her two sons out to Sigmund to be tested. They both showed fear, and she ordered them to be killed because they were unfit for the work of avenging her father's death. Then Signý knew that only a pure Waelsung would be brave enough to assist in carrying out the revenge. Her resolution was quickly made. In the guise of a witch she went to Sigmund's cave in the woods, and dwelt there with him for the space of three days. In due time she bore a son, whom she named Sinfjǫtli. When he was sent to Sigmund, he withstood the test, proving himself a true Waelsung, son's son and daughter's son, and Signý knew now that her plans would be carried out. The boy grew up in the woods with Sigmund, and when the time came, he helped Sigmund to set fire to the hall of Siggeir in the night, guarding it so that no one could escape. Sigmund called to his sister to come out to them and be saved, promising her great honor and full atonement for all her sufferings. But Signý, mindful of the duty of a woman to her husband, as well as of the respect which she owed to her own womanhood, made this answer: "Now shalt thou know whether I have remembered how Waelsung the king was murdered by Siggeir. I had my two sons killed because they showed themselves unfit for the work of vengeance. I have done such deeds for the sake of revenge that it is not possible for me to live longer. Forced to abide with Siggeir in life, I now go with him willingly in death." Then Signý kissed Sigmund, her brother, and Sinfjǫtli, her son, and went back into the flames.

There are three women in the sagas, whose fidelity to a lover raises them to the rank of a hero: Gûdrûn, Signi and Sigrún. Gûdrûn is the heroine of a love story with a happy ending. Signi and Sigrún are tragic heroines. Gûdrûn's fidelity to her betrothed lover cost her many years of hardship and suffering. Fair words, threats and deeds of violence alike availed nothing to turn her from her purpose. She endured much and long, but the fates were on her side. And she lived to see the end of her troubles. Sigrún[1] and Signi[2] are different. Sigrún was a Valkyrie. Riding through the air one time with her companions she met the man Helgi on his return from a successful battle. She bemoaned to him her fate that she had been pledged by her father to Hoðbrodd, the grim son of Granmarr, "Though I have said, Helgi," she added, "that this Hoðbrodd is no better than the son of a cat. One splendid like thee have I wished as my spouse. And now do I fear the wrath of my kinsmen, because I oppose the will of my father." Helgi came to the aid of the woman in distress, raised an army and went out to meet Hoðbrodd in battle. He was victorious, but more men fell in the fight than he himself wished. And to Sigrún must he announce not only the death of the hated wooer, but the fall of her brothers and father as well. Sigrún wept when she heard this, and said, "Fain would I wish them back again, these

[1] "Helga Kviða II," *Edda*, p. 256. [2] *Saxonis*, Lib., VII, pp. 230 ff.

dear ones. But if life to them would snatch me from thy arms, to life would I never call them." After that Helgi and Sigrún became man and wife. But Helgi did not live to grow old. He had spared one brother of Sigrún's in the fight, and this one vowed to Odin that he would avenge the death of his father and brothers. This he did with Odin's own spear, and then he rode away to tell Sigrún what he had done. Sigrún, his sister, cursed him with many curses, but she sang a song of praise to the memory of Helgi, the hero, and never ceased to weep for him. One evening when Helgi had been dead for some time, Sigrún's maid announced to her that armed warriors were to be seen riding toward the mound where Helgi was buried. "Go, Sigrún," she said, "out upon the Sefafell, if thou yearnest to see the prince of thy people. The mound is open, Helgi is come. His wounds are bleeding, and he, the dayling, bids thee cease thy weeping, and still the blooddrops from his wounds." Sigrún went with all speed to the grave, and when she had entered it, she said, "Now do I rejoice to see thee. But, Helgi, thy hair is thick with frost, and thou, thyself, art with deadly dew bedecked. How can I, O Prince, bring help to thee?" And Helgi replied, "Thine alone is the fault, Sigrún of the Sleeping Rock, that Helgi with the dew of grief is dripping. 'Tis thy tears that fall bloody on the Prince's breast, with sorrow laden. But deep shall we drink of the dearest cup, though we have lost joy and lands as men do count. No man shall sing a sorrow song, even though my wounds be plain to see. . . . . Now, I say, shall nothing seem strange, early or late, at the Sleeping Rock, since thou, living and breathing, hast rested a while in the mound of the dead." But at the first dawn Helgi started up. "Now is it time for me to ride the reddened paths, to let the white horse tread the air-way. I must over the rainbow bridge ere cockcrow." Helgi rode away, and Sigrún and her maid went home to her dwelling. Sigrún did not live long after that, but pined away in grief and pain to an early death.

The tragedy in the story of Signi is also brought about by a feud between the chosen lover of the maiden and her own family—again the motif, fidelity unto death, even against the ties of blood. Signi, the daughter of King Sigar, was loved by Hagbart and secretly betrothed to him. But Hagbart had killed Signi's brothers in battle, and for this reason knew that he could never obtain her father's consent to marry her. He resolved, however, to see her again, even at the risk of his life. He dressed himself in women's clothes, and, giving himself out as a Valkyrie, bringing a message to King Sigar, readily obtained admission to the palace. He thought not of the danger, for his confidence in safety through the fidelity of Signi was greater than his fear on account of having killed her brothers. As an honored guest, the Valkyrie maiden was taken to the apartments of the king's daughter. Signi recognized her lover at once, and was silent. Her maids, however, were suspicious of this stranger. They spoke of his hardened hands and hairy wrists. But Hagbart cried out, "What wonder that my tender soles have been hardened, so oft the sand has touched my feet, and thorns have pinned me fast in the midst of my course. And my hands—blood-dripping weapons, and not the distaff, have busied them these many days." And Signi quickly interposed, "The hand that deals out wounds is ne'er so soft as that which holds the fine spun wool." After the maidens had retired, the two alone renewed their vows of love, and Hagbart thus addressed Signi, "If I am taken captive here and condemned to cruel death, wilt thou then, thy holy vows forgetting, after my downfall seek again the marriage bond, thou my only loved one?" And Signi answered, "With thee will I die. If sad fate sink thee into the grave, my life will I not prolong. No vow will be more safely kept, if woman's word know what it be to keep the faith." These words so cheered the heart of Hagbart that he felt greater joy from her promise than pain at his own danger. But the lovers' secret could not be kept for long. The maid-servants betrayed them, and Hagbart was captured after a brave resistance. Nor was he permitted to fight for his life, as befitted a king's son. Sigar refused him this boon, and condemned him to die a disgraceful death on the gallows. Meanwhile Signi had inquired of her maidens if they were willing to share her fate to the last, and follow whithersoever she might lead. These vowed to carry out faithfully every wish of their mistress, and then Signi told them of her decision to follow her lover to the grave. At a given signal they were to set fire to the palace, then, having made nooses of their garments, they were to hang themselves, thus sharing with their mistress the death of Hagbart. In order to test once more the steadfastness of his loved one, Hagbart begged the hangman to first suspend his mantle from the gallows, that he might have a picture of his death beforehand. The request was granted, and Signi's watchman, believing it to be Hagbart himself, gave the signal to set fire to the building. Hagbart saw the flames and cried out, "The pain of death is naught as compared with the joy that I feel in the fidelity of my beloved. Quick, ye hangmen, seize me, raise me in the air. Sweet it is for me, my Beloved, after thy end to die. Lo, the vow has thou fulfilled, since thou art in death, as in life, my companion! Never can our first love die."

There are no startling conclusions to be drawn from this survey of the saga women. To be noted is, that the treatment of women in the hero-sagas is serious. Nowhere is there anything bordering on lightness. Also, two types, well known to literature, are entirely lacking. There is no victim of a despised love, and no patient Griselda. Dido and Medea, the one dying for a faithless lover, the other living only to wreak vengeance upon one, are without a counterpart among the saga women. Equally out of place in this company would have been the patiently suffering wife. Patience in distress is nowhere lauded as an heroic quality. And meekness under oppression was no more a characteristic for a Germanic saga woman than it is for a twentieth-century heroine. Saintliness had not yet come into fashion. The saga women do, however, include a goodly number of familiar feminine characters, ranging in importance from the mere *freothu-webbe* of *Beowulf* to the strongest tragic heroines. Characters of passion and imagination, rather than of intellect, they are, nevertheless, well poised, and courageous to the last degree. To die smiling was the ideal of every Germanic warrior, and the saga heroine went to her death, or to the duty harder than death, with the same brave smile.

* * * * * * * * * * *

The sources of the *Heldensage*, used in this paper: *Beowulf*, ed. by Heyne, 6th ed., Paderborn, 1898; *Deutsches Heldenbuch*, 5 vols., ed. by Jänicke, Amelung, Martin and Zupitza, Berlin, 1866–73; *Eddica Minora*, ed. by Heusler and Ranisch, Dortmund, 1903; *Ekkehardi primi Waltharius*, ed. by R. Peiper, Berlin, 1873; *Das Waltharilied*, trans. and ed. by Althof, Leipzig, 1907; *Fornaldarsøgur Norðrlanda*, ed. by Rafn, 3 vols., Copenhagen, 1829; Jordanis, *De Getarum sive Gothorum, Origine et Rebus gestis*, ed. by Closs, 3d ed., Reutlingen, 1888; *Kudrun*, ed. by E. Martin, 2d ed., Halle, 1902; *Die Lieder der älteren Edda*, ed. by Hildebrand, 2d ed. by Gering, Paderborn, 1904; *Das Nibelungenlied*, ed. by K. Bartsch, 4th ed., Leipzig, 1895; Pauli, *Historia Langobardorum*. "Monumenta Germaniae Historica," Hanover, 1878; *König Rother*, ed. K. V. Bahder, Halle, 1884; *Saxonis Grammatici Gesta Danorum*, ed. by Holder, Strassburg, 1886; *Das Lied vom Hürnen Seyfrid*, ed. by Golther, Halle, 1889; *Snorri Sturluson, Edda*, ed. by F. Jonsson, Copenhagen, 1900; *þiðriks Saga af Bern*, ed. by Henrik Bertelsen, Copenhagen, 1905–11; *Vǫlsunga Saga ok Ragnars Saga Loðbrókar*, ed. by Magnus Olsen, Copenhagen, 1906–1908.

FOREIGN DRAMA ON THE ENGLISH AND AMERICAN STAGE (ITALIAN AND SPANISH)

By Charles C. Ayer

III. ITALIAN DRAMA

The history of Italian drama on the English and American stage can be briefly told, for there is almost nothing to record. While France[1] and Germany[2] during the past few centuries were writing plays which in translation or adaptation have become a part of the standard English repertory, Italy seems to have remained silent. Plays dealing with Italian scenes, events and heroes, there have been in abundance, but they are not from the Italian. *Dante*, the last play produced by Sir Henry Irving in 1903, was from the French. The well-known operetta, *Boccaccio*, is of Viennese origin. The greatest of all dramas dealing with Italian people on Italian soil, *The Merchant of Venice*, *Othello* and *Romeo and Juliet*, were written by an Englishman.

Nevertheless Italy has contributed two names to the history of the world's great dramatists, which should be mentioned in this connection, even though they may not be known to English and American theater-goers. Carlo Goldoni (1707–93), known as the Italian Molière, wrote comedies of delicacy and charm, and Vittorio Alfieri (1749–1803), stately and sonorous tragedies, inspired by the classic French tragedies of Corneille, Racine and Voltaire. But both Goldoni and Alfieri are practically unknown even by name to the English and American public at large. One of Goldoni's most pleasing comedies, *La Locandiera* (*The Mistress of the Inn*), has, however, been given in America, by Eleanora Duse, and another, *Le Donne*

[1] See "Foreign Drama on the English and American Stage. I. French Drama," *University of Colorado Studies*, Vol . VI, No. 4, pp. 287–297, June, 1909.

[2] See "Foreign Drama on the English and American Stage. II. German Drama," *University of Colorado Studies*, Vol. VII, No. 1, pp. 63–71, December, 1909.

Curiose (*The Inquisitive Women*), has been recently used as an Italian opera text and set to music by Wolf-Ferrari. There is also a record of a play, called *Neighbors*, produced in London in 1866 and said to be "adapted from Charles Goldoni's comedy,"[1] but it is impossible now to judge, from the Italian titles of Goldoni's one hundred and twenty-one comedies, which one it may have been. In any case, the play was soon forgotten.

If Goldoni is, then, a name known only to the student of literature, and quite unknown to present-day play-goers, the name of Alfieri is even more remote for the purposes of this paper. No one of his plays has had a career on the English stage, and only his *Saul* given in the original by the elder Salvini has been witnessed by a few American connoisseurs of the past generation.

In this connection it may be interesting to consider the repertory of Tommaso Salvini with reference to the light which it sheds upon Italian dramatic literature. As the greatest tragic actor in the annals of the Italian theater his career is full of interest for us, for he is well known in America, having made five professional tours in this country —in 1873, 1880, 1882, 1886 and 1889. Salvini was born in 1829 and is still living. In 1895 he published his autobiography.[2] From it we see what dramas he himself appeared in, and also what plays constitute the repertory of his almost equally illustrious contemporaries, Adelaide Ristori and Ernesto Rossi, who likewise made tours in the United States.

Salvini tells of a traveling company in Italy in the 40's, which gave alternating performances of the works of Goldoni and Alfieri. In the course of his autobiography he mentions the various plays in which he took part, among others *Merope*, *Saul* and *Philip the Second* by Alfieri; *The Sagacious Wife* and *Pamela* by Goldoni; *Adelchi* by Manzoni (1785–1873); *Oedipus at Colonnos* by Nicolini (1782–1861); *Fornaretto* by Dall 'Ongaro (1808–73); *Francesca da Rimini* by Silvio Pellico (1789–1854); *Pia de' Tolommei* by Carlo Marenco (1800–46); *Sophocles* by Paolo Giacometti (1816–82), written expressly

[1] See CLEMENT SCOTT, *Drama of Yesterday and Today*, Vol. II, Appendix, London, 1899.

[2] SALVINI, *Ricordi, annedoti ed impressioni*, Milan, 1895; *Leaves from the Autobiography of Tommaso Salvini*, The Century Co., New York, 1893.

for Salvini in 1866; and finally *Civil Death* (*La Morte Civile*) by the same author.

This is a goodly list of plays by Italian authors, but no one of them awakens a slumbering memory in the American play-goer, excepting the last. *La Morte Civile* was one of the most powerful and popular plays of Salvini's entire career. In 1880 in the heyday of his fame, an English version of this play was made by Charles Coghlan and called *A New Trial*, but there is no evidence that it made a lasting impression, and the inference is that it was not so much the play itself as the superb acting of Salvini as Conrad the Outlaw which made *La Morte Civile* second only to *Othello* in the great actor's repertory.

Simultaneously with the native Italian plays, there were to be found on the Italian stage in the nineteenth century many dramas translated from the French, German and English. The plays of Scribe, then in his prime, were given frequently. One of Salvini's favorite parts was Orosmane in Voltaire's *Zaire*, though he never appeared in this play in America. His best-known plays of non-Italian origin were *The Gladiator* from the French of Soumet; *Ingomar, the Barbarian* from the German of Friedrich Halm; *David Garrick* by the prolific English playwright, Thomas W. Robertson; and lastly, Shakespeare's *Macbeth, Hamlet, Romeo and Juliet, King Lear, Coriolanus* and *Othello*, in the last of which he won his greatest success and most enduring fame not only in England and America, but also in his native land.

As with Salvini, so with Ristori and Rossi. Both actors, of course, went through a thorough and complete classical training in the Italian repertory, but Ristori's fame rests chiefly on her impersonation of Racine's Phedre, Schiller's Mary Stuart and especially Shakespeare's Lady Macbeth. Rossi, likewise, achieved renown in foreign plays, in the *Cid* of Corneille, in Goethe's *Faust*, and as Louis XI in Delavigne's historical drama of that name, a play which was one of the most impressive in the repertory of Sir Henry Irving. All three actors seemed to favor non-Italian plays.

Salvini tells us that in 1853, or ten years after he went upon the stage, he became interested in Shakespeare, through the Italian translation of Giulio Carcano (1812–84). At that time the quality of form still appeared so important to him that he regarded Voltaire as superior to Shakespeare, and preferred the Orosmane of *Zaire* to the Othello of Shakespeare's play. But gradually the artificial perfection of the French classic school lost its fascination for him. He had become absorbed in the free and inspired drama of Shakespeare. In like manner Rossi and Ristori showed their preference for Shakespeare. Rossi appeared in a repertory similar to that of Salvini, while Ristori appeared as Juliet in her youth and achieved her greatest fame in later years as Lady Macbeth. This is the part in which most Americans will remember her. Nevertheless, in her tours in this country, she did appear in the plays of one Italian dramatist of high standing in the nineteenth century, Paolo Giacometti. He is the author of *Elizabeth*, and of *Marie Antoinette*, played by Ristori, as well as of *Sophocles* and *La Morte Civile*, played by Salvini. But the native Italian stage, during the lifetime of its three greatest actors, was nevertheless poverty-stricken. In 1856 Ristori at the height of her fame had an Italian translation made of the old-fashioned tragedy, *Fazio, or the Italian Wife*. The title of this play would lead one to believe that it was of Italian origin, but it was the work of the Rev. H. H. Milman, an English clergyman, his own work and not adapted from an Italian source. Far from drawing our plays from the Italian stage, we were actually, in this instance, furnishing the Italian stage with an English play, a rare occurrence, indeed, as English plays down to the present day have seldom made their way to the continent. *Fazio*, which dates from the year 1817, has not been seen on the American stage since the early days of Mary Anderson, some thirty-five years ago.

From the foregoing pages we can only infer that throughout the nineteenth century, Italian drama had practically no effect on the English stage. This is the case. The dramatic literature of Italy is a sealed book to us. On the other hand, the music of Italy in the nineteenth century, through the medium of opera, early penetrated to America. The melodies of Bellini, Donizetti and Rossini gladdened the entire musical world. It mattered little that the story of the Druid priestess Norma, the Scotch Lucy of Lammermoor and the Spanish Barber of Seville were sung to us in Italian, a language that we did not understand.

Toward the close of the nineteenth century, a revival of the Italian theater is to be noted. In 1884, Giovanni Verga (1840–), wrote a one-act tragedy, *Cavalleria Rusticana*, which was played by Eleanora Duse. It is better known, however, as an opera, having served as the story to the music drama of Pietro Mascagni, a work which, in 1890, won him a prize and which, translated into all the modern languages, has maintained its place in the modern grand opera repertory. The original drama of Verga has never been given in English. At about the same time, the name of Gabriele D'Annunzio (1862–) began to attract attention outside of Italy. His dramas, deemed morbid and daring, are not intended for the great healthy-minded public, but with Eleanora Duse as interpreter of his passionate and imaginative muse, a new drama from his pen has been, and still is, a literary event of importance. Two of his plays, *La Gioconda* and *The Dead City*, have been given throughout the United States by Miss Florence Roberts.

Another modern Italian author whose work is beginning to be known on the English and American stage is Roberto Bracco. His bright and graceful comedy, *L'Infidele*, under the title of *Countess Coquette*, is in the repertory of Madame Alla Nazimova. Another of his comedies entitled *Three* is promised an early production in London by Miss Gertrude Kingston. In the fall of 1911 Mrs. Leslie Carter produced an effective play from the Italian, *Two Women*, by T. Cicconi, adapted by Rupert Hughes. In the spring of 1913 at the Irving Palace Theater in New York, there was a production in German of *Giannotta's Tears* by Francesco Postonchi, which may or may not be given later in English. In the summer of 1912, Mr. Arnold Daly returned from Europe with a play by the Italian poet, Sembenelli, bearing the imposing title, *Lorenzo the Magnificent*. The play has not been produced, but we can at least see that there is such a play and author. Italy is coming to the fore.

IV. SPANISH DRAMA

If, on the whole, Italy has furnished but little drama to the English and American stage, Spain cannot be said to have done any better. The history of the two countries is practically the same in this respect. In Spain, as in Italy, historical events and personalities have not been lacking. The Spanish cities and the rural and mountain regions are rich in color. They teem with interest and charm. Nevertheless, in Spain the drama, as well as the music, has remained, like the bull-fights, something peculiarly national. And yet, in Shakespeare's time and thereafter, Spain had two dramatists, Lope de Vega (1562–1635) and Calderon (1600–83), who rank among the world's great dramatists. Lope de Vega is said to have written two thousand original dramas, consisting of spiritual plays, historical comedies and dramas of intrigue. The number seems incredible. Calderon, too, was a prolific playwright with five hundred plays to his credit. There was evidently no lack of interest in the drama in Spain. But if we look for traces of this enormous activity of bygone days, we find nothing in our own modern repertory. Lope de Vega and Calderon are now read only by the students and lovers of the poetic drama and in advanced college classes. To the English and Americans at large, they are as remote as Goldoni and Alfieri, Corneille and Racine.

