Circular No. 96 - Crickets and Grasshoppers in Utah

W. W. Henderson

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Circula r 96
November, 1931

CRICKETS AND GRASSHOPPERS IN UTAH

South Panel of Seagull Monument Temple Grounds, Salt Lake City

UTAH AGRICULTURAL EXPERIMENT STATION
Utah State Agricultural College
Logan, Utah
Acknowledgment

This account of the more common and destructive crickets and grasshoppers found in this state was requested by and is made possible through the generous help of the Honorable Herbert S. Auerbach, former State Senator from Salt Lake County, whose great appreciation of the heroic work of Utah pioneers inspired his ambition to make the achievements of the pioneer struggle more widely known among the people of the state who now enjoy the benefits of an established agriculture. This paper also seeks to carry out another purpose which Mr. Auerbach desired, that of placing in the possession of many people who live on farms a non-technical description of the more important species of crickets and grasshoppers and means of destroying them.
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In the written history of Utah, especially that which is reflected in diaries and journals of the pioneer settlers and that found in the oldest publications, there is ample evidence that one of the most serious handicaps to progress in this "far-western" territory was the cricket and its near kinsman, the grasshopper.

Three basic resources on which the first permanent settlers counted were: (1) Good soil suitable for raising crops to sustain life; (2) suitable climate to make possible the maturing of wheat, corn, and vegetables; and (3) sufficient water of good quality not only for home uses but for the purpose of irrigating crops which could not thrive in a desert. The first company of travelers had not seen their first springtime in Utah before they were convinced of the presence of the three necessary conditions. They soon felt, therefore, that the colonization of Utah and contiguous territory could be promptly and successfully carried out. They had thought carefully of the wild and savage man who lived here and who might constitute a serious enemy, but they thought they knew ways of getting along on friendly terms with him. They had thought of the possibility of dangerous wild beasts and poisonous reptiles and were prepared for such events. But crickets and grasshoppers in such numbers as to bring on plagues and pestilences constituted a surprising obstacle of which, apparently, no one had thought.

The sturdy settlers who led the way to Utah never thought of giving up and going back because of adverse climate, soil, desert country, or Indians, but the never-ending hordes of crickets and grasshoppers came near sending a discouraged people back to the Missouri. They did not go back, however, or at least few of them. They courageously went to work to destroy the unexpected enemy and to develop a substantial agriculture in spite of the new foe. The task has required manly effort and has been compensated by an achievement which has brought the admiration of the American people.

It is the purpose of this publication to give a fragmentary account of the struggle against crickets and grasshoppers. The illustrations used in the text are from specimens collected, mounted, and prepared for photography by the author. William C. Matthews, scientific illustrator of the University of California, made the photographs from specimens sent to him. The photographs were retouched in pen by Melvin J. Janes and Theodore Thatcher, students of the Utah State Agricultural College. The general contents have been abstracted from the author's files on Orthoptera. Many acknowledgements are made in the text.

W. W. HENDERSON,
Entomologist.
Crickets and Grasshoppers in Utah

W. W. Henderson

BRIEF HISTORY OF THE WESTERN CRICKET

Earliest Cricket Outbreaks

In his explorations of the Salt Lake Valley, Captain Howard Stansbury made a collection of insects and other animals which were taken back to Washington for identification and study. Among these was a single and mutilated specimen of the Rocky Mountain cricket. This may have been in the mind of Baird, to whom the collections were delivered, when he wrote: "The principal entomological results (of the expedition) is the precise determination of the destructive grasshopper, which, but for the interposition of a species of tern (seagull) at one period was near turning the 'Garden of the Mountains' into a desert." For Baird to be correct about having the right species in mind it must be clear that he should have said "cricket" instead of "grasshopper." There is a distinction between the two. If Baird actually did have a grasshopper in mind, then the "precise determination" to which he refers fades into obscurity, unless by one more chance he had in mind a grasshopper collected by Stansbury and named by Haldeman. Of this grasshopper, Haldeman said: "This fine large grasshopper is probably the species which has been destructive to vegetation in the Valley of the Great Salt Lake." Haldeman may have been correct in the probability he expresses, but the grasshopper he describes is certainly not the species which troubled the earliest settlers in Salt Lake Valley previous to Stansbury's explorations. The notations and descriptions of the early settlers themselves, while not expressed in the technical language of the trained entomologist, are so precise when considered en masse that there can be no doubt that the hopper which plagued the settlers of 1848, 1849, and 1850 was the big black cricket, the Rocky Mountain cricket, referred to in more recent literature as the "Mormon cricket," and technically known to science as Anabrus simplex Hald.

A brief description of the cricket by Anson Call, a Utah pioneer of 1847, is one of many of its kind. This description is to the point, and after the lapse of more than three-quarters of a century serves better in clearing up the identity of the enemy than do the technical descriptions made in the East by various scientists. Call's description is as follows: "When full grown it is about one and one-half inches in length, heavy and clumsy in its movements, with no better power of locomotion than hopping a foot or two at a time. It has an eagle-eyed staring appearance and suggests the idea that it may be the habitation of a vindicative little demon." It is an inter-

1 Contribution from Department of Entomology, Utah Agricultural Experiment Station.
2 Entomologist.

Publication authorized by Director, November 10, 1931.
esting digression to note that when it is understood that the prime motive of the early pioneer in coming to Utah was the hope of improving his religious opportunities, it is easy to see why Anson Call saw demons in the crickets which threatened to make human habitations in Utah impossible.

The early expeditions of the United States Government into the Rocky Mountains and their exploration of the Rocky Mountain valleys generally included someone who gave specific attention to the collection of insects. If these collectors themselves could not identify the insects the collections were turned over to a trained entomologist. Insects are the greatest enemies that human beings have, and it is likely that no new country has ever been entered by man as a pioneer without his finding the enemy in possession. Not only did early exploring expeditions find it wise to beware of insects as well as of Indians and of wild beasts, but early settlers soon found wisdom in such a course. Probably the early settlers observed in some instances what the scientific expeditions were doing, and from these they occasionally caught the spirit of the work. In this connection, the following would indicate a substantial interest in the insect enemies by a Utah pioneer of 1847 who later became the president of the Latter-day Saints Church:

"Insects Wanted—With a view to the formation of an entomological cabinet, and also to furnish specimens to scientific friends abroad, Elder W. Woodruff wishes to make a collection of the various kinds of bugs, beetles, flies, butterflies, millers, moths, worms, spiders, grasshoppers, crickets, and other insects to be found in Utah. Those willing to aid in this matter, and to promote the cause of science, will confer a favor by leaving specimens of insects, such as they may see fit to gather, at the Church Historian's, first door south of the postoffice.

"Brother Joseph Horn, of the 14th Ward, has furnished Elder Woodruff a very large spider of the species known as 'tarantula,' not often met with in Utah."

The earliest reference to crickets in Utah which has come to the writer's attention is found under date of June 4, 1848, in the unpublished journal of Isaac C. Haight, which is now in the Church Historian's Office. The reference is as follows:

"The weather is quite cool and very dry in the valley. Crops begin to suffer for the want of rain. The crickets have destroyed some of the crops and are still eating the heads of grain as soon as it heads out. The prospects for grain are discouraging. Many of the saints begin to think of leaving the valley for fear of starvation."

On June 9, 1848, John Smith, who was left in charge of affairs in Salt Lake Valley during the temporary absence of Brigham Young, wrote a letter to Brigham Young which contained the following:

"As to our crops, there has been a large amount of spring crops put in and they were doing very well till within a few days. The crickets have done considerable damage to both wheat and corn which has discouraged some, but there is plenty left if we can save it for a few days."

The same writer says in a letter to President Brigham Young, eleven days later (June 21, 1848):

"The crickets are still quite numerous and busy eating, but between the gulls and our efforts and the growth of our crops, we shall raise much grain in spite of them. Our vines, beans, and peas are mostly destroyed by frost and the crickets . . . Some of our corn has been destroyed . . . Every..."
thing is as well as could be expected under our ignorance of climate, crickets, etc., but we are gaining a fund of knowledge on all such points.”

John Young, a pioneer of 1847, writing his own biography some years later, said of the hard times and crickets:

“By the time the grass began to grow in 1848, the famine had waxed sore. For several months we had no bread. Beef, milk, pig weeds, segoes, and thistles formed our diet. ... As the summer crept on and the scant harvest drew nigh, the fight with the crickets commenced. Oh! how we fought and prayed and prayed and fought the myriads of black loathsome insects that flowed down like a flood of filthy water from the mountains above. ... I am sure that the wheat was in head, and that it averaged two or three crickets on every head, bending them down. One couldn’t step without crushing underfoot as many as the foot could cover.”

