NEW SAUROPODS FROM CHINA

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Introduction

Since the publication of the notes about a new sauropod, *Mamenchisaurus constructus*, from Yiping, Szechuan, many materials of this group of fossils have been secured in the Institute of Vertebrate Paleontology. They are described in the following according to their geographical distribution.

I. Sauropod from Inner Mongolia

1. A single tooth and a fragment of a scapula (Cat. No. V.929). Locality: Outok district in Ikeshaomeng, S. W. Ordos, Inner Mongolia. The exact site is not reported. They are collected by a geological party of the Ministry of Geology in 1956. The scapula is indeterminable. The tooth is also broken but sufficiently preserved to recognize its general shape and structure as shown in the text figure 1. The lingual side is very much

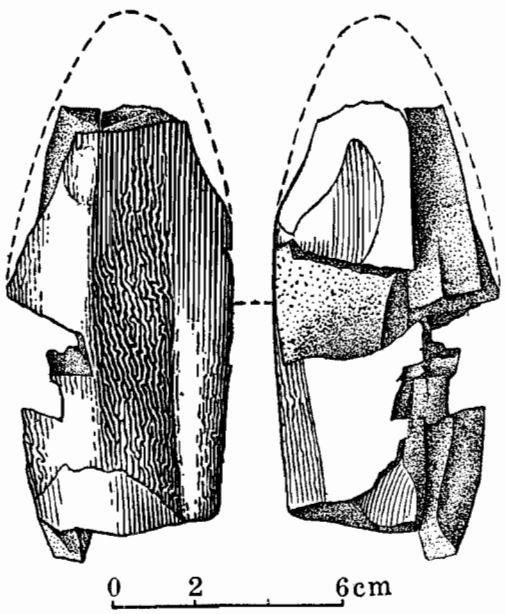
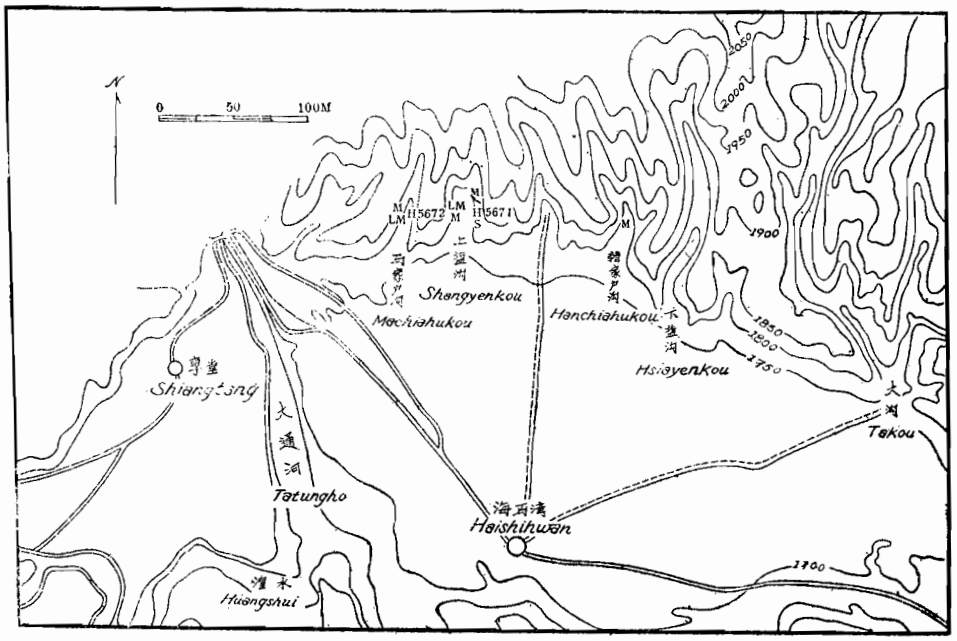


Fig. 1. Sauropoda indet. .Tooth in outer and inner aspects. Locality: Ikeshaomeng S. W. Ordos Inner Mongolia. ×2 nat. size. V 929.

damaged and the labial side shows very fine granulations on the surface. The tip and the root of the tooth are broken. Preserved length 27 mm and the maximum breadth antero-posteriorly 15 mm. Although the tooth is very much damaged, the spatulated shape is well recognizable, characteristic for sauropod. In size and in shape, this tooth shows similarities to the teeth formerly described as cf. *Omeisaurus* from Kuang-yuan. A precise determination is impossible. Age: Cretaceous, according to the field observations. The fossils in question confirm this observation but it is not possible to give a more precise determination on account of the fragmentary nature of the fossils.



