The final values of the field strengths of Cavite and Malabar as derived from comparison with the signals of Tuckerton and Pearl Harbor, and by direct measurement, are shown in Table 5. Below the average observed values are given the values calculated from the Austin-Cohen formula,

$$(1) \qquad E = \frac{377\, I\, h}{\lambda\, d}\sqrt{\frac{\theta}{\sin\theta}}\, e^{-u}$$

where $u = 0.0015d/\sqrt{\lambda}$ and θ is the angle between the stations from the center of the earth.

The observed value of field intensity in the case of Cavite in Table 5 is seen to be approximately three times that calculated from Eq. (1), while the observed strength of Malabar is about twice that calculated from Eq. (1). These ratios of observed to calculated values are much less than those given in M. Guierre's paper.[1]

ZOOLOGY.—*On the alimentary tracts of squirrels with diverse food habits.* A. BRAZIER HOWELL, Biological Survey.

The majority, at least, of the squirrels of the United States may be said fairly to be omnivorous in food habits. At one extreme, however, there are the chipmunks (*Eutamias*) and some tree squirrels which undoubtedly feed as largely as possible upon concentrated fare such as nuts and seeds and occasionally meat. At the other extreme are the gramnivorous prairie dog, marmot, and certain western ground squirrels of the genus *Citellus*.

The difference between these food habit extremes is large, and we would confidently expect some corresponding variation between the internal economy of the two groups discussed. The amount of this difference depends chiefly upon the length of time that present habits have obtained within the species considered, the plasticity of the animal to intestinal variation, and doubtless to unknown complications of one sort or another which it is impossible for the investigator to take into account.

Typical of the group which feeds on concentrated rations is the eastern gray squirrel. It evinces a marked preference for seeds of a nut-like character, and similar items. A variety of provender such as buds, bark, and a small amount of herbage is also consumed, but I am under the impression that such fare is indulged in only when a

supply of more concentrated food is unavailable. This squirrel ranges over a country especially rich in nut-bearing trees, where it encounters comparatively little ecologic competition, as far as we can tell. Too, when its favorite foods show indications of failure it is in the habit of migrating to districts which, from its standpoint, are more favorable. It may therefore be assumed that not very often is this squirrel forced by hunger into eating any great amount of bulky fodder.

Typical of the other extreme is the Belding ground squirrel, selected from among other species with similar habits because specimens chanced to be available. This species undoubtedly has omnivorous proclivities, for I have watched it eating out the soft parts of cicadas (*Okariagana*), and the bodies of small mammals discarded from the skinning table. But it has suffered severe ecologic competition within such associations as appear to us most congenial to such a creature. Over the portion of its range with which I am familiar, every association is occupied by one, or usually more, species of chipmunk, while as many as five forms of other sciuromorphs, partially or entirely terrestrial in habits, may be found dwelling within the same general area. Although prolific, the species is not active, and it appears to us to have been forced by competition into laying its paths in the less crowded places. The more agile chipmunks, which usually fairly swarm about it, hoard stores of food, a thing which the squirrels do not do, and doubtless secure by far the greater part of the local seed crop, almost all obtained by *Citellus* being still in an immature condition. So these little fellows congregate in and about the high mountain meadows where they may feed upon the lush herbage with but few to dispute their menu. I have watched them grazing along through the damp swales, cropping the grass like pygmy cattle, and when one enters a patch of such growth their small forms often scurry away by the score.

These squirrels both aestivate and hibernate, so a great supply of fat must be accumulated. As the food is comparatively low in nutritive value a vast amount must be consumed, and digestion must be rapid. They will stuff themselves until their swollen bellies fairly drag upon the ground, and always the contents of their stomachs and most of the intestinal tract is bright green, a condition which I have not encountered in any tree squirrel, nor among chipmunks unless the latter had been feeding upon green berries.

In examining and comparing the alimentary tracts of these two

mammals it must be born in mind that the gray squirrel was fully a quarter, or possibly a third, larger than the Belding squirrel dissected.

The tree squirrel examined was a spirit specimen, presumably adult, of *Sciurus carolinensis carolinensis* from Washington, D. C. The ground squirrel was subadult—probably a yearling—*Citellus beldingi* from Mammoth, Mono County, California, at an altitude of 9000 feet. In both animals the stomach was well distended.

It was noted that the oesophagus of the *Sciurus* was very small for an animal of such size, its capacity being but little more than half that of the *Citellus*.

