A NEWLY MOUNTED SKELETON OF THE ARMORED DINOSAUR, STEGOSAURUS STENOPS, IN THE UNITED STATES NATIONAL MUSEUM.

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INTRODUCTION.

The Stegosaurs were by reason of their large size, and ornate dermal structure the more striking and characteristic of the large reptilia that inhabited the northern hemisphere in Morrison time. It should be said, however, that the family Stegosauridae is not confined exclusively to North America, for specimens have been found in England, France, and German East Africa that are but little unlike the American representatives. At this time the origin of the family is not known, though it is now generally believed that the Stegosaurs had a bipedal ancestry, and that increasing bulk and development of the dermal armor caused them to lose celerity of movement, thus becoming sluggish, slow-moving quadrupedal creatures of low mentality.

By the measurement of the brain cavity in the skull of *Stegosaurus* it is found that the brain displaces but 56 cubic centimeters of water and has an estimated weight of about 2½ ounces. This small organ directs the movements of a creature estimated to weigh several tons, while the average normal human brain has a capacity of 900 cubic centimeters in a creature weighing from 130 to 150 pounds.

The most remarkable feature of the nervous system of this great brute, however, is the enormous enlargement of the spinal cord in the sacral region, which has a mass of more than 20 times that of the puny brain. At best the intelligence of this animal was of the lowest order, hardly more than sufficient to direct the mere mechanical functions of life.

While the horned-dinosaurs, with skulls from 7 to 9 feet long, were the largest headed land vertebrates the world has ever known, the Stegosaurs are the smallest-headed when the great bulk of the body is taken into consideration. The jaws are provided with a dentition, made up of teeth so small and weak as to be always a source of won-

der and conjecture as to the real character of their feeding habits. They would at least appear to indicate that their food consisted of the most succulent of terrestrial plants. The structure of the large, broad feet suggests they were land-haunting, doubtless of low, swampy regions rather than the upland, and such an environment would be the more natural place to find the soft plant life necessary for their sustenance. In addition to the small head, the great difference in the proportions of the fore and hind legs, the one most striking external feature of *Stegosaurus*, is the unusual development of the skin armor, consisting as it does of two parallel rows of erect alternating bony plates that extend from back of the skull on either side of the midline of the back nearly to the end of the tail; the tail being armed near the tip with two pairs of large bony spikes or spines. There is also a considerable number of small rounded bony ossicles that in life were held in the skin and probably formed a mail-like protection to the head and neck. The primary purpose of this armor must have been for defense, probably protective to the extent of giving the animal a most formidable appearance rather than actually useful as an offensive instrument.

While the fossil remains of these animals are not uncommon in our museums, they consist for the most part of the scattered and disarticulated bones of the skeleton. Only rarely have fairly complete skeletons been found and hitherto there has existed in our museums but one mounted skeleton, that of the Yale University Museum in New Haven, Connecticut, although now dismantled due to the tearing down of the old museum building preparatory to the erection of a new and more spacious institution.

THE MOUNTED SKELETON OF STEGOSAURUS STENOPS.

Thus the recent addition to the exhibition collection of the section of Vertebrate Paleontology in the United States National Museum of a mounted skeleton of *Stegosaurus stenops* makes it the only skeleton of *Stegosaurus* now on exhibition. Photographs as it appears in the exhibition hall are reproduced in plates 57–61.

The present specimen is a composite skeleton—that is, made up of the bones of more than one individual—but by following the type of the species (No. 4934, U.S.N.M.) the most perfect single skeleton known, as a guide, it is believed the mounted specimen gives a very accurate conception of the skeletal structure of this animal. It is based primarily on a specimen (No. 6531, U.S.N.M.) consisting of the nearly complete articulated tail, sacrum, the greater number of the dorsal vertebrae, pelvis, numerous ribs, and dermal plates. The other bones introduced are from individuals found in the same deposit of fossils, known to the collectors as "Quarry 13," located about 8 miles east of the famous Como Bluff in Albany County,

Wyoming. None of the bones used in the mount were found more than 90 feet distant in the quarry from No. 6531, which forms the basis of the mount. It is quite possible that some of these bones may have originally belonged to that skeleton. A considerable number of elements for which bones of the proper size and proportions were not available have been restored. As is customary the restored portions were given a color sufficiently distinctive to make them easily recognized from the originals.