甘蘭永登縣紅古城乡海石灣北的化石产地分佈圖

M. 1947年孙鼎初、苗祥庆採集地点 S. 1955年西北石油局民和盆地石油队採集地点
L.M. 1948年米泰俊、刘东生採集地点 H. 1956年黃为龙採集地点

Fig. 2. Map showing the distribution of vertebrate fossils in the area north of Haishihwan, Hungkuchenhsiang, Yungtenghsien, Kansu. After Young, 1948 and modified by Huang. M: locality of Sun and Miao with *Sunosuchus*, 1947; S: Locality by the Petroleum Bureau with remains of *Mamenchisaurus*, 1955; L. M: Locality of Mi and Liu with *Mamenchisaurus*, 1948; and H: Locality by W. L. Huang, 1956 with *Mamenshisaurus*.

The discovery of this site of Cretaceous sauropod marks the first record of saurischian remains in Ordos.

II. Sauropods from Kansu

The presence of a rich sauropodian locality had been already presaged when I made the study of the fossil crocodiles from Haishihwan, Yungteng, Kansu in 1948. Subsequently new materials have been secured from the following sources:—

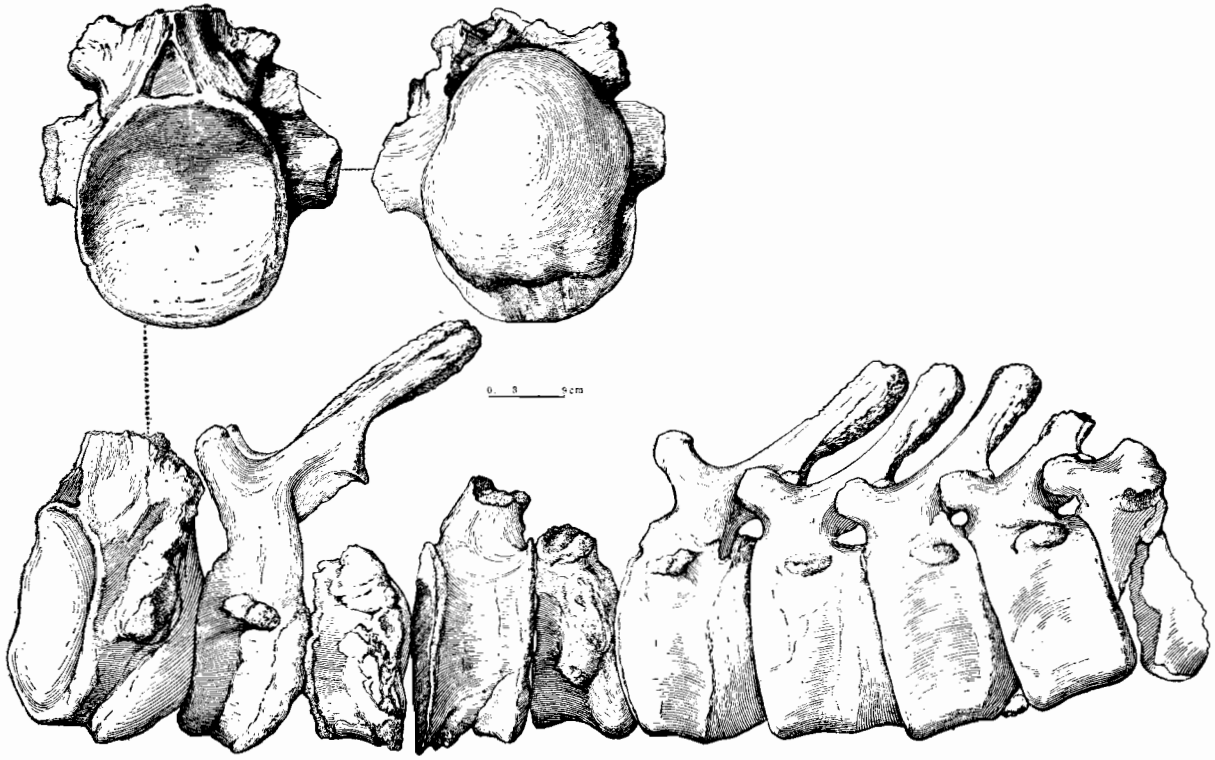


Fig. 3. *Mamenchisaurus constructus* Young. Anterior caudal vertebrae (probably No. 2 to 11) in left side aspect with the first one in anterior and posterior aspects showing the procoelous structure. 1/9 nat. size. Locality: Machiahukou collected by Huang. Field Number 5672. V. 948.