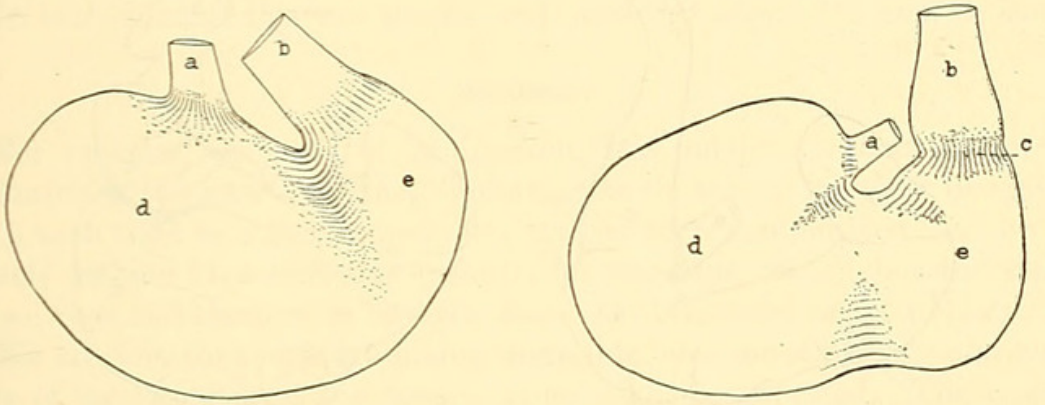

Fig. 1.—Stomachs of *Sciurus carolinensis carolinensis* (left) and *Citellus beldingi* (right): *a* oesophagus; *b* duodenum; *c* pyloric valve; *d* cardiac end; *e* pyloric end. (Both drawn to same scale).

STOMACH

The stomachs of both specimens measured about the same in greatest diameter—namely 50 to 55 mm.—and in breadth they were also somewhat similar; but the stomach of the *Sciurus* was the more capacious due to the fact that the pyloric portion was the more constricted in *Citellus*. In neither are there marked mucous or glandular areas upon the ental surface.

The stomach of *Sciurus*, distended with contents of meal-like consistency and light color, is a simple sack. The cardiac and pyloric tubes are close together—though not in contact—as seems to be the rule in rodents, and there is no external evidence of a pyloric valve. It is as thin-walled and devoid of muscular power as seems possible.

The stomach of the *Citellus* was filled with green vegetable matter markedly fibrous in texture. It was found to be considerably more specialized in this animal, with cardiac and pyloric ends more differentiated, the former being considerably larger than the latter. The two tubes were inclined at a different angle, and there was an external constriction to indicate the position of the pyloric valve. The cranial portion of the cardiac end, and the

entire pyloric division, were much more muscular than in *Sciurus*, with some internal striations.

SMALL INTESTINE

In the *Sciurus* this tract had a length of 1470 mm., with a collapsed width of 7 mm. It was simple, unconvoluted, thin and membrane-like, and uniform for its entire length.

The *Citellus* had a definite duodenal division, 145 mm. long and 8 mm. wide, unconvoluted and markedly reddish in color, in contrast to the grayish

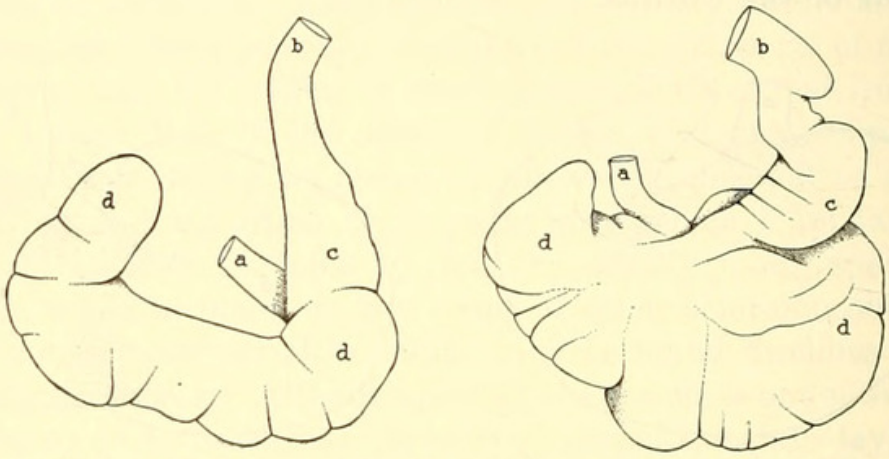

Fig. 2.—Caecal regions of *Sciurus carolinensis carolinensis* (left) and *Citellus beldingi* (right): *a* small intestine; *b* rectal tract; *c* colic portion; *d* caecum. (Both drawn to same scale).

green shade of the remainder of the small intestine, or Meckel's tract.[1] The latter was irregularly convoluted, with a width of 11 or 12 mm. The total length of the small intestine was about 825 mm.

CAECUM

The caecum of the *Sciurus* was shaped like the cross-section of a channel-bar and was relatively simple and vermiform, being but slightly convoluted. In length it measured about 75 mm.