To find examples of Spanish drama on the English stage it is necessary to come at once down to the present day. Spain, like Italy, has a few modern dramatists who challenge the attention of the outside world. The name of José Echegaray (1832–) is now known to American play-goers through his *El Gran Galeoto.* This play was written in 1881 and in 1889 an English version of it was presented in London under the appropriate title of *Calumny.* It could not have met with great success, however, or it would not have fallen promptly into oblivion. For our acquaintance with the play, we are indebted to the English version of C. F. Nirdlinger presented in 1908 by Mr. William Faversham and Miss Julie Opp, under the title of *The World and His Wife.* The previous title of *Calumny*, however, gives a better idea of the subject-matter of the play, which deals with the evil of calumny in a unique and unusual way. Teodora, the trusted, loved and happy wife of Don Julian, chances to cross the public square at Madrid with Ernesto, an intimate friend of her husband. The tongue of gossip begins at once to wag. At first all three are quite unconscious that trouble is in store for them. We see them in their true light—noble, pure and generous. But the effects of the slander, baseless as it is, gradually make themselves felt. Powerless to resist the subtle effects of the intangible poison, they succumb. The wretched husband loses his reason and dies. Forsaken by their former friends, Teodora and Ernesto are forced to seek refuge in each other. Out of their common sufferings springs true love. Together they fly, to begin life elsewhere anew. This is the barest outline of the play, which is written with a prologue in prose and three acts in verse. The unique feature of the play is that the moving force, the villain, as it were, is not a person, but an invisible influence which pervades and penetrates from beginning to end. We do not see this evil spirit as we do in *The Devil* of Franz Molnar, where the Hungarian dramatist allows the malign influence which wrecks the life of a man and woman to appear to us in the person of Satan himself, dressed in modern garb quite like other people, but with a touch of red here and there, and with his hair brushed up into tiny horns on his head, so that he is thus a visible evil genius. The play of Molnar is brilliant and clever. The conception of Echegaray is perhaps more subtle. In the English version it is an effective play in spite of the many liberties taken with it by the adapter, the most unwarranted of which is the introduction of a character not to be found in the Spanish original, a liberty, however, which, it must be admitted, is skilfully taken, and suspected by no one not familiar with the original.

There remains but one other Spanish playwright to mention, Angel Guimerá (1847–). He writes in his native dialect, the Catalán, and when his plays are transferred from Barcelona to Madrid they have to be translated into Castilian. His best-known play is *Tierra Baja* (*The Low Country*). This play was produced under the direction of Mrs. Fiske about ten years ago, under the title of *Marta of the Lowlands*. Mrs. Fiske herself for some reason did not appear in the play and the part of the heroine was taken by the distinguished actress, Mme. Bertha Kalich. California and the far West were again indebted to Miss Florence Roberts for an excellent performance of *Marta of the Lowlands.* In England, the version used by Mr. Martin Harvey is called *The Lowland Wolf.* Guimerá's play has also served as the text to the opera *Tiefland*, with music by Eugene D'Albert, which is in the repertory of the Metropolitan Opera House, New York.

The most recent play of Guimerá to reach America is *Maria Rosa*, translated into English from the Castilian version of the eminent Spanish playwright, Echegaray, already mentioned. It was presented in the spring of 1913 at the Toy Theater in Boston before an exclusive audience of ninety persons at the most, that being the capacity of the tiny playhouse. It might be feared that a play performed before a picked audience of less than a hundred exclusive spectators would not be one calculated to win the plaudits of the great public. But there is no reason why *Maria Rosa*, with its powerful appeal to the human heart, should not please the masses as well as did *Marta of the Lowlands.* It is a mistake to believe that the great public is impervious to beautiful thoughts couched in beautiful language. Guimerá's literary sense is of the highest. He is forceful, imaginative and poetic. Yet his plots are elemental and quite within grasp of the average man. The story of *Maria Rosa* depicted on films could not fail to please a moving-picture audience. Briefly told it is as follows: Some Catalán peasants are at work building a new road in the mountains. The men are angry over a reduction in their wages and the foreman is mysteriously murdered. Andres, the young husband of Maria Rosa, is accused, tried and convicted of the murder. At the opening of the play, he has already been sent away to prison, and the young wife who firmly believes in his innocence tells us the sad story. Word soon comes that Andres has died in prison. Maria Rosa then hesitates no longer. Vowing an oath of fidelity to the memory of her husband, she swears vengeance. But a lover appears on the scene in the person of Ramon, a handsome, dashing fellow, a captivator of women. Maria Rosa's intuitions avail nothing. She falls under the spell of Ramon. A terrible struggle ensues, a spiritual conflict between her loyalty to the memory of Andres and her infatuation for Ramon, who wins her at last in marriage. At the wedding feast, the young bridegroom drinks heavily, and becomes arrogant and boastful. Maria Rosa's latent suspicions are aroused. The guests depart. She is alone with Ramon. Little by little, by her flattery and caresses, she cajoles him into confessing that he killed the foreman, and fastened the guilt upon Andres. Then, as he claims another kiss, she stabs him to the heart.

The *New York Dramatic Mirror* of October 1, 1913, announces that Miss Dorothy Donnelly will soon be seen in a new production of *Maria Rosa.*

If newspaper predictions always came true there would be one more Spanish play deserving of mention in this series, the *Electra* of Perez Goldos (1845–), which was presented in Madrid in 1901 with such pronounced success that the American press at once announced that Miss Julia Marlowe would give the play in English. This is the last we have ever heard of it. But such occurrences are common enough. In this case it is easy to see why Miss Marlowe, after reading the play, changed her mind. *Electra* deals with a situation which is not a living issue in the United States today. A young girl disappointed in love is coerced into a convent. Certain of the characters with modern, free-thinking tendencies combat the influence exerted by an emissary of the church and finally after a deliberate falsehood has been proven, the young girl and her lover are reunited. Throughout the play the ecclesiastical influence in Spain is made to appear in a bad light. In 1901 a play with such anti-clerical tendencies was regarded in Spain as daring and it created a stir. English-speaking people have long ceased to have a vital interest in such a problem. A modern American audience would be bored by it.

The theater of Spain, like Spain itself, has always been, and still is, something that we do not fully understand. The civilization and culture of Spain are to a certain extent Latin, it is true, like that of Italy, but Spain is not as hospitable to outsiders as is Italy. Educated foreigners have not flocked to Madrid, Grenada and Seville as they have to Rome, Florence and Venice to make their home. Spain is off the beaten track even for the modern tourist. Those who desire the latest comforts of modern times are only beginning to find them in Spain, and hence do not go there in large numbers. Theater lovers in particular would find the theater system peculiar. In some theaters plays occupying a whole evening are given. The successes of Paris are drawn upon, and may be seen in Spanish translation. But the theater of distinctly Spanish type is given over to one-act plays, four of which are given in one evening and the people pay for the number of plays they wish to see. It is possible to pay for the entire evening on entering, but as a rule, a ticket-seller passes up and down between the plays, and the people already present decide whether or not they will remain. There are advantages to this system. The four plays are presented in a different order on successive evenings so that the convenience of all is eventually suited. A person has the privilege of presenting himself according to his convenience at 8, 9, 10 or 11 o'clock, the time for the beginning of each play being announced in the newspapers, on handbills and at the entrance to the theater. It should be said for these little plays that many of them are highly meritorious. They represent all styles of drama, tragedy, comedy, melodrama, farce and *zarzuela*, or musical comedy, somewhat as we understand that term. In the last-named there is frequently introduced some Spanish dancing with castanets, which is still in high favor in Spain, though it strikes us as peculiar—at least as very different from the modern dancing steps seen on the American stage. However cosmopolitan we may be, we still remain outsiders in Spain. If we would seek to understand the soul of Spain we must read the book of that title by Havelock Ellis.[1] There we shall find absorbing chapters on Spanish manners and customs, painting, literature, dancing and types of beauty. The name of the author bespeaks the rare insight with which the book is written. In this connection it is to be noted that, at present in New York, some of the higher-class theaters are beginning to give an evening of one-act plays. This is nothing new, however. Fifty years ago a short curtain raiser was always in order, and is to this day in England in many theaters.

[1] HAVELOCK ELLIS, *The Soul of Spain*, Houghton, Mifflin Co., 1908.

And surely, the one-act play has never been seen to greater perfection anywhere than when presented in this country twenty-five years ago by Rosina Vokes.

Spain has sent us no Salvini, Ristori or Rossi, but she did produce Tamagno, the tenor; Sarasate, the violinist; and Carmencita, the dancer. The names of the present leading actors of Spain, Enrique Borras, Maria Guerrero and Diaz de Mendoza, well known in Spain and Spanish America, mean nothing to us. They do not visit the United States. Last year Borras visited Mexico and produced some of the plays of Guimerá.

When it comes to light music of the best kind, Spain and Spanish America turn, like the rest of the civilized world, to Vienna. From the announcements of the current newspapers of Cuba, Mexico, Porto Rico, Honduras, Chile and Peru, one may hear in those countries at the present moment *La Viuda Alegre* (*The Merry Widow*), *Las Maniobras de Otoño* (*Autumn Maneuvres*), *El Conde de Luxemburgo* (*The Count of Luxemburg*), and *La Princesa del Dollar* (*The Dollar Princess*).

THE SERENE EVANGEL OF SCIENCE[1]

By Fred B. R. Hellems

I

"Come unto me, all ye that labor and are heavy laden, and I will give you rest."

The words came so gently, so trustingly, so winningly, from the lips of the reverend speaker, that even careless ears were quickened to hear his lesson.

"When Science can offer the stricken heart a substitute for that divine promise, it may overthrow the Christian religion. Until then, mankind will seek a shelter in the shadow of the cross, a balm in the loving care of a Father who is at once the all-wise and the all-kind."

As I listened, the voice of the speaker became the voices of a thousand Christian apologists from St. Matthew and Francis of Assisi to Cardinal Newman and the pastor I had loved since childhood. Here the faithful have ever found a stay against the persistent aggression of Science, a bulwark against the pervasive tide of Humanism. Through the centuries the thoughtful Christian has been repeating in changing forms the experience of St. Augustine as he felt himself carried away by the irresistible charm of Plato, and exclaimed, half in self-support, half in criticism of the great Athenian's teaching: *Nemo ibi audivit vocantem, Venite ad me qui laboratis.*

And even as this cry represents the heart of Christianity, so it suggests the error of the extreme assailants of revealed religion. Shelley, with his passionate, idealistic pantheism; Huxley, with his conscientious, militant agnosticism; Swinburne, with his almost demoniacal bitterness; Haeckel, with his incisive, relentless materialism—all these, and countless others, have failed to reckon with the strength that is rooted in weakness. Their onslaughts have often appalled the simple and kindly by sheer ferocity, no less than they

[1] Reprinted from the *Forum*, Vol. XLIX, pp. 607–617, 1913, with permission of the editor.

have irritated the thoughtful by a lack of human sympathy. Even in after-years none of us can easily forget the youthful perturbation and instinctive revulsion that swept over his being when he first encountered the flippant and mordant sarcasm of Voltaire, or such hurtling lines as these from Queen Mab:

> Religion! but for thee, prolific fiend,
> Who peoplest earth with demons, hell with men,
> And heaven with slaves.

But now, it seems to me, there has come a change. I do not wish to imply that the fiery, ruthless, jeering types of rationalist, realist and atheist are no longer to be found; I mean only that there are signs of a gentler spirit in Science, of a greater breadth in Naturalism, and of a kindlier heart in Humanism. Belike their champions feel that a triumphant cause may doff its most bristling arms; or it may be they have traced more clearly the course of religion, and have reached an understanding of its place in evolution as a direct outcome of elemental human nature. Perhaps, again, they have simply learned that a "sweet reasonableness" is, after all, the surest path to the upward surging heart of man in his present stage of progress. At any rate, they seem more willing to grant that eternity is no slight thing to lose; that "the hope, whereto so passionately cling the dreaming generations from of old," is not to be dashed lightly down like a childish gaud; and that the final dayspring of victorious truth ought to come richly fraught with tenderness and healing.

And today, if my ears have heard aright, Science is standing before the great congregation of civilized mankind and declaring this gospel: "Come unto me, and ye shall not labor with wrung hands unto bitterness, nor be heavy laden unto faintness. Come unto me, and for the peace that passeth understanding I will give you the peace that is based upon reason and knowledge. Come unto me, and for the inveterate hope of a life to be, ye shall learn the glorious meaning of the life that is. Come unto me, and for your need of an Omnipotent Kindness to save you from sin and shame, I will teach you the beauty and dignity of human nature. Come unto me, and the Earth shall have more gladness and the Hours more hope."

II

In this serene evangel the opening promise may well prove to be the most fruitful and important. It is desperately hard to decide just how large a part has been played in the history of religious feeling by physical want and weakness and fear; but it has been very large. When a thoughtful delver into the psychology of religion tells us that "hungering after righteousness is an irradiation of the crude instinct of food-getting," our lips may start to word a protest; yet we must agree with the author of *The Mystic Rose* that every man, when he happens to be brought down face to face with the elemental realities of existence, birth and death, hunger and thirst, *ipso facto* becomes a religious subject. And it is indisputable that in the dim abysses of time, when primitive man first became feelingly aware of his own weakness, he soon learned to appeal for help to something outside himself. Then, with the development of the race, with the growth of needs and emotions and capacities, this instinct to look beyond the known kept taking on new aspects, until it is almost impossible to trace the remote and humble origins of many phases of religious experience. From the transcendental ecstasies of St. Mary of Ognies and other famous ascetics it might seem a far cry to the physiological needs of early man, yet who can be quite sure that they are not closely akin?

In any event, the factors just enumerated have been powerfully operative in a score of ways. King Hunger has made many sinners; but he has also made many saints. Pain and suffering and fear have driven many men to violate laws and conventions; but they have driven more to seek some superhuman stay and solace. "I am lord of bodies, I am lord of souls," runs the proud vaunt of Poverty in one of the saddest of the *Little Gray Songs;* and it is heartbreakingly true.

But what if want and distress should be replaced by comparative material comfort? What if Poverty should be driven from his lordship, and King Hunger should be dethroned? There can be little doubt, I think, that we should see a decided decrease in the number of men and women who profess a need of the supernatural.

Our youngest poet of the workaday world may not be quite justified in singing, "The days that make us happy make us wise"; but assuredly they do make us more inclined to depend on ourselves and to trust the common lot. Of course, it would be an idle mockery to assert that all pain and suffering will be eliminated by scientific progress and economic development; but the possible betterment is so tremendous that it can hardly be overstated. Much is being done, as we all know; but the advance in the next few decades may well make earlier progress seem like stagnation.

In all probability the most striking improvement will be in the rearing of children, and this will be greatly facilitated by a declining birth-rate. The fundamentally and demonstrably unfit will not long be allowed to propagate their like, to be a bane to themselves, a drag to their struggling fellow-men. And the present prolific but poverty-burdened proletariat will learn, or be taught, to refrain from procreation that is a mere accident of lust, wherein the gratification of a moment may bring into being a life that is destined to number its weary length of years by pain. Nor will women, even of the humbler classes, if classes there must be, consent to a motherhood that degrades them to mere links in the age-long chain of human misery. Instead of hutches of starveling offspring, with woeful bodies and lowering faces, will be seen cheerful homes with two or three children, sweet and well nurtured and pure souled—the most gladsome sight that gives joy to any unspoiled human heart. Men of intellect and authority, spurred by a sanguine temperament, may repeat the legendary injunction uttered on the threshold of an empty world, "Increase and multiply." Weak-willed, ignorant slaves of passion may continue to cast the burden of their indulgence on the Lord, trusting that he will provide. But Science will declare, and common-sense must agree, that the exhortation of the reckless optimist and the excuse of the improvident parent are alike utterly out of place "in an age in which the earth and sea, if not indeed the very air, swarm with countless myriads of undistinguished and indistinguishable human creatures, until the beauty of the world is befouled and the glory of the heavens bedimmed. To stem back that tide is the task now imposed on our heroism, to elevate and purify and refine the race, to introduce the ideal of quality in place of the ideal of quantity which has run riot so long, with the results we see." And with all the thoughtful care now being devoted to the regeneration of humanity from a physical basis, the work will henceforth speed apace.

Then, granted a race that has been developed in this enlightenment, the further task of science and social economics will be comparatively light. Even if the physicist never succeeds in connecting civilization with the illimitable source of power dimly described in intra-atomic energy, even if he should never be able to harness the tides, or fully utilize the rays of the sun, yet the improving methods of production will soon provide abundance for all. Indeed, in our own thriving land it is a question whether this stage has not been reached already, and whether the problem is not largely one of equitable distribution. In any event, this latter difficulty will some day remain alone, and who can doubt that it will find an early solution? Surely it is not undue optimism to expect that we shall attain at least the success of Mr. Stefansson's friendly Esquimaux villages, where the huts that had meat sent thereof to those that had none. We may shrink instinctively from such a word as Socialism, with the regrettable connotation it has developed in the United States, or even such words as Socialized Democracy; but under another name, or no name, the coming century will see some realization of the dreams of men like William Morris, who caught the shadows of the future mirrored on the dying past. Howbeit, the new society will not prove to be what any of our vaticinating socialists have predicted; for it will assume unforeseeable aspects to meet unforeseeable needs and conditions. It will certainly be more widely different from our present conjectures than the glowing vision of G. Lowes Dickinson is different from the dead and definite system of Babœuf. And, doubtless, when it does come, many men will wonder why the past erred so widely in forecasting its details, whereas more men, of the type of Herbert Spencer and Mr. Mallock, will wonder why they were so fearful of its coming. But whatever form it may assume, I am sure it will be possible to think of the new life in the words used by the dearest and most prescient dreamer of the nineteenth century, when he was describing the Dalesmen of Burgstead: "Thus then lived this folk in much plenty and ease of life, though not delicately nor desiring things out of measure. They wrought with their hands and wearied themselves; and they rested from their toil and feasted and were merry: tomorrow was not a burden to them, nor yesterday a thing which they would fain forget: life shamed them not, nor did death make them afraid."

III

Herewith it has been suggested that scientific development and economic advance will bring to the children of men not only material comfort, but gladness and joy in everyday life. If this be not true, then the new age were almost as well unborn. But it is true. Not only will Science multiply a thousandfold the permissible pleasures of the ordinary type, it will reveal new horizons of enjoyment and make men capable of the highest intellectual delight. The joy of learning and knowing will be recognized as fundamental, and be evoked to its fullest potentialities. Even in the Middle Ages dear old Thomas Aquinas saw and declared that beatitude was the action of man's intelligence rather than of his will, albeit his religious argument did go on to explain that the knowledge constituting happiness must be knowledge of God. Again and again the Angelic Doctor returns to his text, *Beatitudo est gaudium de veritate.* Moreover, quite apart from philosophical authority, it is patent to all that learning is a natural joy, nor need we any longer adduce such dignified names as Aristotle and Albertus Magnus in support of a truth on which they insisted so convincingly.

And what an infinity of opportunities will be made accessible by progress in knowledge and education! From the inconceivably great in astronomy to the immeasurably small in sub-atomic chemistry and physics the mind will range through an unending variety of delight, such as today could be enjoyed only by a handful of favored students, who can weigh the sun and compute the life period of an atom of radium. The glowing, vari-colored parterres of the sky may become almost as familiar as the cheery plots of our homely gardens. The bewildering mysteries of radioactivity may become as commonplace as ordinary phenomena of light and heat. Similarly, the world of biology will open many channels of aesthetic enjoyment. Even if graceful radiolaria and thalamophora do not quite justify the enthusiastic claim that they "transcend all the creations of the human mind by their peculiar beauty," they will none the less brighten the eye and gladden the heart. The picturesque course of evolution, the upward march through boundless time, will be emotionally realized as well as intellectually accepted. Each day scientific truth will become a more natural part of man's equipment, and will be transmuted by poet and artist into charming verse or enchaining picture.

IV

And this brings me to the thought that in the dawn heralded by Science, when men shall be well educated and well nurtured, Art and Beauty will at last come into their kingdom. Today the pain and bitterness of life make artistic enjoyment an unheard or empty phrase for most of our fellow creatures, and this in turn makes it a halting, hesitant pleasure for all thinking men.

> For since the world by sorrow is defiled,
> Even the Most Beautiful
> Must our sorrow share.