A. There are seven consecutive middle caudal vertebrae, a left humerus, a right radius and a right ulna, a left femur, a left fibula, two left and two right metatarsalia, a claw and many fragments mostly vertebrae and ribs. Field number as M. L. I. 4, 12, 13, 19, 20 etc. Cat. No. V. 946. Locality: Machiahukou N. of Haishiwan.

In addition to the above enumerated fossils from Machiahukou, some fragments of bones of undeterminable nature have been also collected from Shangyenkou immediately east of Machiahukou.

Those fossils have been collected by the late Mr. T. H. Mi and Mr. T. S. Liu, in the autumn of 1948, of a field party sent by the then Laboratory of Vertebrate Paleontology, Geological Survey of China.

B. About ten caudal vertebrae, a right humerus, a left ilium, a right femur, a right tibia and fibula, a broken fibula and a large rib (Cat. No. V. 947) were collected by the North-western Bureau of Petroleum. The etiquette is marked as: Shangyenkou, Haishihwan, Yengteng, Kansu, and is certainly the same locality as that of the other explorers mentioned in the present and previous paper (Young, 1948). It is also almost certain that the right astragalus collected by Huang, 1956, mentioned below was derived from the same level as the specimens enumerated above. We take the pleasure to give our acknowledgment to the above mentioned Bureau for gifting these valuable material to our Institute for study.

C. In the summer of 1956 the Institute of Vertebrate Paleontology sent Mr. W. L. Huang to this area for making additional collection of dinosaurs. The following specimens have been collected:

1. From Machiahukou (apparently the same site as that of Mi and Liu, the field number of the Institute, 5672): part of much damaged sacrum, some ten anterior caudal vertebrae with eleven almost consecutive chevrons, many fragments of vertebrae and ribs, a left scapula, right coracoid and humerus, two metacarpals, a pair ischia, a left femur, a left fibula and tibia (broken), a right astragalus and some foot bones (Cat. No. V. 948).

2. Only a left astragalus from Shangyenkou apparently referable to the skeleton listed above under B (Cat. No. V. 945).

Besides those bones of Sauropoda, a single spine of apparently Stegosauria is collected, with a small vertebra of probably a theropod from Machiahukou.

From the above-mentioned fossils it is clear that we have to deal with three different individuals of partly well preserved skeletons, since we have two left femora present in the site of Machiahukou (the collection of Mi and Liu and that of Huang belong to two individuals) and the specimens from Shangyenkou represent of course another individual. This fact is enough to show how rich it is the sauropodian remains in the Haishihwan region (fig. 2).

Systematically, however, all these remaihs belong to a single species despite the differences in size and minor anatomical characters.

