cate caution in the rounding off of such numbers. This applies especially to the reports of such statistics as may be used by a reader in further calculations for some special purpose of his own. If correlation coefficients and reliability coefficients are reported, for example, the reader may wish to employ these in estimating the value of the correlation coefficient corrected for attenuation. For this purpose, he will want values sufficiently accurate so that his final estimate of the correlation coefficient corrected for attenuation will be in error only through the unreliability of the original data and not through the rounding-off errors in the published numbers.

These considerations apply to biological, economic and social statistics as much as to any other. In this connection, Dr. Roessler argues that, "since the errors of measurement are ordinarily tremendously greater in biological, economic and social investigations than in physical observations, the retention of more than one doubtful figure in a constant is unjustified." A consideration of the standard error concept would lead us to believe that the relatively larger errors of measurement in social investigations would result in obtaining relatively larger estimates of the standard errors of the statistics from them, and that any sound procedure for rounding off a statistic in the light of its standard error should therefore apply as well to social as to physical data.

In the light of these various considerations it seems desirable to urge Kelley's suggestion[2] rather than Dr. Roessler's. That is, keep the figures in the reported result to the place indicated by the first figure of one half the probable error.[3]

The number of places which must be kept in the computations in order to guarantee the accuracy of the last figure in the reported result will depend, of course, on the nature of the computations.[4] If any single rule is to be followed, it should be one which would guarantee the accuracy of the last retained figure from any of the more ordinary types of computation. Walker and Sanford have shown[5] that if the less accurate of two approximate numbers contains n significant digits, their product and their quotient each contains n or $n-1$ significant digits. And about once in four times the error will affect one more place than this rule states.

[2] SCIENCE, 60: 524, 1924.

[3] This amounts to the insertion of "one third of" in front of "the standard error" in Roessler's rule. Thus the two rules often result in keeping the same number of places.

[4] Incidentally it is to this problem that Scarborough addressed his treatment in *Numerical Mathematical Analysis*, p. 11, quoted by Roessler.

[5] Helen M. Walker and Vera Sanford, "The Accuracy of Computation with Approximate Numbers," *The Annals of Mathematical Statistics*, vol. 5, no. 1, pp. 1–12, 1934.

It would therefore seem desirable to keep two more places in computation than the number of places to be reported.

The following rule should therefore be urged instead of the one proposed by Dr. Roessler: *In a final published constant, retain no figures beyond the position of the first significant figure in one half the probable error; keep two more places in all computations.*

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SELENIUM BEARING VEGETATION DURING LATE CRETACEOUS TIME[1]

DURING the past year evidence has been obtained that points clearly to the fact that at the time the continental portion of the Medicine Bow formation was being deposited certain plants were present that absorbed selenium in large quantities. The preservation of selenium in these plant-bearing rocks is all the more striking because of the fact that the samples taken for analysis were from weathered surfaces and from beds tilted at steep angles. Leafy carbonaceous shale has been collected from a type section in southern Albany County, Wyoming, that has given upon analysis over 150 parts per million selenium. Sandstones contacting these seleniferous carbonaceous veins have yielded as high as 157 parts per million selenium. Sandstones in this formation not subjected to this influence are only moderately seleniferous if at all. The concentration of selenium in the carbonaceous material is confined to the top part of a vein where skeletal leaves and other vegetable characters are still recognizable. The coal and lignitic matter in the Medicine Bow formation has been found to be only sparingly seleniferous. This fact correlates with current observations in that selenium absorption in quantity is a highly specialized phenomenon and therefore not common to all native plant genera.

This is the first evidence that has been found in the Rocky Mountain region showing an unusual enrichment of selenium in vegetative remains during Cretaceous time. While it is true that one may find seleniferous carbonaceous matter, for example, in the basal Dakota (Lower Cretaceous) that yields more selenium than is found in the associated conglomerates, yet the selenium content of the Medicine Bow material reported on is in a class by itself when compared with any other carbonaceous beds that have been examined thus far.

These data, brought out in the study of the nonmarine portion of the Medicine Bow formation, confirms the theory advanced by the Wyoming investiga-

[1] Contribution from the Research Chemistry Department of the University of Wyoming.

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.

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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.

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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.

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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*