

and Banff in the Alberta part of the Mountains. This agrees with the findings of Oberholser (1898) who, apparently many years ago, so identified some of the material examined by the writer.

On the evidence of an examination of specimens of migrants, *swainsoni* is the commoner of the two races during migration in southern Alberta and Saskatchewan. However, migrant specimens referable to *incana* have been seen from Old Wives Creek, central southern Saskatchewan where one was taken on May 28, 1895; two from Cypress Lake, May 31 and June 2, 1921; four from Lac la Nonne, Alberta, two of which were collected on May 24, 1926, the others on September 2 and 17, 1926, respectively. A migrant from Elko, British Columbia (May 26) also seems referable to *incana*. Specimens used as a basis for published records of *almae* in other parts of the continent should be re-examined since many will probably prove to be examples of *incana*.

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LAND SNAILS OF THE CYPRESS HILLS AND THEIR SIGNIFICANCE¹

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THE CYPRESS HILLS of southwestern Saskatchewan and adjacent Alberta make up a dissected plateau rising to elevations between four and five thousand feet above sea level. Completely surrounded by the plains, much of which is semi-arid, the hills present a striking biological contrast. Associated with coniferous forests suggestive of the foothills or the northern plains are floras and faunas very different from those of the lower areas nearby. The problems are: have we here a relic of the preglacial biota, and if so, how has it survived; if not of preglacial origin, what are the relationships of

the assemblage, and how has it been able to traverse over 150 miles of now unsuitable habitat. Striking relationships have been found by the botanists and ornithologists, but their conclusions are open to the objection, probably not really valid, that seeds and spores can be blown, and birds can fly. A group that appears to be secure against dismissal on such grounds is that of the land snails. Terrestrial gastropods have no means of dissemination other than their own slow crawl. They are sensitive to environment, and are sufficiently diversified to indicate geographical relationships. With these thoughts in mind I have made, from time to time, small

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collections of land snails from different parts of the Cypress Hills. More recently I have had an opportunity to identify all of this material, and to reach certain conclusions regarding its relationships and origin. Detailed descriptions, with illustrations, have been prepared, and will be published. It is possible, however, that additional collections may be made in the near future, which, while they would not be likely to alter the general picture, would require further time for study. The present paper, therefore, is a report of progress, with the conclusions that appear justified from the results to date. I am indebted to Dr. F. A. Urquhart, Director of the Royal Ontario Museum of Zoology, for the loan of specimens in his collections. The remaining material is preserved in the National Museum of Canada. Dr. J. P. E. Morrison, U.S. National Museum, confirmed the identification of *Vitrina alaskana*.

The following species of land snails were collected by me from the western extremity of the Cypress Hills plateau, known as the Head of the Mountain. This is located in section 8, township 8, range 3, west of the 4th meridian, Alberta. The shells occurred in mould and under logs in light stands of pine. The elevation here is about 4700 feet.

Oreohelix strigosa stantoni Dall

Oreohelix subrudis subrudis (Pfeiffer)

A larger series was later collected in the vicinity of Cypress Hills Park, Saskatchewan, section 20, township 8, range 26, west of the 3rd meridian. Most of the specimens were found under logs in the pine forest, but the majority of the *Oreohelix* shells were taken in the open, following a heavy rain. The elevation here is approximately 4000 feet.

Oreohelix subrudis limitaris (Dawson)

Euconulus fulvus alaskensis (Pilsbry)

Zonitoides arboreus (Say)

Vitrina alaskana Dall

Discus cronkhitei anthonyi (Pilsbry)

Vertigo modesta (Say)

Of the combined list of eight species or subspecies, two are widely distributed in North America, one is characteristic of the eastern regions, one is restricted to the Cypress Hills, and four have their nearest relationships in the Rocky Mountain region.

It is considered unlikely that these mollusks could have survived close proximity to a continental glacier, even if the Cypress Hills plateau was not overrun by the ice. Moreover, in a relict fauna, there should be more elements special to the area, such as *Oreohelix strigosa stantoni*. It is believed that most, if not all, of the land snail fauna entered the Cypress Hills in early post-glacial time.

To explain the preponderant Rocky Mountain aspect of the fauna, the following hypothesis is proposed. The northeasterly withdrawal of the ice front opened a notch-like area between the Rocky Mountains and the Cypress Hills. Into this a flora and fauna spread from the southwest. Because of the climatic conditions, the forms represented were predominantly of alpine type. Further shrinkage of the ice permitted an approach towards the present climatic conditions. The plains became warmer and drier, and the alpine assemblage withdrew to the higher elevations of the Cypress Hills. Meanwhile the present woodlands belt of the more northerly plains became occupied by plants and animals from the southeast, as there was no longer an ice barrier to prevent their spreading from this centre. But to the southwest the development of semi-arid plains produced a barrier against both the introduction of the Rocky Mountain forms into the northern woodlands and the contamination of the Cypress Hills assemblage by woodlands, i.e., eastern, elements.



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