Nevertheless, with all deference to the great Rodin and other unseasonable mourners, Art is not dead. We do believe still in the wonder and the beauty and the power whose forms are faintly descried above all the want and ugliness and ignorance. Even when every passing day is aimless and hopeless for millions of our brothers, a few are ever seeking the soul beneath the form, aspiring toward the unseen and unheard beauty that breathes in all beautiful things. They catch faint gleams thereof in statue, or painting, or noble building. They hear its echo in song of bird or human voice, in pealing organ or tinkling brook. They dream of it with some supreme master of prose, or float out toward its far-off divine abode on the winged words of some beloved poet. But withal, even in their most exalted moments, they are haunted by a background of unendurable vice and misery. While none can quite escape this background, the noblest spirits suffer most; and only some such word as despair can voice the mood of all those cultivated men and women who believe in a temple for Beauty, yet cannot worship with free hearts while their ears are saddened by the cry of those who sin or suffer. But in the days that shall be, when the whole level of life has been raised, they shall worship in gladness. Their hearts shall be stirred to unknown depths, and thrilled with undreamed pleasures, because of the goodly communion of fellow spirits. It is almost as true in art as in mystical religions that our fullest and most expansive joy is attained only in an atmosphere of sympathy and kinship; and in the new day the congregation will be almost as wide as mankind itself. Moreover, it may be confidently hoped that Art will serve one great moral end by elevating and purifying the emotions; and will fulfil an important function of religion by meeting our demand for a symbolism of the unknown and inexpressible. It may teach us to deal with dreams and aspirations, all the glorious domain of the heart's desire, without confusing the will to believe with objective reality.

V

Then at last we shall believe in Life. And believing in Life we shall confidently base our ethics on the beauty and dignity of human nature, even as Kant did; but the words shall be rich with an unsuspected depth and range of meaning. So, too, we shall interpret afresh Plato's health of the soul, and teach that the unpardonable sin is the sin against Life.

What may have happened in other worlds we know not; but on our own tiny planet mankind is Life's crowning manifestation. Slime and ooze in the primal ocean; fishlike creatures, learning painfully to breathe the air; sad-eyed chattering things, swinging through darksome jungles; beast-fearing half-men, hiding in hillside caverns —all these and a thousand intermediate things we were. But in this all-hazarding embodiment of the vital impulse was something different from the rest of nature. Step by painful step, up the endless, pitiless steeps of the ages, it was brought through countless wanderings and struggles and failures to become the speaking, thinking, working, aspiring creature that is man.

Every day, Life becomes more wonderful to me, the sin against Life more unpardonable. Here is the supreme thing in our universe. To create this, time and space and matter have toiled for aeons upon aeons. Without it, time and space and matter have no meaning. Its infinite miracle is intrusted to you, or to me, for a few fleeting years, and we waste it away, or cast it away, even as a child might treat a toy that he thinks will be restored to him anew when he wakes on tomorrow after tomorrow.

But in the coming dawn men shall know the miracle of Life and pay it reverent homage. No longer shall they be guilty of the witless wit that laughs in the tragic presences of Life. No longer shall the eye be blind to vital pictures rich with majestic meaning; nor shall the ear be deaf to Life's final harmonies. And because each man's little life is a part of this great Life, he shall wear it proudly, "as kings their solemn robes of state," and humbly, as a token that he is a servant and helper of mankind.

VI

Thus far nothing has been said of death or immortality; and very little will be said even now. For in the Evangel of Science these themes do not play a momentous part. The new gospel is so filled with the positive and the actual, that it has no serious concern either with the great negative, which is death, or with the elusive uncertainties of a life beyond. Nor will its devotees require threats of future punishment and promises of eternal bliss to keep them striving for the right. Freed from hunger and want, enriched by the "gifts of science and gains of art," believing in the beauty and dignity of human nature, clear-eyed, cool-hearted, and limpid-souled, they will realize that goodness and truth and mercy lead upward to the heights where man is man, while dishonesty and cruelty and lust lead backward to the darkness where man is again a part of the hate and deformity of time. And if one tragic-hearted poet of humanity could return to his earthly haunts, he might hear his brothers singing a hymn like this:

> A creed is a rod,
> And a crown is of night;
> But this thing is God,
> To be man with thy might,
> To grow straight in the strength of thy spirit
> And live out thy life as the light.

VII

With that rhythmic admonition ringing in my ears, I must take leave of my subject. The day of supernaturalism will not quickly pass for all mankind. Generation after generation we have been taught to mistrust our nature, to see in it only weakness and imperfection, to regard this world as merely a door to another, to consider our life here as a shadow in comparison with the reality beyond. Habits of belief ingrained for centuries do not easily yield to a new evangel. But each hour is increasing the number of those who seek their revelation in human nature, their guidance in reason and the experience of the race. Scientific thought, insisting on realistic clarity and soundly based ethics, but transfusing them with kindness and love, is proclaiming to the sons of men such a gospel as I have feebly suggested in the foregoing pages; and one cannot fail to be impressed by the number of those who are quietly accepting this less mystical faith. "A future state, a purely spiritual world, in short, the universe of the unseen and transcendent, may all be there; but we can know our duty and live our life without the help of voices heard so faintly that we cannot be sure whether they belong to Truth or to Hope." Such is the profession of many earnest hearts, and who shall say that they do not toil for their fellow-men devotedly and unselfishly—and happily withal? Striving toward a clear-purposed goal, they are glad and confident in the knowledge that the surest path, nay, the only path, to the realm-of-things-as-they-ought-to-be lies through the land-of-things-as-they-are.

And let me not be told that such spirits are rare in this grim old world! Do we not know goodly numbers of them, you and I? Do they not move beside us quietly and helpfully day by day? If they nurse no delusions, they allow no fear. If their calm lucidity of soul is marred now and again by sadness, it is begotten by pity for the present, not by fears for the future. If they are not radiant with visionary ardor, they are inspired by unconquerable faith; nor does the star of joy shine any the less brightly above them because it is kindled of reality. And thus they build the City of God, not by heaven-compelling rites or magic words, in a sphere of mystic unreality, but patiently, stone by stone, with faithful hands, in their own daily walks. For they know that when all is known the City of God can be none other than the city of man.

Volume X Number 4

The University of Colorado Studies

Birds of Boulder County, Colorado

Norman deWitt Betts

Published by the
University of Colorado
Boulder, Colo.

December, 1913

Price, 50 Cents

This publication is issued four times a year, the first number in each volume appearing in January or February.

Educational institutions, libraries, societies and individuals desiring to be placed on the exchange list should make request to the "Secretary of the University of Colorado, Boulder, Colo.," to whom also should be addressed any correspondence in regard to purchase of single copies.

All exchanges should be addressed to the "Library of the University of Colorado, Boulder, Colo."

Binding note: Title-page, contents and alphabetical index of Volume X are included with this number.

VOLUME X NUMBER 4

THE UNIVERSITY OF COLORADO STUDIES

FRANCIS RAMALEY
EDITOR

PUBLISHED BY THE
UNIVERSITY OF COLORADO
BOULDER, COLO.

DECEMBER, 1913

Price, 50 Cents

CONTENTS

BIRDS OF BOULDER COUNTY, COLORADO[1]

By Norman deWitt Betts[2]

Introduction and Acknowledgments

The bird-life of Colorado has received considerable attention during the past few years. The state is a large one, however, and with the varied conditions belonging to a mountainous region, with semi-arid plains and alpine summits, its bird problems are not soon exhausted. The large variations in altitude mean that questions of zonal distribution and of local migration from plains to mountains are added to the work called for in the study of a "one-climate" locality. Conclusive data on vertical migration can be obtained only through the co-operation of several observers. The mountainous region, furthermore, renders difficult the careful and systematic observations necessary to a knowledge of the distribution of the breeding birds in relation to altitude. It is an extensive area with a need for intensive work, a work for which a locality, or county, list seems better adapted than a state list. Boulder County embraces areas quite typical of the northeastern quarter of the state and seems well situated for systematic study.

[1] *Publication of the Colorado Biological Survey*, No. 15. Other articles published recently (all in these *Studies*) are: No. 9, "Animals and Plants described as new from Colorado in 1911," by T. D. A. Cockerell; No. 10, "The Sawflies of Boulder County, Colorado," by Sievert A. Rohwer; No. 11, "Preliminary List of the Algae of Colorado," by Wilfred W. Robbins; No. 12, "Some Desmids from Alpine Stations in Colorado," by G. H. Wailes; No. 13, "The Grass Flora of Tolland, Colorado, and Vicinity," by Francis Ramaley and Miss Mary Esther Elder; No. 14, "The Amphibia and Reptilia of Colorado," Part I, by Max M. Ellis and Junius Henderson.

[2] The field studies by Mr. Betts were made while he was engineer of the timber-testing station at the University of Colorado. This article was prepared at the editor's request.—Editor.

In 1909 Professor Junius Henderson published a list[1] of the birds of Boulder County. The present paper is a revision of that list together with a brief analysis of the bird-life of the region. While a few species have been added to the 1909 list, the chief aim in the revision has been to bring together the information bearing on relative abundance, zonal distribution, and dates of migration and nesting of the birds occurring regularly in the county. Information concerning the migrant water-birds is very incomplete in regard to the species occurring, as well as to their abundance and time of migration. Quite full information has, however, been published concerning the water-birds of the Barr chain of lakes, about fifteen miles east of the county line. This has been used as a guide to the probable status of several species in the county.

The information as to nesting has been secured chiefly from the notes and collections of eggs made by Denis Gale[2] during the years 1883 to 1893, and now in the University of Colorado Museum. Migration dates are largely from the field notes of Professor Henderson and the writer. The estimates of relative abundance and distribution have been based to a large extent on the writer's notes, made during a three years' residence in the county, though free use was made of such information in Gale's notes and in Henderson's list as was definite in regard to the altitudinal zones adopted. For a number of migration dates not acknowledged in the text, the writer is indebted to Dr. S. Griswold Morley and to Mr. Dean Babcock. For information concerning the adjacent districts—Estes Park, Loveland and the Barr Lakes—the available literature[3] has been consulted and many references thereto incorporated in the annotated list.

[1] HENDERSON, JUNIUS, "Annotated List of the Birds of Boulder County, Colorado," *University of Colorado Studies*, Vol. VI, No. 3, April, 1909. (This list includes a full bibliography of papers published up to 1909.)

[2] See *Auk*, Vol. XXII, October, 1905.

[3] SCLATER, W. L., *A History of the Birds of Colorado*, 1912.

COOKE, W. W., *Birds of Colorado*, Colorado State Agric. Col., 1897–1900.

FELGER, A. H., "Annotated List of the Water Birds of Weld, Morgan and Adams Counties, Colorado," *Auk*, 1909.

HERSEY AND ROCKWELL, "Annotated List of the Birds of Barr Lake District, Adams County, Colorado," *Condor*, 1909.

KELLOGG, V. L., "Summer Birds of Estes Park, Colorado," *Trans. Kans. Acad. Sci.*, 1889.

WIDMANN, OTTO, "List of Birds Observed in Estes Park, Colorado," *Auk*, 1911.

The nomenclature used is that of the third edition of the American Ornithological Union *Check-List* and the 16th "Supplement" published in *The Auk* for 1912.

Geography of Boulder County

Boulder County extends approximately twenty-four miles north and south and thirty-two miles east and west. The Continental Divide forms the western boundary and rises to elevations of from 12,000 feet to over 14,000 feet. The eastern third of the county is a part of the plains region of Colorado and has an elevation of from 5,000 to 6,000 feet. Differences in elevation between the eastern and western boundaries of the county are accompanied by a great variety of climates. Hence, for purposes of bird study a division of the county into zones is necessary. The plains and the region above timberline form fairly distinct zones. The intervening mountainous country is forested, the character of the tree growth changing with elevation. Three forest types are usually distinguished, the Western Yellow Pine or Rock Pine,[1] the Lodgepole Pine,[2] and the Engelmann Spruce.[3] The data available for a classification of bird-life according to altitude are not, however, sufficiently definite to make advisable the use of more than two zones in the forested region. The open and dry Yellow Pine region of the foothills and lower mountains has been taken as one zone. The dense and somewhat more moist forests of Lodgepole Pine, and those of Engelmann Spruce and Alpine Fir,[4] have been grouped as another unit and called the Mountain Zone.

The *Plains Zone* lies approximately between 5,000 and 6,000 feet in elevation. It was formerly a semi-arid, treeless region with the exception of the cottonwood and willow bordered creeks. Much of it has now been transformed by irrigation into cultivated fields, though tracts of considerable size remain in their original dry condition. There are many ponds; a few are natural, though most of them are the result of irrigation. Some cat-tail marshes occur, although none of large extent. Shade trees in the towns and about the farms furnish

[1] *Pinus scopulorum.*
[2] *Pinus murrayana.*
[3] *Picea engelmanni.*
[4] *Abies lasiocarpa.*

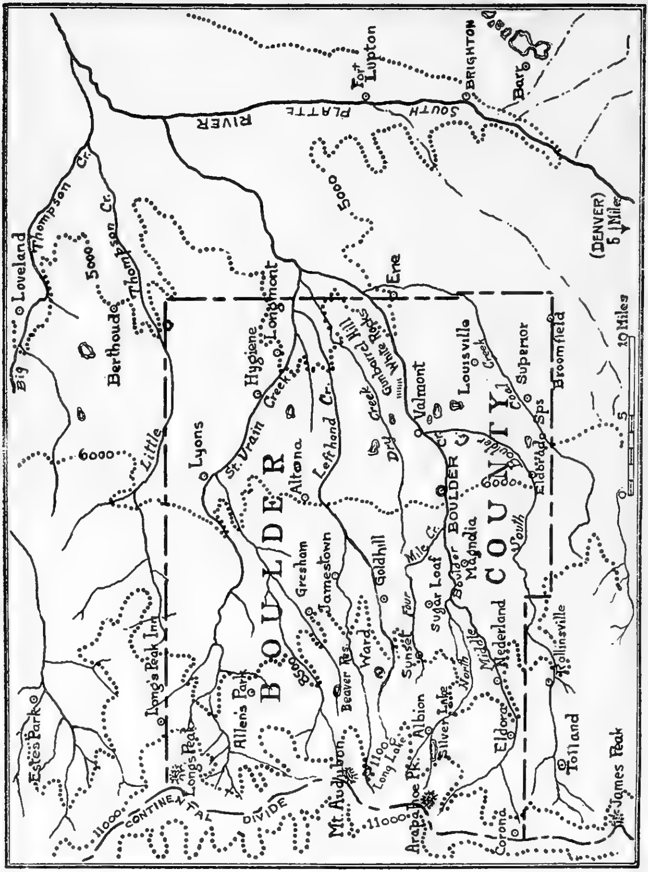


FIG. 1.—MAP OF BOULDER COUNTY, COLORADO, AND PARTS OF ADJACENT COUNTIES

considerable cover for a number of species of birds that formerly must have been limited to the creek bottoms. Boulder County contains no scrub-oak or pinyon pine, which form such characteristic belts along the foothills farther south, and in the western part of the state. The region corresponds to the Upper Sonoran[1] life-zone of the United States Biological Survey.

The *Yellow Pine Zone*, or "Foothill Zone" of botanists,[2] extends from the plains to the elevation at which the open parklike growth of the western yellow pine gives place to the closely growing trees of lodgepole pine. Many of the more moist north slopes of this area are covered with a fairly dense growth of Douglas Fir.[3] The narrow creek bottoms in the canyons, which cut the zone into many ridges, support a scattering growth of deciduous trees and shrubs, chiefly willows, cottonwoods, aspen and box-elder with thickets of alder, thorn-apple, wild plum, choke-cherry and mountain maple. The smaller runs which drain the ridges into the principal creeks and toward the plains, though dry much of the year, also support a thicket-like growth of shrubs. They furnish an important cover for birds in both winter and summer, as well as a considerable supply of small fruits—chiefly choke-cherry and thorn-apple—for the fall migrants. On the lower border of the yellow pine zone the foothills are abrupt so that there is a fairly distinct line of division from the plains zone. The upper limit of the zone, however, is neither very definite nor regular, as the lodgepole pine extends farther to the east and reaches considerably lower elevations on the north than on the south slopes of ridges. On the tops of ridges 8,500 feet may be taken as approximately the dividing line. The yellow pine district corresponds to the Transition life-zone of the United States Biological Survey.

The *Mountain Zone* as here understood includes the remainder of the forested region and corresponds to the "Montane" and "Subalpine" of botanists. It extends up to an elevation of 11,000 or 11,500 feet, timberline varying with topography and exposure.

[1] Perhaps, following Merriam's terms used elsewhere, this would best be called "*dilute* Upper Sonoran."

[2] Cf. RAMALEY, "Plant Zones in the Rocky Mountains of Colorado," *Science*, N.S., Vol. XXVI, pp. 642–643, 1907.

[3] *Pseudotsuga mucronata;* known also as Douglas Spruce.

While lodgepole pine and Engelmann spruce frequently occur in the same stand of timber, pure forests of lodgepole are found only in the lower part of the zone. So far as bird-life is concerned, the lodgepole forests serve to separate the dry and open yellow pine region from the moister spruce and fir forests. Aspen groves are frequent in the lower part of the zone, in the forest and along the borders of parks and near mountain meadows. Glacial lakes, frequently enlarged for reservoir purposes, are common higher up, at elevations of about 10,000 feet and higher.

The *Alpine Zone* embraces the area above timberline. The highest altitudes reached are Long's Peak, 14,271; Arapahoe Peak, 13,320; and Mt. Audubon, over 13,000 feet. Dwarf willows penetrate the zone here and there along the courses of streams from the perennial snow banks. In general, the region is rocky with vegetation in patches which decrease in area to mere pockets among the rocks along the crest of the range.

The accompanying map is based on the Topographic Map prepared in 1912 by the State Geologist of Colorado. It shows the position of Boulder County in relation to the Continental Divide, Barr Lakes, Estes Park and Tolland (in Boulder Park). The dotted contour lines at 6,000, 8,500 and 11,000 feet divide the county roughly into the zones just described.

Annotated List of Birds of Boulder County

The following list is printed in two styles of type. Birds that are regarded as of regular occurrence are in bold-face. Italic is used for the species whose claim to a place in the bird-life of the region rests on so few records that their occurrence in the future would be expected only as an accident of migration, or whose status has not been fully determined. Hypothetical species are inclosed in brackets.

There have been difficulties in deciding just what number of records make a bird "regular in occurrence," especially in view of the fact that the normal number of individuals for a species in any given region is so variable. It has been the intention to indicate as "regular" all the species credited to the county whose records suggest that they would at the present time be expected to occur, either commonly or rarely. In a few cases records from the adjoining regions have influenced the expectations.

The term *permanent resident* has been applied to those species of which some individuals are present regularly at all times; *summer resident*, to those which presumably nest in the region but are not present in winter; *winter resident*, to the species nesting farther north but which are present during the winter; and *migrant*, to those merely passing through the county to their summer or winter quarters. *Visitant* has been applied to a few species present at various times but not falling into the four main divisions. The terms for relative abundance have been chosen to express the frequency with which the species are observed rather than their numerical abundance. At the best the terms record only field impressions. *Abundant*, *common*, *infrequent* and *rare* have been used. Migration records have been given in the form of inclusive dates, accompanied by the available records. This method was used on account of the rather wide variation in many of the dates, indicating that the available data were not exact enough for averaging, or that there is an unusual local variation in arrival.

Order PYGOPODES, Diving Birds

Suborder Colymbi, Grebes

Family COLYMBIDAE, The Grebes

Colymbus nigricollis californicus, Eared Grebe (4)[1]

Migrant; infrequent on the lakes of the Plains zone. The only definite migration dates are May 12 and September 22, 1912. One specimen in the University collection was taken in 1908. Gale took several sets of eggs on June 19, 1890, just north of the county near Loveland. Reported to be a common breeder at the Barr Lakes; will probably be found breeding occasionally in the county.

Podilymbus podiceps, Pied-billed Grebe (6)

Summer resident; infrequent in the summer; common in migration on the lakes of the Plains. Noted between April 7 and October 16. Young birds were seen by the writer near Gunbarrel Hill, August 3, 1912; Gale found many nests with eggs just north of the county, June 19, 1890. It nests "abundantly" at the Barr Lakes.

[1] The "A.O.U. Numbers" are given in parentheses after the English name of each species.

Suborder Cepphi, Loons, etc.

Family **GAVIIDAE**, The Loons

Gavia immer, Loon (7)

Migrant; apparently rare; the records are from the Plains. One was taken by L. C. Bragg, 1901; one seen by Henderson, May 7, 1905; there was a specimen in possession of F. M. Manshardt taken March 10, 1908; and one was seen by the writer on May 10 and 11, 1912.

Order LONGIPENNES, Long-winged Swimmers

Family **STERCORARIIDAE**, The Jaegers, etc.

Stercorarius parasiticus, Parasitic Jaeger (37)

There was one specimen in Mrs. Maxwell's collection taken near Boulder in December some time previous to 1874. Sclater records only three specimens for Colorado.

Family **LARIDAE**, The Gulls and Terns

Rissa tridactyla tridactyla, Kittiwake (40)

There was one specimen in Mrs. Maxwell's collection taken in Boulder County in December; it is the only record for Colorado.

Larus delawarensis, Ring-billed Gull (54)

Migrant; probably rather common on the lakes of the Plains. Hunters report it occasionally, and it is common at the Barr Lakes. Definite dates for the county are May, 1902, and October 31, 1909 (specimens in the University collection), and September 22, 1912 (3 birds seen by the writer). Gale listed it as a "summer visitant" for "Boulder Valley."