“In May and June of that year (1848) myriads of these destructive pests, an army of famine and despair, rolled in black legions down the mountain sides and attacked the fields of growing grain.”

To show how the crickets had engendered fear of starvation among the earliest settlers and how many of them lost heart, the following account is introduced. This account was written by Thomas Collister in February, 1869, and was addressed to George A. Smith of the Historian’s Office of the Latter-day Saints Church:

“I give you an incident which occurred in this valley in the summer of 1848. When the crickets descended upon everything green, all the nursery trees had been destroyed, and much of the grain and the inevitable destruction of everything was apparent to all. President John Young, second councillor to President John Smith, president of the stake, came to him and in the most emphatic manner said, ‘Father Smith, it is your duty to send an express to Brother Brigham and tell him to not bring the people here, for if he does, they will all starve to death.’ Father Smith looked thoughtful for a few moments and replied, ‘Brother John Young, the Lord led us here and He has not led us here to starve.’ So dark were the circumstances that the hearts of the strongest Elders were faint. Elder John Neff, who was building a mill on Mill Creek, came to Father Smith and said, ‘Father Smith, I have stopped building my mill; there will be no grain to grind and Brother John Young tells me that we shall have to leave here and advises me to stop wasting my money.’ Father Smith replied, ‘Brother Neff, go on with your mill and as far as I have property I will guarantee success; and had I sufficient means I would secure you against any loss. We are not going to be broken up and I entreat you to go ahead with your mill, and if you do so, you shall be blessed and it shall be an endless source of joy and profit to you.’ In a very short time after this the gulls from the Lake made their appearance and devoured the crickets.”

Pratt, in his diary of August 10, 1848, says: “We had to struggle against great difficulties in trying to mature a first crop. We had not only the difficulties and inexperiences incidental to an unknown and untried climate, but also swarms of insects equal to the locusts of Egypt.” Talmage says in his “Story of Mormonism”: “Drought and unseasonable frosts made the first years’ farming experiments but doubtful successes, and in the succeeding spring the land was visited by the devasting plague of the Rocky Mountain crickets. They swarmed in innumerable hordes upon the fields, darkening the sun in flight, destroying the grain as they alighted, devouring all
before them, leaving the land a desert in their tracks."

It should be noted here that Talmage was confused in the identity of the Rocky Mountain cricket which is wingless and does not fly, but there was probably no mistake about the innumerable hordes and the devastating plague which they brought upon Utah pioneers.

In 1849 there were many more people in Utah and a much larger acreage of crops. The crickets were not numerous in the vicinity of Salt Lake City and did not cause the damage and induce the fear and terror of the previous year, but in other places not far distant they were much in evidence. Thomas Bullock notes in his diary: "Ezra Chase said that the land (Ogden's Fort) was very productive in grain. A short distance below, he said, 'It will yield a hundred bushels of crickets to the acre and 50 bushels of mosquitoes.'"

As the years went by and the country became more thickly populated, crickets became less of a problem and pioneer literature makes less mention of them. Occasionally, however, an outbreak did occur and cause new alarm. In its issue of May 2, 1860, The Deseret News voices sentiment once more under the heading of "Crickets," as follows:

"Reports from North, South, and West represent that in some places the crickets are very numerous, and fears are entertained that they will make sad havoc with the crops where they have made their appearance in countless numbers.

"In the vicinity of the upper settlements on Kay's Creek, Davis County, myriads of those destructive creatures are said to have hatched and they have already commenced the work of destruction, and if they do not leave for some other place, as they sometimes do when large enough to travel, the presumption is they will require all the grass and grain in that neighborhood for subsistence and will take it, despite the efforts of the inhabitants to prevent them from doing so."

Fighting the Crickets

The early settlers of Utah were greatly puzzled to know what to do about the crickets. No one had ever seen or heard of them before or of anything else just like them. The terrorizing effect they had on people is summarized by Wells as follows: "The foe was utterly unconquerable as far as human efforts were concerned; there was nothing the heartsick farmers could do but stand idly by and see the labor of the season destroyed. Children gazed with wonder and terror; women looked with eyes full of tears and strong men watched with hearts full of despair."

Those early pioneers were not unresourceful, however, and they soon began to discover effective means of combat. John Young has an interesting word to say about it:

"My brother Franklin and I were trying to save an acre of wheat of father's, growing not far from where the Salt Lake Theatre now stands. The wheat was just beginning to turn yellow. The crickets would climb the stalk, cut off the head, then come down and eat it. To prevent this, my brother and I each took an end of a long rope, stretched is full length, then walked through the grain holding the rope so as to hit the heads, and thus knock the crickets off. From sunrise till sunset we kept at this labor; for as

15In *Journal History*, Latter-day Saint Church Historian's Office, September 2, 1849, Salt Lake City.
darkness came the crickets sought shelter, but with the rising of the sun they commenced their ravages again."

This method of fighting the enemy must have availed little, if anything. About the only result that could be hoped for would be that of wearing the crickets out and discouraging them so they would go elsewhere. Neither of these results was at all probable. The evil day of utter destruction of the crop may have been postponed a little so that if the grain were ripening, the poor farmer might get a little more of it. Talmage says: "The people scarcely knew how to withstand the assault of this new foe; they drove the insects into trenches, there to be drowned or burned; men and women and every child that could swing a stick, were called to the ranks." Bancroft quotes Nebeker in his History of Utah as follows: "Channels were dug and filled with water to prevent their travel, but they would throw themselves across; it was impossible to fight them back." Again, the crickets entirely disappear where fowls and swine are permitted to range."

Interest and cooperation on the part of people in combating the cricket must have been quite unanimous. Thomas Bullock says that "President Brigham Young and many other brethren were busy killing crickets, building fences, etc." Perhaps these fences were cricket fences, which indicate another method of fighting the insect. These methods were as effective at that time as they are at the present time, for even now (1931) there are occasional local outbreaks of these same crickets in outlying districts in Colorado, Utah, Idaho, Montana, and Oregon, and the old pioneer methods of control are often practiced.

Seagulls

Running through the diaries and journals of Utah pioneers there are numerous accounts of the role which the seagull (probably Larus californicus) played in saving the crops from the ravages of the crickets. The following is a good sample:

"The first I knew of the gulls, I heard their sharp cry. Upon looking up I beheld what appeared like a vast flock of pigeons coming from the Northwest. It was about three o'clock in the afternoon ... there must have been thousands of them; their coming was like a great cloud; and when they passed between us and the sun, a shadow covered the field. I could see the gulls settling for more than a mile around us. They were very tame, coming within four or five rods of us.

"At first we thought that they also, were after the wheat and this fact added to our terror; but we soon discovered that they devoured only the crickets. Needless to say, we quit drawing the rope and gave our gentle visitors the possession of the field. As I remember it, the gulls came every morning for about three weeks, when their mission was apparently ended, and they ceased coming. The previous crops were saved."

In order that the reader may be able to properly evaluate the foregoing account, it should be remembered that the account was written from memory some years after the incident occurred and had reference to what happened in June, 1848. The gulls had no doubt discovered the range of the

17In Journal History, Latter-day Saint Church Historian's Office, 1848, Salt Lake City.
18In The Improvement Era, Vol. 4, p. 818.
20In The Frontier Guardsman, Sept. 5, 1849.
21In Journal History, Church Historian's Office, June 8, 1849.
22In Journal History, June 9, 1848. Latter-day Saint Church Historian's Office, Salt Lake City, Utah.
ravaging crickets and came daily for their food until the cricket season was over. When the supply was exhausted they went elsewhere, perhaps, to better feeding grounds.

A note in the same publication (June 6, 1849) states: "The gulls were flying south. They appear to go to the lake to roost at night, and return to the Big Field and neighborhood in the morning to devour the crickets." These gulls were probably in evidence more or less during the entire spring and summer seasons, year after year, just as they are at present and just as they may now be observed any spring and summer in Utah, although, naturally, it was possible that they were observed only in crises. A note now and then in old journals would indicate the belief that the gulls made

Figure 1—Seagull Monument, Temple grounds, Salt Lake City, Utah. Erected to the memory of the gulls for their destruction of the crickets in Utah in early pioneer days.
their singular appearance for the one crisis of 1848 and that they have never been seen before or since. Most of the tilling operations of farmers in springtime within many miles of Great Salt Lake are accompanied at the present time by great flocks of gulls, which are ravenous in their feeding, devouring all kinds of animal life as the farm machinery exposes it to the surface. Insect larvae and small mammals are especially sought. A seagull can gulp down a pocket gopher or a ground squirrel so quickly that an observer wonders where the victim is while he is still watching the operation. The seagull goes on hunting for more just as if he had a food sack somewhere that would never fill. When the second and third crops of alfalfa are being cut anywhere within five or ten miles of the lake shore, it is a common sight, in "a grasshopper year," to see the advancing cutter-bar of the mowing machine stir up a swarm of grasshoppers which soon alight again behind the mowing machine only to be picked up clean by a flock of close-following gulls.

