H. Adams), which has as one of its characters a more or less completely developed gill. A new genus of the patelliform Limnæids, *Protancylus*, from the lakes of Celebes differs by the same character from the Palæarctic *Ancylus*. The authors suggest that these facts indicate that these forms retain ancient characters belonging to a time when the fresh-water Pulmonates were less differentiated from the marine Opisthobranchiates than at present. Welcome details are also given of the opercula and radula of various Melanians and *Viviparidæ*. There are a few *Neritinæ*, two *Corbiculæ* and a species of *Batissa*, but one of the curiosities of the Celebes fauna is the absence of Naiades, though the latter occur both east and west of Celebes, in Borneo and Australasia.

WM. H. DALL.

AN INSTANCE OF LOCAL TEMPERATURE CONTROL OF THE DISTRIBUTION OF MAMMALS.

IT is a well-known fact that boreal mammals, such as lemmings (*Synaptomys*), red-backed mice (*Evotomys*) and long-tailed shrews (*Sorex*), are found locally in cool situations far to the south of their normal range. The faunal status of the species is thus in no way altered, however; for the occurrence of an animal beyond its usual geographic limits does not prove that the species can defy the influences of climate.

While every life zone undoubtedly has its outlying islands, perhaps the best-known instances of the phenomenon are the small boreal areas scattered through the transition zone and northern part of the upper austral zone in the eastern United States. Many of the 'boreal islands' are found on mountain tops, where their presence is readily explained by the low temperature of high elevations, but others occur practically at sea level, or at an altitude much below that normally attained by the zone in which they lie. Good descriptions of 'islands' of this kind have been recently published by Mr. Vernon Bailey and Mr. Chas F. Batchelder. Mr. Bailey calls attention to 'Tamarack Swamps as Boreal Islands,'* and mentions the fact that the layer of sphagnum with which these swamps are generally carpeted acts as a cooling agent, partly by protecting the ice which during the winter forms beneath it, and partly by inducing evaporation, by which the air at the surface is continually cooled. He found many 'islands' of this kind in the upper austral zone near Ann Arbor, Michigan. Mr. Batchelder describes the cold rock slides in which the Hudsonian *Microtus chrotorrhinus* occurs in the Canadian zone of the Adirondacks, and the swamps that afford the Canadian *Evotomys gapperi* a congenial home in the transition zone of southern New England.† The so called 'rock vole,' *Microtus chrotorrhinus* was found in Essex County, New York, on "a steep hillside heavily wooded with an old mixed growth. The lower slopes were made up of a talus of large angular blocks of rocks piled one upon another as they had fallen from the cliffs above. The damp rocks were covered with sphagnum and ferns, and from the holes and spaces between them came currents of cold air, indicating the presence of masses of yet [August 29] unmelted ice somewhere in the depths below." Of *Evotomys* in southeastern New England he says: "One may look for it with some confidence in almost any large tract of wet ground that retains its moisture through the summer, but is not subject to serious floods, and which bears a growth of woods sufficiently heavy to afford it dense shade, so that the ground beneath and the roots of the trees are covered with a deep carpet of sphagnum. * *

*SCIENCE, N. S., III., p. 250, February 14, 1896.

†Proc. Boston Soc. Nat. Hist., XXVII., pp, 188 and 192–193, October, 1896.

* * One of the most evident peculiarities of such a spot as this, in southern New England, is that the dense shade and abundant evaporation maintain a temperature during the hottest summer weather that is far below that of the surrounding country. In these aspects of coolness, moisture and shade there is a striking resemblance to the woods *Evotomys gapperi* inhabits in extreme northern New England and other parts of the Canadian zone." These accounts, interesting and suggestive as they are, give no clue to the exactness of correspondence between the temperature of the southern boreal islands and that of the main northern part of the boreal zone. So far as I am aware, no attempt to correlate the two has yet been published.

During the summer of 1897 I had the opportunity to make some approximately exact observations on the relative temperatures of a 'boreal island' and the immediately contiguous upper austral zone in the bottom of Fort Valley, at the north end of Massanutten Mountain, Warren County, Virginia. The locality was so inaccessible —to reach it and return necessitated a drive of nearly twenty miles—that only a small part of the day could be spent in making observations, and my instruments were merely cheap thermometers bought at a country store; but, in spite of these obstacles in the way of completeness and accuracy, the results are sufficiently positive to show how important a field is open for similar work done under favorable conditions and with accurate instruments.