Xema sabini, Sabine's Gull (62)

One specimen in the University collection was secured by James Cowie on September 15, 1907, out of a flock of six. Recorded from the county by Cooke; apparently rare in Colorado.

Sterna forsteri, Forster's Tern (69)

Migrant; probably occurs regularly in limited numbers on the lakes of the Plains, as it is common at the Barr Lakes, where it breeds. Seen in the county May 12 and September 15, 1912, by the writer.

Hydrochelidon nigra surinamensis, Black Tern (77)

Migrant; common though not numerous about the lakes on the Plains. A specimen in the University collection was taken in 1904. Noted by the writer in the fall only, between August 6 and September 15. It is a common breeding bird at the Barr Lakes.

Order STEGANOPODES, Totipalmate Swimmers

Family **PELECANIDAE**, The Pelicans

Pelecanus erythrorhynchos, White Pelican (125)

The writer saw six on a small slough on the Plains May 12, 1912. This appears to be the only definite date for the county, though hunters state that it is occasionally seen. Reported as infrequent, though regular, at the Barr Lakes.

Order ANSERES, Lamellirostral Swimmers

Family **ANATIDAE**, The Ducks, Geese and Swans

Mergus americanus, Merganser (129)

C. W. Rowland took one near Boulder on November 23, 1913 (Henderson). Occurs regularly as a winter resident and migrant at the Barr Lakes.

Mergus serrator, Red-breasted Merganser (130)

Reported as a migrant by Rowland (Henderson). Reported as regular in occurrence at the Barr Lakes.

Lophodytes cucullatus, Hooded Merganser (131)

Henderson has seen one taken in the county. Probably of regular occurrence as it is "not uncommon" at the Barr Lakes.

Anas platyrhynchos, MALLARD (132)

Migrant; common on the lakes of the Plains. There are several records for late December and early January; a few individuals may occasionally remain all winter. At the Barr Lakes there are many species of ducks which are indicated in the present list as migrants only. In Boulder County there are no large bodies of water that remain open all winter. Pierce (Kellogg, 1889) reported the mallard as a summer resident at Estes Park.

Chaulelasmus streperus, GADWALL (135)

Migrant; common on the lakes of the Plains. Birds have been seen during the last of May; one was noted by the writer on August 3; Kellogg noted a pair in summer in Horseshoe Park (Estes Park). It is a resident at the Barr Lakes.

Mareca americana, BALDPATE (137)

Migrant; reported as common on the lakes of the Plains. Some have been seen as late as the latter part of May. It is common at the Barr Lakes and a few breed there.

Nettion carolinense, GREEN-WINGED TEAL (139)

Migrant; common on the lakes of the Plains. Pierce (Kellogg, 1889) reported it as a summer resident at Estes Park.

Querquedula discors, BLUE-WINGED TEAL (140)

Summer resident; common in migration on the lakes of the Plains. Many remain late in the spring. Three broods of young ducks (about half grown on August 4) and several pairs of adults were noted by the writer in the summer of 1912. Three birds were observed on May 30, 1910, on a mountain lake (9,000 feet) and Mr. Acord reported that a pair of teal had nested for three successive summers at Beaver Lake (about 9,500 feet).

Querquedula cyanoptera, CINNAMON TEAL (141)

Migrant; from reports of hunters apparently infrequent though regular on the lakes of the Plains.

Spatula clypeata, SHOVELLER (142)

Migrant; common on the Plains. Some remain well into May.

Dafila acuta, PINTAIL (143)

Migrant; common on the Plains.

Aix sponsa, Wood Duck (144)

James Cowie and Bert Werley took three near Boulder in 1904 (Henderson). It is rare in northeastern Colorado.

Marila americana, REDHEAD (146)

Migrant; reported as common on the Plains.

Marila valisineria, CANVAS-BACK (147)

Migrant; reported as regular though less common than the Redhead.,

Marila affinis, LESSER SCAUP DUCK (149)

Migrant; common on the Plains lakes.

Clangula clangula americana, GOLDEN-EYE (151)

Migrant; reported by hunters as rather infrequent. One in the University collection was taken February 17.

Clangula islandica, Barrow's Golden-eye (152)

Gale lists this species as a "summer visitant" for the mountain region and states that he "saw one of the goldeneye ducks with three young ones on upper lake of North St. Vrain, about ten days old," July 19, 1886. It occurs regularly as a migrant at the Barr Lakes.

Charitonetta albeola, BUFFLE-HEAD (153)

Migrant; reported as common on the lakes of the Plains.

Harelda hyemalis, Old-Squaw (154)

Rare migrant; reported by Rowland (Henderson). One was taken by Judge Park (recorded by H. G. Smith) about November 20, 1903, at Longmont; as Longmont is near the county line, the record may not belong to Boulder County. The species is rare in Colorado.

Erismatura jamaicensis, Ruddy Duck (167)

Migrant; common on the Plains.

[*Chen hyperboreus hyperboreus*, Snow Goose (169)]

Of regular occurrence though not common in migration at the Barr Lakes.

Branta canadensis canadensis, Canada Goose (172)

Migrant; common on the Plains. Cooke found it nesting in the county in 1897. Gale records it on March 18 and also lists it as a "summer visitant."

[*Branta canadensis hutchinsi*, Hutchins' Goose (172*a*)]

Of regular occurrence though not common at the Barr Lakes in migration.

Olor columbianus, Whistling Swan (180)

There are two specimens in the University collection taken on March 27, 1906; three birds were brought in to Professor Henderson for identification by hunters in the spring of 1907. Sclater regards the species as an occasional straggler on migration in Colorado.

Order HERODIONES, Herons, Storks, etc.

Suborder Herodii, Herons, Bitterns, etc.

Family ARDEIDAE, The Herons, Bitterns, etc.

Botaurus lentiginosus, Bittern (190)

Summer resident; common in the marshes of the Plains zone. It has been noted between April 28 and September 30. Full-grown young observed July 27, 1912.

Ixobrychus exilis, Least Bittern (191)

Summer resident; probably occurs regularly though easily overlooked. A pair found by the writer nesting in a marsh on the Plains near Boulder June 5, 1910, and July 9, 1911. These are the only county records (and apparently the second and third nesting records for Colorado).

Ardea herodias herodias, Great Blue Heron (194)

Summer resident; common in the Plains zone. It has also been recorded from the lower part of the Yellow Pine zone. The St. Vrain colony near Hygiene is well known locally. Arrives, March 20–30 (3 records); leaves, September 25—October 16 (3 records). Gale found it nesting May 12, 1888. It was also noted occupying nests May 5, 1912.

Egretta candidissima candidissima, Snowy Egret (197)

One was taken in the county by Hersey May 4, 1876; two were collected in the spring of 1908 (one of which is now in the University collection); one was seen by the writer May 12, 1912. While rare in Colorado, the species appears to reach the state regularly in its northward wanderings.

Nycticorax nycticorax naevius, Black-crowned Night Heron (202)

Summer resident; common along the creeks and reservoirs of the Plains zone. No large colonies have been reported. Arrives, April 7 (1 record); leaves, September 15–25 (3 records).

Order PALUDICOLAE, Cranes, Rails, etc.

Suborder Grues, Cranes, etc.

Family **GRUIDAE**, The Cranes

Grus canadensis, Little Brown Crane (205)

Felger (*Auk*, Vol. XXVI) records a specimen taken by A. T. Allen near Boulder in March, 1901. There are not many records for Colorado.

[*Grus mexicana*, Sandhill Crane (206)]

On March 31, 1912, a flock of about 40 cranes (probably this species) was seen by the writer. It is regarded as of regular occurrence in migration at the Barr Lakes.

Suborder Ralli, Rails, Coots, etc.

Family **RALLIDAE**, The Rails, Coots, etc.

Rallus virginianus, Virginia Rail (212)

Permanent resident; common as a summer resident of the marshes of the Plains zone. At least a few winter regularly in some of the marshes where open water is found among the cat-tails. Nesting dates are: eggs May 28, 1904 (Rockwell); June 7, 1904 (Bragg); downy young May 14, 1910, and August 6, 1911 (the writer).

Porzana carolina, Sora (214)

Summer resident; common in the marshes of the Plains zone and infrequent in the marshes of the Yellow Pine zone. It has been observed from May 8 to October 22. A pair was observed at 9,500 feet June 28, 1889, by Gale, and the writer found a nest with five eggs at 8,500 feet, July 4, 1910. The nesting dates on the Plains run from May 25 to June 12 (3 records). Felger found a dead specimen on Arapahoe Glacier (about 12,500 feet) September 2, 1903. Widmann saw one at 9,000 feet near Estes Park on July 9, 1910.

Fulica americana, Coot (221)

Summer resident; abundant as a migrant and infrequent as a summer resident on the ponds of the Plains zone. Arrives, April 3–5 (2 records); leaves, October 19—November 10 (2 records). Gale found eggs June 19, 1890, probably just north of the county; young birds were seen by the writer June 30, 1912, near Gunbarrel Hill.

Order LIMICOLAE, Shore Birds

Family PHALAROPODIDAE, The Phalaropes

Lobipes lobatus, Northern Phalarope (223)

Occasional on plains in migration (Henderson). It was listed for the region by Gale but without data. Apparently common at the Barr Lakes.

Steganopus tricolor, WILSON'S PHALAROPE (224)

Summer resident; common in migration and rather infrequent as a summer resident on the Plains. Arrives, May 3–5 (2 records); leaves, July 24—August 3 (2 records). Gale found a nest with four eggs on May 31, 1892, near Boulder and also took five sets between May 19 and June 19, 1890, just north of the county near Loveland.

Family RECURVIROSTRIDAE, The Avocets and Stilts

Recurvirostra americana, AVOCET (225)

Migrant; infrequent on lakes in Plains zone. The only definite records for the county: a pair seen May 10, 1888 (Gale); a pair seen May 20, 1904 (Rockwell); three birds seen August 3, 1912 (the writer). It nests at the Barr Lakes, and Gale collected several sets of eggs just north of the county (May 19—June 19, 1890).

Family SCOLOPACIDAE, The Snipes, Sandpipers, etc.

Philohela minor, Woodcock (228)

One was seen near Boulder in 1887 by John Bentley (Cooke), and one by Henderson May 24 and 30, 1905. It is a rare bird in Colorado.

Gallinago delicata, WILSON'S SNIPE (230)

Permanent resident; common as a migrant, less so as a summer resident; infrequent though regular as a winter resident of the Plains. Migrant flocks were noted April 3. A downy young, apparently but a few days old, was noted by the writer June 5, 1910, a few miles east of Boulder. A dead bird, found September 9 hanging on a barbed-wire fence, at an elevation of 8,500 feet, is the only record for the mountains of the county. Widmann, however, saw several near Estes Park at an elevation of 9,000 feet in July, 1910.

[*Macrorhamphus griseus scolopaceus*, Long-billed Dowitcher (232)]

Common migrant at the Barr Lakes.

[*Pisobia maculata*, Pectoral Sandpiper (239)]

Common migrant at the Barr Lakes.

Pisobia bairdi, BAIRD'S SANDPIPER (241)

Migrant; probably common about the Plains lakes. Noted in the fall between July 27 and September 25. Abundant at the Barr Lakes.

Pisobia minutilla, LEAST SANDPIPER (242)

Migrant; probably common about the lakes of the Plains. Noted May 12 and August 6. Common at the Barr Lakes.

[*Limosa fedoa*, Marbled Godwit (249)]

Occurs regularly in migration at the Barr Lakes.

Totanus melanoleucus, GREATER YELLOW-LEGS (254)

Migrant; probably of common occurrence about the lakes of the Plains, though not so numerous as the following species. It has been noted April 21, May 5 and September 28.

Totanus flavipes, YELLOW-LEGS (255)

Migrant; common about lakes of the Plains. It has been noted, May 5, July 9 and between July 27 and September 28.

Helodramus solitarius cinnamomeus, WESTERN SOLITARY SANDPIPER (256*a*)

Migrant; common about the lakes and wet meadows of the Plains. It has been noted between May 5 and 8 in the spring and between July 27 and September 10 in the fall, always in small numbers.

Catoptrophorus semipalmatus inornatus, Western Willet (258*a*)

One was seen by the writer on August 13, 1910. The species probably occurs regularly as it is "very common" at the Barr Lakes.

[*Bartramia longicauda*, UPLAND PLOVER (261)]

Occurs regularly as a summer resident at the Barr Lakes, though it does not appear to be common.

Actitis macularia, SPOTTED SANDPIPER (263)

Summer resident; infrequent on the Plains and common about the lakes of the Mountain zone as high as 10,500 feet (Long Lake). Arrives, May 5–8 (2 records); seen at 10,000 feet on May 31 by Gale; leaves, September 10–22 (2 records). Several sets of eggs collected by Gale were dated June 8 to July 14, at elevations of 8,500 to about 10,500 feet; two sets were found by the writer on July 3 and 5 at about 10,000 feet.

Numenius americanus, LONG-BILLED CURLEW (264)

Migrant; probably common on the Plains. The only definite migration dates are April 15–21, 1912. Gale saw three in the county May 10, 1888, and, on other occasions, collected several sets of eggs (one on May 4) without definite locality records. He also listed it for the "mountain" region. Hunters report it from the lakes. It is common at the Barr Lakes.

Family **CHARADRIIDAE**, The Plovers

[*Squatarola squatarola*, Black-bellied Plover (270)]

Occurs regularly in migration at the Barr Lakes.

Oxyechus vociferus, KILLDEER (273)

Permanent resident; abundant on the Plains as a summer resident and infrequent in the wet meadows of the lower part of the Mountain zone. A few remain on the Plains all winter. Migrants have been noted as early as March 19. Gale records three nests between May 4 and June 18.

[*Podasocys montanus*, MOUNTAIN PLOVER (281)]

Gale mentions in his notes on June 1, 1886, the capture of the young of this species "on the dry plains" but does not refer definitely to Boulder County. While the species is reported as common farther east on the plains near the Barr Lakes, it is at least not regular in its occurrence near the foothills in summer.

Order GALLINAE, Gallinaceous Birds

Suborder PHASIANI, Pheasants, Grouse, Quail, etc.

Family **ODONTOPHORIDAE,** The Bob-whites, Quail

Colinus virginianus virginianus, BOB-WHITE (289)

Permanent resident; common on the Plains. On account of the introduction of eastern birds, its status as a native species is not known. Gale recorded a nest with thirteen eggs, May 17, 1888. Kellogg (1889) heard this species in Estes Park and learned that it had been introduced there. Widmann also reported it at Estes Park at 8,500 feet and 9,040 feet.

Family **TETRAONIDAE,** The Grouse, Ptarmigan, etc.

Dendragapus obscurus obscurus, DUSKY GROUSE (297)

Permanent resident; infrequent in the lower part of the Yellow Pine zone, and common in the Mountain zone. From observations on young birds Gale believed eggs were laid about the middle of May in the Yellow Pine and the middle of June in the Engelmann spruce forests.

[*Bonasa umbellus umbelloides*, Gray Ruffed Grouse (300*b*)]

Cooke saw a family of old and young, August 12, 1899, on South Fork in Estes Park, at 9,000 feet elevation. This record is just north of the county. The species is rare in Colorado.

Lagopus leucurus leucurus, White-tailed Ptarmigan (304)

Permanent resident; common in the alpine region, remaining above timberline in the summer. Some of the birds come down to at least 9,000 feet elevation in the winter. Gale noted birds in the white plumage as early as November 20 and as late as April 13. There appear to be no records of fresh eggs for the county, though Gale recorded a nest with five eggs on June 14 just south of the region near Georgetown, in Clear Creek County.

Pedioecetes phasianellus campestris, Prairie Sharp-tailed Grouse (308*b*)

Gale includes the form *columbianus* in his list of birds wintering in Boulder Valley. In discussing his observations on their nesting habits he remarks that they were diminishing in numbers. Osburn (Sclater) stated that the species was formerly abundant near Loveland just north of the county. There appear to be no definite records for the county and it is probable that the species is not now present in the region.

Family **PHASIANIDAE,** The Pheasants

Phasianus torquatus, Chinese Ringneck (Introduced)

In 1911 and 1912, found rather infrequently on the plains of the county. This species, from information furnished the writer by Mr. F. C. Lincoln of Denver, was liberated near Denver in considerable numbers by Mr. W. F. Kendrick about twenty years ago; it appears to be thriving and has been reported at an altitude of 9,000 feet.

Order COLUMBAE, Pigeons and Doves

Family **COLUMBIDAE,** The Pigeons and Doves

Columba fasciata fasciata, Band-tailed Pigeon (312)

Summer resident; infrequent in the Mountain zone. Records run from June 2 to September 3. Kellogg (1889) and Widmann (1910) noted the species in Estes Park. There are no nesting records for the region.

Zenaidura macroura marginella, Western Mourning Dove (316*a*)

Summer resident; abundant on the Plains, common in the Yellow Pine and infrequent in the lower part of the Mountain zone. Arrives, March 18—April 19 (7 records). In most cases the birds have left by the end of September. Single birds have been seen October 19 and November 17 and it was reported to Gale that a few wintered in 1888. Eggs have been recorded from May 15 to July 23 (the latter in the Yellow Pine zone).

Order RAPTORES, Birds of Prey

Suborder Sarcorhamphi, American Vultures

Family CATHARTIDAE, The American Vultures

Cathartes aura septentrionalis, Turkey Vulture (325)

Summer resident; infrequent. Nearly all the county records are from near Lyons, at the lower edge of the Yellow Pine zone. Birds were seen at this place by Gale in 1888, by Markman in 1907 and by Henderson in 1908. Gale recorded their nests in trees occupied also by Great Blue Herons. A few have been seen near Boulder and in the Yellow Pine zone. They have been noted between April 16 and October 2.

Suborder Falcones, Falcons, Hawks, Eagles, etc.

Family BUTEONIDAE, The Hawks, Eagles, etc.

Circus hudsonius, Marsh Hawk (331)

Migrant; common on the Plains. It has been noted as early as February 22 and as late as December 26. There appear to be no definite summer records except one on August 13, though Gale observed it building a nest in May just north of the county. Common summer resident at the Barr Lakes. Gale listed it as a winter bird for Boulder Valley without further data.

Accipiter velox, Sharp-shinned Hawk (332)

Migrant; probably rather common and occurring throughout the county. Dates for arrival and departure are April 6 and October 12. One was taken at Goose Lake, in the upper part of the Mountain zone, September 3, 1905. There are no definite summer or winter records, though Gale listed it as a winter bird.

Accipiter cooperi, Cooper's Hawk (333)

Summer resident; probably infrequent; the records are from the lower part of the Mountain zone. It is more common as a migrant on the Plains in September. There are no definite winter records, the latest fall date being October 21 (in the Yellow Pine zone). Gale found nests with eggs in the upper part of Left Hand Creek, May 29 and June 10, 1890, and June 28, 1889. Widmann reported one from Estes Park in July, 1910.

Astur atricapillus atricapillus, Goshawk (334)

Visitant; probably rare. H. G. Smith saw one in a taxidermist's shop killed at Sugarloaf (Yellow Pine zone), February 21, 1888. One was reported by Sprague in his notes many years ago (Henderson). Two were killed in 1908, one of which is in the University collection (Henderson). One was seen by Mr. and Mrs. McHarg near Boulder, December 26, 1912.

Buteo borealis calurus, WESTERN RED-TAIL (337*b*)

Permanent resident; common in the summer from Plains to Mountain zone. Infrequent in the winter, when it is apparently confined to the Plains. Arrives in migration in March and is most numerous in September and October. Gale found eggs on the Plains and in the Mountain zone from May 26 to June 3.

Buteo swainsoni, SWAINSON'S HAWK (342)

Permanent resident; common on the Plains. There appear to be no definite records for the mountains of the county, though Widmann recorded one at Estes Park on June 12, 1910. It is infrequent in winter. On September 15, 1912, the writer observed a flock of about fifty birds on the open plains near Boulder, many of which appeared to be catching grasshoppers. Gale found nests between May 12 and June 10.

Archibuteo lagopus sancti-johannis, ROUGH-LEGGED HAWK (347*a*)

Winter resident; common on the Plains. It occurs in the Yellow Pine zone in migration at least. Arrives, October 15–30 (2 records), and leaves, March 14–31 (3 records). One in the University collection was taken February 10, 1910.

Archibuteo ferrugineus, FERRUGINOUS ROUGH-LEG (348)

Summer resident; infrequent. Probably common during migration. Gale listed it as wintering on the Plains but does not mention the species further in his notes. Two specimens in the University collection are labelled March 27 and August 16. There are no nesting records for the county, but birds were seen by the writer July 29, 1911, in the Mountain zone. Pierce (Kellogg) reported the species common at Estes Park and Widmann saw two specimens there June 10, 1910.