The skeleton as mounted measures 14 feet 9 inches in length between perpendicular uprights and 7 feet 11 inches high from the base to the top of the dermal plate above the hips. The Yale specimen is much larger, being 19 feet 5 inches long, and 11 feet 10½ inches from the base to the top of the highest plate. The much smaller size of the specimen in the United States National Museum may be attributed not only to its pertaining to a smaller species but also to the fact that the bones composing it were of individuals which had not reached their maximum development.

The actual articulation of the skeleton brings out some features in the proportions of the animal that would hardly be appreciated in a study of the individual bones. The wide hips (see pl. 60), necessitating a corresponding expansion of the posterior thoracic ribs, the flat-sided anterior half of the body (see pl. 59), the rapidly drooping tail, the pose being clearly indicated by the wedge-shaped centra of the anterior caudals. In the latter respect this mount is in striking contrast to the Yale specimen, which has the tail high above the ground. It was particularly gratifying to find that when the dermal plates were properly spaced above the backbone that the number required was in close agreement to an earlier expressed opinion [1] "that there are not more than 18 in the complete series of flat plates." In this specimen 19 were required to complete the two rows, and it would now appear that, allowing for some variation within the individual, there could not have been less than 18 or more than 20 plates in the complete series. The greatest uncertainty yet exists as to the exact number of cervical vertebrae. In the present mount the first 12 vertebrae are considered as belonging to the neck, thus leaving 15 of the 27 presacrals as pertaining to the thoracic region. While the type of *S. stenops* has a complete presacral series present, unfortunately those at the junction of the neck with the body are so crushed as to render them valueless for determining this important point. The cervical ribs are also partially unknown and it is not at all certain that as restored from scattered elements they represent the true shape or show the exact transition in form from the first to the last.

[1] Gilmore, C. W., Proc. U. S. Nat. Mus., vol. 49, 1915, p. 355.

The other anatomical details of the skeleton of *Stegosaurus* have been so fully covered in an earlier paper[1] that no notice of them need be taken here except to mention that the digital formula of the forefeet is still in doubt. Following fragmentary evidence in the form of several incomplete feet in the collections, they were restored, as follows: Digit I, two phalanges; digit II, three phalanges; digit III, four phalanges; digit IV, three phalanges; and digit V, two phalanges. Digits I and II being terminated by broad, flat, hooflike unguals; the other three digits terminated by short but transversely expanded elements which in life were doubtless inclosed entirely within the muscular mass of the foot, thus giving but little, if any, external indication of their presence.

The fossil bones used in this mount were largely prepared by N. H. Boss, preparator in the section of vertebrate paleontology, who also modeled many of the missing parts. The actual mounting of the skeleton is the work of Thomas J. Horne, preparator in the same section, who is to be highly commended for the skill displayed in overcoming the many difficult mechanical problems presented. The inconspicuousness of the framework of iron necessary to support these fragile, though heavy bones shows for itself the highly skilled character of the work. For the pose of the skeleton and whatever anatomical discrepancies may be found I alone must be held responsible.

Many of the bones used in the mount are described and figured in Bulletin 89, United States National Museum, these being indicated in the appended list of bones used in the mount.

Measurements of skeleton.

Length between perpendiculars	14 feet 9 inches.
Length of tail between perpendiculars	8 feet.
Greatest width of hips	3 feet 2 inches.
Greatest height to top of highest plate	7 feet 11 inches.
Greatest width of shoulders	2 feet 10.5 inches.
Height of shoulders	2 feet 11 inches.
Height of elbow	1 foot 8 inches.
Height of hip	4 feet 10.5 inches.
Height of knee	2 feet 4 inches.

THE STEGOSAURUS EXHIBIT IN THE UNITED STATES NATIONAL MUSEUM.