The role of the seagull in Utah's pioneer history, or indeed in passing events of the present day, is interesting and important. No matter how one may look at this role now, the early settler looked upon the coming of the gulls as a divine miracle.

**Crickets as Food**

John Young says:

“They (the Indians) kept on hand baskets made purposely to put in the creeks to catch the loathsome insects as they floated down the streams, and they caught them by the tons, sun-dried them, then roasted them and made them into a silage that would keep for months. Their skill in this convinces me that the coming of the crickets had been continuous for ages.”

One is left to draw his own conclusions as to what the Indians did with this silage that would keep for months, but the inference is not entirely obscure. John Young's statement about crickets floating down the streams of water is confirmed by a similar statement of Cyrus Thomas (page 14). In describing the food of native tribes in Salt Lake Valley, Stansbury says: “Lizards and crickets also formed a portion of their food.”

In an address delivered in the Salt Lake Tabernacle, on July 25, 1880, Erastus Snow said:

“The savages had learned in their destitution to profit by these visitations (crickets and grasshoppers), for when the insects would devour all the green things, they would turn in and devour the insects. And on this ground, on this city plot, the first company of savages who visited the pioneer camp, after the exchange of salutations, retired to prepare their evening repast and they emptied out of their sacks bushels of dried grasshoppers, on which they made their supper. Our people had not learned to do this yet, but had it not been for the providential appearance of the gulls, we would have been brought to the same necessity—to gather up the crickets and salt and dry them to subsist upon.”

S. S. Haldeman, who gave the cricket its scientific name, *Anabrus simplex*, following his technical description of it, said: “This seems to be one of the
species which is eaten by the aborigines of the valley of the Great Salt Lake."\(^2\text{32}\) The Improvement Era for September, 1904, contains an interesting note on crickets as food under the heading, "Feasting on Crickets." The article is as follows:

"An echo of early times is reported from Rush Valley. It appears that millions of black crickets have appeared, coming from Death Canyon and Skull Valley. Near Harker's Canyon the mountains for miles about have been denuded of every vestige of green. The pests are headed towards Vernon. The Indians are gathering them to eat, preserving them for winter use, while the coyotes have stopped killing sheep and are feasting on crickets upon which, like the prairie chicken, they are growing sleek and fat."

**Expert Testimony**

There is a great temptation to lengthen the historical account of the Rocky Mountain cricket in Utah, but to continue would give undue consideration to this phase of the study. Nevertheless, there is one especially interesting account given by a professional entomologist who was here in the state with Hayden in his United States geological survey of the territory in the early seventies. This scholarly entomologist, Cyrus Thomas, then Federal Entomologist, states:

"*Anabrus simplex* Hald.—Found in great abundance between Brigham City, Utah, and Fort Hall, Idaho. Also occasionally met with farther south in Utah and north of Fort Hall to the boundary line of Montana, which is here along the range separating the waters of the Atlantic from the Pacific. At some points we found them so abundant as literally to cover the ground. In two or three instances they all appeared to be moving in one direction, as if impelled by some common motive. I recollect one instance on Port Neuf River, where an army was crossing the road; it was probably as much as two hundred yards in width; I could form no idea as to its length; I only know that as far as I could distinguish objects of this size (being horseback), I could see them marching on. I think that in all the cases where I saw them thus moving, it was toward a stream of water. They appear to be very fond of gathering along the banks and in the vicinity of streams. In the north part of Cache Valley I frequently noticed the ditches and little streams covered with these insects, which having fallen in, were floating down on the surface of the water, and though watching them for hours, they would flow on in an undiminished stream.

"While encamped on a little creek near Franklin, in this valley, it was with difficulty we could keep them out of our bedding; and when we went to breakfast we found the underside and legs of the table and stools covered with them, all the vigilance of the cook being required to keep them out of the victuals.

"But the strangest part of its history is that it will go in pursuit of and catch and eat the Cicada. This latter insect also made its appearance in this valley the past season in immense numbers, covering the grass and sage and other bushes, especially those which formed a fringe along the little stream. Up these the Anabrus would cautiously climb, reach out with its foreleg, and plant its claw in its victim's wing; once the fatal claw secured a hold, the Cicada was doomed, for without ceremony it was at once sacrificed to the voracious appetite of its captor. No uniformity appeared to be preserved in this process; sometimes they would commence with the thorax, at others with the head, not even taking the trouble to remove the legs or wings.

"I noticed in the road, where one of the armies was crossing, a number of large hawks feasting themselves upon the helpless victims. As I returned through Malad Valley (August 20, 1871) the females were depositing their

eggs. They press the ovipositor perpendicularly into the ground almost its entire length.\textsuperscript{27}

The Cricket Now-a-days

The Rocky Mountain cricket is almost a thing of the past as far as the older settlements of Utah are concerned. There are occasional outbreaks, however. The outbreak may occur in some small newly settled or unsettled portion of the state or adjoining states, or it may be a somewhat feeble "comeback" in outlying portions of old settlements touching the hills; the "big, black, loathsome cricket," however, has almost passed into history. More serious outbreaks have recently occurred in Idaho, Montana, Wyoming, Colorado, and Nevada,\textsuperscript{28} but these outbreaks are in the more newly settled or unsettled portions of these states.

CRICKETS AND GRASSHOPPERS DISTINGUISHED

In general, little distinction is made between crickets and grasshoppers. Both crickets and grasshoppers have large, strong, biting jaws. Both have large, strong hind legs adapted for jumping, and both destroy crops in the same way. In these respects they are alike.

Crickets have long slender antennae, or feelers, in many cases exceeding the length of the body. The female has a long sword-shaped ovipositor or egg-laying structure. The body of the cricket is somewhat robust, shorter, and inclined to be slightly flattened.

Grasshoppers have short, less slender antennae much shorter than the body. The female has a short, blunt ovipositor of separate parts, and the body is more elongate and cylindrical.

To the layman these apparently small points of difference may not seem important, but they are in reality as significant in insects as horns and hoofs in cattle and horses; and, as there are other less easily described characters than horns and hoofs which distinguish cattle from horses, so there are others less easily described characters than antennae and ovipositors which distinguish crickets from grasshoppers.

BRIEF HISTORY OF GRASSHOPPERS IN UTAH

Grasshopper Injury

All the havoc wrought by crickets, all the fears they instilled in the souls of the settlers, all the cooperative warfare, and all the fine literary descriptions of the "myriads," the "hordes," the "armies," the "clouds" have been duplicated and perhaps exceeded in nearly all respects in case of grasshoppers. The first attack of grasshoppers in Utah, however, was less pretentious, but they always return and seldom, if ever, miss a year in making an attack on some unprotected line. The old so-called Rocky Mountain locust has disappeared, which has made a tremendous difference. This species probably created more terror and was more spectacular in its peculiar behavior than any other insect of pioneer days. It actually made the cricket

\textsuperscript{27}Hayden, Z. V. Geological Survey of Montana and Adjacent Territories, p. 438. 1872.
a modest creature. While the Rocky Mountain locust has disappeared it has left many substitutes. Crops are now raised in spite of the grasshopper, but the annual loss caused by this insect is still enormous.

**Earliest Grasshopper Outbreaks**

Captain Howard Stansbury began his explorations of the Great Salt Lake Valley in 1849 and continued through 1850. His report to the Federal government was published in 1852. Sometime during the expedition Stansbury collected specimens of a species of grasshopper, which was referred to S. S. Haldeman for study. Following his technical description of the species, Haldeman says:

"This fine large grasshopper is probably the species which has been destructive to vegetation in the valley of the Great Salt Lake. It is nearly as large as the destructive *Oedipoda migratoria* (with which it is congeneric). The last-named species is known under the English name of migratory locust. There are still great swarms of this species of grasshopper found destroying crops in the spring in the north end of Tooele County bordering Great Salt Lake. The Stansbury-Haldeman reference is one of the earliest authentic records of grasshopper destruction in Utah. Another early account is as follows: "The grasshoppers are performing the work of destruction at a fearful rate in some parts of the valley. We are credibly informed that between the Cottonwood Creeks, whole fields of various grains are totally extinct by their operations; that in one ten-acre field, which was very promising, not a green thing is to be seen; also similar news from the Big Field, and various part of the county."