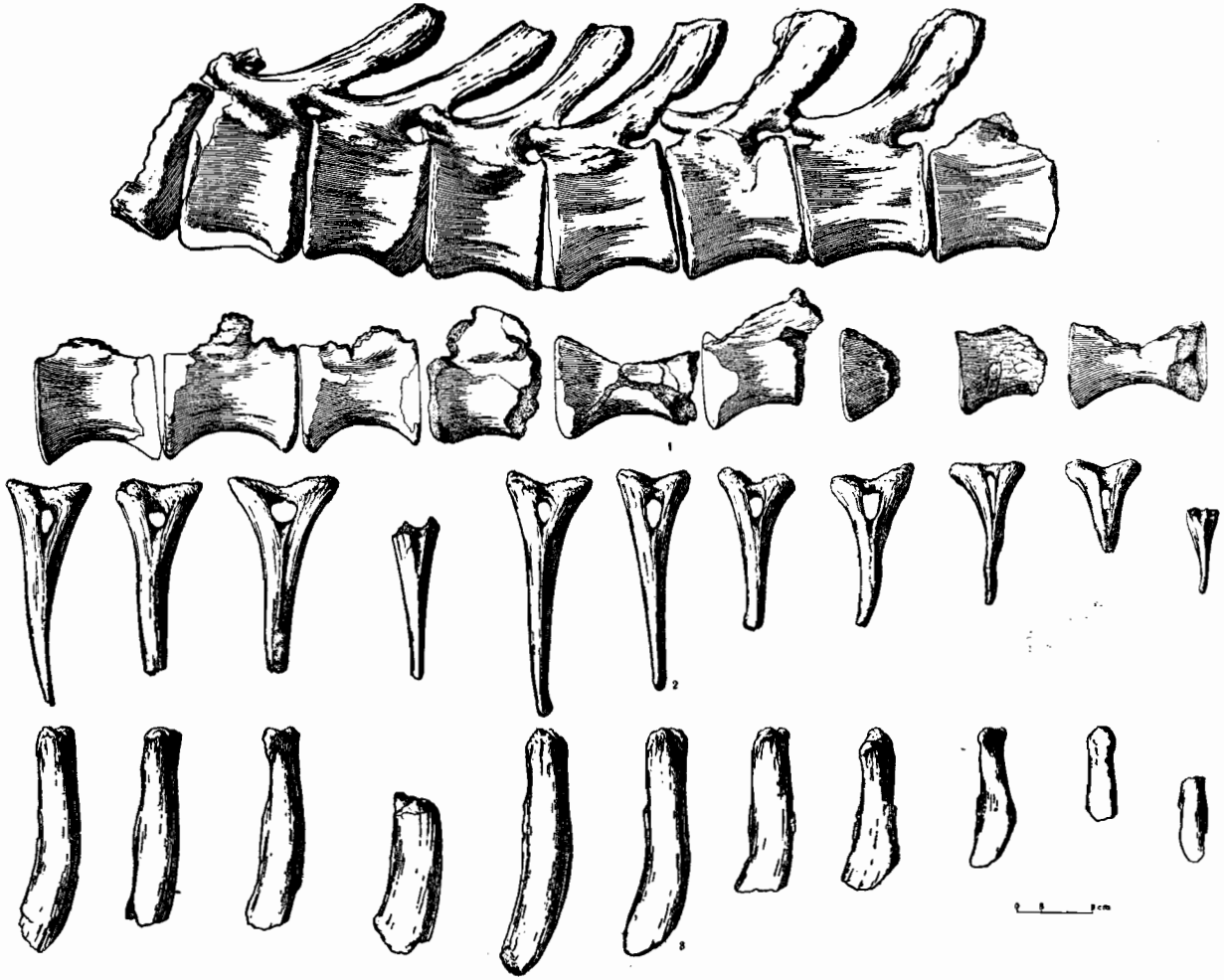


Fig. 4. *Mamenchisaurus constructus* Young. 1, Above: Anterior middle caudal vertebrae collected by Mi and Liu from Machiahukou in left side view. V 946. 1, below: middle caudal vertebrae collected by the Bureau of Petroleum from Shanyenkou. In left side view, V 947. 2. Chevrons collected by Huang in anterior view and 3 in side view from Machiahukou, they are mostly in connection with the anterior caudal vertebrae figured in fig. 3. V 948. All in 1/9 nat. size.

Description

Vertebrae.—The *sacrum*, although present in the collection, is too poorly preserved for an adequate description. It is badly broken into four pieces and impossible to connect them together owing to the fact that many parts are missing.

On the contrary, most of the caudal vertebrae are well preserved. The curious fact is that all those vertebrae derived from different sources and localities seem to compose the most part of the tail without even a single one represented in duplication. The ten anterior caudal vertebrae with the following five in consecutive series represent the anterior part of the tail followed by the seven middle caudal vertebrae collected by Mi and Liu, and the ten posterior caudal vertebrae are collected by the Petroleum Bureau. They are mostly so nicely connected together as if they were really belongihg to the same individual. In the anterior caudal vertebrae, even the chevrons are more or less well represented (Figs. 3 & 4).