In 1904 a natural size life restoration of *Stegosaurus stenops* Marsh (see pl. 62), formed a part of the United States National Museum exhibit at the World's Fair held in St. Louis during that year. At the close of the fair it was returned to Washington and there made a part of the exhibition series of the Section of Verte-

[1] Gilmore, C. W., Bull. 89, U. S. Nat. Mus., 1914.

brate Paleontology. This restoration was an enlargement to life-size of a small statuette modeled by Charles R. Knight, the well known artist and animal sculptor. Although according to our present knowledge of the skeletal anatomy it is now known to be inaccurate in some respects, taken all in all it presents a most striking picture of the supposed life appearance of this curious animal.

In 1913 the type-specimen of *Stegosaurus stenops* Marsh the most perfect skeleton known was prepared for exhibition. This skeleton as now displayed (see pl. 61), shows the precise relative position of every bone as originally found. Some important parts are missing, such as the distal half of the tail, hind feet, and some minor bones, yet it is by far the most perfect example of a *Stegosaurus* skeleton that has yet been discovered. The retention of the greater number of the dermal plates in their original relationship makes the specimen invaluable as a guide for the proper articulation of these puzzling elements in subsequently discovered specimens.

Although some bones are missing and others are slightly disarranged the position of the skeleton (see pl. 61) is that of an animal which died a natural death, for such disarrangement as exists can be attributed to the natural shifting of the bones rather than to their having been torn apart by any of the contemporary predatory carnivores.

This exhibit of Stegosaurian specimens is now made complete by the recent addition of the mounted skeleton previously described, and the arrangement in the exhibition hall of these important specimens as now displayed, is well shown in the reproduced photograph (pl. 61). The three specimens—i. e., the mounted skeleton, the skeleton in relief, and the life-sized restoration—constitute a most comprehensive and interesting exhibit of this curious dinosaur.

It is further supplemented by a small model (see pl. 63) restoration which I prepared in 1915 of *S. stenops* one-twelfth natural size, based on the type of that species. In this model was incorporated all of the evidence relating to its external appearance, accumulated during several years study of a large series of Stegosaurian remains. It was particularly gratifying to find, after mounting the actual skeleton, that but slight changes were suggested as necessary either in the proportions or pose of the model.

When compared with the earlier restoration made by Knight (compare pls. 62 and 63), certain differences are to be observed. The most important of these is a shortening of the body, thus bringing the fore and hind limbs closer together; a reduction in the number of erect skin plates; the transposition of the largest plate of the series from above the hips to a point above the base of the tail; a reduction in the total length of the head, and the changing of its flat upper surface to a slightly convex contour which is more in

conformity with the evidence furnished by several skulls of this animal now in the collections. Finally, the digits are represented as being terminated by flattened hoof-like nails rather than by elongated slightly curved claws as shown in plate 62.

The above corrections incorporated in this latest restoration (pl. 63) effect a considerable change in the proportions and general aspect of this reptile, and were only made possible by the discovery of better preserved specimens and the study of considerably greater number of individuals than were available at the time Knight made his restoration of this animal. It is to be expected that future discoveries will bring about still further modifications in our present conception of the life appearance of *Stegosaurus*.

List of bones used in the mounted skeleton of Stegosaurus stenops. No. 8612, U. S. N. M.