The Deseret News of June 13, 1853, publishes the following editorial under the title "Present Prospects":

"Within the past week grasshoppers have done much damage in Davis County, where some fields had hitherto escaped; and in the city, after eating up young fruit trees and shrubbery, they have barked and killed thousands of apple, peach, pear, and other trees two or three years old, and are now eating the peaches, some of which are as large as pigeons' eggs.

"Between grasshoppers and drought the grass is entirely used up in many places, and distant ranges, which snow under in the winter, will have to be sought for all surplus stock, or it may fare but poorly for feed when the next snows fall."

An appeal follows in which all people are urged to guard all crops from grasshopper attack.

On June 20, 1855, another editorial in The Deseret News presents a serious grasshopper situation. The account, which appeared under the captain, "A Re-enforcement of Grasshoppers," is as follows:

"The farmers in the south part of the county had several days of rejoicing last week, that the inveterate enemy of their crops had disappeared, many of them having sowed their fields for the third time; but on Friday afternoon an innumerable multitude, a cloud of grasshoppers, descended upon their farms, leaving the proprietors to speculate upon the 'Fable of the Fox and the Swallow,' while the more hungry swarm devoured the last remaining patches which had been left by the previous swarms, and devoured the tender blade

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of the third sowing. . . . The fourth sowing has commenced—seed very scarce; some of the farmers are drilling the wheat as seed has failed where sowed broadcast as usual.”

On the 27th day of the same month The News published another grasshopper editorial under the heading “Grasshoppers, etc.”:

“Hon. Calvin C. Pendleton arrived in this city from Iron County on the 24th . . . the grasshoppers have destroyed all the grain at Paragonah, nine-tenths as Parowan; all the wheat at Fort Johnson, and about one-tenth of the grain at Cedar City; the grain at Harmony is uninjured.

" . . . The fields look like a desert and every separate bench appears to be hatching out fresh crops of grasshoppers. . . . A small party has also started to Santa Clara Mission to plant corn. The people of Iron County are in first-rate spirits. The public square at Parowan City (10 acres) has been planted with potatoes in the hope that the united efforts of men, women, and children, chickens, ducks, turkeys, etc., etc., may save a sufficiency to have occasionally a little potato soup next winter. Nine-tenths of the wheat crops are destroyed at Fillmore. Chalk Creek very low, fresh recruits of grasshoppers hatching on the benches. The fields at Nephi City look like the seat of desolation.”

Grasshopper “Wars”

The first grasshopper “war” in Utah occurred in 1855. It was fortunate for the settlers that both crickets and grasshoppers did not bear down on them at the same time. Had the grasshopper war of 1855 occurred at the same time as the cricket war of 1848 or even the year after, there would probably have been little or nothing left for the settlers. It is fortunate in all lands that the world’s calamities are spread out along the years. The cricket war was most dreadful in 1848 and eased off in 1849 and 1850. The grasshopper war of 1855 had only small echoes in 1856, but another big grasshopper war occurred in 1867. This one was carried into 1868, and in some places there were severe attacks in 1871. In the early days, this enemy was so numerous and the people and fields so few that resistance to the enemy was simply out of the question. The grasshoppers overwhelmed the farmers and took all they had. People turned out en masse with brush whips to frighten the insects away. By this means small patches were protected. The fields are fast becoming more numerous and the grasshoppers less numerous. More definite methods of control have been worked out. One individual alone can now poison and destroy grasshoppers on an acreage that would have seemed immense some seventy-five years ago.

Popular literature on grasshoppers in Utah is abundant and significant. There is enough early literature to indicate that grasshoppers were a major thought in Utah in the old days. This importance merits more attention than can be given. The Deseret News of July 7, 1858, carried the following article, which further indicates the importance of the grasshopper in the early history of Utah and other states:

“The vast swarms of grasshoppers which have been devastating the prairies of Texas steered a northeast course upon their departure thence, and as they rose to a great height from the ground, as though for long journey it is a melancholy conclusion that they are coming up this way. Myriads of them are now eating up vegetation in Ohio. It is, therefore, no very violent supposition that Pennsylvania with a rather milder climate than Iowa is not unlikely to be visited by them. These insects are not like the common grasshopper which are every summer found in our fields and
roads, but are of the size of a locust, with the same gregarious habits. The ordinary grasshopper is weak of wing and never rises to a great height, whereas the legions which have so repeatedly desolated Utah and Texas, rise far into the upper air, and move off together to great distances like wild geese. They appear in innumerable hosts, and instead of scattering, alight in a body upon some devoted locality which they attack and destroy with the systematic movement of an army. They will thus eat up a crop of corn or cotton in a very short time.

"In Utah this plague visited the growing cereals with utter destruction as often as three times in one season, so that the afflicted Mormons were reduced to extremities for food. They seem now to have attacked our frontier states, and to be moving gradually into the body of the republic. The horrors of famine have never been felt in our country, and accustomed to the most prolific abundance, it is a calamity to which no one has ever looked, yet these grasshoppers are a terrible visitation to a region."

It may be well to note here that The Deseret News calls attention to the distinction between a grasshopper and a locust. The difference pointed out by The News hardly fits the case. In fact, the terms "grasshopper" and "locust" are interchangeably used and either is considered in good use for the same insects. With certain species it has become customary to use the term locust and with certain others the term grasshopper, but there is little, if any, ground for an attempt to disentangle the two.

The Rocky Mountain Locust

Of all known damaging species of grasshoppers in Utah, the Rocky Mountain locust was the most menacing. This species occurred in immense numbers; it was gregarious and migratory in habit and could fly hundreds of miles with apparent ease. It was this species which formed in clouds and darkened the sun, migrating in countless billions to the states of the Mississippi Valley and causing utter destruction of the crops. As settlements sprang up in other western states the grasshopper problem became more and more serious.

"The injury by the Rocky Mountain locust to the agriculture, and, as a consequence, to the general welfare of the States and Territories west of the Mississippi, had been so great during the years 1873, 1874, 1875, and 1876, as to create a very general feeling among the people that steps should be taken by Congress looking to a mitigation of an evil which had assumed national importance. This feeling found expression, during the year last mentioned, in various memorials to Congress, one of the most important and cogent of which was that from a conference of the governors of various Western States and Territories, held at Omaha, Nebraska, on the 25th and 26th of October, 1876. This memorial prayed for the creation of a commission of five experts to thoroughly investigate the subject, and an appropriation of $25,000.

"The United States Entomological Commission was created in pursuance of an act of Congress appropriating $18,000 to pay the expenses of three skilled entomologists to be attached to Dr. F. V. Hayden's United States Geological and Geographical Survey of the Territories, and to report upon Rocky Mountain locusts, with a special view as to the best practicable method of preventing the injuries from these insects and of guarding against their invasions. The Secretary of the Interior appointed Mr. Charles V. Riley, of Saint Louis, Missouri, as chief, Mr. Cyrus Thomas, of Carbondale, Illinois, as disbursing agent, and Mr. A. S. Packard, Jr., of Salem, Massachusetts, as secretary. Upon receiving their appointments, the Commissioners at once met in Washington for the purpose of organization. . . ."

Expert Testimony

The entomologists named on this commission proceeded at once to their tasks, came out to the "Far West" immediately, and began their studies. When the commission reached Utah they made every effort possible to get a history of the locust in this state by interviewing prominent and reliable persons who had observed the actual conditions. A summary of their finding is included for their historic value:

"Utah was for the first time, so far as known, visited in 1851, as we were informed by Brigham Young, late president of the Latter-Day Saints. Ogden was also visited the same year and much damage was done. (F. A. Brown.)

"1852—Locusts were observed on the plains of Northern Utah and Southern Idaho about the first of August, 1852, by Mr. W. N. Byers. No information, however, has been obtained by settlers in Utah relative to the movements of the locusts this year.

"1853—Mr. A. L. Siler, of Ranch, Kane County, says that locusts flew into the Salt Lake region in this year, coming from the east, in July.

