a single plant was noticed which was completely dead. Numbers of plants of *Larrea* and *Prosopis* had been frozen to the ground, but all these observed were sending forth a vigorous growth of shoots from the base which were already 10 to 50 centimeters tall. The wholesale destruction of the vegetation implied by Professor Cottam's observations of "brown water-soaked cambium layers even at the crown of most shrubs" was not evident along any of the forty or fifty miles of road traveled by the writer in this life zone. Also the bronzing of the junipers in the Upper Sonoran zone noted by Professor Cottam had disappeared, at least in the Beaver Dam Mountains and the regions of Zion and Bryce Canyons.

Interesting was the evident variation in resistance to the frost of plants even of the same species. Some of the difference in effect was doubtless due to difference in altitude and exposure. The areas at the extreme upper edge of the Lower Sonoran, 900 to 1,000 m in the St. George area and somewhat higher west of the Beaver Dam Mountains, in general suffered more, except where sheltered. But of specimens of *Larrea* growing side by side, with no apparent difference in conditions or size of plant, one would be frozen to the ground, while another might have only the tips of the branches nipped. Every degree of injury excepting actual death was present in a small area of uniform altitude and exposure. However, all plants of *Larrea* had evidently produced far less fruit this year than is usual for this species.

Contrary to Professor Cottam's conclusion that this occurrence "emphasizes the inadequacy of Merriam's theory of zonation in its failure to take into consideration temperature data of the dormant period," these later observations would indicate that, in this instance, at least, the ignoring of the dormant period was quite justified. And a week of sub-zero weather would seem to be quite a severe test. The facts suggest that the life zones are states of equilibrium reached by the vegetation as a result of the action of definite climates over a long period of time, and that they are not likely to be profoundly disturbed by brief intervals of "unusual weather."

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EXPERIMENTAL STUDY OF THE SURVIVAL VALUE OF ACRIDIAN PROTECTIVE COLORATION

THE problem of protective coloration has recently received renewed attention in the scientific press: (Shull;[1,2] Carpenter;[3] McAtee;[4] O'Byrne;[5] Sumner;[6] Cockerell;[7] Carrick;[8] *et al.*).

The writer has for several years been carrying on a series of experiments attempting to determine the efficiency of native and domestic birds in discovering for food those grasshoppers whose color patterns appear to blend perfectly with the background of their environment.

The *predators, real enemies,* were mocking-birds, sparrows, cardinals, turkeys and bantams. Acridians noteworthy for their concealing resemblances, at least as far as the human observer is concerned, were the *prey.*

A garden plot 12×16 feet was marked off into squares 16×16 inches. These squares were arranged in checkerboard fashion to represent four different types of natural background: black, white and red soils; the fourth green, transplanted bermuda. The acridians were picketed on the various squares of the checkerboard plot or for some experiments anesthetized.

The native birds could be easily observed and checked from a screened porch and from the house windows. The domesticated birds permitted experimenters to follow their every movement.

The records of 33 experiments (June 9 to July 1, 1937) show that out of 459 acridians placed on non-harmonizing or non-protected backgrounds of the checkerboard plot and subjected to predator depredations, 405 or 88.24 per cent. were eaten by the birds, while 54 or 11.76 per cent. survived.

On the other hand, of the protectively colored acridians placed on harmonizing backgrounds 276 or 60.11 per cent. were missed by the birds, while only 183 or 39.85 per cent. of the acridians protected by concealing colors were eaten.

Since over 72 per cent. of the specimens used in these experiments were matched pairs it is evident that the more conspicuous were eaten, while the concealed or partly concealed were the individuals most likely to escape the keen eye of the predators. Further, it should be noted that in these matched pair tests a normally protected grasshopper became a non-protectively colored individual only because it was placed on a contrasting soil background rather than a harmonizing background. Therefore, when the bird-predator skipped a cryptically colored specimen of the same species, it was clearly a test of bird visual-perception.

The evidence shows that birds intent on securing acridians as insect-food often failed to see and repeatedly skipped or passed over protectively colored

1 A. F. Shull, SCIENCE, 81: 443–452, 1935.
2 A. F. Shull, SCIENCE, 85: 496–498, 1937.
3 G. D. H. Carpenter, SCIENCE, 85: 356–359, 1937.
4 W. L. McAtee, *Quart. Rev. Biol.*, 12: 47–64, 1937.
5 Harold O'Byrne, *Ent. News.*, 44: 57–61, 1933.
6 F. B. Sumner, *Proc. Nat. Acad. Sci.*, 21: 345–353, 1935.
7 T. D. A. Cockerell, SCIENCE, 84: 203–206, 1936.
8 Robert Carrick, *Trans. Royal Ent. Soc.*, 85: 131–139, 1936.

acridians, while the non-protected were much more consistently eaten.