Table 1 Measurements of Caudal Vertebrae of *M. Constructus* (in millimeters)

No. of Vert.	Length without the joints	Posterior breadth	Posterior height	Entire height (including spina dorsalis)
1	?82	?244	285	—
2	91	210	229	591
3	?62	232	?238	—
4	?121	245	236	—
5	80	—	205	—
6	127	?129	240	502
7	153	?121	?224	458+
8	152	136	?231	426
9	122	129	?180	344+
10	—	—	178	—
11	—	?128	176	—
12	121	140	177	385
13	126	130	150	359
14	126	140	155	347
15	133	128	158	342
16	135	139	148	297
17	144	116+	135	291
18	146	110+	126+	—
19	143	122	133	—
20	150	120	130	—
21	138	131	133	—
22	?133	—	?106	—
23	166	—	?101	—
24	—	—	—	—
25	—	—	—	—
26	?147	—	—	—

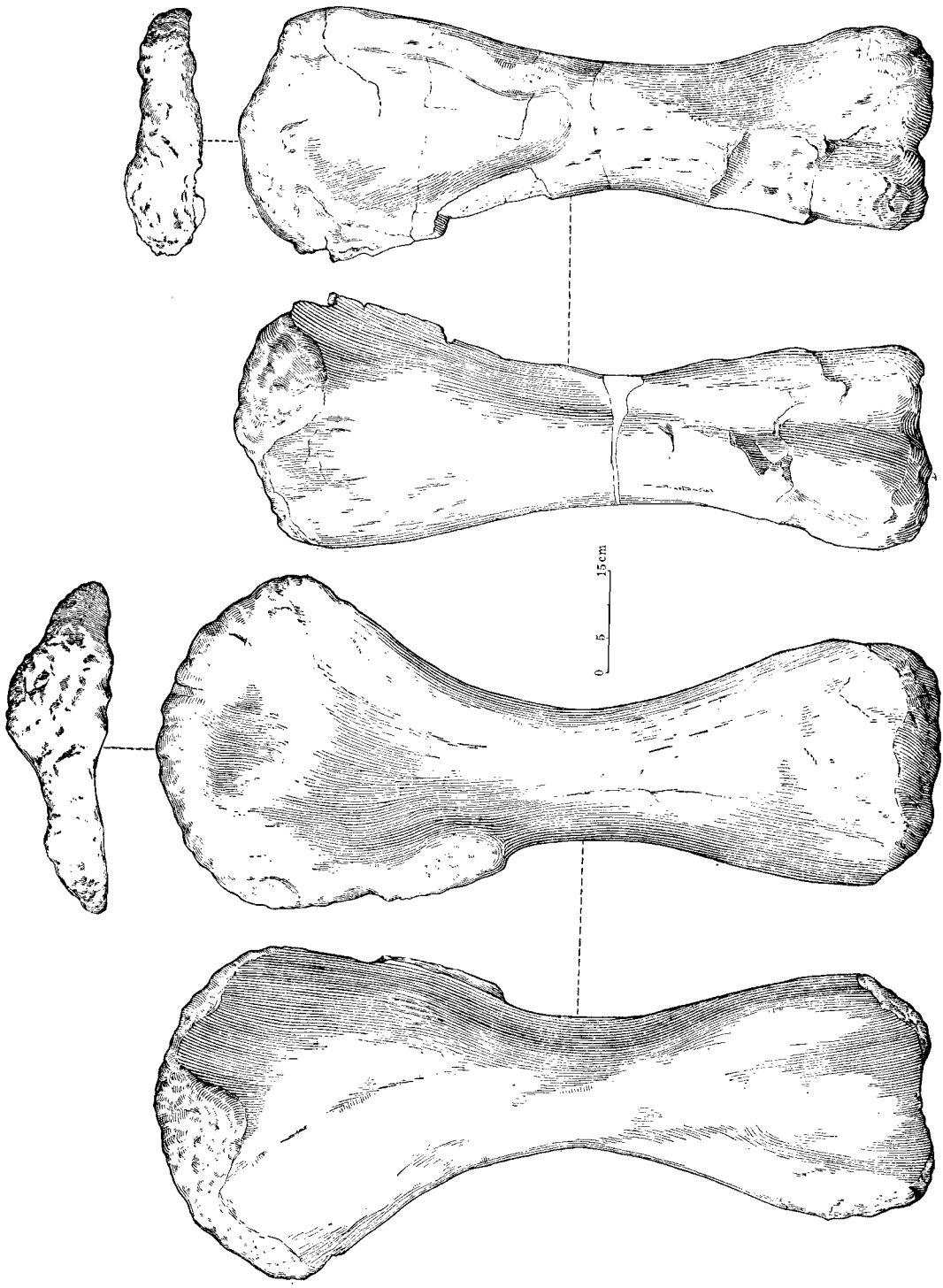


Fig. 5. *Mamenchisaurus constructus* Young. Right (Shangyenkou V 947) and left (Machiahukou V 946) humerus in anterior and posterior aspects with the outline of the distal ends. 1/10 nat. size.