Bones used.	Catalogue numbers U.S.N.M.	Field numbers.	Diagram number.
Skull	4935	Sk 4 180	4
Right dentary	4935	Sk 4 180	4
Atlas	4935	Sk 4 180	4
*Axis	4935	Sk 4 180	4
*Tenth cervical vertebra	7348	123	4
*First dorsal vertebra	6531	59	13
Second dorsal vertebra	6531	60	13
*Third dorsal vertebra	6531	61	13
Fourth dorsal vertebra	6531	.....	13
Sixth dorsal vertebra	6531	.....	13
Seventh dorsal vertebra	6531	.....	13
Eighth dorsal vertebra	6531	.....	13
Ninth dorsal vertebra	6531	66	13
*Eleventh dorsal vertebra	6531	.....	13
Twelfth dorsal vertebra	6531	.....	13
Thirteenth dorsal vertebra	6531	.....	13
Sacral vertebrae	6531	19	11
Fifth caudal vertebra	6531	17	11
Sixth caudal vertebra	6531	27	11
Seventh caudal vertebra	6531	28	11
Eighth caudal vertebra	6531	29	11
Ninth caudal vertebra	6531	30	11
Tenth caudal vertebra	6531	31	11
Eleventh caudal vertebra	6531	32	11
Twelfth caudal vertebra	6531	33	11
Thirteenth caudal vertebra	6531	34	11
Fourteenth caudal vertebra	6531	35	11
Fifteenth caudal vertebra	6531	36	11
Sixteenth caudal vertebra	6531	37	11
Seventeenth caudal vertebra	6531	38	11
Eighteenth caudal vertebra	6531	39	11
Nineteenth caudal vertebra	6531	40	11
Twentieth caudal vertebra	6531	41	11
Twenty-first caudal vertebra	6531	42	11
Twenty-second caudal vertebra	6531	.....	11
Twenty-third caudal vertebra	6531	.....	11
Twenty-fourth caudal vertebra	6531	45	11
Twenty-fifth caudal vertebra	6531	46	11
Twenty-sixth caudal vertebra	6531	.....	13
Twenty-seventh caudal vertebra	6531	.....	13
Twenty-eighth caudal vertebra	6531	.....	13
Twenty-ninth caudal vertebra	6531	.....	13
Thirtieth caudal vertebra	6531	.....	13
Thirty-first caudal vertebra	6531	.....	13
Thirty-second caudal vertebra	6531	.....	13
Thirty-third caudal vertebra	6531	.....	13
Thirty-fourth caudal vertebra	6531	.....	13
Thirty-fifth caudal vertebra	6531	.....	13
Thirty-sixth caudal vertebra	6531	.....	13
Thirty-seventh caudal vertebra	6531	.....	13
Thirty-eighth caudal vertebra	6531	.....	13
Thirty-ninth caudal vertebra	6531	.....	13
Fortieth caudal vertebra	6531	.....	13
Forty-first caudal vertebra	6531	.....	13

List of bones used in the mounted skeleton of Stegosaurus stenops. No. 8612, U. S. N. M.—Continued.