Fort Valley lies between two parallel ranges of low mountains, extending nearly north and south, between the forks of the Shenandoah River. Its eastern side is formed by the abrupt, regular, western slope of Massanutten Mountain. On its western side the slope is less precipitous, and the mountain chain is much broken into separate peaks and irregular ridges. At its point of opening into the broad level Shenandoah Valley, two miles south of the railroad station of Waterlick, Fort Valley is narrowed to a mere pass, scarcely wide enough to allow the exit of a small stream, Passage Creek, and a wagon road. At this point the bottom of Fort Valley is only about 750 feet above sea-level, and scarcely 200 feet above the nearest point on the Shenandoah River. On the east Massanutten Mountain rises to an elevation of some 1,800 feet, and on the west Three Top Mountain barely reaches 2,300 feet. Just here the west slope of Massanutten Mountain is unusually precipitous. For several hundred feet below the summit the face of the mountain is a sheer, bare cliff; below this a rough talus slopes abruptly to the edge of Passage Creek.

The upper austral flora of the Shenandoah Valley passes uninterruptedly over these low mountains and through Fort Valley. Near the mouth of the Fort a few characteristic species, such as the pawpaw and persimmon, both of which are very common immediately outside, disappear, but this is evidently due to lack of congenial soil, as both grow at much greater heights on the neighboring mountains. A fine growth of hemlock gives the place a somewhat un-austral aspect, but these trees are freely interspersed with gums (*Nyssa*), three-leaved hop trees (*Ptelea*), fringe trees (*Chionanthus*), tulip trees (*Liriodendron*) and southern bass woods (*Tilia pubescens*)—a typical austral assemblage.

The mammal fauna outside of the 'boreal islands' showed no peculiarities. It was simply that of the upper austral zone, and it extended wherever I trapped on the mountains as well as in the valleys. Among the hills on the west side of Fort Valley are a few small cold streams, and on the banks of these I secured two boreal mammals, a red-backed mouse (*Evotomys carolinensis*) and a shrew (*Sorex fumeus*). The nearest points from which the former has been recorded are Roan Mountain, North Caro-

lina,* altitude 6,000 feet, and Travellers' Repose, West Virginia,* altitude about 3,000 feet. The shrew is recorded from Roan Mountain† and from the higher mountains of central Pennsylvania.‡ Both of these animals occurred also in considerable numbers among the loose rocks of the talus at the narrowest part of Fort Valley, altitude 750 feet.§ This boreal colony was completely surrounded by the upper austral fauna, which extended more than a thousand feet above it. The mammal fauna of the talus slope was not made up exclusively of these two species. As might be expected, such abundant, freely roaming austral forms as the wood rat (*Neotoma pennsylvanica*), white-footed mouse (*Peromyscus leucopus leucopus*), and chipmunk (*Tamias striatus striatus*), were often caught in traps set among the loose rock masses. These common species would naturally wander from the woods over the comparatively small area of the rock slide in search of food. A single short-tailed shrew (*Blarina brevicauda*) was taken there also. This animal, however, ranges freely into the boreal zone.||

As I have already said, the talus sloped abruptly to the edge of Passage Creek. It was in no way peculiar, but had all the well-known characteristics of such formations. It supported a very scant tree growth. The rock fragments were overgrown with lichens, and in protected places there were large mats of moss and ferns, but I found no sphagnum. At the point where my temperature observations were made, a widely open cavity had been formed beneath some unusually large rock fragments held from slipping downward by the roots of trees. From this cavity at the base of the talus, as well as from smaller ones on its sides, there was a constant outpour of cold, damp air. This was especially noticeable on hot, still days, when the air currents kept the ferns about the mouths of the crevices continually waving, while all other vegetation was motionless. From the large cavity to the edge of the water was a distance of about ten feet. The rocky bed of the stream at this point was only some twenty feet wide. On the opposite side of the stream was a flood-plain, perhaps twenty yards across. It was very irregular in surface, and consisted merely of masses of sand brought down from the valley above during freshets and lodged among the rocks. The flood-plain was well wooded, first with a fringe of shrubs and further back from the stream bed with a vigorous growth of trees, such as I have already described. Beyond the flood-plain rose the gradual slope of Three Top Mountain. Although parts of the flood-plain afforded what appeared to be perfect shelter for red-backed mice and smoky shrews, the most careful trapping failed to bring to light anything but the common upper austral mammals. Colonies of pine mice (*Microtus pinetorum*) occupied places that were sufficiently sandy, and white-footed mice abounded. I also detected the work of a mole which appeared to be that of *Scalops aquaticus*. It is safe to say that at this point the typical boreal species were strictly confined to the talus, the more sedentary austral forms to the flood-plain and warm mountain sides, but that the more active and abundant austral species wandered freely in search of food.

