tors that many of the toxic areas existing at present in the Rocky Mountains area in soils and shales of a definite geological character have been brought about by vegetative enrichment of selenium through cycles of growth and decay of highly seleniferous native plants, such as the Astragali represented by *A. bisulcatus, A. sabulosus, A. racemosus, A. pectinatus, A. flaviflorus, A. grayi,* etc.

O. A. BEATH
C. S. GILBERT

MOUNTAIN ROAD CASUALTIES AMONG ANIMALS IN COLORADO

IN July, 1935, I noted the numbe[illegible]dead animals, mostly mammals, seen on mountain r[illegible]n a portion of Colorado. The results of thi[illegible]ere published in SCIENCE for January 3, 1[illegible]ualties among Animals on Mountain Roads."

I was in essentially the same region from the 7th to the 19th of August, 1936, accompanied by Robert Potts of Denver, who did the driving and noted more of the victims than I.

The itinerary was as follows: From Colorado Springs through Cañon City and Salida, across Monarch Pass to Gunnison; thence north to Crested Butte and the "ghost towns" of Gothic and Pittsburgh. Returning via Gunnison we went to Montrose over Blue Mesa, and returned the same way to Gunnison, Monarch Pass and Colorado Springs. The homeward trip from Cañon City to Colorado Springs was made via Florence and Pueblo, a roundabout route taken because of rainy and stormy weather.

The most notable differences between the 1936 list and that of 1935 are the greater number of Say's ground squirrels, 27 instead of 12, a less number of prairie dogs, 36 instead of 56, and five chipmunks, when none were recorded for 1935. The road from Cañon City to Colorado Springs via Pueblo is really a plains road, and I give the list for that separately.

The list follows: Mammals: cottontail rabbit, probably *Sylvilagus nuttalli pinetis,* 3; white-tailed jack rabbit, *Lepus townsendi townsendi,* 3; Wahsatch chipmunk, *Eutamias minimus consobrinus,* 5; Say's ground squirrel, *Callospermophilus lateralis lateralis,* 27; Gunnison's prairie dog, *Cynomys gunnisoni,* 36; mouse, sp. 2; muskrat, 1. Birds: sparrow, sp. 1; bird, sp. (?), 1; barn swallow (?), 1.

Between Cañon City and Colorado Springs via Pueblo were noted 5 pale striped ground squirrels, *Citellus tridecemlineatus pallidus;* 1 kangaroo rat, *Dipodomys ordi richardsoni;* 1 black-tailed jack rabbit, *Lepus californicus melanotis;* 1 plains cottontail, *Sylvilagus auduboni baileyi;* and a bull snake, *Pituophis,* sp.

EDWARD R. WARREN

COLORADO SPRINGS, COLO.

PORRITCH FOR DR. MORRIS

IN SCIENCE for September 25 that versatile Nestor of science, Dr. Robert T. Morris, surgeon, geneticist, dendrologist, horticulturist, caryologist and ichthyologist, under the caption "Wanted: A New Word," appears in quest of an uncoined term, which he specifies "should be from the Greek," to indicate the mud-enveloped food of bullheads, flounders, wild ducks, etc.

The Greeks, as usual, "had a word for it"—at least they referred to mud-feeding critters as "borborophagous" (βορβοροφάγος). If umbrage be taken to that term as cacophonous and sesquipedalian, perhaps ilyophagous (ἰλύς, mud) might be preferred. Slime-feeders, therefore, could be called *ilyophagi,* and their habits *ilyophagous.* The words βρωμα (that which is eaten; food) or, I think more appropriately and euphoniously, τροφή (nourishment; food) could then be suffixed to the food-source itself. Thus, *ilyotrophe* (or *ilyobroma*) for the mud-food, and *ilyotrophism* (or *ilyotrophy*) for the food habit of these animals.

W. A. DAYTON

RANGE FORAGE INVESTIGATIONS,
U. S. FOREST SERVICE

SCIENTIFIC BOOKS

TIME AND SPACE

Geometry of Time and Space. By ALFRED A. ROBB. vii + 408 pp. Cambridge University Press, 1936.

THIS volume is essentially a second edition of Professor Robb's "A Theory of Time and Space" published in 1914. It contains, however, a much extended, illuminating introduction and new mathematical matter. Many of the proofs of theorems have been given simpler form.

There lies implicit in Einstein's special theory of relativity a four-dimensional space-time geometry in which "points" represent "events"; this geometry was first formulated by Minkowski. In space-time the fundamental geometric relation is that of the "interval" between two events.