Bones used.	Catalogue numbers U.S.N.M.	Field numbers.	Diagram number.
Forty-second caudal vertebra	6531	.....	13
Forty-third caudal vertebra	6531	.....	13
Forty-fourth caudal vertebra	6531	.....	13
Forty-fifth caudal vertebra	6531	14	13
Dermal plates:			
No. 1	7615	197	4
*No. 2	7615	196	4
No. 3	7383	47	7
*No. 4	7615	185	4
*No. 6	7584	211	4
No. 7	7584	212	4
*No. 8	7584	209	4
No. 9	7584	208	4
No. 10	7584	210	4
No. 11	7584	9	5
No. 12	7584	207	4
No. 13	4714	43	7
No. 15	6521	82	11
No. 16	6531	45	13
No. 17	6531	47	11
No. 18	6531	20	13
No. 19	6531	43	11
Dermal spines:			
Nos. 1 and 2	6531	18, 17	13
Nos. 3 and 4	6531	15, 16	13
Femur, right	7380	12	5
Femur, left	4929	216	4
Tibia, right	7380	75	5
Tibia, left	.....	.....	.....
Fibula, right	7380	27	5
*Fibula, left	7389	161	7
Scapula, right	7361	96	5
*Scapula, left	4929	184	4
Coracoid, right	7361	96	5
Coracoid, left	2112	197	7
Humerus, right	4929	212	7
Humerus, left	4929	183	4
Ulna, right	4929	202	7
Ulna, left	4929	150	4
Radius, right	4929	16	8
Radius, left	4929	149	4
Illum, right	6531	79	13
Ilium, left	6531	79	13
Pubes, right	6531	111	13
Pubes, left	6531	49	13
Ischium, right	6531	51	13
Ischium, left	6531	54	13
Calcaneum, right	7397	179	7
*Metatarsals I, II, and III, right foot	4280	77	5
Metatarsals I, II, and III, left foot	7349	.....	.....
*Proximal phalanx, digit I, right foot	4280	77	5
Proximal phalanx, digit I, left foot	7612	.....	.....
Ungual phalanx, digit I, right foot	7369	74	5
Ungual phalanx, digit I, left foot	7782	105	7
*Proximal phalangials, digits II and III, right foot	4280	77	5
*Proximal phalanx, digit II, left foot	7349	.....	.....
Ungual phalanx, digit II, right foot	7366	115	7
Ungual phalanx, digit II, left foot	7736	72	7
*Ungual phalanx, digit III, right foot	4280	77	5
Ulnare, left	4929	201	4
Metacarpals, I. IV, and V, left	4929	201	4
Metacarpal, I, right	7764	214	7
Proximal phalanx, digit I, left foot	736	3	5
Third cervical rib, left	.....	.....	.....
First dorsal rib, left	7411	25	13
Second dorsal rib, right	7411	16	11
Second dorsal rib, left	6531	76	13
Third dorsal rib, left	7731	156	4
Fifth dorsal rib, right	7411	23	13
Sixth dorsal rib, left	7809	203	7
Sixth dorsal rib, right	6531	7	13
Seventh dorsal rib, right	6531	75	13
Seventh dorsal rib, left	6531	.....	13
Eighth dorsal rib, left	6531	51	13
Eighth dorsal rib, right	7731	158	4
Ninth dorsal rib, left	7731	171	4
Fifteenth dorsal rib, right	6531	.....	13
Sternal bone, right	6531	87	13

* Those elements marked with an asterisk indicate they were figured in Bulletin 89, U.S.N.M. 1914.

When numbers are missing in the above series of vertebrae, ribs, etc., it indicates that those bones were entirely restored.

The position of the bones as found in the quarry may be determined by referring to the quarry map published as plate 37 in Bulletin 89, U. S. National Museum 1914.

EXPLANATION OF PLATES.

PLATE 57.

Mounted skeleton of *Stegosaurus stenops* Marsh. About 1/28 natural size. Viewed from the right side.

PLATE 58.

Mounted skeleton of *Stegosaurus stenops* Marsh. About 1/20 natural size. Oblique view of right side.

PLATE 59.

Mounted skeleton of *Stegosaurus stenops* Marsh. About 1/14 natural size. Viewed from the front.

PLATE 60.

Mounted skeleton of *Stegosaurus stenops* Marsh. About 1/14 natural size. Viewed from the back.

PLATE 61.