"1855—Locusts were more wide-spread and destructive this year than any other, perhaps, excepting the year 1867. Reports of their devastations have been received from residents of Plain City, Weber County, which afterward enjoyed a respite for twelve consecutive years, i.e., until 1867. Salt Lake City and Nephi were also afflicted by them. They also appeared in Spanish Fork City and at Beaver, in southern Utah; they came in August, 1855, and destroyed nearly the entire crop; but the crops were good in 1856. Payson was visited in 1855, and damage was done by locusts in 1866. It is evident that northern and central Utah were overrun by them this year. 'After the crops were destroyed, there was not time to get grain from any quarter. The people had to husband their supply to keep the wolf from the door until another harvest; a great many living upon roots, greens, and in fact anything that would sustain life. The harvest of 1856 furnished plenty; the grasshopper war was over.' (Salt Lake Herald.)

"1856—Ogden suffered this year and for each successive year until and including 1870 (John I. Hart); also Salt Lake City and Payson. It thus appears that northern Utah, i.e., from Ogden to Idaho (Cache and Malad Valleys) has suffered for sixteen years in succession, from 1854 until 1870, but in Central and Southern Utah, i.e., south of Salt Lake City and vicinity, there are no reports of destructive locusts during the years 1857-1863.

"1857—The locusts 'ate everything green in Salt Lake Valley.' (Iowa Homestead.)

"1863—No reports of destructive locusts south of Ogden; at this time they were noticed each year from 1863 until 1870.

"1864—Swarms of locusts visited Salt Lake City and vicinity, and Ogden.

"1865—Swarms appeared at Beaver, in southern Utah, in the autumn.

"1866—Beaver was again visited by swarms, which laid eggs, and their young appeared in 1867, and locusts abounded in the years 1867, 1868, 1869, 1870, and 1871, small crops being raised. Payson was visited in 1866, and suffered for five successive years, i.e., until 1871. Logan and Smithfield, Cache County, suffered this year more perhaps than other settlements outside of Cache County.

"1867—This was, like 1855 and 1860, one of the worst locust years in Utah. The trouble extended from Cache County, where half the grain was devoured, to Salt Lake and in the desert county of Juab at Nephi, as well as south to the town of Beaver. At Saint John's, Tooele County, great swarms came late in the summer, large numbers hatched in 1868, and swarms appeared in 1869, and many young appeared in the spring of 1870; this year being the most calamitous. At this settlement some farmers did not raise a crop for seven successive years. 'These locusts arrived in the northern part of this Territory the summer before last and deposited their eggs. These generated the following spring, and immigrated to this city and surroundings last autumn; they deposited their eggs here, and this last
spring they hatched out in numbers beyond calculation.' (California Farmer, August 20, 1868.) Their progeny was destructive about Salt Lake City in 1868.

"1868—Besides the points already noticed, locusts arrived at Heber, Wasatch County, in a swarm 'like a cloud.' They were also destructive at Salt Lake City and vicinity, and at Croydon.

"1869—Cache County, and Salt Lake City, Croydon, Morgan County, as well as the other settlements previously mentioned, were visited this year.

"1870—This was a calamitous year in Cache, Weber, and Wasatch Counties, i.e., in northern Utah; Ogden, Weber, and Plain City, being visited by them. Professor Thomas states that locusts abounded in the Territory in 1870 and for three years previous. In this year locusts apparently prevailed throughout the entire extent of the Territory.

"1871—After abounding in Northern Utah the locusts may usually be expected the following year in Central and sometimes in Southern Utah. Southern Utah was infested by them more this year than any other known. They were observed in Kanab and Hebron, Washington County. At Silver Reef but few eggs were deposited, but they did much damage to orchards, vineyards, and gardens. At Paragonah locusts laid eggs in abundance in 1871 and in 1872; one-half the crops were destroyed by their progeny. (Dr. E. Palmer). Locusts also abounded, according to Professor Thomas, in the northern parts of the Salt Lake Basin, particularly in Box Elder Canyon and Cache Valley. Salt Lake Basin, early in August, he found to be 'swarming with myriads of these grasshoppers, and even after we had passed eastward on the railroad to the heights near Aspen Station, I noticed the air filled with their snowy wings, but could not tell exactly the course they were taking, but thought they were moving southwest.'

"1872—We have no information from unpublished sources that the locust did any damage this year, but swarms are reported in a Utah paper as leaving the Territory in August and September, 1872.

"In 1873 and 1874 there were no locusts observed in Utah. In July, 1875, a few indigenous locusts (Caloptenus spretus) were observed by the writer at Lake Point, Salt Lake. None were observed by Mr. J. D. Putnam at Spring Lake Villa, about 70 miles south of Salt Lake City. Mr. Alexander Stalker, of Franklin, Idaho, informed us that the locusts flew into Malad Valley in 1875.

"1876—Swarms of locust, early in October, settled down at Logan and Smithfield, Cache County, Croydon, Morgan County, and at Salt Lake City, extending at least three miles south of the city.

"1877—The young hatching from eggs laid the previous autumn did some injury to fields at Farmington; several fields of wheat were injured at Saint John. Much damage was done in Cache and Malad Valleys. If the wet weather had not destroyed a large percentage of the young, especially in Morgan, Davis, and Salt Lake Counties, as well as Cache and Malad Valleys, serious damage would have resulted, showing that the invasion was a formidable one in 1876.

"We find, in conclusion, that while Southern and Central Utah are more or less exempt from locust invasions, Malad and Cache Valleys and Weber County have been infested fourteen out of the past nineteen years."

MORPHOLOGY OF THE GRASSHOPPER

For further information on the history of grasshoppers and crickets as they affect the state of Utah, reference is made to the early pioneer newspapers and to the reports of the United States Entomological Commission published first in 1878 and for several succeeding years.

Before taking up individual descriptions of the pioneer grasshoppers, locusts, and crickets, it is necessary to enter into a brief and simple con-
sideration of the general structure of these insects. Only the most familiar characters are referred to and to no more of these than is absolutely essential to an understanding of the descriptions themselves.

A glance at Figure 2 quickly reveals the fact that the body of the locust has three regions: Head, thorax, and abdomen. On the upper margin of the head are the large compound eyes, one on each side; the antennae, feelers or horns, extend out from in front of the eyes. These antennae are not fixed structures like the horns of a cow but are flexible and may be readily extended by the locust in any direction. The mouth is underneath. opens sidewise, and has attached to it two pairs of smaller horns, or feelers, more properly called palps, used for smell, taste, or touch. The thorax is that portion of the body to which the two pairs of wings and the three pairs
of legs are attached. That portion of the thorax just behind the head, to which the front pair of legs is attached, is the prothorax. Each leg consists of a small basilar joint, a much larger femur or upper leg, a long tibia or lower leg, and the foot which has three joints. The upper or front wings are usually long, narrow, and tough; usually they are not used for flying but rather for protecting the broad hind wings which fold like a fan when not in use. In a few species the wings are rudimentary and in some they are absent. The abdomen is elongate, ringed, worm-like, and flexible. Females have four short, heavy prongs which constitute the ovipositor on the tip of the abdomen for digging holes in the hard ground where they lay their eggs. The tip of the abdomen of the male is blunt and lacks the horns for digging; by this character the sexes are easily distinguished. Females, too, are nearly always conspicuously larger than males and often show differences in color, structure, and behavior.

Crickets are similar to grasshoppers in their general form; therefore, all structures described above for the latter above may readily be distinguished in the cricket.

SOME PIONEER SPECIES

Two-striped Mermiria

This grasshopper is widely distributed throughout the United States. It is known to entomologists as Mermiria bivittata (Serv.), having been given this technical name by Serville, a French scientist, to whom specimens were sent from this country. His description appears in his work entitled "Historie Naturelle des Insects," published in Paris in 1839. This grasshopper was overlooked by the earliest students of insects in this state and
the layman probably was not struck by its peculiar appearance; therefore, it was not identified as being in Utah until a late date, although, with other kinds of grasshoppers, it has no doubt been carrying on its destructive work in many of our fields since the early days of Utah's development.

**Figure 5**—Two-striped Mermiria, *Mermiria bivittata* (Serville)

This creature is yellowish-gray or grayish-yellow in color, the body being more yellowish and the upper wings more grayish. A distinct blackish stripe begins just behind each compound eye, runs backward on the body, and fades out on the upper wing. It is from these two stripes or ribbons (*vittae*) that the insect gets its name. There are no other conspicuous markings except that the long hind tibiae or often pinkish or even a little more inclined to red. The head is cone-shaped and from the side resembles a dunce cap. The antennae are conspicuous and inclined to be much flattened in the basal half. The hind legs are exceedingly long, stilt-like, and awkward when it comes to walking but extremely useful in making a long jump. The females are often nearly 2 inches in length, not including the antennae and the long hind legs which when stretched out give the creature a length of nearly 3.5 inches. The males are decidedly smaller. These insects are never found in the more desert places in our state but exist plentifully in many irrigated fields. They feed on rank vegetation of various kinds but seem to be particularly fond of grain, corn, and alfalfa (Figure 5).