Now there are two contrasting points of view which may be taken in the systematic logical development of the appropriate geometric ideas. The first proceeds from the qualitative to the quantitative, and is strictly analogous to the Euclidian postulational approach to ordinary geometry. It is this kind of approach which Robb has chosen to use in his book. The basic relationship from which he starts is that of one event, B, being *after* another, A: speaking physically, B is *after*

A if, for some idealized reference particle P, the two events may be regarded as happening at P, the event B happening after A at the particle. Evidently the notion of *after* so defined is more fundamental in character than that based on the classical concept of absolute simultaneity.

Robb's development culminates in the proof of the quantitative formulas basic in the analytic geometry of the space-time.

The alternative type of approach is that associated with the name of the great mathematician, Riemann. Here we proceed inversely from the quantitative to the qualitative, in the following manner. Between any pair of points (events) is assumed a relationship called *interval.* The numerical intervals s between all possible pairs of points may be thought of as given in an (infinite) double entry table. Now it happens that this complete table may be condensed in a single formula, namely,

$$s^2 = (t_2 - t_1)^2 - (x_2 - x_1)^2 - (y_2 - y_1)^2 - (z_2 - z_1)^2$$

where (t_1, x_1, y_1, z_1) and (t_2, x_2, y_2, z_2) are to be thought of as mere labels attached to the points. Geometric facts consist of all those properties ultimately expressible in terms of points and intervals only.

This second Riemannian mode of approach is very much more brief and direct than the Euclidian approach adapted by Robb. In a day when the quantity of mathematical material to be absorbed has become of enormous extent, one can scarcely afford the time necessary to follow the logical sequence of Euclidian ideas set up by Robb when a much deeper understanding is available in this alternative simpler way. Yet the task performed by Robb is well worth doing, inasmuch as the kind of space-time which he treats is so basic in physical theory that it should be treated from different points of view. However, physicists and mathematicians who know the elements of ordinary geometry and possess a slight acquaintance with the physical facts underlying the special theory of relativity will continue to hold firmly to the Riemannian point of view, if only for reasons of intellectual economy.

GEORGE D. BIRKHOFF

THE SCIENCE OF THE EARTH

Down to Earth. By CAREY CRONEIS and WILLIAM C. KRUMBEIN. 501 pp., many ill. University of Chicago Press. $3.75.

THIS is a new-style text-book intended primarily for use in the "New Plan" for instruction at the University of Chicago. It is, however, eminently suitable for any introductory course in geology in any institution. Incidentally, it is also nicely adapted for the general reader who wants to be pleasantly introduced to the science of the earth.

The break with tradition reveals itself most conspicuously in the format of the volume. The large bold type, wide spacing of lines and paragraphs, the liberal use of black-face type and larger type for the initial words of paragraphs, the poetical quotations which embellish most chapters and the simplified diagrams and cartoons, ultra-modern in conception, leave nothing of the stodgy appearance of the classical treatise on a recondite subject. The authors and publisher have recklessly opened themselves wide to the charge that they have succumbed to the lure of the age of jazz and are trying to give to science a popular swing. The charge will doubtless be hurled, but in the reviewer's opinion, it will be entirely muffled by the paeans of rejoicing which their book will also evoke.

The departure from traditional style is also apparent in the text itself—more so in the first than in the second half of the book. There is a studied effort "to enliven the subject without in any sense writing it down." Although the authors have not approached their topic in any spirit of levity, they are witty or facetious on every possible occasion, and occasionally they make use even of slang. The flavor of their writing is well illustrated by many of the chapter headings. "Second-rate Planet" covers the description of the size, shape and density of the earth. "The Tooth of Time" is the title of the chapter on rock weathering. "End of the Line" is the camouflage for an essay on stream deposits. "What Price Continents" intrigues the reader to the consideration of crustal warping which renews the altitude of lands above seas. "Vulcan's Chimneys" refers, of course, to volcanoes. "Universal Cemetery" is the heading of the chapter on fossils and fossilization. "Gargantuan Calendar" introduces the geologic time scale. "Invertebrate Heyday" reveals the record of invertebrate life in early Paleozoic time. "Crossing the Strand" describes the ascent of air-breathing quadrupeds from their piscine progenitors. "Megalomania" is the heading for the chapter on dinosaurs, and "Money and Politics" is a ten-page review of the economic aspects of geology.

Beneath this lightness of touch there is, however, plenty of good solid geology. The customary topics of a college course in "introductory geology" are all here and for the most part are treated in the usual sequence—the materials of the earth, processes which alter the surface of the earth, history of the earth and its inhabitants through geologic time. Not all the problems of geology are solved; indeed, the reader will inevitably gain the correct point of view "that the science of geology is a living, changing, growing one."

The treatment of illustrative material is especially