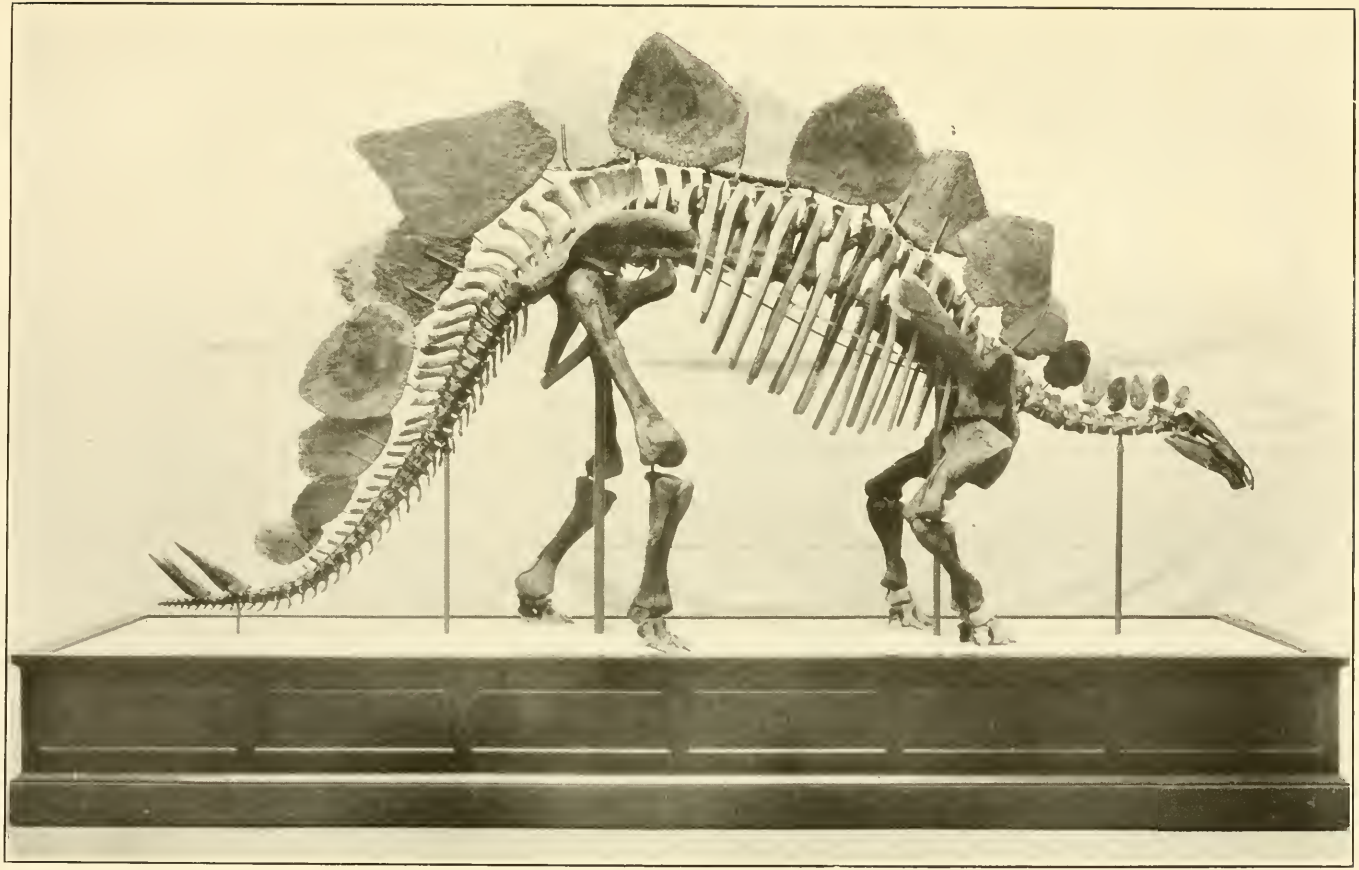
View of the Stegosaurus specimens as exhibited in the United States National Museum. 1. Mounted skeleton No. 8612. 2. Type of *Stegosaurus stenops* No. 4934, shown as found. 3. Life-sized restoration of *Stegosaurus stenops* No. 5794. Viewed from above. All about 1/63 natural size.

PLATE 62.

Life-sized restoration of *Stegosaurus stenops* in United States National Museum No. 5794. Oblique view of the left side. Original modeled by Mr. Charles R. Knight in 1903.

PLATE 63.

Model restoration of *Stegosaurus stenops* Marsh. About 1/27 natural size. Modeled by Charles W. Gilmore, 1915. Based on the type and other specimens in the United States National Museum.