Aquila chrysaetos, GOLDEN EAGLE (349)

Permanent resident; rather infrequent. Occasionally reaches the Plains zone but most frequently reported from the Yellow Pine. Gale took several sets of eggs between March 21 and April 11. A pair nested on the cliffs at Left Hand Creek in 1912. Kellogg reported a pair at Specimen Mountain (near the range in Estes Park).

Haliaeetus leucocephalus leucocephalus, BALD EAGLE (352)

Migrant; rare; recorded from Plains and Yellow Pine zones. Henderson records one seen by himself and one seen by Blanchard. The writer saw two December 5, 1909, and one March 17, 1912. Kellogg (1889) recorded one from Estes Park.

Family **FALCONIDAE**, The Falcons, etc.

Falco mexicanus, PRAIRIE FALCON (355)

Summer resident; probably infrequent. Gale twice found it nesting along the St. Vrain, apparently in the Yellow Pine zone (May 4, 1893; May 7, 1899), and took four eggs from a nest on the Little Thompson (probably over the county line) April 30, 1889. Blanchard reported one from the county (Henderson). Kellogg took one above timberline near Estes Park and Widmann saw several there in July, 1910.

Falco perigrinus anatum, Duck Hawk (356*a*)

Migrant; infrequent. There are two specimens in the cabinets at the State Capitol labelled "Longmont," one taken September 11, 1898, by Harry Holland, the other by B. Hayward. Gale observed a pair at their nesting site just north of the county, April 2, 1889. Pierce (Kellogg) noted one at Estes Park in June. Reported as common in migration at the Barr Lakes.

Falco columbarius richardsoni, Richardson's Pigeon Hawk (357*b*)

Migrant. The status of the Pigeon Hawks is not well determined for the county. They are rather common in migration but the form which appears to be the more common in the state, *Falco columbarius columbarius*, has not been definitely recorded from the county, though Kellogg reported it from Estes Park (1889). Some of the migrants are probably of this form. Richardson's Pigeon Hawk has been taken near Silver Lake at 10,000 feet, in September (Henderson), while Gale took one near Boulder January 5, 1885, and listed it as a winter bird of the plains and mountains.

Falco sparverius sparverius, Sparrow Hawk (360)

Summer resident; common from the Plains to the Mountain zone. Abundant as a migrant, occurring above timberline in the fall. A few sometimes remain through the winter (Henderson). They arrive March 12—April 1 (4 records), and leave October 10–16 (4 records). Eggs were found by Gale in the Plains and Yellow Pine zones between April 23 and June 12.

Pandion haliaetus carolinensis, Osprey (364)

One was seen on the Plains by the writer, April 21, 1912. Reported as not uncommon during migration at the Barr Lakes.

Order STRIGES, Owls

Family **ALUCONIDAE,** The Barn Owls

Aluco pratincola, Barn Owl (365)

One was found in a deserted prospect hole on the Plains by the writer, October 31, 1909, and again on November 7. Though an attempt to secure the bird was unsuccessful, there was every opportunity to make certain of its identity. It is rare in Colorado.

Family **STRIGIDAE**, The Horned Owls, etc.

Asio wilsonianus, Long-eared Owl (366)

Permanent resident; common. Gale took many sets of eggs between April 13 and May 16, apparently in the creek valleys in the Yellow Pine zone and at the western edge of the Plains. It occurs in winter on the pine mesas near Boulder.

Asio flammeus, Short-eared Owl (367)

Winter resident; common in the meadows on the Plains. Arrives, September 15—November 20 (2 records); leaves, February 22—March 31 (3 records).

[*Strix varia varia,* Barred Owl (368)]

Gale mentions in his notes having seen this species but gives no data. There is but one definite record for the state.

Cryptoglaux acadica acadica, Saw-whet Owl (372)

Permanent resident; probably rather common. Gale found several nests with eggs at an elevation of about 8,500 feet; young two weeks old, May 24; fresh eggs, June 3. Sprague reported it from the mountains (Henderson). A specimen was taken by the writer in the lower Yellow Pine, May 15. W. G. Smith found it breeding at Estes Park (Sclater). There are no definite winter records; it has been taken north of the county in winter, however, and probably is a permanent resident.

Otus asio maxwelliae, Rocky Mountain Screech Owl (373*e*)

Permanent resident; common in the Plains zone and along the creeks where they leave the foothills. Gale took many sets of eggs between April 11 and April 21, and stated that he had not observed the species above an elevation of 6,000 feet. Pierce (Kellogg) reported it as rare at Estes Park, and Widmann heard several there in July, 1910, at an elevation of 9,000 feet. This subspecies was named by Ridgway from Boulder County specimens in honor of Mrs. Maxwell, of Boulder, who prepared the collection of birds and mammals of Colorado for the Centennial Exposition at Philadelphia.

Otus flammeolus flammeolus, Flammulated Screech Owl (374)

Permanent resident. Although this species has been considered rare in the United States, there are more records of its occurrence in the vicinity of Boulder County than there are for either the Pygmy or Saw-whet Owls, and, if it has not been nearly exterminated by the collectors, should be classed locally as infrequent rather than rare. There was a specimen from Boulder County in the Maxwell collection taken in March, one taken by Gale (Cooke), and one by Sprague, September 22, 1897. W. G. Smith took three female specimens with nests and eggs between June 2 and June 20, 1890, at Estes Park, from 8,000 to

10,000 feet (Cooke). Dille records two females with nests and eggs in June, 1903, from the same locality.

Bubo virginianus pallescens, Western Horned Owl (375*a*)

Permanent resident; common in the Plains and Yellow Pine zones and occurring in the higher mountains (from reports of residents). Gale found eggs between March 3 and 24. Kellogg and Widmann both report it from Estes Park.

[*Nyctea nyctea*, Snowy Owl (376)]

Very rare winter visitor (Henderson). It has been taken about twenty miles north and south of the county and is considered a rare winter visitor to Colorado by Sclater.

Speotyto cunicularia hypogaea, Burrowing Owl (378)

Summer resident; common on the Plains. Gale was informed of their presence as early as March 10; October 13 is the latest date noted by the writer. There appear to be no definite winter records. Fresh eggs were found by Gale on May 10 near Valmont (three nests running from 20 to 30 inches in depth below the surface and having burrows about six feet long). He also found young just hatched on June 10.

Glaucidium gnoma pinicola, Rocky Mountain Pygmy Owl (379)

Permanent resident; infrequent. Gale saw one on March 10, and had two specimens taken December 13 and January 20 in the Yellow Pine zone (7,500 feet). There is one in the University collection taken near Boulder by Bragg. The writer saw one in the Yellow Pine on July 4, and several in Boulder between January 3 and February 14, 1912. Sclater records a nesting record by W. G. Smith in Estes Park at 10,000 feet.

Order COCCYGES, Cuckoos, Kingfishers, etc.

Suborder Cuculi, Cuckoos, etc.

Family CUCULIDAE, The Cuckoos, Anis, etc.

Coccyzus americanus occidentalis, California Cuckoo (387*a*)

Visitant; rare in summer in the Plains zone. There is one specimen in the University collection taken by Bragg in 1904. The writer has five records of cuckoos for the county seen in July and August, 1910–12. Material is not available for determining the relative standing of the eastern and western forms of the Yellow-billed Cuckoo in the county and all have been referred to the western form on the basis of the specimen mentioned.

Suborder ALCYONES, Kingfishers

Family ALCEDINIDAE, The Kingfishers

Ceryle alcyon alcyon, BELTED KINGFISHER (390)

Permanent resident; infrequent in summer on the Plains and more common in the mountains, reaching the lakes in the spruce forests. It is infrequent in winter on the Plains. There are no nesting dates available, though Gale took one on May 15 "within a few days of laying."

Order PICI, Woodpeckers, etc.

Family PICIDAE, The Woodpeckers

Dryobates villosus monticola, ROCKY MOUNTAIN HAIRY WOODPECKER (393*e*)

Permanent resident; common in summer in the Yellow Pine and Mountain zones. Becomes more numerous in the lower Yellow Pine and reaches the adjoining edge of the Plains in winter. Gale took many sets of eggs between May 8 and June 13 at elevations of 8,200–10,000 feet.

Dryobates pubescens homorus, BATCHELDER'S WOODPECKER (394*b*)

Permanent resident; infrequent in the Yellow Pine and Mountain zones (little data on its upper limit). It is found on the Plains in the winter. The Rocky Mountain form of the Downy is much less common than the Rocky Mountain Hairy Woodpecker in the county. Gale found nests with eggs from June 11 to June 30 (5 records).

Picoides americanus dorsalis, ALPINE THREE-TOED WOODPECKER (401*b*)

Permanent resident; infrequent; probably confined to the vicinity of the spruce forests in summer. One was seen by the writer on two occasions in the winter of 1911–12, at 5,800 feet (lower edge of the Yellow Pine).

Sphyrapicus varius nuchalis, RED-NAPED SAPSUCKER (402*a*)

Summer resident; common, occurs chiefly from the middle of the Yellow Pine to the middle of the Mountain zone—the region where aspen is common. Arrives, April 26–28 (2 records); leaves, September 4 (1 record). Gale took many sets of eggs between May 29 and July 1 (55 sets in the University collection), at 7,500 to 9,200 feet. They were located almost without exception in live aspens.

Sphyrapicus thyroideus, WILLIAMSON'S SAPSUCKER (404)

Summer resident; common in the Yellow Pine and lower part of the Mountain zone. Arrives, April 5–10 (2 records); two dates for departure are September 17 and November 6. Gale's many sets of eggs (there are 57 in the University collection) were taken between May 24 and June 16 from 7,500 to 9,500 feet. The nesting sites were in decaying aspen or conifer stubs.

Melanerpes erythrocephalus, RED-HEADED WOODPECKER (406)

Summer resident; common on the Plains and infrequent in the Yellow Pine zone. Arrives, May 18–27 (5 records); leaves, August 25—September 14 (4 records); latest date seen October 23, 1904. Eggs have been found from May 25 to June 28 (4 records).

Asyndesmus lewisi, LEWIS'S WOODPECKER (408)

Permanent resident; common in summer in the Yellow Pine zone; infrequent as a wintering bird in the orchards and cottonwoods of the Plains. Eggs have been found from May 28 to June 20 (10 records, mostly Gale's).

Colaptes cafer collaris, RED-SHAFTED FLICKER (413)

Permanent resident; common in summer from the Plains to the Mountain zones, probably breeding nearly to timberline. Common in winter in the Plains and Yellow Pine zones. It is the most abundant woodpecker in the county at all times of the year. Gale's sets of eggs were taken from May 3 to May 30, apparently on the Plains and in the Yellow Pine zone. He records one nest taken May 17 of "11 eggs slightly sat upon, seemingly the joint laying of two females." Birds showing a red nape patch and others with yellow feathers in the wings are occasionally seen—probably hybrids with the eastern Flicker.

Order MACROCHIRES, Goatsuckers, Swifts, and Hummingbirds

Suborder CAPRIMULGI, Goatsuckers, etc.

Family **CAPRIMULGIDAE**, The Goatsuckers, etc.

Phalaenoptilus nuttalli nuttalli, POOR-WILL (418)

Summer resident; common in the Yellow Pine zone. Its note has been heard as early as May 6; and it has been seen as late as September 29. There are no nesting records. Gale, Blanchard and Sprague have also reported it from the county. Kellogg and Widmann both found it at Estes Park.

Chordeiles virginianus henryi, WESTERN NIGHTHAWK (420*a*)

Summer resident; abundant in the Plains and Yellow Pine zones and rather common as high as the spruce forests. Arrives, May 26—June 2 (6 records); leaves, August 28—September 26 (5 records); a single bird was noted as late as October 15, 1911. Eggs have been found from June 24 to July 22 (5 records). Gale found its nest at 9,500 feet and the writer has seen it in July between 10,000 and 10,500 feet.

Suborder Cypseli, Swifts

Family MICROPODIDAE, The Swifts

[*Cypseloides niger borealis*, Black Swift (422)]

Gale lists this species for the region but without data. Widmann includes it in his list of birds seen at Estes Park (just north of the county) in the summer of 1910 (*Auk*, 1911). Other records for the state are from the southwestern part only.

Aeronautes melanoleucus, White-throated Swift (425)

Summer resident; common locally in the Yellow Pine zone about the cliffs of the canyons. Arrives, May 3–7 (4 records), earliest date April 10 (Gale); leaves, September 19—October 2 (3 records). Eggs have apparently not been taken in the county.

Suborder Trochili, Hummingbirds

Family TROCHILIDAE, The Hummingbirds

[*Archilochus alexandri*, Black-chinned Hummingbird (429)]

Gale lists this species for the county but does not give any data. It has not been taken in the eastern part of the state.

Selasphorus platycercus, Broad-tailed Hummingbird (432)

Summer resident; common in the Yellow Pine and Mountain zones. Arrives May 6–21 (5 records), one record for May 19 at 8,500 feet; leaves August 21—September 1 (4 records). The dates for eggs run from June 3 to July 17, the latter being at elevations of 8,500 and 10,000 feet. The bird has been noted at timberline in early July.

Selasphorus rufus, Rufous Hummingbird (433)

One was taken near Boulder by Gale. There was one in Mrs. Maxwell's collection with no locality label (Henderson). According to Sclater the species is rare in the eastern part of the state.

Order PASSERES, Perching Birds

Suborder Clamatores, Songless Perching Birds

Family TYRANNIDAE, The Tyrant Flycatchers

Tyrannus tyrannus, Kingbird (444)

Summer resident; common on the Plains and reaching at least to the upper limit of the Yellow Pine zone. Arrives, May 5–23 (8 records); leaves, August 25–28 (4 records). Eggs have been found from June 7 to July 2 (Gale and Blanchard).

Tyrannus verticalis, Arkansas Kingbird (447)

Summer resident; while common on the Plains during migration, this species is infrequent in summer and confined to the dry eastern portion of the county. Arrives, May 5–18 (3 records); leaves, August 21–29 (3 records). Eggs were found by Gale from June 1 to 18 (8 records). Pierce (Kellogg) reported it as rare at Estes Park.

Tyrannus vociferans, Cassin's Kingbird (448)

One was taken by A. Mackenzie in Gregory Canyon near Boulder on September 28, 1904. Kellogg (1889) reported it as common in Estes Park; apparently not since reported from there.

Sayornis sayus, Say's Phoebe (457)

Summer resident; common on the Plains and infrequent in the Yellow Pine zone. Arrives, April 4–9 (4 records); leaves, September 10–28 (3 records). Eggs have been found June 8 and 23 (Henderson and Gale, 2 records).

Nuttallornis borealis, Olive-sided Flycatcher (459)

Summer resident; common in the upper part of the Yellow Pine and the lower part of the Mountain zone. Arrives, May 18 (1 record); leaves, August 28 (1 record). Gale found eggs (first hatching) between June 22 and July 8, at about 8,000 to 9,500 feet.

Myiochanes richardsoni richardsoni, Western Wood Pewee (462)

Summer resident; common in the Plains, Yellow Pine and lower part of the Mountain zone. Arrives, May 8–18 (3 records); leaves, August 26—September 12 (3 records). Eggs have been found June 21 and July 12 (Gale, 2 records).

Empidonax difficilis difficilis, Western Flycatcher (464)

Summer resident; common in the upper part of the Yellow Pine and the lower part of the Mountain zone. Arrival, not determined; latest fall date, September 10. Gale found eggs from June 12 to July 4, at elevations from 8,500 to 10,000 feet. The nests were practically all placed on rocky ledges or the sides of prospect tunnels or shafts. Widmann found the species at several places in Estes Park (7,500 feet).

Empidonax trailli trailli, Traill's Flycatcher (466)

Summer resident; common on the Plains (and probably extending to some extent up the creeks into the Yellow Pine). Gale found eggs from June 3 to July 3. The nests were in low bushes near creeks and were "invariably pensile."

[*Empidonax minimus,* Least Flycatcher (467)]

In Gale's notes casual mention is made of finding a nest of this species with four eggs on June 26, 1890, apparently near Duck Lake. Other notes, however, leave the impression that this species may not have been intended and, as the only nesting record for the state, it seems best to drop it. From the records in eastern Colorado, it seems likely that the species passes through the county in migration; the writer feels sure that he heard their notes in May, but secured no specimens.

Empidonax hammondi, HAMMOND'S FLYCATCHER (468)

Summer resident; distribution and abundance not well determined, probably of infrequent occurrence. Gale mentions three nests, saddled on boughs at heights of 7, 14 and 30 feet. They were found from June 17 to 28, apparently at elevations of 9,500 to 10,000 feet. These are the only definite records for the county. Widmann noted the species in three places just north of the county in the Yellow Pine zone (6,200 feet, Forks Hotel, July, 1910).

Empidonax wrighti, WRIGHT'S FLYCATCHER (469)

Summer resident; common, probably from the upper part of the Yellow Pine to the middle of the Mountain zone. Arrives on the Plains, May 8 (specimens); last fall date September 28 (Gale). Eggs were found by Gale from June 15 to July 27, in the Mountain zone, apparently up to 10,000 feet. The nests were placed in low aspens, willows or firs and were saddled on the fork of a branch. Widmann observed the species near Estes Park at an elevation of about 9,000 feet.

Suborder OSCINES, Song Birds

Family **ALAUDIDAE,** The Larks

Otocoris alpestris leucolaema, DESERT HORNED LARK (474*c*)

Permanent resident; common on the Plains in summer. It occurs also above timberline, though it has not been recorded in the county from the intermediate zones during the summer. It is the most abundant bird on the Plains during the winter, often collecting in very large flocks. It has been noted above timberline as early as March 25 and as late as October 20. Eggs have been found on the Plains between April 23 and June 12. Gale believed but one brood was reared and that the variation in time of laying was caused by the destruction of many of the first nests by late spring snows.

Family **CORVIDAE,** The Crows, Jays, Magpies, etc.

Pica pica hudsonia, MAGPIE (475)

Permanent resident; common in the Plains and Yellow Pine zones and occurring in the Mountain zone to at least 9,500 feet. In winter it gathers in flocks, often of considerable size, on the Plains, but is found throughout the summer range as given. Eggs have been found from April 18 to May 25.

Cyanocitta stelleri diademata, LONG-CRESTED JAY (478*b*)

Permanent resident; common in the Yellow Pine and lower part of the Mountain zone. In winter it is also found in the cottonwoods and orchards of the Plains. Gale found eggs from May 8 to May 29.

Aphelocoma woodhousei, Woodhouse's Jay (480)

Felger has one taken by Gale on the St. Vrain, October 31, 1887 (Henderson). There is one in the University collection taken by Bragg in the foothills near Boulder in 1904. This species is common in the southern part of the state.

Perisoreus canadensis capitalis, ROCKY MOUNTAIN JAY (484*a*)

Permanent resident; common, chiefly confined to the Mountain zone at all times. "Have seen a few in Boulder twice during severe winter weather" (Henderson). Eggs have not been taken; Gale believed from observations on young birds out of the nest that they should be found about the last of April.

[*Corvus corax sinuatus*, Raven (486)]

Pierce (Kellogg, 1889) reported this species as an occasional visitant at Estes Park. Apparently rare on the eastern slope.

Corvus cryptoleucus, White-necked Raven (487)

Noted at Boulder in 1894 by R. A. Campbell (Cooke). Listed by Gale as a "summer visitant" without further data. Sclater states that they were apparently abundant along the eastern foothills about forty years ago but are now seldom, if ever, seen.

Corvus brachyrhynchos hesperis, WESTERN CROW (488*b*)

Permanent resident; infrequent on the Plains. Gale recorded a few nests with eggs between April 24 and May 2. The writer found half-grown young in the nest, June 4. Blanchard and Markman reported a flock in the lower Yellow Pine in December, 1906 (Henderson).

Nucifraga columbiana, CLARKE'S NUTCRACKER (491)

Permanent resident; common in the Mountain zone and at times in the Yellow Pine—probably depending upon the seed crop in the western yellow pines. Gale found two nests with three eggs each, one on March 7, 1888, and the other on April 5, 1889, at elevations of about 9,000 and 9,500 feet.

Cyanocephalus cyanocephalus, PINYON JAY (492)

Visitant; common in the Yellow Pine and occasionally found on the Plains and in the Mountain zone (9,500 feet). They have been observed in every month of the year (except December). The birds apparently remain in flocks at all times and no indications that they nest in the county have as yet been found. Henderson found them in very large flocks near Lyons, October 1–4, 1908.

Family ICTERIDAE, The Blackbirds, Orioles, etc.

Dolichonyx oryzivorus, Bobolink (494)

Summer resident; local in the bottomlands on the Plains near Boulder. Arrives, May 24–28 (5 records); latest fall date September 9. Henderson first noticed it in the county in 1904. There seems to be no reason to doubt that it nests, though eggs have not been taken. Widmann noted one male in Estes Park, June 15, 1910.