**Elliott Locust**

This locust is known to science by the technical name *Aulocari elliotti* Thos. It was first definitely observed by Professor Cyrus Thomas, United States Entomologist, in Colorado and Wyoming in 1870 and was named by him for Henry W. Elliott who was artist of the same government expedition. This locust has long been known to be an enemy to agriculture in Utah and other western states.

Its general color is dusky gray, generally with many tiny spots of darker color suggesting grains of black pepper, especially over the upper wings. The body of the female, which is quite robust, is about 1 inch in length; that of the male is smaller and more slender. The head is large and bulging, especially in the back. The femur of the hind leg is extremely strong, suggesting enormous jumping power. The wings are clear and not large for

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3 Proceedings Academy of Natural Sciences of Philadelphia, p. 82. 1870.
the size of the locust so that it is not a powerful flyer. Three blackish spots on the femur are inconspicuous in some specimens but much marked in many others, especially on the inner surface. Often there is a whitish band or stripe running down the back. The tibiae are heavily spined and blackish-blue in color. This species, which is numerous in the state, is widely distributed in dry-land sections and at times is destructive to cereal and alfalfa crops as well as to range grasses. A female is shown in Figure 6 and a male in Figure 7. (Note the tip of the abdomen which shows an important structural difference between the sexes.)

Chorthippus curtipennis (Harris)

This species exists in Utah pasture lands in great numbers; in fact, it has a wide and continuous range over the Northern United States and Canada. No one has ever ventured to give it a common name. Thaddeus W. Harris, one of our earliest American entomologists, discovered this insect a century ago in various North Atlantic states, and on account of the half-developed wings, gave it this classical name in 1835. The species was later discovered to range west of the Alleghany Mountains and still later through the upper valley of the Mississippi; as settlements and entomologists came farther West, this species was found along the way and proved to be one of Utah's most troublesome enemies.

This insect is about the size and color of a Rocky Mountain locust, or the "red-legged" or the "Atlantic locust," discussed later. To any one not ac-

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customed to note the technical differences between grasshoppers this species is easily confused with the others. It is probable that in early days when grasshoppers were destructive in Utah this species was often incorrectly called the Rocky Mountain locust.

Although it is much like the \textit{Melanoplus} in size and color, it is much more like the two-striped \textit{Mermiria} to which it is quite closely related. It is greenish-brown in color with a broad gray band running lengthwise on the back. This band widens on the head and narrows behind the head, then widens again on the tip of the pronotum and narrows down on the wings, which barely reach the tip of the abdomen in males and only half reach the tip in females. A small narrow patch of black usually borders each side of the broad gray band in the region of the pronotum. The head is cone-shaped when viewed from the side, but the point of the "cone" is much more blunt than in the two-striped \textit{Mermiria}. Figure 8 shows a female of this species from the back.

\textbf{Pellucid Locust}

This grasshopper was first identified and described in 1862 by Scudder of Boston.\textsuperscript{6} He reported it in Maine, Vermont, Massachusetts, and Connec-

\textsuperscript{6}In \textit{Journal}, Boston Society of Natural History, Vol. 7, p. 472.
ticut. Since 1862 it has been discovered by various entomologists in nearly every state in the United States as well as in Canada and Old Mexico. It was first identified in Utah in 1893 by Bruner, Federal Entomologist at that time. There is no doubt that it has been a serious menace to crops in this state from the earliest days of settlement; it was not distinguished from other species which it closely resembles. It is believed that this grasshopper is the most numerous and most destructive of grasshoppers in Utah. It is known in some places by the common name of "warrior," perhaps because of its migratory tendencies. It is not a desert species but rather prefers more luxuriant vegetation. It is abundant in fields and pastures and in the more grassy areas of canyons and hills. It is often destructive to range forage.

![Figure 9—Pellucid locust—female](image)

The insect is brownish-gray, varying from yellowish-brown in color with conspicuous dark spots or "blotches" over the body and the upper wings. Two conspicuous light stripes run backward from the points of the "shoulders" and merge in a single stripe that runs to the tip of the wings. Females are about 1.25 inches in length and somewhat robust; the males are smaller. The underwings are clear or pellucid, from which characteristic the grasshopper gets its name. A female is shown in Figure 9.

**Haldeman's Locust**

This species of locust, or grasshopper, was first observed in Utah. It was taken in the collection made by Captain Howard Stansbury during his exploration and survey of the valley of the Great Salt Lake in Utah. As already stated, the Stansbury collection of insects made in Utah was turned over for study to S. S. Haldeman of Washington, D. C. Professor Haldeman gave this grasshopper the technical name of *Hippiscus corallipes* and expressed the probability that it represented the species which had done such notorious damage to crops in Utah. It is apparent now that Professor Haldeman was wrong in his supposition, although the locust he described no doubt caused considerable damage, as is still the case; but this locust is not the chief culprit. Although it was first observed in Utah, it has since been found in ten western states surrounding Utah.

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Females are large, robust, and clumsy. Some specimens measure 2 inches in body length and 0.5 inch in width. The males are somewhat smaller. They are dark gray in color with large conspicuous blackish spots covering the forewings. A whitish stripe runs backward from each compound eye along the edge of the back, the two stripes approaching each other behind the head, separating again on the thorax and then converging to form a single stripe behind. The wings exceed the abdomen when resting. When the hind wings are unfolded they are a brilliant yellow color in some specimens and a brilliant red in others. The legs are often yellowish in color but in most specimens are a deep coral red, from which the species received its technical name, *corallipes*. Figure 10 portrays a female.

(Dissosteira sparcata* Saus.

Probably no one has ever proposed a common name or even a nickname for this grasshopper. The technical name given was proposed for the species in 1884 by Saussure, a French entomologist. His specimens were collected in California. Later discoveries showed the species to exist in Nevada and in Idaho; in 1906, Rehn and Hebard of the Academy of Natural Sciences of Philadelphia collected it in Utah. This is the first notice of its being in this state.

The body of the female is about 1.5 inches long and inclined to be slender; males are smaller. They are gray or yellowish-gray in color, generally with many conspicuous blackish spots over the body and upper-wings. The underwings are clear, almost transparent, with an obscure marginal band of black. These insects are powerful and rapid fliers and when at rest on the ground are not easily approached. Because of this they are difficult to capture.

This species is not numerous in Utah and is not as serious a pest as some others; however, in a few localities it often is highly destructive. It is numerous in the dry-farm fields over the west side of Cache Valley and ranges down through the foothill farms along the Wasatch Range from Box Elder to Utah County. Its nearest relative in Utah is the large black-winged Carolina locust which probably the most conspicuous and best known of all grasshoppers.

Shoshone Grasshopper

The Shoshone grasshopper was discovered and identified in 1873 by Cyrus Thomas, Federal Entomologist. It was first observed in Arizona, but later observations revealed the fact that it was also well known in Utah.

It is a large species, ranking among the giant grasshoppers of America. Females have bodies easily 2 inches long; the wings at rest project nearly 0.5 inch beyond the tip of the abdomen, giving the body a longer appearance. As usual, males are smaller. They are clear, foliage green in color so that they are well hidden in the rank vegetation where they are generally found. One might easily mistake them to be large katydids. The only conspicuous mark varying from the uniform green is a light longitudinal stripe running down the back from the center of the head almost to the tip of the wings. In some cases this stripe is absent. The lower legs, or the tibiae, are coral red.

This is not a desert species and it is rarely found in damp, grassy pastures. It inhabits the low shrubbery and herbage of the more productive foothills and seems to find its paradise in corn fields, sweet clover, alfalfa, and irrigated grain fields (Figure 11).

