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CONTENTS

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- A Submarine Design in Tiles *Cover*
By W. H. Southwick
- Aristocrats of Abyssinia *Frontispiece*
- Transplanting a Coral Reef Roy Waldo Miner 273
A Description of the Bahaman Coral Reef Group Soon to Be Opened at the American Museum
- The Ethiopians and Their Stronghold Wilfred H. Osgood 286
The People of Abyssinia and the Rich and Varied Land They Inhabit
- José Frank M. Chapman 299
Two Months from the Life of a Barro Colorado Coati
- In Quest of the Giant Panda Dean Sage, Jr. 309
An Account Describing the Work of the Sage West China Expedition near the Borders of Tibet
- Streamlining — Old and New Harold Ward 321
A Principle Long Practiced by Nature, which Man Has only Recently Begun to Study
- Nesting Days Alfred M. Bailey 331
With the Return of Spring the Bird World Reawakens
- Building a Super-Giant Rhinoceros William K. Gregory 340
The Problems Encountered in Reconstructing the Skeleton of Baluchitherium
- Trailside "Talking" Pools William H. Carr 344
How a Stream and a Series of Pools Have Been Made to Tell Their Own Stories
- Science in the Field and in the Laboratory 352
Current Events in the World of Natural Sciences
- Reviews of New Books 359
Recent Publications for Those Interested in Nature

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Building a Super-Giant Rhinoceros

*The problems encountered in reconstructing from fragmentary remains the skeleton of *Baluchitherium*, a gigantic, prehistoric rhinoceros*

BY WILLIAM K. GREGORY

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*Contrary to a widespread popular belief, scientists are unable to reconstruct an otherwise unknown animal from a single bone. The following article gives some idea of the difficulties encountered even when many bones are available, though the varying sizes of the individual animals from which, in this instance, the bones came, complicated the matter considerably. That they have been able, however, to reconstruct a "new" animal of extraordinary size and unusual interest is obvious. The scientific results of this work are being published by Walter Granger and William K. Gregory in the *American Museum Novitates and Bulletin*. — THE EDITORS.*

EZEKIEL'S vision of the valley of dry bones came again in our days to Henry Fairfield Osborn, who prophesied concerning the valleys of dry bones in Asia. And he sent thither his young men, the keepers of his behemoths and the masters of his leviathans, and they went forth into the desert places. And when they went down into the valleys of the desert, lo, the bones were buried in the rock. And they searched far and near and looked hither and thither, and behold, the valleys were full of bones, and lo, they were very dry. Then the prophet girded up his loins and went down himself after his young men into the valleys of dry bones. And he came upon a small bone by the roadside and he prophesied and said: Thou shalt be called *Eudinoceras*, because thou art the father of all those whose horns are exalted upon their foreheads. And the bone answered and spake unto him, saying: "My lord, thou sayest it." And he prophesied again and said: "Come forth, O bones, from thy rocky sepulchres!" And lo, there was a sound as of many picks and spades and the bones came forth out of the rocks and the bones came together, bone to his bone. And when he had prophesied yet again they stood up upon their feet, like unto giants. But the greatest of them all was *Baluchitherium*.

Dropping the parable and coming down

to the dry bones of fact, we may begin our chronicle of *Baluchitherium* with the year 1909, when Mr. C. Forster Cooper, then a graduate student of Cambridge University, came to New York to spend a year studying palæontology at the American Museum of Natural History under Prof. Henry Fairfield Osborn, and caught the vision of the valleys of dry bones in Central Asia. Thus it was that Mr. Forster Cooper was willing to risk exposing himself to the usually accurate marksmanship of the vigilant tribesmen of Baluchistan for the sake of opening up to science their undiscovered palæontological treasures.

Accordingly in 1910 and 1911 he made two journeys into Baluchistan and succeeded in finding and bringing out a number of new and important fossils, including the jaws of some very large extinct species of rhinoceros and a few bones of truly Titanic size and unknown provenance. The enormous atlas vertebra of this form somewhat resembled that of a horse and so did the middle bone of the forefoot. The astragalus, or pulley-bone of the ankle, however, was more like that of a rhinoceros, while the huge thigh bone in some ways suggested that of an elephant. Most remarkable of all, the sixth vertebra of the neck was so big that, when boxed, it made a full load for a camel. Although in some features re-