The interesting fact is that the anterior caudal vertebrae are procoelous as that of *Mamenchisaurus* from Szechuan. Since no chevrons of the middle caudal vertebrae are present, it is impossible to know whether they are forked in our present individual too. In *Mamenchisaurus* the forking of the chevron starts from tenth or eleventh vertebra. In this respect there is no difficulty in referring our specimens to this genus anatomically. Our specimens are robuster and larger in size.

Anterior limbs.—The left scapula and right coracoid from Machiahukou collected by Huang are too fragmentary for detailed description. The left humerus collected by Mi and Liu and the right one collected by the Petroleum Bureau as well as the proximal part of a left humerus collected by Huang represent evidently three individuals, since there are two left humeri from Machiahukou (Liu and Mi and Huang worked in the same locality). The humerus, marked as 5672 although incompletely preserved, represents the largest one among the three humeri. The maximum breadth of it exceeds the other two specimens. The humerus collected by Mi and Liu is the smallest one represented thus probably a rather young individual. In anatomical respect there is no need to mention the differences among them but they certainly belong to the same species. The difference compared with that of *Helopus* and *Tienshanosaurus* is not great. The humerus of the type species of *Mamenchisaurus* is unknown (Fig. 5).

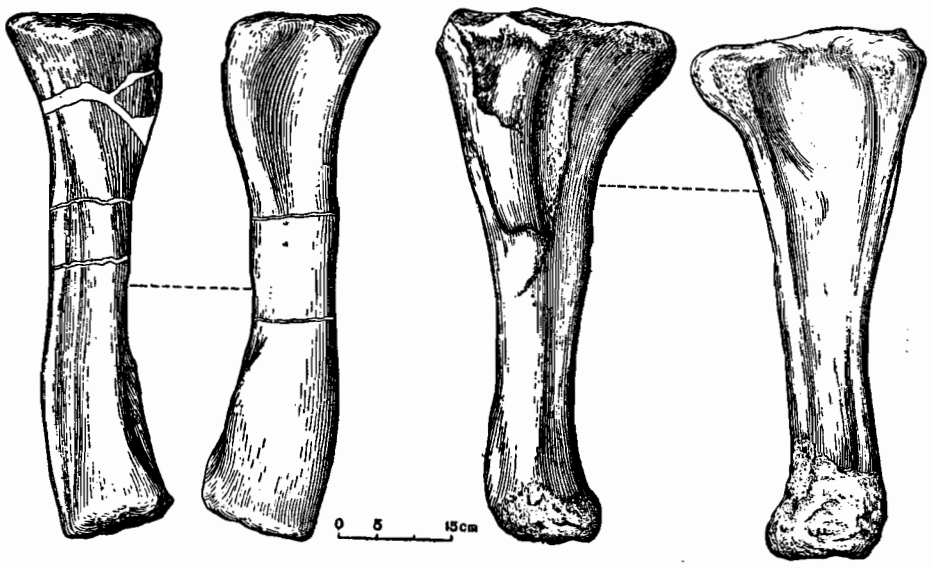


Fig. 6. *Mamenchisaurus constructus* Young. Right radius and ulna in anterior and external views. Locality: Machiahukou. 1/10 nat. size, V 946.

The *lower arm* is only indicated by the right radius and ulna of Mi and Liu's collection. They are well preserved and complete. They may be of the same individual as the left humerus mentioned above. Both bones are subequal in length (the ulna being only five millimeters longer than the radius). The proximal maximum expansion of the ulna is extremely expanded, being only a little less than the half of the total length of the bone. Both bones represent the only complete specimens among all known sauropods in China (Fig. 6).