Rocky Mountain Locust

Under this heading will be discussed three species which entomologists have technically named *Melanoplus femur-rubrum* (DeGeer), *Melanoplus spretus* Thomas, and *Melanoplus atlantis* Riley. These three supposed species have never been satisfactorily distinguished one from another. If the females of these three are independently described, as indeed they have been, a careful examination of these descriptions reveals the fact that they are all alike; the males, however, show a slight variation in the descriptions given. *M. femur-rubrum*, commonly known as the red-legged locust, has a single blunt tubercle on the tip of the abdomen and the tibiae are always red. The tibiae of *M. spretus* and *M. atlantis* are often red and often bluish; on the tip of the abdomen there is a blunt two-pointed tubercle. The only specimens of *M. spretus* which seem to have an actual existence are now in the collections of the United States National Museum at Washington, the Academy of Natural Science at Philadelphia, Cornell University at Ithaca, New York, and possibly in one or two other museums. These are remnants of the Rocky Mountain locust. Careful examination of these specimens

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Figure 11—Shoshone grasshopper, *Schistocerca shoshone* (Thomas)—female

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41*Proceedings, Academy Natural Sciences, Philadelphia, p. 295. 1873.*
shows that they cannot be distinguished from \textit{M. atlantis} except that they are considerably larger. They were apparently collected in the Middlewest after a migratory flight of several hundred miles. After such a long flight it is possible that they could have become somewhat permanently "ballooned," so that it is not safe to consider these few specimens as distinct with only a few degrees in size to their credit. With hundreds of specimens of these supposed three species which to outward appearance are all alike, the trained entomologist is often unable to distinguish them.

\textbf{Figure 12—Atlantic locust, \textit{Melanoplus atlantis} (Riley)—male}

If these three supposed species are distinct, the first one to be identified and described was \textit{Melanoplus femur-rubrum}, named in 1773 by DeGeer, a French entomologist.\textsuperscript{42} \textit{Melanoplus} signifies a black armour and \textit{femur-rubrum}, red legs. The second to receive expert attention was \textit{Melanoplus spreatus}, named by Cyrus Thomas.\textsuperscript{43} This name was probably given because this locust was a haunting spirit to the settlers whose crops it destroyed. The third locust was named \textit{Melanoplus atlantis} by C. V. Riley in 1875.\textsuperscript{44} It is said that Dr. Riley intended the name to be \textit{atlantis} which could signify the Atlantic locust, then known to be numerous in all the Atlantic states; however, he inadvertently omitted the letter "t," his omission giving the locust a rather peculiar name.

\textsuperscript{42}In Memoires pour Servir a l'Historie des Insects, Vol. 3, p. 498.
\textsuperscript{43}Transactions Illinois State Agricultural Society, Vol. 5, p. 450.
\textsuperscript{44}Annual Report, Insects of Missouri, p. 169. 1875.
These three forms, distinct species or not, are widely and continuously distributed over nearly the whole of North America. They are unquestionably more numerous and more destructive than any other grasshopper. They live in the lowlands and in the highlands; they seem to have no concern as to altitude and not much concern as to humidity, moisture, or temperature. Scudder mentions the collection of *M. spretus* at an elevation of 13,000 feet. As long as vegetation can thrive, these grasshoppers seem to thrive also. They devour all kinds of crops—fruit, vegetables, and cereals—and are considered the enemies of all farmers.

These grasshoppers are below average in size, their bodies seldom reaching more than 1 inch in length. They are dark gray in color, or slightly yellowish from the underside. They have few markings except for a variable blackish blotch on each side of the thorax. The wings at rest reach a little beyond the tip of the abdomen; when expanded the wings are clear and transparent. Apparently the powers of flight are limited rather than extensive. Figure 12 portrays the male *Melanoplus atlanis* and Figure 13 the male *Melanoplus femur-rubrum*.

What has become of the old-time Rocky Mountain locust causing clouds in the sky several miles wide, 10 or 12 miles long, and thick enough to hide the sun? It is probably extant, if it were possible to solve the confusion associated with it. The numbers have probably been reduced, because the settlers first took possession of the open, clear, grassy pastureland of the Rocky Mountain states, plowed it, tilled it, and thus more or less destroyed its breeding grounds. There are still frequent neglected patches, roadsides, and other places similar to the old breeding grounds and it is here that the locust breeds. As the western states become more thickly populated and as cultivation becomes more extensive and continuous, the grasshopper will be brought still more under control.

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Packard Locust

This locust was given its technical name, *Melanoplus packardi*ii, by Scudder in 1878 and was named presumably for A. S. Packard, well-known American entomologist, who also was the first to collect and identify it as being in Utah. It is typically Western American, having been found in nearly all states west of the Missouri River and ranging into Canada. It is neither desert- nor mountain-loving but is numerous in Utah, especially in cultivated fields.

![Figure 14 - Packard locust, *Melanoplus packardi*ii (Scudder) - male](image)

The species is large for *Melanoplus*, this particular group being small for grasshoppers. Females are 1.5 inches long and inclined to be robust with heavy legs, making them good jumpers. They are yellowish-brown in color, more yellowish beneath and more brownish or grayish above. The head and pronotum are conspicuously marked with a broad band of brown which begins between the compound eyes and runs back to the tip of the pronotum. This median band is bordered by a light, narrower band of nearly the same extent on each side; each of these bands is bordered by a brown band on the side of the pronotum. There are three dark spots on each femur and the tibiae are generally red, although in some specimens they are bluish. The wings are clear, transparent, and a little small for the size of the insects; consequently, they are especially good flyers. A male is shown in Figure 14.

Two-Lined Locust

This locust is not only a pioneer for Utah but is known to be an early settler for America in general, except that it does not seem to occur along the Atlantic seaboard. It was given the technical name of *Melanoplus bivitatus* by Say in 1825. Except for the pellucid locust, it is probably Utah's

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48 In Journal Academy Natural Sciences, Philadelphia, Vol. 4, p. 308.
most destructive grasshopper. One might almost say that this insect is
domesticated because of the range on the farms and in fields where the most
edible kinds of vegetation are found.

This species is often confused with the Packard locust to which there
is a striking resemblance, although the two are distinct. The two-lined
locust is large, the females having a body length which reaches 2 inches. It
is yellowish-brown in color without conspicuous markings except for a long
whitish stripe which runs backward from each compound eye along the edge
of the back, the two lines diverging slightly to the tip of the pronotum and
then converging to meet about halfway down the wings and extending
as a single line to the tip of the wings. The wings are not large for
the size of the locust, which is consequently not an especially good flyer.
There are two stripes on the Packard locust, but they do not extend
to the wings. The pellucid locust has two stripes also which may cause a
confusion between it and small specimens of the two-lined locust; however,
the two stripes of the pellucid locust are limited to the wings and do not
extend to the pronotum and head. No illustration is given here of the two-
lined locust since it resembles the Packard locust so closely that even a
picture might not disclose the difference.

Western Meadow Grasshopper

The meadow grasshopper in the eastern states is a different species from
that which is found in Utah; accordingly, the name applied to this species
is the western meadow grasshopper. This species was first discovered by
Morse in 1891 and was described by him from specimens collected in Cali-
ifornia, Oregon, and Washington. It has long been known by the Utah
meadow farmer, although he apparently did not realize that it differed
particularly from any other grasshopper. Morse gives it the classic name
of Conocephalus vicinus.

This grasshopper is green in color like the meadow or sedge grass which
it commonly frequents. Its color is an almost perfect protection to it from
enemies which would otherwise prey upon it. Its structures are on the
long-line order so that its shape makes it especially adaptable to its grassy
house which seldom discloses its presence even though it exists in exceed-

CRICKETS AND GRASSHOPPERS IN UTAH

ingly great numbers. It is nearly 1 inch long, the females easily reaching this length. The body of the female is further prolonged 0.5 inch by a long sword-shaped ovipositor or egg-laying instrument common to all female crickets. A brown band extends backward from between the compound eyes to the tip of the pronotum. This band is narrow in front but widens as it extends backward.

The hind legs are long and slender, and the antennae, or feelers, are exceedingly long and hair-like, in many cases 1.5 inches in length, therefore much exceeding the length of the body. When at rest, the wings reach to the end of the abdomen, but they are delicate and are not commonly used for flight. This grasshopper makes little attempt at flying but makes long quick jumps or "dives" into the tall grass when disturbed and loses itself more effectively. A curious adaptation exists in the upper wings of the male. At the base of each of these wings there is a peculiar roughened area or sounding box; the two are rapidly and skillfully rasped together by the males to produce a loud, shrill "song."

The western meadow grasshoppers are often so numerous in the meadow-lands of Utah as to make the grass look stripped and shredded. Because of there being so much moisture where these insects exist, control measures are not highly important. A female is shown in Figure 15.

**Western or Mormon Cricket**

Though first discovered in Utah, the western cricket, named by Haldeman, *Anabrus simplex*, has since been found to exist in all surrounding states. It is a creature of the desert hills of the Great Basin with Utah as a center. Although the name "cricket" has been inseparably fastened to this insect, it does not belong strictly in the cricket family. It is more closely related to the katydids than to the crickets. "Western cricket" is by far the earliest common name applied to the species, but it is more recently becoming known as the "Mormon cricket," probably because it was the Mormon people who were first to acquire such bitter acquaintance with it.