Molothrus ater ater, Cowbird (495)

Summer resident; common on the Plains, and occurring in the Yellow Pine "up to 8,000 feet or more" (Henderson). Arrives, May 7–10 (3 records); latest fall date available August 21. Gale found eggs between May 31 and July 3 in the nests of Traill's Flycatcher, Thick-billed Red-wing, Brewer's Blackbird, Black-headed Grosbeak, Yellow Warbler and Western Yellow-throat. Widmann observed a male at Estes Park in July, 1910.

Xanthocephalus xanthocephalus, Yellow-headed Blackbird (497)

Summer resident; common in the marshes of the Plains. Arrives, April 7–17 (2 records); leaves, September 12–24 (3 records); the latest date seen is October 30, 1910. Eggs have been found between May 10 and June 13 by Gale (8 sets in the University collection are dated May 10, 1886). Professor Ramaley saw one bird at Tolland in Gilpin County (9,000 feet) in August, 1911, and Gale listed it as a mountain bird, without definite data.

Agelaius phoeniceus fortis, Thick-billed Red-wing (498*d*)

Permanent resident; abundant in summer on the Plains and common in the marshes of the Yellow Pine and Mountain zones at least as high as 9,200 feet at Eldora Lake and 9,000 feet at Tolland. In winter, flocks of male Red-wings are common on the Plains. Females arrive in migration in March and April and probably leave in October. Eggs have been found between May 10 and June 15. Kellogg found a nest and eggs on June 21 at Estes Park. The subspecific forms of summer and winter birds have not been determined for the county and all are assigned to *fortis*.

Sturnella neglecta, Western Meadowlark (501.1)

Permanent resident; abundant in summer on the Plains, common in the Yellow Pine and infrequent in the lower parks of the Mountain zone (Tolland, 9,000 feet). In winter it is common in small bands in the meadows of the Plains. Eggs have been found from May 12 to June 10 (Gale). Kellogg recorded the occurrence of this species above timberline near Estes Park.

[*Icterus galbula*, Baltimore Oriole (507)]

Gale mentions in his notes under date of June 25, 1884, a nest containing five eggs, presumably found in Boulder County. It is very rare in Colorado and according to Sclater has been recorded with certainty only from the northeastern corner of the state.

Icterus bullocki, BULLOCK'S ORIOLE (508)

Summer resident; common on the Plains. Arrives, May 8–13 (3 records); leaves, September 18–30 (2 records). Gale found young birds in the nest, June 18 and 21. Pierce (Kellogg) reported it as an occasional visitant at Estes Park.

Euphagus cyanocephalus, BREWER'S BLACKBIRD (510)

Summer resident; common locally on the Plains and in the parks of the Yellow Pine and Mountain zones. According to Gale it visits the range about the middle of June—presumably after nesting. Arrives, May 3–10 (5 records); leaves, September 15—October 22 (3 records). Gale's notes mention its arrival on March 23, 1886; the date, if correct, is exceptional. Eggs have been found from May 20 to June 5 (Gale).

Quiscalus quiscula aeneus, BRONZED GRACKLE (511*b*)

Summer resident; rare in the Plains zone. First noted, May 8–19 (2 records); the only fall record is September 30. Gale found a nest on May 20, 1886, and apparently in 1887. Blanchard reported it in Boulder Canyon in 1903 (Henderson). The writer noted it near Boulder in summer only once, June 12, 1910.

Family **FRINGILLIDAE,** The Finches, Sparrows, etc.

Hesperiphona vespertina montana, WESTERN EVENING GROSBEAK (514*a*)

Winter resident; erratic in its occurrence but occasionally common near Boulder in winter. Henderson reported it abundant at Boulder between 1901 and 1909, feeding during the winter on the seeds of the box-elder. Since then it has been noted between October 5 and November 27, 1910. The last spring date at Boulder is May 18. Dille reported young birds near Altona and in the mountains in August and September, 1904 (Henderson), and also reported a nest and eggs at Estes Park on July 4, 1903 (about 9,000 feet). Gale noted the species in December, 1888, and March, 1889.

Pinicola enucleator montana, ROCKY MOUNTAIN PINE GROSBEAK (515*a*)

Permanent resident; infrequent. The records for the county appear to be confined to the spruce regions of the Mountain zone, excepting one—a specimen "taken by Gale at 9,000 feet, November 15, 1887" (Henderson). The writer found it in the spruce forests in March, July and September. Henderson's records and the specimens in the University collection were from the spruce region.

Carpodacus cassini, CASSIN'S PURPLE FINCH (518)

Permanent resident; rather infrequent in summer in both the upper part of the Yellow Pine and the lower part of the Mountain zone; in winter it is found chiefly along the edge of the Plains and the lower gulches of the Yellow Pine zone.

There are a few records for December, January and February from near Boulder. A flock noted on the Plains, March 12, were possibly migrants. Gale found eggs between June 15 and July 3. Widmann observed three pairs in Estes Park village at 7,500 feet.

Carpodacus mexicanus frontalis, House Finch (519)

Permanent resident; abundant on the Plains, especially in the towns, where, in the spring, its song is the dominant one. It is also found occasionally in the Yellow Pine zone. Gale reported it as breeding at Gold Hill (8,300 feet) June 8, 1891. Widmann observed a pair in Estes Park in 1910. Eggs have been found on the Plains, May 6.

Loxia curvirostra minor, Crossbill (521)

Permanent resident; infrequent in the Yellow Pine and Mountain zones. Gale took a nest April 3, 1893, and observed young birds flying about, May 8.

Leucosticte tephrocotis tephrocotis, Gray-crowned Rosy Finch (524)

Winter resident; rather common in mixed flocks of this genus in the Yellow Pine and Mountain zones and probably above timberline at times. The records extend from 7,500 feet (Magnolia, 1895 and 1910) to about 10,000 feet. It has been observed between November 6 and March 30 (the last date is Gale's). A bird of this species and one of the Black Rosy Finch (taken by the writer on December 29 at about 9,000 feet) had been feeding on the seeds of *Rumex.*

Leucosticte tephrocotis littoralis, Hepburn's Rosy Finch (524*a*)

Winter resident; infrequent, but probably occurring regularly in flocks of this genus. There were specimens in the Maxwell collection, Gale took two on November 17, 1888, and the writer observed a few, December 29, 1911, in a flock consisting largely of the Gray-crowned and Brown-capped Rosy Finches.

Leucosticte atrata, Black Rosy Finch (525)

Winter resident; rare. The only definite record for the county is a specimen taken near Ward by the writer on December 29, 1911. There was one in Mrs. Maxwell's collection, taken presumably in the county with other Rosy Finches, though this is not now definitely known. Judging from the status of this bird in other parts of the state, it probably occurs regularly and the few records both for this and for Hepburn's are due to the scarcity of winter visits of observers to the region where it is found.

Leucosticte australis, Brown-capped Rosy Finch (526)

Permanent resident; common above timberline during the summer. Insects and seeds caught on the permanent snow-banks form one source of its food. In winter it has been noted in the Yellow Pine and lower part of the Mountain zone, "coming down to 8,000 feet or less in winter" (Henderson). The eggs of this species, which is restricted to Colorado, have never been taken (Sclater).

Acanthis linaria linaria, REDPOLL (528)

Winter resident; erratic in its occurrence but at least occasionally common. Fall dates are October 21 and November 5; last spring dates, March 12 and 14. It has been found in the Plains and Yellow Pine zones. Gale reported it in 1888 and it was numerous about Boulder in the winter of 1910–1911.

Acanthis linaria rostrata, Greater Redpoll (528*b*)

Sprague took one near Magnolia, December 9, 1895, not quite typical but assigned by Ridgway to this subspecies (Cooke). It is the only record for Colorado.

Astragalinus tristis tristis, GOLDFINCH (529)

Permanent resident; common in summer on the Plains and found at least in migration in the Yellow Pine zone; infrequent in winter on the Plains (there appear to be no February records). Gale found young able to fly on July 4 and a freshly built nest July 31; a nest with four eggs was found by the writer, August 27, on the Plains. Gale noted a flock on March 13 between 8,000 and 9,000 feet.

Astragalinus psaltria psaltria, ARKANSAS GOLDFINCH (530)

Summer resident; common on the Plains and occurring also in the Yellow Pine. Arrives, May 21—June 10 (3 records); leaves, September 21—October 24 (3 records). Gale does not mention this species in his notes. Widmann observed a few at 9,000 feet near Estes Park in July, 1910.

Spinus pinus, PINE SISKIN (533)

Permanent resident; common in summer on the Plains and in the Yellow Pine and Mountain zones. Infrequent in winter on the Plains. Gale found young in the lower part of the Mountain zone on June 30 and also a nest with eggs, July 5.

Plectrophenax nivalis nivalis, Snow Bunting (534)

Recorded from Boulder by Cooke. Not many records for the state, though probably of regular occurrence in the northern part.

Passer domesticus, EUROPEAN HOUSE SPARROW (Introduced)

Henderson first noticed it in Boulder in 1898 and found it at Jamestown (in the Yellow Pine zone) in 1904. It is now common in the towns of the county, in the mountains as well as on the Plains.

Calcarius ornatus, CHESTNUT-COLLARED LONGSPUR (538)

Migrant; apparently very erratic in its appearance close to the foothills. It has been recorded from the county by Cooke, and was common in the fall of 1912 near Boulder in the last half of September.

Pooecetes gramineus confinis, Western Vesper Sparrow (540*a*)

Summer resident; common on the Plains and found to the upper limit of the Yellow Pine zone. Gale took a specimen in migration on Bald Mountain at 11,000 feet, September 15, 1888. Arrives, April 2–23(4 records); leaves, September 24—October 8 (4 records).

Passerculus sandwichensis alaudinus, Western Savannah Sparrow (542*b*)

Summer resident; common in the breeding season in a large grassy park at Tolland, Gilpin County (9,000 feet), just south of the Boulder County line. Common in migration on the Plains. Arrives, April 14—May 8 (2 records); leaves, September 28–30 (2 records). A specimen was taken on the Plains, May 14. The writer has seen birds on the Plains in summer which appeared to be of this species but specimens were not taken.

Ammodramus savannarum bimaculatus, Western Grasshopper Sparrow (546*a*)

Summer resident; infrequent in the meadows on the Plains. No migration data available. One specimen was collected by Bragg on the plains in the summer of 1903, and the writer noted several in June, July and August of 1910 and 1911. On June 12 one was feeding a young bird just able to fly.

Chondestes grammacus strigatus, Western Lark Sparrow (552*a*)

Summer resident; abundant on the Plains in the dry areas. Arrives, May 5–15 (7 records); leaves, August 12–29 (4 records). Gale found a nest with eggs on the Plains, June 3.

Zonotrichia querula, Harris's Sparrow (553)

An immature female was taken by the writer on the Plains near Boulder, November 5, 1912. It is infrequent in the state, though probably of regular occurrence as a fall migrant.

Zonotrichia leucophrys leucophrys, White-crowned Sparrow (554)

Summer resident; abundant in the grassy parks from the upper part of the Yellow Pine zone to a little above timberline. It is the characteristic bird of the mountain meadows and at Tolland (9,000 feet), in early June, its song is the dominant one in the morning chorus. Arrives, April 24–28 (4 records); leaves, September 30—October 22 (3 records). It has been noted on the Plains as late as June 2–8 in the spring. Gale mentioned seeing birds on December 13 but he apparently did not separate the White-crowned and the Gambel's Sparrows, the latter of which has since been found wintering. Gale found many nests between June 15 and July 20, and believed they nested but once. Widmann observed singing males in June in Estes Park (7,500 feet).

Zonotrichia leucophrys gambeli, Gambel's Sparrow (554*a*)

Winter resident; abundant on the Plains during migration and infrequent in winter. Single birds have been noted in migration in the lower part of the Mountain zone but they appear to be rare outside of the plains. Migrants arrive March 20 and have been noted as late as May 8; in the fall they arrive September 10–22 (3 records), and leave by the first of November.

Spizella monticola ochracea, Western Tree Sparrow (559*a*)

Winter resident; abundant on the Plains and occasionally found in the lower part of the Yellow Pine zone. Arrives, October 13–22 (4 records); leaves, March 12—April 7 (3 records).

Spizella passerina arizonae, Western Chipping Sparrow (560*a*)

Summer resident; abundant in migration and common in summer from the Plains to the lower part of the Mountain zone. Arrives, April 26–30 (4 records); leaves, October 1–16 (4 records). Gale recorded a nest on July 8, 1890, at about 10,000 feet. Widmann found it from 6,000 to 9,000 feet near Estes Park.

[*Spizella pallida*, Clay-colored Sparrow (561)]

Kellogg (1889) secured a specimen just north of the county in Estes Park, August 10. Also observed by Widmann at the same place in the summer of 1910. Dean Babcock of Estes Park stated that he had seen the species there in 1912. It is, therefore, quite surely a regular migrant in the county and probably a summer resident in restricted localities.

Spizella breweri, Brewer's Sparrow (562)

Migrant; common on the Plains. Henderson took two in September at 10,000 feet. It has been seen as early as May 5 and as late as September 25. It has been noted on July 9 and August 6 and may be found to breed sparingly in the county.

Junco aikeni, White-winged Junco (566)

Winter resident; common in the Yellow Pine zone and along the edge of the Plains. Arrives, October 17–27 (4 records); leaves, March 13—April 8 (4 records). Cary reported a nest with young birds on June 11, 1905, found by Walter Blanchard in the Yellow Pine at about 7,000 feet near Magnolia; this is the only summer record for the region. Gale observed the species at 10,000 feet in migration in April.

Junco hyemalis hyemalis, Slate-colored Junco (567)

There are two specimens in the University collection from Boulder, one taken January 8, 1904, by Mr. Juday and one not dated. The species apparently occurs regularly in the state in migration and may have been overlooked in the county.

Junco hyemalis connectens, SHUFELDT'S JUNCO (567*b*)

Winter resident; common in the Plains and Yellow Pine zones. Arrives, October 1–21 (4 records); leaves, April 2–6 (2 records).

Junco hyemalis montanus, Montana Junco (567*f*)

There is one specimen in the University collection taken near Boulder, January 18, 1904. Felger has two taken by Gale but without data (Henderson). There is not enough difference between the specimen in the University collection and specimens of the common form *mearnsi* to serve as a guide for field identification, and *montanus* might easily have been overlooked.

Junco hyemalis mearnsi, PINK-SIDED JUNCO (567*g*)

Winter resident; abundant on the Plains and common in the Yellow Pine zone. Arrives, September 14—October 7 (3 records); leaves, April 9–28 (2 records). A few birds were observed at timberline on September 3, 1910, suggestive of a migration route along the range. Gale noted birds at 10,000 feet in April, and it seems likely that all the Juncos occur in migration in the higher zones of the mountains. The winter flocks are of mixed species, the four forms often being present in the same band. The Pink-sided are the most numerous and the Gray-headed the least so, while the White-winged seem more partial to the Yellow Pine areas than the others.

Junco hyemalis annectens, Ridgway's Junco (567*h*)

A specimen was taken by McGregor near Boulder on November 25, 1892. The "subspecies" was pronounced a hybrid by Ridgway (*Birds of North and Middle America,* Part I), *J. p. caniceps* × *J. h. mearnsi.*

Junco phaeonotus caniceps, GRAY-HEADED JUNCO (570*b*)

Permanent resident; in summer, infrequent in the Yellow Pine and common in the Mountain zone. In mid-winter rather infrequent along the edge of the Plains and Yellow Pine zones. Arrives on the Plains, October 1–13 (4 records); Gale noted them in the Mountain zone, March 23. Eggs have been found between May 23 and July 10 at 7,500 to 10,500 feet. Birds have been noted at timberline in July.

Amphispiza nevadensis nevadensis, Sage Sparrow (574.1)

One was taken at Left Hand by Dille, March 18, 1904. This is the only record for the northern part of the state.

Melospiza melodia montana, MOUNTAIN SONG SPARROW (581*b*)

Permanent resident; common in summer in the marshes of the Plains and infrequent in the parks of the Yellow Pine and lower part of the Mountain zone (9,000 feet at Tolland). Common in winter in the bottomlands on the Plains.

Widmann observed it as high as 8,500 feet near Estes Park. The writer found young in the nest on the Plains, May 27.

Melospiza lincolni lincolni, LINCOLN'S SPARROW (583)

Summer resident; common in summer in the wet parks of the Mountain zone. Arrives on the Plains, May 5 (1 record); seen at about 10,000 feet, May 31. In the fall it reaches the Plains, September 9 (1 record), and leaves October 13–16 (3 records). Gale took many sets of eggs between June 10 and July 19 (mostly in the last week of June at about 10,000 feet). Widmann observed a few at Estes Park in June as low as 7,500 feet.

Pipilo maculatus arcticus, Arctic Towhee (588)

There is a specimen in the University collection taken in the Yellow Pine zone, December 22, 1909. Henderson saw one in Boulder on April 21, 1907. Owing to the difficulty in distinguishing the Arctic from the Spurred Towhee in the field this bird may have been overlooked in the migration period.

Pipilo maculatus montanus, SPURRED TOWHEE (588*a*)

Summer resident; abundant in the canyons and runs of the Yellow Pine zone. It occurs on the Plains in migration. Arrives, April 2–18 (3 records); leaves, October 9–22 (4 records). Blanchard took a set of five eggs, May 4.

Pipilo fuscus mesoleucus, Canyon Towhee (591)

One was taken at Boulder by H. S. Reed (H. G. Smith) March 17, 1895. This is the most northern record for the state.

Oreospiza chlorura, GREEN-TAILED TOWHEE (592.1)

Summer resident; common in the Yellow Pine and Mountain zones. Arrives, May 1–9 (4 records); leaves, September 19—October 7 (4 records). A single bird was seen December 17, 1911, by the writer and on March 7, 1912, by Mrs. Saul Epsteen—possibly the same bird, which may have remained through the winter. Eggs have been taken from May 26 to July 9. Gale found it nesting, at about 10,000 feet, June 30 and July 9. Widmann found it from 6,000 to 9,000 feet, near Estes Park.

Zamelodia ludoviciana, Rose-breasted Grosbeak (595)

There is a record of a pair nesting at Longmont in 1894 (Cooke) and only one other record of its occurrence in the state.

Zamelodia melanocephala, BLACK-HEADED GROSBEAK (596)

Summer resident; common on the Plains and infrequent in the Yellow Pine zone. Arrives, April 22—May 16 (2 records); leaves, August 13–27 (3 records). Gale found eggs between May 21 and June 17.

Guiraca caerulea lazula, Western Blue Grosbeak (597*a*)

Dille took two and saw others near Altona in June, 1902. Felger took one in 1903 (Henderson). The writer saw one on the Plains, June 30, 1912. These appear to be the most northern records for the state. It is probably a regular though rare visitant.

Passerina amoena, LAZULI BUNTING (599)

Summer resident; infrequent on the Plains and common in the lower part of the Yellow Pine zone. Arrives, May 8–19 (4 records); leaves, August 7–29 (4 records). Gale observed nest-building on June 21 and found eggs, July 3. A specimen in the University collection taken September 4, 1905, is labelled Camp Albion (11,000 feet).

Spiza americana, Dickcissel (604)

Bragg collected one near Boulder in 1903. The writer observed a male in two localities, July 9 and 24, 1910, and July 9 and 20, 1911. Mr. and Mrs. T. A. McHarg reported one seen at Lyons, August 12, 1912. It will be interesting to note whether this species becomes established in the county as a regular summer resident, as in the case of the Bobolink.

Calamospiza melanocorys, LARK BUNTING (605)

Summer resident; abundant on the dry mesas of the Plains. Arrives, May 10–17 (4 records); leaves, August 27—September 12 (3 records). Eggs have been found between June 1 and 22.

Family **TANGARIDAE,** The Tanagers

Piranga ludoviciana, WESTERN TANAGER (607)

Summer resident; rather common in the Yellow Pine zone. Gale stated that it was to be found up to 10,000 feet. Arrives, May 5–16 (6 records); leaves, September 30—October 10 (2 records). Gale took a set of four eggs on June 17 at about 8,500 feet.

Family **HIRUNDINIDAE,** The Swallows

Petrochelidon lunifrons lunifrons, CLIFF SWALLOW (612)

Summer resident; abundant in the Plains and Yellow Pine zones and occurring, at least in migration, in the Mountain zone at 9,000 feet. Arrives, May 5 (1 record); leaves, August 13–28 (4 records). Nests nearing completion have been noted May 21 and June 1 on the Plains. A former nesting-site on a cliff at White Rocks appears to have been abandoned, and the birds are now nesting commonly under the eaves of barns on the Plains.

Hirundo erythrogastra, Barn Swallow (613)

Summer resident; common on the Plains and less so in the Yellow Pine and Mountain zones. Abundant in the fall migration on the Plains. Arrives, April 21–27 (3 records); leaves, September 15–29 (4 records). Gale found eggs from June 15 to 28, and also noted a second laying on August 3 at an elevation of about 8,000 feet.