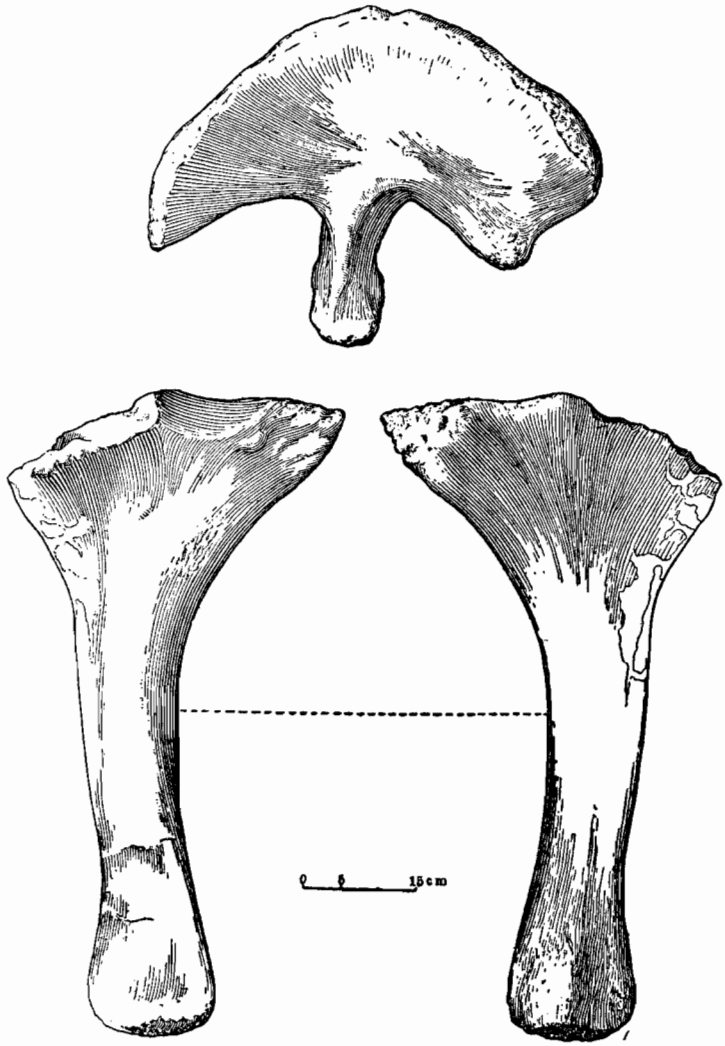


Fig. 7. *Mamenchisaurus constructus* Young. Left ilium (Shangyenkou V 947) in external view and left ischium (Machiahukou V 948) in external and inner views. All in 1/10 nat. size.

There are two metacarplia (a right II and a right (?) IV) in the collection of Huang, which may serve as a supplementary part of the lower arm although they may not belong to the same individaul. They look rather small as for such robust humerus and lower arm described above.

Posterior limbs.—The *pelvic girdle.* From this part of the skeleton we have only the left ilium from Shangyenkou and a part of ischium from Machiahukou (the left is complete) at our disposal. The ilium is similar to that of *Tienshanosaurus,* but differs from the named form by the more scute angle (less than 90 degrees) between the pubis peduncle and the axis of the bone. Furthermore, the posterior crest above the ischiatic peduncle is extremely reduced and the so-called ischiatic peduncle is almost unrecognizable. suggesting that its connection with the ischium is very loose. The both features show that our form is more fitted to aquatic life than the other forms (Fig. 7).

With the exception of the damage of the proximal part of the right ischium the both ischia are well preserved. Comparing with the known ischia of the sauropods, it is the largest one, but structurally there is little difference among all those known forms. And yet, it may be added that the distal end of our specimen is less expanded and more truncated as compared with that of *Omeisaurus, Tienshanosaurus* and also *Helopus.* In this respect it shows more similarity to that of *Camarasaurus.* The proximal end is more expanded, more than one half of the total length of the bone (Fig. 7).

There are three *famora* from the Haishihwan region (a left one by Mi and Liu; a right one by the Petroleum Bureau and a left one by Huang). The specimen of Huang is the largest, representing the largest femur of the Chinese sauropods but still much smaller than that of the American forms (for instance, the length of *Camarasaurus* is 1,800 and that of *Apatosaurus* is 1,785 mm). The femur is typically built as most sauropod but the less trochanter is clearly recognizable in the Shangyenkou specimen. The fourth trochanter of all the three specimens sets well above the middle point of the total length of the bone (Fig. 8).

There are a left fibula from the collection of Mi and Liu, a right tibia and two fibula from Shangyenkou and a proximal part of a left tibia and a left fibula collected by Huang at our disposal. All these bones are typically built for a sauropod. The proximal end of both bones are strongly expanded similar to that of *Apatosaurus.* For the ratio between the femur an the tibia or fibula see table 3. It shows that the latter bones are comparatvley shorter (Fig. 9).