In *Citellus* the caecum was excessively irregular in shape, more spherical and much convoluted. Its longest dimension was about 70 mm., and it was almost as broad. The most capacious part was posterior to the junction with the small intestine. This was not the colic portion, but constituted a posterior extension of the true caecum. There was also a definite protrusion of the caecal wall medially, which may or may not be a step towards, or doubtfully away from, a double caecum.

[1] See MITCHELL, P. C., *On the intestinal tract of mammals*. Trans. Zool. Soc. London **17**: 438–536. 1905.

COLIC PORTION

The postcaecal inflation in *Sciurus* consisted merely of a gradual narrowing from the full diameter of the caecum until at 30 mm. from the end of the small intestine the hind gut was uniform in size and character with the remainder of the rectal tract.

In *Citellus* the caecum, posterior to the small intestine, did not narrow gradually. The departure of the hind gut from the caecum was marked by a valve-like constriction, and the colic portion, 25 mm. in length, was convoluted with a suggestion of two loops.

RECTAL TRACT

In both animals this was simple, and measured about 340 mm. in length.

DISCUSSION

For practical purposes of comparison, the unknown quantities in the evolution of the intestinal tract, important as these may be, must be ignored until such time as a great supply of data has been accumulated, and we can merely assume in a tentative manner, for the time being, that the results as we now find them were brought about by differences in food habits.

We are told that nuts are highly digestible, and the simplicity and weakness of the stomach of the *Sciurus* is as might be expected. The citelline stomach, slightly more capacious from a relative standpoint, is more muscular for the handling of tougher, more fibrous food. The easily assimilated food of *Sciurus* is reduced in the large stomach to a condition necessitating but relatively little action by the small intestine and the caecum, both of which are comparatively simple. It is to be noted that the length of the small intestine is actually almost twice as long in *Sciurus* as in *Citellus*, and therefore the additional length may, and probably does, compensate in part for its simplicity. The significance of this discrepancy in length is not clearly understood. It is at variance with what might be expected, after an examination of some of the other rodents which I have dissected, and I venture no opinion as to its real import.

The stomach of *Citellus*, although more muscular, is not of sufficient size to hold for long the great amount of herbage which the animal habitually consumes. The contents, therefore, are soon passed on to the small intestine, more specialized and more efficient for this work than in *Sciurus*. The process is completed in the highly complex caecum, so much better fitted as an engine for the final reduction of coarse fare than is the same part of the tree squirrel.

CONCLUSION

From the foregoing data it is tentatively concluded that in comparing the intestinal tracts of a nut-eating and a grass-eating squirrel, size of the

stomach is not of great import. Muscularity is important in reducing fibrous substances, but a stomach may compensate for lack of great size in handling quantity by passing the contents quickly on to the small intestine and thence to the caecum, both of which must then be of larger diameter and more specialized than is necessary in the case of the animal which feeds chiefly upon nuts.

ZOOLOGY.—*Description of a new scincid lizard and a new burrowing frog from China.* LEONHARD STEJNEGER, U. S. National Museum.

The National Museum has recently received from the Museum of Comparative Zoology, in exchange, two skinks from the province of Yunnan, which appear to represent an undescribed form of the genus *Leiolopisma*, nearly related to the species occurring in eastern and central China, generally known as *L. laterale* or *L. laterale reevesii*. A skink, evidently belonging to the same group as the above, was described in 1879 by Dr. John Anderson[1] from a single specimen collected at Momien, extreme western Yunnan, under the name *Mocoa exigua*. It has not been recognized since, and Boulenger in his Catalog[2] refers to it doubtfully as a synonym of *L. laterale*. Anderson's description is not explicit enough to settle the question, but the coloration as described seems to be sufficiently different from that of *L. laterale* to permit them being considered synonymous, inasmuch as *M. exigua* is said to have "a dark brown band from the snout along the back to the tail, on which it disappears near the root," while in *L. laterale* and its supposed subspecies the back is pale brown or olive with small scattered dusky spots or lines.

Leiolopisma barbouri, sp. nov.

Like *L. laterale*, but legs much smaller; preanals enlarged; four supraoculars; ear-opening about as large as eye-opening; prefrontals separated from anterior supraocular by frontal; forelegs reach corner of mouth; hind legs less than one half the distance between axilla and groin; 26–28 scale rows.

Type locality.—Yunnan-fu, province of Yunnan, China.

Type.—Mus. Comp. Zoöl., no. 7261; J. Graham, collector.

The paratypes in the National Museum (Nos. 68723–4) are essentially like the type, though, because of their less perfect preservation, the measurements are less reliable. All three specimens are rather pale with a narrow dark brown dorso-lateral line from the rostral through eye to the tip of the tail, bordered above by a still narrower whitish line, these lines being located on the fourth scale row on each side from the middle of the back. Pale area

[1] *Zoological results of the two expeditions to Western Yunnan*, p. 797.

[2] Cat. Liz. Brit. Mus. **3**: 264. 1887.