Iridoprocne bicolor, Tree Swallow (614)

Summer resident; infrequent in the Mountain zone. Possibly occurs on the Plains in migration, though all records for the region are from the mountains (9,000 feet, Tolland; 9,000–10,000 feet near Ward; 9,000 feet, Long's Peak Inn). Gale observed nest-building on May 31 and found eggs from June 12 to 17; the nest sites were abandoned woodpecker holes. The writer noted it on May 29 at Tolland.

Tachycineta thalassina lepida, Northern Violet-green Swallow (615)

Summer resident; common from the edge of the Plains at Boulder to the middle of the Mountain zone. Arrives, May 4–13 (4 records); leaves, August 13—September 9 (3 records). Gale found eggs at about 9,500 feet (Beaver Park), July 10–20.

Riparia riparia, Bank Swallow (616)

Summer resident; common locally on the Plains. Arrives, April 24 (1 record, Gale). The writer observed a colony nest-building on May 19, 1912, and incubating June 12, 1910. Birds were still at their nesting-sites, July 27 and August 13 (the latest date seen).

Stelgidopteryx serripennis, Rough-winged Swallow (617)

Summer resident; infrequent on the Plains. Probably occurring also in the Yellow Pine, as a pair was observed at Estes Park (7,500 feet) by Widmann in June, 1910. Arrives, May 8–12 (2 records); latest fall date August 14. The writer observed them entering small caves in a sandstone cliff and also preparing a hole in a river bank, but has no dates for eggs.

Family **BOMBYCILLIDAE,** The Waxwings

Bombycilla garrula, Bohemian Waxwing (618)

Winter resident; rather erratic in its movements though common at times in the Yellow Pine and Mountain zones. First fall dates are November 6 and December 6; leaves, March 13—April 8 (6 records). Henderson noted a flock of 150 on February 13, 1905. It has frequently been observed feeding on the berries of the juniper and kinnikinnick.

Bombycilla cedrorum, Cedar Waxwing (619)

One was taken by Bragg at Boulder on July 4, 1904 (now in the cabinets at the state capitol). The writer saw three on Boulder Creek, September 11, 1910, feeding on the fruit of thorn-apple. The species is not of common occurrence in the state.

Family **LANIIDAE**, The Shrikes

Lanius borealis, Northern Shrike (621)

Winter resident; rather common on the Plains, and recorded once from the Mountain zone, by Gale, in migration (October 17). Arrives, October 17–23 (4 records); leaves, March 7–19 (3 records).

Lanius ludovicianus excubitorides, White-rumped Shrike (622*a*)

Summer resident; rather common in the dry eastern portions of the county, though seldom seen near Boulder except in migration. Arrives, April 18—May 3 (5 records); latest fall date August 25. (Sclater gives April 9–14 [W. G. Smith] for arrival at Loveland, a little north of the county.) The only record for the mountains is one seen near Nederland (8,200 feet) by the writer, May 25, 1912. Gale found eggs between May 20 and June 25.

Family **VIREONIDAE**, The Vireos

Vireosylva olivacea, Red-eyed Vireo (624)

One was taken at Boulder by Bragg, May 30, 1904. It is rare in the surrounding region.

Vireosylva gilva swainsoni, Western Warbling Vireo (627*a*)

Summer resident; common in the Plains, Yellow Pine and part of the Mountain zone. Arrives, May 18–21 (2 records); leaves, August 23–28 (2 records). Sclater gives May 12 (H. G. Smith) for Loveland. Nest-building has been observed on the Plains, May 28 and June 3. In the mountains it is usually, if not always, found in the deciduous trees—aspen groves. Widmann observed the species near Estes Park from 6,000 to 9,000 feet.

Lanivireo solitarius plumbeus, Plumbeous Vireo (629*b*)

Summer resident; rather common in the Plains and Yellow Pine zones. Arrives, May 18–21 (3 records); leaves, September 17–28 (2 records). There are no definite nesting dates for the county. While found in summer in the cottonwoods at least six to eight miles out on the Plains, it appears to prefer the pine woods of the Yellow Pine zone. Widmann observed it from 6,000 to 7,500 feet in the vicinity of Estes Park.

Family **MNIOTILTIDAE**, The Wood Warblers

Mniotilta varia, Black and White Warbler (636)

One was observed at Boulder by Minot, June 1, 1880. Sclater gives but four records for Colorado.

Vermivora virginiae, Virginia's Warbler (644)

Summer resident; common in the Yellow Pine zone, particularly where it meets the Plains. Arrives, May 4–15 (2 records); leaves, September 17–21 (3 records). Widmann observed one in July at 8,000 feet near Estes Park, and H. G. Smith (Sclater) found a nest in the same region placed on the ground under a ledge, June 20.

Vermivora celata celata, Orange-crowned Warbler (646)

Migrant; probably rather common in the Plains and Yellow Pine zones. Noted in the spring from May 4 to May 21, and in the fall, September 8–18. It has been recorded from the county by Minot and one was taken by Bragg. A specimen taken on September 18, 1910, by the writer was identified by Oberholser as typical *celata*, though he believes the Rocky Mountain birds to be mainly *orestera*, a form not at present accepted by the American Ornithological Union.

Vermivora peregrina, Tennessee Warbler (647)

Migrant; probably of regular occurrence on the Plains, though at present the records are few. Seen in the spring, May 23 and May 31 (Minot), and in the fall, September 25.

Dendroica aestiva aestiva, Yellow Warbler (652)

Summer resident; abundant on the Plains and common in the Yellow Pine. Arrives, April 30—May 11 (7 records); leaves, August 14–28 (4 records). Gale found eggs June 1–23. Widmann observed several pairs at Estes Park (7,500 feet) and found a nest with eggs, June 24.

Dendroica coerulescens coerulescens, Black-throated Blue Warbler (654)

A specimen was found dead by J. J. Blanchard, October 16, 1911, near Boulder Creek in the Yellow Pine zone. This is the third record for Colorado.

Dendroica coronata, Myrtle Warbler (655)

Migrant; common in the spring on the Plains. Arrives, May 2–7 (3 records). It has not been definitely recorded in the fall, possibly from confusion with the Audubon's Warbler when in its fall plumage.

Dendroica auduboni auduboni, Audubon's Warbler (656)

Summer resident; infrequent in the upper part of the Yellow Pine and common in the Mountain zone. Arrives on the Plains, April 16—May 7 (8 records);

leaves, October 13–21 (4 records). Gale found many sets of eggs between June 16 and July 9, one at about 11,000 feet.

Dendroica striata, Black-poll Warbler (661)

Henderson saw one at Boulder, May 7, 1905, with full opportunity to study it at short range. It is rare in Colorado.

Dendroica townsendi, TOWNSEND'S WARBLER (668)

Migrant; rather common in the fall migration. It has been noted from the edge of the Plains to about 10,500 feet. Arrives, August 28—September 5 (4 records); the latest fall date is October 3. It has not been recorded in the spring though it probably passes through the county at that time, as Chapman gives May 11 as a date for arrival at Loveland (just north of the county).

[*Seiurus aurocapillus,* Oven-bird (674)]

Minot believed he heard the notes of this species at Boulder and Nederland in 1880. It is rare in Colorado.

Seiurus novoboracensis notabilis, Grinnell's Water-thrush (675*a*)

Minot observed it at Boulder and Nederland in the latter part of May, 1880. One was taken by Bragg at Boulder, May 14, 1904. Widmann saw one in the Yellow Pine zone east of Estes Park, July 16. It may prove to be a regular migrant, though it has not been seen very often in Colorado.

Oporornis tolmiei, MACGILLIVRAY'S WARBLER (680)

Summer resident; common in the Yellow Pine and occurring in the Mountain zone at least to 9,000 feet and probably in the spruce regions, as Henderson took one at 10,500 feet in early September. Arrives, May 4–15 (2 records); leaves, September 9—October 1 (5 records). There is one set of five eggs in the University collection taken by Gale on June 28, 1883, on "Left Hand Creek." Chapman records a nest taken at Estes Park, June 15.

Geothlypis trichas occidentalis, WESTERN YELLOW-THROAT (681*a*)

Summer resident; common about the marshes of the Plains. There is one record for the Yellow Pine at Estes Park where Widmann observed a male, June 30, at about 7,500 feet. Arrives, (April 14, earliest) May 8–20 (2 records); leaves, September 10–30 (4 records). Gale found eggs twice, June 17 and 20.

Icteria virens longicauda, LONG-TAILED CHAT (683*a*)

Summer resident; rather common along the base of the foothills, where the Yellow Pine meets the Plains. Arrives, May 8–17 (3 records); leaves, August 25—September 9 (2 records). No nesting dates are available.

Wilsonia pusilla pileolata, PILEOLATED WARBLER (685*a*)

Summer resident; common in the Mountain zone. Arrives on the plains in migration, May 4–12 (3 records); leaves, September 15—October 9 (4 records). It has been noted at 9,000 to 10,000 feet at the end of May, and on the Plains as early as August 27 in the fall. Gale took many sets of eggs between June 10 and July 2, one at 11,000 feet.

Setophaga ruticilla, REDSTART (687)

Migrant; apparently rare. The few records are for the Plains. Minot observed it, May 31, 1880; Henderson, May 25, 1905; and the writer, August 24, 1909, and July 28, 1912. The last date was that of a female and indicates possible breeding. Mr. Dean Babcock, of Estes Park, stated that he had seen the bird there in migration (at about 9,000 feet).

Family **MOTACILLIDAE,** The Wagtails

Anthus rubescens, PIPIT (697)

Summer resident; common above timberline. Arrives on the Plains in migration, April 23–26 (2 records); leaves, September 22 (1 record). Noted above timberline as late as September 15. Gale found nests above timberline between June 29 and July 10; he also saw young birds near Gold Hill in August and believed they nested in that vicinity (8,000 to 8,500 feet).

Family **CINCLIDAE,** The Dippers

Cinclus mexicanus unicolor, DIPPER (701)

Permanent resident; in summer common along the streams of the Yellow Pine and Mountain zones; in winter infrequent in the lower part of the Yellow Pine and in the western part of the Plains. It has been noted a little above timberline as late as September 4. Gale found eggs between April 28 and June 27. The writer saw young in the nest at 8,500 feet, July 28.

Family **MIMIDAE,** The Thrashers, Mockingbirds, etc.

Oreoscoptes montanus, SAGE THRASHER (702)

Summer resident; rare along the base of the foothills; rather common in fall migration on the Plains. Arrives, April 7 (1 record); leaves, September 24–25 (2 records). Though no nests have been taken in the county, the writer observed them in July (9–21) in 1910, 1911 and 1912. In one case the birds appeared to be in full song. The species has also been noted in the county by Henderson, Dille and Young (Henderson).

Mimus polyglottos leucopterus, WESTERN MOCKINGBIRD (703*a*)

Summer resident; rare on the Plains. In the spring it has been seen May 15 (Gale) and May 17 (Henderson). Gale found a few nests, May 31, 1886, and June 1–10, 1887. It was not observed by the writer. It is apparently more common both east and northeast of the county—near the Barr Lakes and toward Ft. Collins.

Dumetella carolinensis, CATBIRD (704)

Summer resident; common on the Plains and in the Yellow Pine zone. Arrives, May 8–15 (4 records); leaves, September 14–20 (3 records). Gale found eggs between June 1 and July 3. Widmann observed it at Estes Park (7,500 feet).

Toxostoma rufum, BROWN THRASHER (705)

Summer resident; rare on the Plains. Arrives, May 5–15 (3 records); no fall dates available. Gale found a nest with four eggs on June 25, 1883, and several nests, May 31, 1886. The writer saw a pair, July 21, 1912. Henderson recorded one seen in the county.

Family **TROGLODYTIDAE,** The Wrens

Salpinctes obsoletus obsoletus, ROCK WREN (715)

Summer resident; occurs locally on the Plains, is common in the Yellow Pine and occurs at least in the lower part of the Mountain zone at 9,000 feet. Arrives, April 27—May 8 (3 records); leaves, October 8–27 (3 records). Gale recorded three nests found between June 11 and 24.

Catherpes mexicanus conspersus, CANYON WREN (717*a*)

Permanent resident; common in the canyons of the lower Yellow Pine zone. Noted near Boulder Falls (in the upper part of the Yellow Pine zone) and, in winter, at White Rocks, about seven miles out on the Plains. The writer found a nest site which was occupied three successive years; young in the nest July 10, 1910, and July 23, 1911, and six eggs on May 8, 1912. Dille (Sclater) found a nest with three eggs, April 4.

Troglodytes aedon parkmani, WESTERN HOUSE WREN (721*a*)

Summer resident; rather common on the Plains, and common in the Yellow Pine and Mountain zones. Arrives, April 28—May 8 (5 records); leaves, September 11–22 (3 records). Birds have been seen nest-building as early as May 12, and feeding young in the nest as late as July 23. Eggs have been found from May 26 to June 17. One nest in the University collection was labelled 10,000 feet by Gale.

Telmatodytes palustris iliacus, Prairie Marsh Wren (725*d*)

Migrant; probably common in the marshes of the Plains. Seen in the spring, April 3—May 2 (3 records); in the fall, September 24—October 31 (4 records). Gale "supposed" he saw a marsh wren, May 7, 1887, his only reference to this species. Two specimens taken in October, 1910, by the writer were identified by Oberholser as of this subspecies (*iliacus*), and all the county records have been assigned to this form. Sclater gives *plesius* as the form occurring in both the eastern and the western parts of the state; both forms may occur in the county.

Family **CERTHIIDAE,** The Creepers

Certhia familiaris montana, Rocky Mountain Creeper (726*b*)

Permanent resident; rare in summer in the Mountain zone, though perhaps overlooked; in winter common in the Plains and Yellow Pine zones (possibly higher). It reaches its winter range September 18—October 6 (4 records); and leaves, March 5–17 (3 records). Gale found a nest with five eggs, June 11, 1890, "between bark and trunk of large balsam stub," probably at about 9,500 feet. The writer saw a bird, June 23, near Estes Park at 8,500 feet. Kellogg found it at timberline near Estes Park.

Family **SITTIDAE,** The Nuthatches

Sitta carolinensis nelsoni, Rocky Mountain Nuthatch (727*c*)

Permanent resident; in summer common in the Yellow Pine and lower part of the Mountain zone; in winter common in the Yellow Pine, also reaching the Plains. Gale found eggs between May 21 and June 5, one nest being taken at 9,500 feet.

Sitta canadensis, Red-breasted Nuthatch (728)

Summer resident; rare in summer, the only definite records are from the Mountain zone; in migration it is rather infrequent in the Yellow Pine. Gale believed it to be a permanent resident. It has been noted in the spring, April 2–8 (2 records); and in the fall, October 22—November 17 (3 records). Gale found a nest, June 6, 1889 (probably at about 9,000 feet), and saw birds at about 10,000 feet. The writer saw several birds in the lower Yellow Pine, August 28.

Sitta pygmaea pygmaea, Pygmy Nuthatch (730)

Permanent resident; common in summer in the Yellow Pine and lower part of the Mountain zone; in winter common in the Yellow Pine, occurring in bands of ten to twenty, in which are usually a number of Mountain Chickadees, a few Rocky Mountain Creepers and Rocky Mountain Nuthatches and occasionally Golden-crowned Kinglets. Gale found many nests from May 28 to June 19, mostly from 8,500 to 9,500 feet. One nest in the University collection is labelled July 1, 1890, 10,000 feet.

Family **PARIDAE,** The Titmice

Penthestes atricapillus septentrionalis, Long-tailed Chickadee (735*a*)

Permanent resident; in summer common in the deciduous growth along the streams of the Yellow Pine zone; in winter common in similar situations on the Plains. It reaches the Plains, September 10–25 (3 records); has been seen there as late as April 14. There are no records for eggs from the county though Gale found a completed nest, May 12. Just north of the county, Widmann observed young out of the nest, July 15, at 6,000 feet, and also noted birds at 8,000 feet.

Penthestes gambeli gambeli, Mountain Chickadee (738)

Permanent resident; abundant in the Yellow Pine and Mountain zones. In winter it is occasionally seen with the Long-tailed Chickadees on the Plains but some apparently remain in their summer range throughout the year. Gale took many sets of eggs between May 25 and June 15, mostly between 8,000 and 10,000 feet.

Family **SYLVIIDAE,** The Kinglets, Gnatcatchers, etc.

Regulus satrapa olivaceus, Western Golden-crowned Kinglet (748*a*)

Winter resident; rather rare in the Yellow Pine zone. Six records made by the writer are in October, November, January and February. A specimen was taken August 21, 1888, by Gale (Henderson), and several birds were seen August 28–30 by the writer at 10,500 feet. W. W. Robbins collected one near Tolland, June 15, 1909, at 10,000 feet. It is probable that the bird will be found a rare summer resident in the spruce regions. (The subspecific form of the Golden-crowned Kinglet occurring in the county has not been determined. Sclater's list has been followed, though the A.O.U. *Check-List* includes Colorado in the range of the eastern form *satrapa*.)

Regulus calendula calendula, Ruby-crowned Kinglet (749)

Summer resident; common in the Mountain zone. Seen in the spring, April 28, at 9,300 feet; reaches the Plains in the fall, September 24–25 (2 records), and leaves, October 6–23 (4 records). Gale took a number of nests between June 1 and July 5. He noted an empty nest at 11,000 feet.

Polioptila coerulea obscura, Western Gnatcatcher (751*a*)

Henderson saw one at Boulder on May 12, 1905, under favorable circumstances for identification. It is not common in the eastern part of the state and this is the most northerly record given by Sclater.

Family **TURDIDAE,** The Solitaires, Thrushes, Bluebirds

Myadestes townsendi, Townsend's Solitaire (754)

Permanent resident; in summer common in the upper part of the Yellow Pine and in the Mountain zone, at least occasionally reaching timberline (Mt. Audubon, July 4, 1912); in winter common in the lower part of the Yellow Pine and along the edge of the Plains. Gale found eggs between May 19 and June 29, mostly at 8,500 to 9,500 feet. The nests were placed under ledges or in mine shafts.

Hylocichla fuscescens salicicola, Willow Thrush (756*a*)

The only record for the county is that of a nest taken by Gale, June 13, 1884, near Gold Hill; later in his notes, however, he describes the same nest as being that of a Wood Thrush. Widmann saw several of this species near Long's Peak Inn, 9,000 feet (only a short distance north of the county line), in July, 1910, and Dean Babcock informed the writer that they were frequently seen there in the summer of 1912. It has probably been overlooked in the county, though it does not appear to be common in Colorado.

Hylocichla ustulata swainsoni, Olive-backed Thrush (758*a*)

Summer resident; common along the creeks in the upper part of the Yellow Pine and the lower part of the Mountain zone. Arrives on the Plains, April 16—May 12 (5 records). Recorded in the fall, September 13 and October 19 (Gale). The same observer found eight nests between June 23 and July 18. In the vicinity of Estes Park, Widmann observed them along the streams from 6,000 to 9,000 feet.

Hylocichla guttata guttata, Alaska Hermit Thrush (759)

Sprague took a specimen (the first for the state) on October 6, 1895, at Magnolia. As the species appears to be a regular migrant in the eastern part of the state (Sclater), it is not unlikely that, since Sprague's observation, it has been overlooked in the county.

Hylocichla guttata auduboni, Audubon's Hermit Thrush (759*a*)

Summer resident; common in the Mountain zone and infrequent in the upper part of the Yellow Pine. Arrives on the plains and in the mountains, May 13–30 (4 records); leaves the plains, October 21–22 (2 records). Gale found many sets of eggs between June 10 and July 12 at 8,500 to 10,000 feet. The writer has seen it from near timberline down to about 8,000 feet in the first week of July. It holds first place among the birds of the county as a songster.

Planesticus migratorius propinquus, Western Robin (761*a*)

Permanent resident; abundant in summer in the Plains and Yellow Pine zones and common in the Mountain zone, occurring up to timberline; in winter infrequent in the Yellow Pine and along the edge of the Plains. The full tide of spring migration occurs about the last of March at which time birds may be found at 9,000 feet. The fall migrants leave in the latter half of October. Gale found eggs between May 7 and July 17 from the Plains to near timberline. Many birds show a considerable amount of white at the corners of the tail and probably not all are typical of the western subspecies.

Ixoreus naevius, Varied Thrush (763)

The writer saw a bird of this species in Gregory Canyon, near Boulder, December 5, 1909, under conditions favorable for accurate observation. It is the only record for Colorado.

Saxicola oenanthe leucorhoa, Greenland Wheatear (765*a*)

Minot recorded a specimen from Boulder, May 14, 1880. Ridgway considered the record as probably of this subspecies with the possibility of it being *S. o. oenanthe* (Henderson). It is the only record for Colorado.

Sialia sialis sialis, Bluebird (766)

Gale found a nest with four eggs on June 18, 1887, probably in the Yellow Pine zone. The bird, though rare in Colorado, apparently occurs regularly in the eastern part of the state.