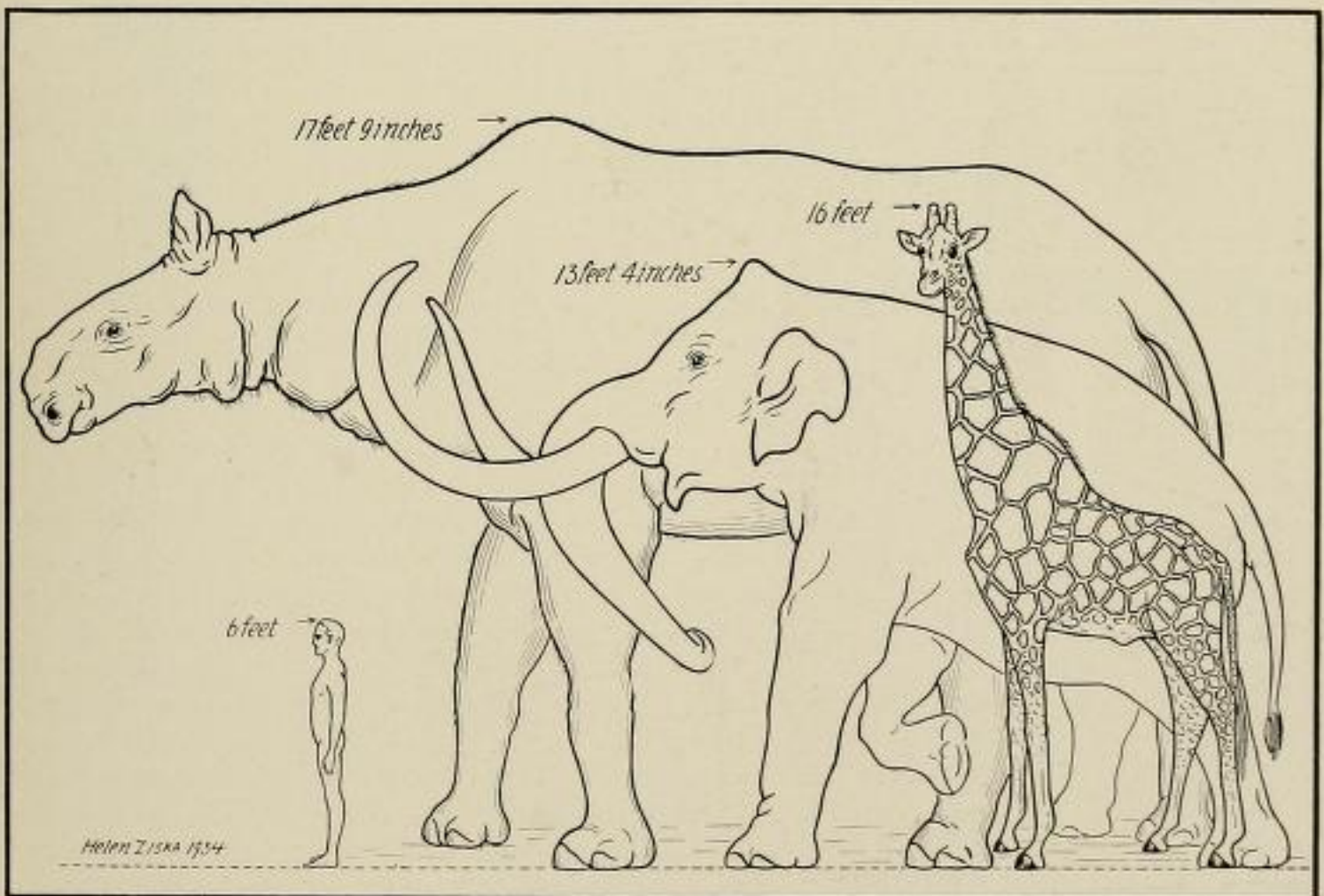
sembling that of a horse, it had great "caves" on either side of the centrum, or basal portion, beneath the tunnel for the spinal cord. This was a feature hitherto unknown in the vertebræ of mammals but common in the vertebræ of the huge sauropod dinosaurs. Mr. Cooper considered these "caves" as adaptations to secure lightness combined with strength, and they were obviously not indicative of relationship with dinosaurs.

On the basis of these and other facts he rightly concluded that he had discovered a new member of the ancient and honorable order of Perissodaetyla (odd-toed hoofed mammals, including tapirs, rhinoceroses, and horses); but he believed at that time that the giant was also quite distinct from the rhinoceroses although perhaps remotely allied with them.