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*Figure 16—Western or Mormon cricket, *Anabrus simplex* Haldeman—female*

The western cricket is large and robust, about 1.25 inches in length and nearly 0.5 inch thick. Males and females are about the same size. They are black or blackish in color with no conspicuous markings. The legs are large and somewhat clumsy, the jumping legs are especially long but apparently do not possess the ability of making good jumpers; their hops are rather limited. Neither males nor females have wings, but small vestiges of wings can be seen beneath the tip of the pronotum. The antennae are long and filamentous. Females possess a long sword-shaped ovipositor which extends backward from the tip of the abdomen. Figure 16 shows a female from the left side and Figure 17 a male from the back.

Sand Cricket

This insect can hardly be classified as a grasshopper because it neither hops nor lives in the grass. Neither can it be classified as a cricket because it lacks certain points of form demanded by the student of classification. It is almost certain that it did not cause appreciable injury to the pioneers of Utah. It is listed merely because it is a close relative of both grasshoppers and crickets and because it is often found in vegetable gardens where it causes some concern, being mistaken for a scorpion or a poisonous spider, neither of which it resembles. This species was discovered in this
state by Cyrus Thomas. It is yellowish and black in color, nearly 1.5 inches in body length, robust and awkward in appearance, and without any vestige of wings. It is nocturnal in habit, which accounts for the fact that it is not frequently seen. It is also subterranean in its habits in Utah and is often brought to the surface of the ground in the garden when digging for potatoes, which it sometimes feeds upon but damages only slightly (Figure 18).

Cave or Camel Cricket

This insect is easily recognized as a cricket or grasshopper of some kind because of its enormously developed hind legs and its ability to make long, quick jumps. It is brownish in color, without wings, has long quick-moving

Figure 19—The cave or camel cricket

antennae; its back is always strongly bowed up, suggesting its name. It is seen only at night, or in dark cellars or in damp basements. It is mentioned here not as an enemy but as a grasshopper which is probably harmless or even beneficial, since it generally feeds upon decaying vegetation (Figure 19).

Snowy Tree Cricket

This species is numerous in Utah and does considerable damage to small twigs of trees and bushes of many kinds by boring the twigs with numerous small punctures in which females lay their eggs. The insects are decidedly cricket-like in general form, their color being light green when full grown but more nearly white in the younger stages. This insect occurs in great numbers throughout the state, in cities as well as in rural communities. In late summer and fall the night air is filled with the constant singing of the males. The most characteristic nocturnal sound out of doors is this loud cry of the males which continues during the night, the great monotone issuing in a continuous series of chirps which slacken only either as daylight approaches or when the temperature falls. Figure 20 shows a female.

![Snowy tree cricket, Oecanthus niveus (DeGeer)](image)

**METHODS OF CONTROL**

It is conceivable that a small outbreak of western crickets may occur again in Utah at times, especially in sparsely settled places; therefore, control measures are highly necessary. No entirely satisfactory methods of control have yet been devised, however. The United States Department of Agriculture, which is working on this problem, has published useful information. The government recommends poisoning the crickets with the following mixture:

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bran</td>
<td>100 lbs.</td>
</tr>
<tr>
<td>Amyl acetate</td>
<td>3 oz.</td>
</tr>
<tr>
<td>Salt</td>
<td>5 lbs.</td>
</tr>
<tr>
<td>Liquid sodium arsenite</td>
<td>8 lbs.</td>
</tr>
<tr>
<td>Water</td>
<td>11 gals.</td>
</tr>
</tbody>
</table>

Probably the most effective method used to date consists in the construction of barriers in the form of trenches or fences, or both, which the insects cannot cross. These trenches should contain water, which makes emergence from the trench practically impossible, once the crickets get into it. Low board fences, a foot or so high, may be constructed across the path of the migrating insects, these fences being mounted with a 3-inch strip of tin or oil cloth to make a barrier over which the enemy cannot make a vertical ascent.

The pioneers of Utah did not attempt to poison the crickets but made ditches containing water; they also constructed fences which proved most effective. It is to be understood, however, that these fences merely turn the insects in some other direction and do not destroy them.

Poisoning the western cricket with bran mixture has never been rewarded with anything more than partial or even doubtful success and the construction of the barriers is costly. It has been found in Montana, where there have been recent outbreaks of the Western cricket, that the insects can be dusted with a contact poison which brings about a wholesale destruction. This contact poison is made by mixing together 1 pound of sodium arsenite and 4 pounds of hydrated lime, or by mixing together 1 pound of calcium arsenite and 3 pounds of hydrated lime. This mixture may be scattered over heavily infested ground by various and well-known kinds of dusting machinery.

The cricket has many natural enemies such as birds and mammals which prey upon it; it is also ravaged by internal parasites and diseases which often nearly destroy the species.

Grasshoppers are a plague to agriculture over the entire world. This fact has made necessary a universal or world-wide fight against them. This world-wide effort has brought into use many devices and many methods, all of which have had much trial. There has been much perfecting of method and much elimination of less effective combat. For Utah, apparently it is best to concentrate on two methods of destruction: One of these is aimed at the destruction of the eggs by cultivation and the other at a destruction of the grasshoppers by poisoning.

It is well-known that all the destructive species of grasshoppers in Utah lay their eggs in neglected, unmolested, or uncultivated ground. The eggs are laid in masses under and close to the surface. Farmers are beginning to realize that neglected ground is a breeding place for weeds which, if allowed to continue, will constantly sow the fields. They must get the same idea about grasshoppers. To drag the roadsides, ditchbanks, dry unused knolls and such places late in the fall with harrows would effectively expose the grasshopper eggs to the severe weather of fall and winter and bring about enormous destruction. This practice need not be general, except when grasshopper injury has been apparent. When grasshopper eggs are laid, they are deposited in masses which are surrounded by a secretion which protects the eggs against the weather. The idea of harrowing is to break up these masses or to tear them loose from beneath the ground. In some cases a single harrowing may do the job. In tough or grassy ground several operations may be necessary. Such cultivation, if well done, is the least expensive and most effective method of fighting grasshoppers.
Grasshoppers may be readily destroyed by feeding them a mixture made of the following ingredients:

- White arsenic or Paris green ............... 1 lb.
- Cheap molasses .......................... 2 qts.
- Wheat bran or alfalfa meal ............... 25 lbs.
- Water .................................... 2-4 gals.
- Amyl acetate ................................ 1 oz.

Sodium arsenite, calcium arsenite, or lead arsenate may be substituted for white arsenic or Paris green, using double the amount. White arsenic is most effective, however, and is usually much cheaper and more easily obtained in this state where it can be had from the smelters at a low rate. Crude beet sugar molasses is easily obtained in Utah and at a figure so low that it scarcely becomes a cost item. It is essential in the mixture for three reasons: (1) It gives the bait an aroma which attracts the insects, (2) it makes the bait more palatable to them so that they eat it more greedily, and (3) it preserves the moisture in the mixture, thus prolonging the aroma-emitting period. Sawdust may be substituted in part (probably 50 per cent) for wheat, bran, or alfalfa meal. This is especially true in places where sawdust is available. The amount of water added varies, the main thought being to use enough to make the mixture good and damp so it can be squeezed into a ball in the hand but not so wet that it will not separate readily when sown broadcast by hand in the field. The mixture must be damp so that the aroma will arise from it to attract the grasshoppers; otherwise, they will not find it. It must not be too wet or it will not scatter well. It has been found that if a small amount of the mixture reaches every square foot of ground, many more grasshoppers are destroyed than if a portion of the mixture only reaches every square yard.

The time of scattering the poison mixture is important. The essential fact is that the grasshoppers do not readily find the mixture unless the aroma from it attracts them, the aroma being too slight unless the mixture is damp; in the arid climate of Utah it soon dries it out. If it is scattered in the heat of the day, drying takes place rapidly and little good is done. It is recommended that the bait be placed out early in the morning; this not only insures a longer period of usefulness but also means that grasshoppers, which do not feed at night and are more voracious when the sun begins warming up a little in the morning, will eat the mixture. Cloudy days somewhat resemble night to grasshoppers at least; therefore, they do not feed to any extent on cloudy days and it would, therefore, be practically useless to scatter poison mixture on such days. The purpose of the amyl acetate is to help the aroma; two or three oranges or lemons may be used as a substitute if the amyl acetate is not available.

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