All experiments point to but one general conclusion —concealing coloration protects acridians against bird predators.

The details of these experiments will be published elsewhere.

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COLUMNAR STRUCTURE IN EXTRUSIVE BASALTS

IN two recent texts on geology the impression is given that columnar structure in basalt is a characteristic of intrusive flows. In one text the lower canyon of Yellowstone River, near Tower Fall, is pictured on a plate entitled "Intrusions," with the caption: "Sills lie parallel to surrounding structures." Since the lower basalt at that point rests upon the "Tower Fall Conglomerate," a distinctive stream-gravel, there is no doubt that the bed represents a surface flow. At Overhanging Cliff a child of 14 can recognize the sand and gravel beneath the basalt and understand the porous and ashy contact of the lava on the stream bed. A more diagrammatic section of a lava flow could not be invented.

North of Tower Fall Ranger Station one can look across the river and see where the basaltic lava flowed northward onto the little valleys at the foot of the Precambrian Buffalo Plateau. The river has cut across these valleys and the intermediate ridges, showing in section the V-shaped valleys, all filled to the same level with columnar basalt. Certainly this was a surface flow. It appears to be a part of the flow at the canyon.[1]

Another text pictures Giant's Causeway as an example of intrusive basalt. Now if you stand on the Causeway and look east, you see a high cliff with two horizontal bands of red material lying between layers of columns. The red layers are ferruginous soils developed on the basalts between eruptions. What we really have at the Causeway is a series of successive surface flows of basalt, all of them hardening with columnar structure. To complete the story, near Portrush I collected charred pine wood—a log of it—and a perfect charred cone of the Strobus type between two layers of basalt. In the face of these statements the author of the book writes me that "the basalts of Giant's Causeway look like intrusives." These strata are well described and explained in a "Guide to Belfast . . . prepared for the British Association" (1892), and in other publications. Professor Charlesworth, of Queen's University, Belfast, in a letter recently received, restates the extrusive origin of the Giant's Causeway basalts. (*Cf.* Proc. London Geologists' Assoc., 1935.)

Columnar basalts, to be sure, often are intrusive. But care is needed in showing examples of such.

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[1] *Cf.* U. S. Geol. Surv. Folio 30, 1899.

SOCIETIES AND MEETINGS

THE TENNESSEE ACADEMY OF SCIENCE

THE Tennessee Academy of Science, like the American Association for the Advancement of Science, was initiated by geologists. It was projected by Dr. George H. Ashley, now state geologist of Pennsylvania, promoted at Knoxville by Dr. C. H. Gordon, then professor of geology, University of Tennessee, at Nashville by Dr. L. C. Glenn, professor of geology, Vanderbilt University, and its first secretary was Wilbur A. Nelson, then assistant in the Tennessee Geological Survey, now professor of geology, University of Virginia. Botanists have taken the lead in recent years and were first to organize a section. At the meeting on November 26 and 27, 1937, at George Peabody College, sections in geology and physics were organized, and the three sections had sessions on Friday afternoon, with Dr. Jesse M. Shaver, chairman for botany, Dr. L. C. Glenn, for geology, and Professor Slack, for physics. At the general sessions of the academy, President Louis J. Bircher, of Vanderbilt University, presided on Friday morning and Vice-President Peyton N. Rhodes, of Southwestern University, on Saturday morning.

The two organizations affiliated with the academy, Tennessee Ornithological Society and the Barnard Astronomical Society, were represented on the program, Albert F. Ganier of the former discussing the subject, "Mid-winter Birds of the Nashville Area," and Mrs. Roberta Lyne, president of the Barnard Club, superintending an exhibit of Barnard manuscripts and the showing of a "McMath-Hulbert Observatory" motion picture film. Five papers by representatives of the federal and state departments of conservation indicated the interest of these organizations in the work of the academy.

Dr. C. H. Gordon, in his address, as the first president in 1912, urged the establishment of a "State Conservation Commission whose functions shall be to provide for the conservation of the material and human interests of the State including the waterpowers, forests, minerals and other resources and conditions affect-