Sialia mexicana bairdi, CHESTNUT-BACKED BLUEBIRD (767*a*)

Summer resident; infrequent in the Yellow Pine zone; occurs on the Plains in migration. Arrives, March 31 (1 record); leaves, September 15—October 8 (4 records). Gale found two nests on June 8, 1887, one with young birds. Widmann observed two pairs in Estes Park (7,500 feet) in 1910.

Sialia currucoides, MOUNTAIN BLUEBIRD (768)

Summer resident; abundant at the western edge of the Plains and in the Yellow Pine and common in the Mountain zone, occurring up to timberline. Arrives on the Plains and in the mountains, February 21—March 16 (10 records); leaves, October 10–21 (4 records). Gale found many nests between May 15 and June 30, and recorded one as early as April 28; his sets were taken mostly at 8,500 to 9,500 feet.

VERTICAL DISTRIBUTION

A provisional distribution of the breeding birds and summer visitants in relation to altitudinal zones is given in the following tables. Species printed in italic have been found principally in one zone.

TABLE I

Breeding Birds Occurring in the Plains Zone: 5,000–6,000 Feet

Total, 72 *Characteristic,* 37

*Pied-billed Grebe**
Blue-winged Teal
Bittern
Least Bittern
Great Blue Heron
Black-crowned Night Heron
Virginia Rail
Sora
Coot
Wilson's Phalarope
Wilson's Snipe
Spotted Sandpiper
Killdeer
Bob-white
Western Mourning Dove
Turkey Vulture
Western Red-tail
Swainson's Hawk
Sparrow Hawk
Rocky Mountain Screech Owl
Western Horned Owl
Burrowing Owl
California Cuckoo
Belted Kingfisher
Red-headed Woodpecker
Red-shafted Flicker
Western Nighthawk
Kingbird
Arkansas Kingbird
Say's Phoebe
Western Wood Pewee
Traill's Flycatcher
Desert Horned Lark
Magpie
Western Crow
Bobolink
Cowbird
Yellow-headed Blackbird
Thick-billed Red-wing
Western Meadowlark
Bullock's Oriole
Brewer's Blackbird
Bronzed Grackle
House Finch
Goldfinch
Arkansas Goldfinch
Pine Siskin
Western Vesper Sparrow
Western Grasshopper Sparrow
Western Lark Sparrow
Western Chipping Sparrow
Mountain Song Sparrow
Black-headed Grosbeak
Lazuli Bunting
Lark Bunting
Cliff Swallow
Barn Swallow
Bank Swallow
Rough-winged Swallow
White-rumped Shrike
Western Warbling Vireo
Plumbeous Vireo
Yellow Warbler
Western Yellow-throat
Long-tailed Chat
Sage Thrasher
Western Mockingbird
Catbird
Brown Thrasher
Rock Wren
Western House Wren
Western Robin

* Species printed in italic have been found chiefly in this zone.

TABLE II

BREEDING BIRDS OCCURRING IN THE YELLOW PINE ZONE: 6,000–8,500 FEET

Total, 70 *Characteristic*, 13

Sora
Killdeer
Dusky Grouse
Western Mourning Dove
Western Red-tail
Golden Eagle
Prairie Falcon
Sparrow Hawk
*Long-eared Owl**
Saw-whet Owl
Rocky Mountain Screech Owl
Western Horned Owl
Rocky Mountain Pygmy Owl
Rocky Mountain Hairy Woodpecker
Batchelder's Woodpecker
Red-naped Sapsucker
Williamson's Sapsucker
Red-headed Woodpecker
Lewis's Woodpecker
Red-shafted Flicker
Poorwill
Western Nighthawk
White-throated Swift
Broad-tailed Hummingbird
Kingbird
Say's Phoebe
Olive-sided Flycatcher
Western Wood Pewee
Western Flycatcher
Magpie
Long-crested Jay
Pinyon Jay
Thick-billed Red-wing
Western Meadowlark
Brewer's Blackbird
Cassin's Purple Finch
House Finch
Crossbill
Pine Siskin
Western Vesper Sparrow
Western Chipping Sparrow
Gray-headed Junco
Mountain Song Sparrow
Spurred Towhee
Green-tailed Towhee
Black-headed Grosbeak
Lazuli Bunting
Western Tanager
Cliff Swallow
Barn Swallow
Northern Violet-green Swallow
Western Warbling Vireo
Plumbeous Vireo
Virginia's Warbler
Yellow Warbler
Macgillivray's Warbler
Dipper
Catbird
Rock Wren
Canyon Wren
Western House Wren
Rocky Mountain Nuthatch
Pygmy Nuthatch
Long-tailed Chickadee
Mountain Chickadee
Townsend's Solitaire
Olive-backed Thrush
Western Robin
Chestnut-backed Bluebird
Mountain Bluebird

* Species printed in italic have been found chiefly in this zone.

TABLE III

BREEDING BIRDS OCCURRING IN THE MOUNTAIN ZONE: 8,500–11,500 FEET

Total, 65 *Characteristic*, 19

Spotted Sandpiper
Killdeer
Dusky Grouse
*Band-tailed Pigeon**
Western Mourning Dove
Cooper's Hawk
Western Red-tail
Ferruginous Rough-leg
Golden Eagle
Flammulated Screech Owl
Western Horned Owl
Rocky Mountain Pygmy Owl
Belted Kingfisher
Rocky Mountain Hairy Woodpecker
Batchelder's Woodpecker
Alpine Three-toed Woodpecker
Red-naped Sapsucker
Williamson's Sapsucker
Red-shafted Flicker
Western Nighthawk
Broad-tailed Hummingbird
Olive-sided Flycatcher
Western Wood Pewee
Western Flycatcher
Hammond's Flycatcher
Wright's Flycatcher
Magpie
Long-crested Jay
Rocky Mountain Jay
Clarke's Nutcracker
Thick-billed Red-wing
Western Meadowlark
Brewer's Blackbird
Rocky Mountain Grosbeak
Cassin's Purple Finch
Crossbill
Pine Siskin
Western Savannah Sparrow
White-crowned Sparrow
Western Chipping Sparrow
Gray-headed Junco
Mountain Song Sparrow
Lincoln's Sparrow
Green-tailed Towhee
Barn Swallow
Tree Swallow
Northern Violet-green Swallow
Western Warbling Vireo
Audubon's Warbler
Macgillivray's Warbler
Pileolated Warbler
Dipper
Rock Wren
Western House Wren
Rocky Mountain Creeper
Rocky Mountain Nuthatch
Red-breasted Nuthatch
Pygmy Nuthatch
Mountain Chickadee
Ruby-crowned Kinglet
Townsend's Solitaire
Olive-backed Thrush
Audubon's Hermit Thrush
Western Robin
Mountain Bluebird

* Species printed in italic have been found chiefly in this zone.

TABLE IV

BREEDING BIRDS OCCURRING IN THE ALPINE ZONE, ABOVE 11,500 FEET

Total, 5 *Characteristic*, 3

*White-tailed Ptarmigan**	White-crowned Sparrow
Desert Horned Lark	*Pipit*
Brown-capped Rosy Finch	

* Species printed in italic have been found chiefly in this zone.

It is interesting to note that the following fifteen species, which occur in all the zones of the county except the Alpine, range according to the A.O.U. *Check-List* from the southern boundary of the United States to the provinces of Mackenzie, Yukon, and northern Alberta in Canada (except that the subspecific forms of the Nighthawk, Red-wing and Robin change in the most northern part of their range):

Spotted Sandpiper	Brewer's Blackbird
Western Red-tail	Pine Siskin
Belted Kingfisher	Western Chipping Sparrow
Red-shafted Flicker	Barn Swallow
Western Nighthawk	Western Warbling Vireo
Western Wood Pewee	Western House Wren
Magpie	Western Robin
Thick-billed Red-wing	

The Broad-tailed Hummingbird, however, which is common in the Mountain zone and found even at timberline, ranges north only to southern Idaho.

The data on the altitudinal limits of the breeding ranges are hardly exact enough in the majority of cases to make an extended comparison between vertical and latitudinal range of much value at present. A careful study of that nature should, however, prove quite interesting in connection with the proper limits of the life-zones.

LOCAL MIGRATION PROBLEMS

A number of points in connection with the influence on local migration of the mountain ranges, and of the comparatively short seasons at the high altitudes, are of considerable interest. On account of the difficulty of securing direct evidence in problems of this nature none of the theories have been satisfactorily established.

It has been suggested that birds nesting in the higher zones migrate north along the plains and then follow the mountain valleys up to their breeding areas. Denis Gale believed that the Rocky Mountain Hermit Thrush reached its home by a mountain route and that it did not occur on the plains. While thrushes are certainly not common as migrants near Boulder, they occur on the plains and have been recorded as common at times at the Barr Lakes east of the county. In the migration of the Mountain Bluebird large flocks occur both on the plains and in the forested regions and some of the dates for arrival in the upper part of the Yellow Pine zone have been as early as any for the plains. The spring of 1912 was very late in the Mountain zone, yet Robins, Bluebirds and a Ruby-crowned Kinglet were noted long before the snow had bared the ground. The presence of birds going to or coming from more northern breeding areas further confuses the data. It seems likely, however, that such a vertical migration will be found true of the ground-nesting birds, some of which arrive on the plains before the snow has left their summer habitat.

In the first part of September, flocks of Robins are common in the forested region, and in the experience of the writer their direction of flight was very consistently toward the east, whether in the Yellow Pine or in the high regions of the spruce forests. While evidence of this kind is only suggestive, the trend of the Continental Divide along the western border of Boulder County in relation to Middle Park and northwestern Colorado also suggests a possible migration route across the range into Boulder County. A map of Colorado shows the Divide to be at its most eastern position at this point, while the location of the mountain ranges in the central and southern part of the state are such as to make the east slope the more direct route south. It would be interesting to determine whether flocks of Robins actually cross the range in the autumn flight. Such evidence would be good proof of a migration route and would account for such records as the finding of a dead Sora on Arapahoe Glacier. Gale believed that a Northern Shrike which he saw in the mountains had crossed the range, following up the migrating flocks of Juncos.

The question of secondary migration, with a second nesting at a higher altitude, is also an interesting one. F. M. Drew[1] stated that in San Juan County the White-crowned Sparrow raised its first brood at a comparatively low elevation and then moved up to timberline for a second nesting. A. W. Anthony,[2] in regard to the same question, wrote as follows:

> These notes [Drew's] were verified by my own observations at Silverton in 1883, when White-crowns were found in abundance along the willow-lined streams in May and June and several nests were taken. After the first week in July, however, they were rather scarce in the lower valleys but suddenly made their appearance about the snow banks above timberline where a second brood was raised and where they remained in abundance until late in the fall.
>
> In this instance a migration certainly took place in the midst of the nesting season. To what extent in latitude it is impossible to ascertain, but vertically it could not have been less than 2,000 feet, and it is not unreasonable to suppose that in gaining this elevation some distance was also gained in latitude.

There appears to be no evidence as yet from Boulder County that a similar migration takes place. Denis Gale found the White-crowns' nests mostly from about 10,000 feet to timberline and between June 15 and July 20. He believed they nested but once. The presence of migrants on the plains from the last of April to the first week in June indicates that the individuals nesting at the highest altitudes may be simply the late migrants. The writer has found White-crowned Sparrows to be common at Tolland (9,000 feet) in the last of May and in the middle of July, and also common at timberline in the first week of July.

In this connection Denis Gale wrote as follows concerning the second nesting of the Robin:

> Judging from the greater number of nests of this second family raising, which is early in July, I opine some of the birds have their first nests in the valley or foothills, and choose the higher mountain canyons for their second. They are not uncommon at timberline, 11,000 feet above sea-level, and at this point, in many situations in which they are seen, young could not be raised until July.

[1] *Bull. Nut. Orn. Club*, Vol. VI, 1881.

[2] *Zoe*, Vol. I, p. 379, 1891.

The writer has observed the second nesting of the Robin on the plains and did not notice any diminution in their numbers about Boulder. On the other hand, he has observed Robins at 10,000 feet in the last of April. While this negative evidence is not offered as proof that a secondary migration for the purpose of nesting does not occur, it at least indicates that more data are needed before such a claim can be made for Boulder County birds.

Bibliography

Anthony, A. W. "Winter plumage of *Leucosticte australis*." *The Auk*, N.S., Vol. IV, p. 257, 1887. [Describes male, female and young from Gold Hill.]

———. "A new subspecies of the genus *Dryobates*." *The Auk*, N.S., Vol. XIII, p. 32, 1896. [Describes *D. v. montanus* from Boulder, changing name to *monticola*, in Vol. XV, p. 54, of same magazine.]

Bailey, Florence M. *Handbook of birds of the Western United States*. Ed. 1, Boston, 1902, and later revised editions. [A general manual with keys and descriptions of the birds of the entire region.]

Bendire, C. E. "Notes on the habits, nests and eggs of the genus *Sphyrapicus* Baird." *The Auk*, N.S., Vol. V, pp. 225–240, 1888. [Contains Boulder County notes by Gale.]

———. "A peculiar nest of *Cinclus mexicanus*." *The Auk*, N.S., Vol. VI, p. 75, 1889. [Describes a roofless nest collected by Gale on North Boulder Creek.]

———. "*Picicorvus columbianus* (Wils.), Clarke's nutcracker. Its nest, eggs, etc." *The Auk*, N.S., Vol. VI, pp. 226–236, 1889. [Contains Boulder County notes by Gale.]

———. "Description of the nest and eggs of *Megascops asio maxwelliæ*, the Rocky Mountain screech owl." *The Auk*, N.S., Vol. VI, pp. 298–302, 1889. [Contains Boulder County notes by Gale.]

———. "*Megascops asio maxwelliæ*." *The Auk*, N.S., Vol. VII, p. 91, 1890. [Describes pellets collected by Gale.]

———. *Life histories of North American birds*. U. S. Natl. Museum. Part I, Spl. Bull. No. 1, 1892. Part II, *Id.*, No. 3, 1895.

Bergtold, W. H. "White Pelican in Colorado." *The Auk*, N.S., Vol. XXX, p. 430, 1913. [Records one at Niwot, May 17, 1912.]

Betts, N. deWitt. "Notes from Boulder County, Colorado." *The Auk*, N.S., Vol. XXVII, pp. 218–219, 1910; Vol. XXVIII, p. 18, 1911; Vol. XXIX, p. 399–400, 1912.

———. "Christmas bird census at Boulder." *Bird-Lore*, Vol. XIII, p. 41, 1911.

Burnett, W. L. "Another canyon wren record for Colorado." *The Auk*, Vol. XXV, p. 87, 1908.

Carey, Merritt. "New records and important range extensions of Colorado birds." *The Auk*, N. S.,Vol. XXVII, pp. 180–85, 1909. [Records nesting of *Junco aikeni* at 7,000 feet in Boulder County.]

Cooke, W. W. *The birds of Colorado*. Bull. No. 37, State Agricultural College, 1897.

———. *Further notes on the birds of Colorado*. *Id.*, No. 44, 1898.

———. *The birds of Colorado*. *Id.*, No. 56, 1900.

Dartt, Mary. *On the plains and among the peaks; or how Mrs. Maxwell made her natural history collection*. Philadelphia, 1879. Interesting account and contains list of Mrs. Maxwell's Centennial Exposition collection of Colorado birds, the list prepared by Ridgway and afterwards published in *Field and Forest*.]

Dille, F. M. "Notes of occurrence and nesting of certain species additional to the 'Birds of Colorado.'" *The Auk*, N.S., Vol. XXVI, pp. 86–88, 1909.

Felger, A.H. "Colorado notes," *The Auk*, N.S., Vol. XXVI, pp. 85–86, 1909.

HENDERSON, JUNIUS. "Boulder, Colorado, birds increasing." *The Wilson Bulletin*, Vol. XIV, No. 39, p. 74, 1902.

——. "Preliminary list of birds of Boulder County, Colorado." *University of Colorado Studies*, Vol. I, pp. 233–237, 1903.

——. "Additional list of Boulder County birds, with comments thereon." *University of Colorado Studies*, Vol. II, pp. 107–112, 1904.

——. "Bobolinks increasing at Boulder, Colorado." *The Wilson Bulletin*, Vol. XVI, No. 48, p. 92, 1904.

——. "The Bobolink in Colorado." *The Auk*, N.S., Vol. XXI, p. 486, 1904.

——. "Colorado notes." *The Auk*, N.S., Vol. XXVII, pp. 421, 422, 1905.

——. "With the birds in northeastern Colorado." *The Wilson Bulletin*, Vol. XVIII, No. 57, pp. 105–110, 1906.

——. "Destruction of herons by a hailstorm." *The Condor*, Vol. IX, p. 162, 1907. [Refers to the St. Vrain heronry. *Lyons Recorder* first reported the occurrence in issue of July 18, 1907, but designated them as cranes, this writer correcting the error by a letter in the next issue, July 25, 1907.]

——. "Nesting of crossbills in Colorado." *The Auk*, N.S., Vol. XXIV, pp. 440–442, 1907. [Based on Gale's notes.]

——. "Colorado notes." *The Condor*, Vol. IX, p. 198, 1907.

——. "An early Colorado naturalist—Denis Gale." *University of Colorado Studies*, Vol. V, pp. 25–34, 1907. [Includes some bird notes.]

——. "The American dipper in Colorado." *Bird-Lore*, Vol. X, pp. 1–7, 1908. [Based on Boulder County observations of Gale and this writer.]

——. "Annotated List of the birds of Boulder County, Colorado." *University of Colorado Studies*, Vol. VI, pp. 219–242, 1909.

——. "A history of the birds of Colorado." *The Auk*, N.S., Vol. XXIX, pp. 277–278, 1912. [A review of Sclater's volume, but adds Boulder County records.]

HERSEY, J. CLARENCE. "The little white egret (*Ardea candidissima*) in Colorado." *American Naturalist*, Vol. X, p. 430, 1876. [Records a Boulder County specimen taken in May, 1876.]

KEYSER, LEANDER S. *Birds of the Rockies*, Chicago, 1902. [A story of the author's travels, rather than an account of the birds of the state.]

Longmont Ledger. "The home of the crane." June 10, 1904. [Editorial description of the St. Vrain heronry, but calls the birds cranes. This is corrected and other information added by a letter from Professor Henderson in the next issue, June 17, 1904, under the heading "Blue herons."]

MARKMAN, HARVEY. "Scientific expedition to northeastern Colorado. Zoölogy. 4. Account of species seen, with distribution." *University of Colorado Studies*, Vol. IV, pp. 153–158, 1907. [Contains some Boulder County records.]

MCGREGOR, R. C. "*Junco ridgwayi* in Colorado." *The Auk*, Vol. X, p. 205, 1893. One taken near Boulder. [Believed now to be hybrid.]

MINOT, H. D. "Notes on Colorado birds." *Bulletin Nuttall Ornithological Club*, Vol. V, p. 223, 1880. [Notes species at Boulder and Nederland.]

OBERHOLSER, HARRY C. "A new *Agelaius* from Canada." *The Auk*, N.S., Vol. XXIV, pp. 332–336, 1907. [Gives distribution of several subspecies, including Boulder County records.]

RIDGWAY, ROBERT. "A monograph of the Genus *Leucosticte*, Swainson, or gray-crowned purple finches." *U.S. Geol. and Geog. Surv. Terr. Bull.*, Vol. I, No. 1, 2d ser., pp. 51–82, 1875. [Records some of Mrs. Maxwell's specimens.]

———. "*Scops flammeola* in Colorado." *Bulletin Nuttall Ornithological Club*, Vol. V, p. 185, 1880. [Notes specimen in Mrs. Maxwell's collection.]

———. "Mrs. Maxwell's Colorado Museum; catalogue of the birds." *Field and Forest*, Vol. II, pp. 195–198, 1887.

———. "Mrs. Maxwell's Colorado Museum; additional notes." *Field and Forest*, Vol. III, p. 11, 1887.

———. *The birds of North and Middle America.* U.S. National Museum, Null. No. 50, Parts I, II, III, IV.

SCLATER, WILLIAM L. *A history of the birds of Colorado*, London, 1912. [A general treatise, giving records and descriptions of all Colorado species. Many of the altitudes indicated on the topographic map are erroneous.]

SMITH, HORACE G. "Random notes on the distribution of some Colorado birds, with additions to the state avifauna." *The Auk*, N.S., Vol. XXV, pp. 184–191, 1908. [Contains Boulder County records.]

SPRAGUE, W. A. "The dwarf thrush in Colorado." *The Auk*, N.S., Vol. XIII, p. 85, 1896. [One taken at Magnolia. Author's name erroneously appears as U. A. Sprague.]

WIDMANN, OTTO. "List of birds observed in Estes Park, Colorado, from June 10 to July 18, 1910." *The Auk*, N.S., Vol. XXVIII, pp. 304–319, 1911. [Some Boulder County observations.]

ALPHABETICAL INDEX TO VOLUME X

[illegible]

[illegible]