Since it was his well-earned right to give

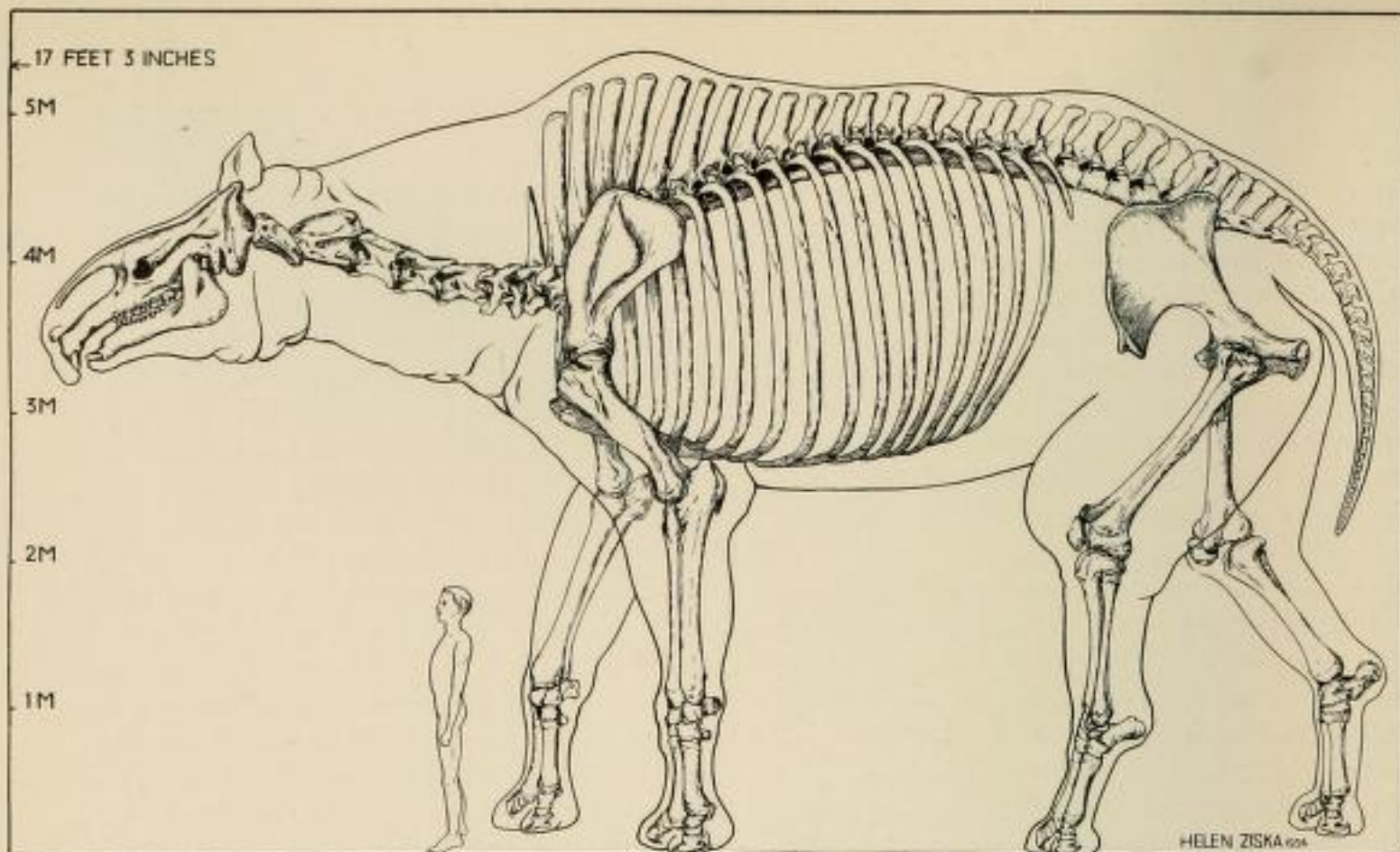
a name to this extraordinary animal, he named it *Thaumastotherium osborni*, literally "Osborn's Wonder Beast," in honor of his friend and teacher. It was soon pointed out to him, however, that the name *Thaumastotherium* had already been "preoccupied" for another fossil and was therefore unavailable according to the rules of nomenclature. He accordingly changed the name of the genus to *Baluchitherium*, the species remaining as before.