For temperature observations I established four stations. Station 1 was on the flood-plain at the base of Three Top Moun-

* Bailey, Proc. Biolog. Soc. Washington, XI., p. 130, May 13, 1897.

† Merriam, North American Fauna, No. 10, p. 66, December 31, 1895.

‡ Rhoads, Proc. Acad. Nat. Sci., Philadelphia, 1897, p. 223, May, 1897.

§ The altitudes of localities in this region are from the Luray sheet of the United States Geological Survey Topographic Map.

||See Miller, Proc. Boston Soc. Nat. Hist., XXVIII., p 38, April 30, 1897.

tain; station 2 was a few yards back from the edge of the stream directly opposite the large cavity in the talus; station 3 was at the water's edge on the opposite side of the stream from station 2, and station 4 was in the cavity at the foot of the talus. At each station the thermometers were placed on the surface of the ground in positions where they would be protected from all direct rays of the sun, and so far as possible from any influence of reflected heat. The conditions at station 4 were somewhat exceptional, but even here the thermometer was not placed under ground, but on the surface of the rocks beneath the overhanging roof of the widely open cavity. The detailed results of the readings are given the following table:

Date 1897	Hour P. M.	Station. 1	2	3	4	Water.	Sky.
Aug. 20.	1.20	72.5°				69°	Sl'tly cloudy
" "	2.15		67°	64°	58°		" "
" "	2.40			63°	57°		" "
" "	2.50			68°	59°		
" "	3.40			66°			Clouds hea'y
" "	4.00			66°	59°		" "
" "	4.30	70°					" "
" 22	1 00	75.5°					" thin
" "	1.30		72°		59°	72°	" "
" "	2.50		72°				Almost clear
" "	3.10		72°				Clear
" "	3.50				61°		"
" "	4.20	75°					Clouds thin
" 24	12.45	69°					" "
" "	1.30	71°	70°			66°	Clear
" "	2.15		70°+		60°		
" "	3.40		68°		60°		
" 30	1.30	77°				71°	Clouds dense
" "	2 20		79°		58°		" thin
" "	3.45		72°		58°		" dense
Sept. 1	2.00	74°				73°	Clear
" "	2.30		77°		58°		"
" "	3.30				58°		"
" "	3.40		74°		58°		"
" 5	2.30			67°			"
" "	3.20		75°		54°		"
" "	4.00					70°	"
" 7	1.10	88°					"
" "	2.45		80°	63°			"
" "	3.00				56°	70°	"
" "	5.40		74°		56°		"
" 9	5.00		79°	66°			"
" "	5.10				56°		"
" "	5.45		76°				"
" 11	3.00		80°	67°		73°	"
" "	3.40		80°		57°		"
" "	5.30		74°		57°		"
" 13	3.00			67°		73°	"
" "	3.30		79°		58°		"
" "	4.20				58°		"
" "	5.30		78°		58°		"
Mean.		74.6°	75°	65.7°	57.8°	70.7°	"

The readings at stations 2 and 4, being the most important to compare, are printed in heavy type. It is to be remembered that these two stations were less than fifty feet apart.

On comparing the means of the readings at stations 2 and 4 it is seen that the boreal mammals lived in an atmosphere the mean temperature of which, during the afternoon, at nearly the hottest part of the summer, was about 17° lower than that of the region occupied by the upper austral fauna. How this relationship might be altered by including observations taken throughout the day and night can only be guessed at, but I think it would remain essentially the same. The question next arises as to how nearly the means of 75° and 58° correspond with the known means, for the same season, of the upper austral zone and boreal zone respectively. Turning to the only published table of zone temperatures* we find that the range of normal mean temperature of the six hottest consecutive weeks at extreme northern and southern localities in the two zones is as follows: upper austral, 71° to 78°; boreal (Canadian), 57° to 64°. In each case, therefore, the mean temperature of the station coincided with that of the life zone to which the fauna of the station belonged.

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THE ANNUAL INSPECTION OF THE PRIBILOF SEAL ROOKERIES.

IN compliance with the Act of Congress of 1893, the U. S. Fish Commission has each year made an investigation respecting the condition of seal life on the Pribilof Islands.

This work, usually performed in connection with former duties on the steamer *Albatross*, was officially resumed by the writer during the past season in connection with the work of the Division of Fisheries.

*Merriam, Laws of Temperature Control of the Geographic Distribution of Terrestrial Animals and Plants. *The National Geographic Magazine*, VI., pp. 229–238, December, 1894.