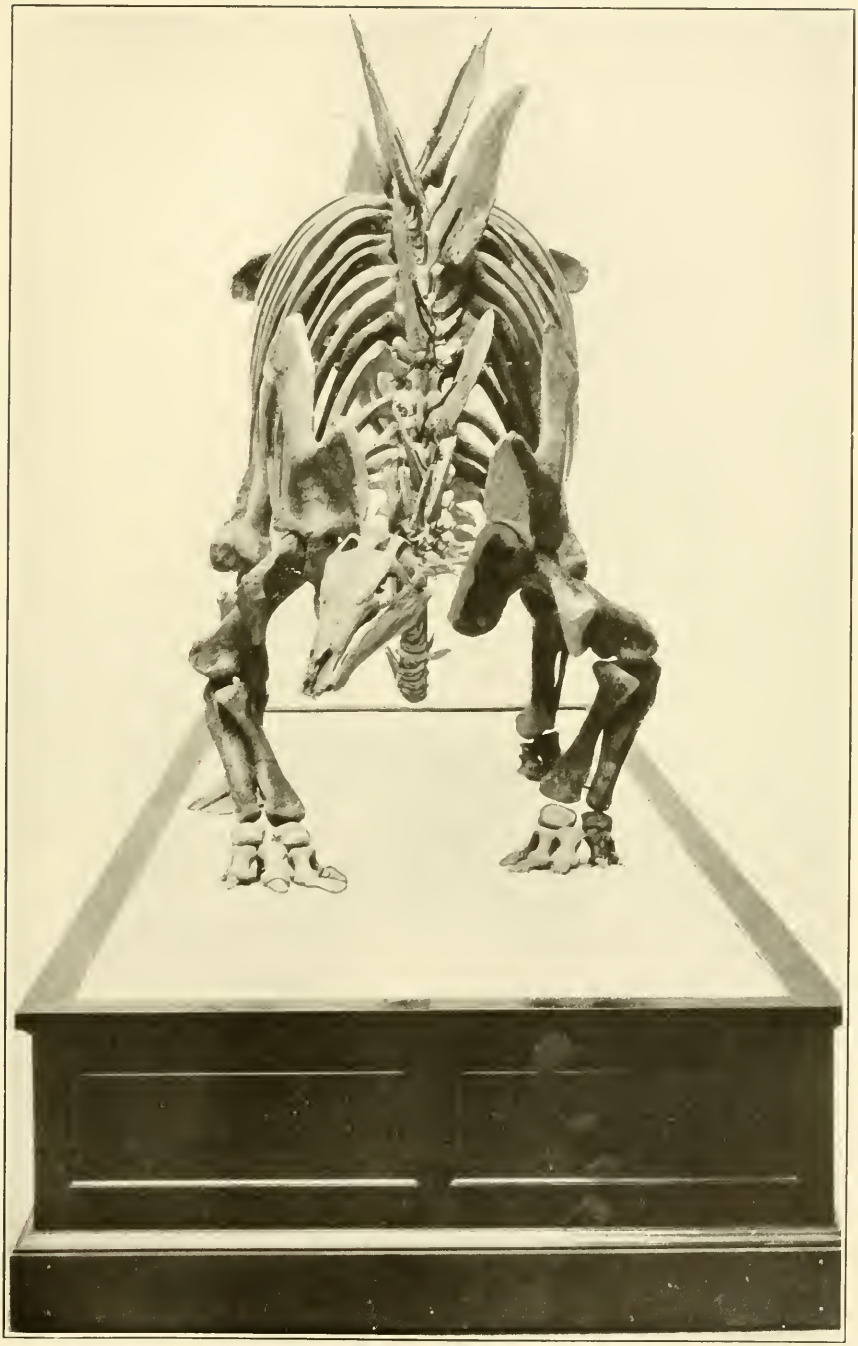


SKELETON OF STEGOSAURUS STENOPS, FROM THE RIGHT SIDE

FOR EXPLANATION OF PLATE SEE PAGE 390

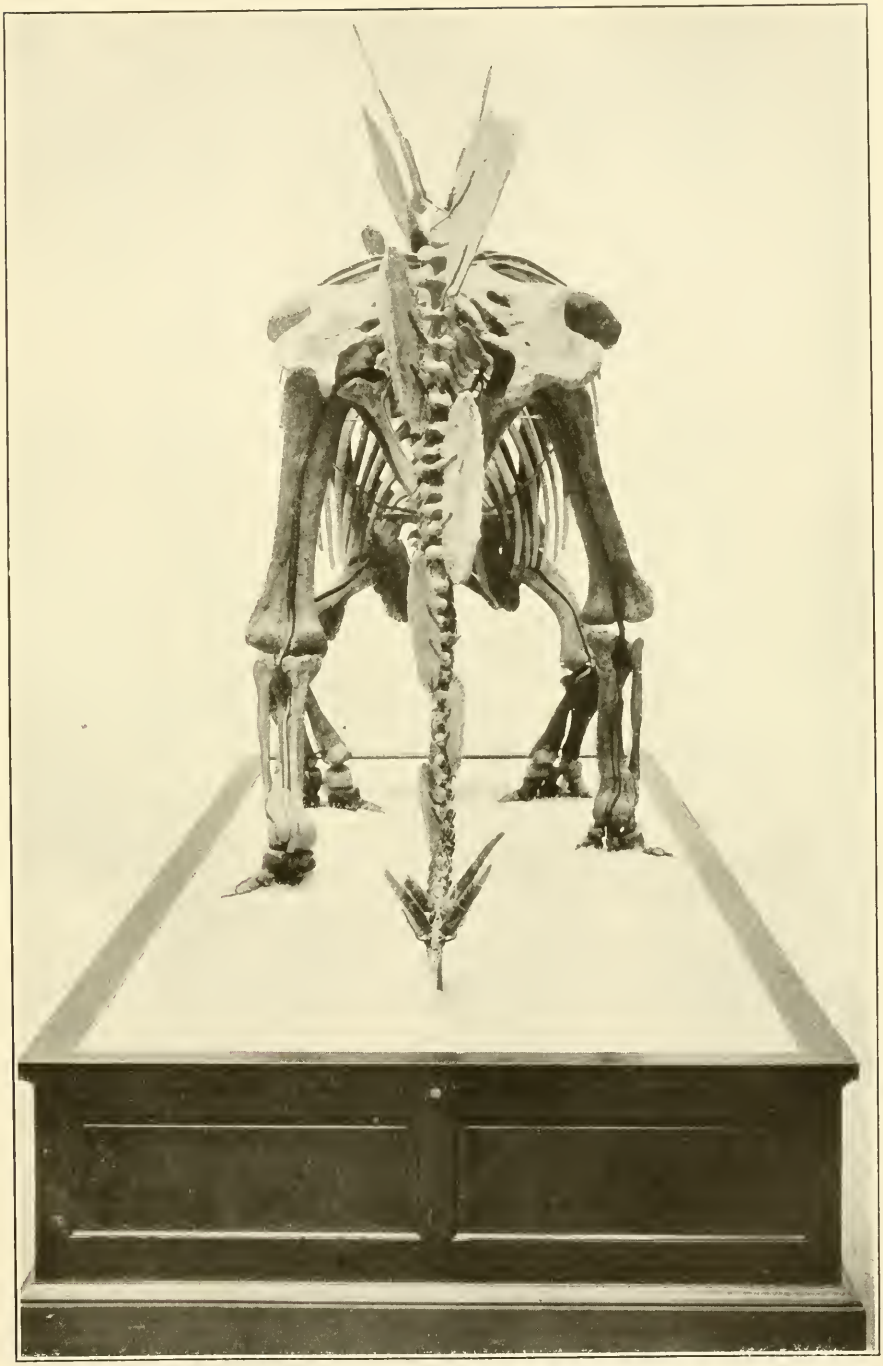
SKELETON OF STEGOSAURUS STENOPS, OBLIQUE VIEW

FOR EXPLANATION OF PLATE SEE PAGE 390.



SKELETON OF STEGOSAURUS STENOPS, FROM THE FRONT

FOR EXPLANATION OF PLATE SEE PAGE 390



SKELETON OF STEGOSAURUS STENOPS, FROM THE BACK

FOR EXPLANATION OF PLATE SEE PAGE 390.

STEGOSAURUS SPECIMENS AS SHOWN IN THE U. S. NATIONAL MUSEUM

FOR EXPLANATION OF PLATE SEE PAGE 393

LIFE-SIZED RESTORATION OF STEGOSAURUS STENOPS IN THE U. S. NATIONAL MUSEUM

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MODEL RESTORATION OF STEGOSAURUS STENOPS

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