In 1914 a Russian soldier who was also a student of geology discovered some Titanic fossil bones in Turgai, a part of Russian Turkestan, and these were eventually collected and set up in the Moscow Museum and described under the name *Indricotherium asiaticum* in 1915, 1922, by Professor Borissiak. This material included a palate with well preserved premolars and molars, which showed beyond doubt that *Indrico-*



A Comparison

This drawing, made to scale, shows the comparative outlines of the largest *Baluchitherium* (as restored), the largest fossil elephant (*Archidiskodon maibeni*), and a large modern giraffe. Drawn by Mrs. Helen Ziska



The restoration of the skeleton of Baluchitherium, as completed by Walter Granger and William K. Gregory. Drawing by Mrs. Helen Ziska



The small bone shown at the left in the photograph above is the middle metacarpal bone from a modern white rhinoceros. The others are the corresponding bones from a small, a large, and a super-giant Baluchitherium. The largest of these is twenty-five inches in length

therium was a giant rhinoceros, related more or less closely to the earlier hornless rhinoceroses of North America. Later evidence indicated that *Indricotherium* is at least closely related to *Baluchitherium* but the crown pattern of its fourth upper premolar is slightly more complex.

In 1922-30 the Central Asiatic Expedition under the leadership of Roy Chapman Andrews, with Walter Granger in charge of palæontology, found many scattered bones of *Baluchitherium* at various places in the Gobi Desert. The most outstanding find was an incomplete skull, about four feet, three inches, in length, which was described by Professor Osborn in the American Museum *Novitates* (No. 78, May 25, 1923). In this article a preliminary sketch restoration of the skeleton was attempted, in which Forster Cooper's specimens of neck vertebrae and limb bones were combined with the new skull. The rest of the backbone was conjectural, as well as the length of the neck, the height at the shoulder, and the total length of the animal.

In 1933, when the last of the huge *Baluchitherium* bones had been cleared of the matrix, Professor Osborn generously placed the entire collection in our hands for comparative study, together with casts of the most important specimens of Forster Cooper's and Borissiak's material, which had been presented to this Museum in exchange for casts of our skull. We also had constantly before us the well illustrated memoirs of Forster Cooper and Borissiak. Our special purpose was to gain a more accurate knowledge of the skeleton as a whole and to attempt still another provisional restoration of the skeleton which may serve until future discoveries make possible closer approximations to finality.

For nearly a year we struggled with this problem of evolving a consistent restoration of the skeleton out of many odd lots of bones belonging to what, for the sake of simplicity, we finally graded as sizes I, II, III, IV, in descending order. We found eventually that if we multiplied the length of a given bone of No. IV size by 1.4, it would equal the known length of a corresponding bone of No. I size, and that even our No. II grade bones had to be en-

larged by 20 per cent to fit with our No. I bones. All the drawings of the individual bones were made to one fifth natural size and the smaller grades were then enlarged by the appropriate factor. But, when all this was done, we still had to make hypothetical restorations of a good many of the vertebrae, we had to determine the probable height of the animal at the shoulders, the length of the neck, the distance between the fore and hind limbs in the standing pose, the height at the pelvis, and many other important measurements. Literally scores of trials were made, checked back and forth against the available facts and then rejected or modified. In other words, the method of trial and error was followed through long and often discouraging months. A less willing and indefatigable artist than Mrs. Helen Ziska would have balked at filling many portfolios with trial drawings, while a less skillful artist could not have fitted together so convincingly the drawings of bones of originally different sizes.

In the later stages of the restoration we began to pay attention to the probable outlines of the body, with due regard to certain given anatomical landmarks that were visible in the bones. Here we reasoned that since the teeth and many individual bones show that we have to do with a fairly primitive rhinoceros, it is highly likely that the skin characters and even general contours were at least distinctly suggestive of a generalized rhinoceros type, but with long limbs and a relatively small head. In fact, our restoration is more definitely rhinoceros-like in almost every feature than were the restorations either of Borissiak or Osborn.

In conclusion, we expect to hear even many times more the oft-quoted remark of the farmer who said of the giraffe, "There ain't no such animal." And we likewise expect to be told that the head in our restoration is impossibly small, the neck not long enough to reach the ground, the scapula absurdly small, and so forth *ad lib!* But although welcoming constructive criticisms, we respectfully invite qualified critics to spend a year or two in making a new and better restoration from the same material.