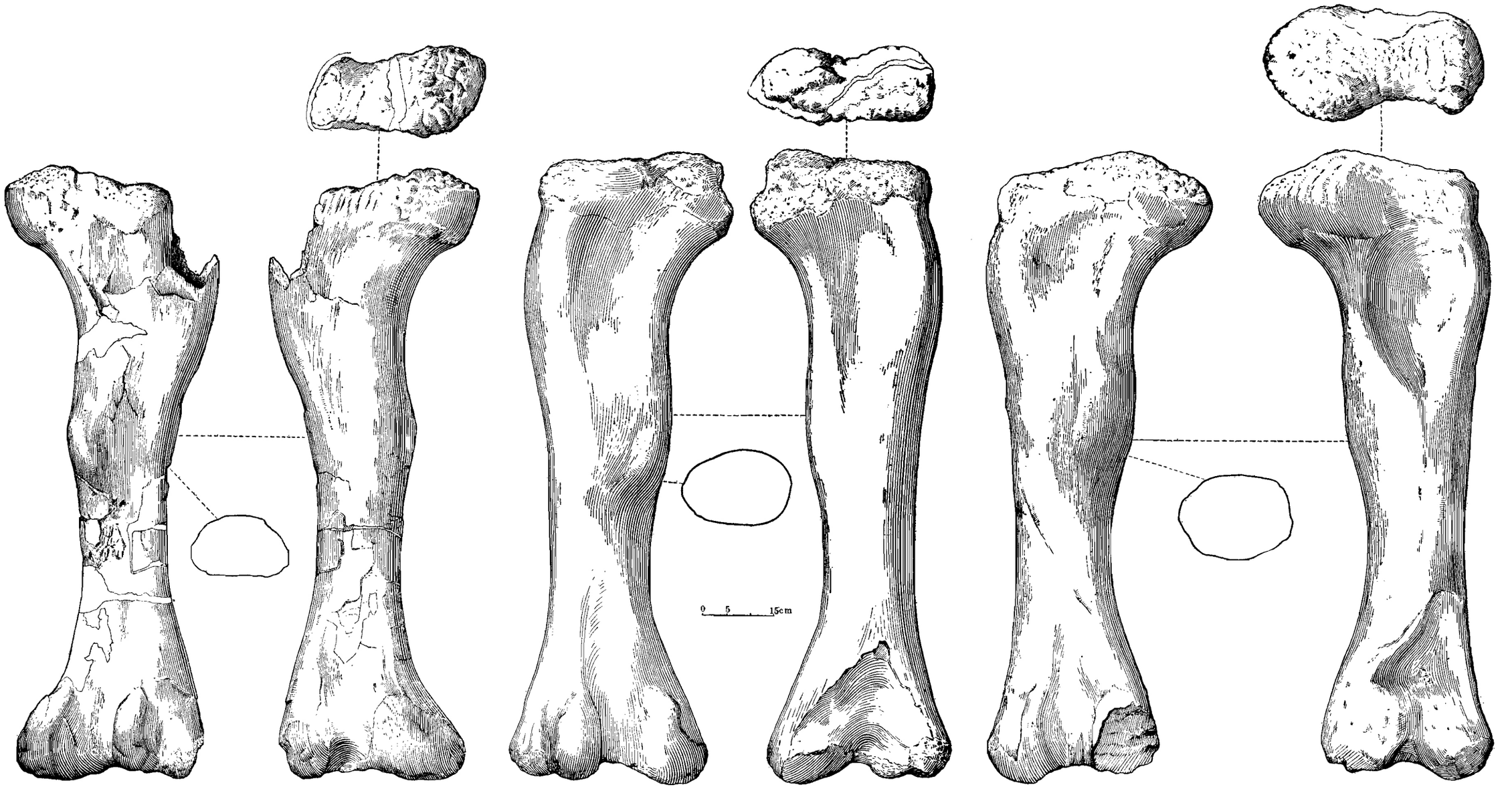


Fig. 8. *Mamenchisaurus constructus* Young. Left to right: Right from Shangyenkou (V 947); left femur from Machiahukou (Huang, V 948) and another left femur from Machiahukou (Mi and Liu, V 946). All in posterior and anterior views with the outlines of the proximal end and the cross-section of the beam below the fourth trochanter. All in 1/10 nat. size.

Table 2 Measurements (in millimeters)

	Machiahukou, Mi and Liu	Machiahukou, Huang	Shangyenkou specimen	Changshou specimen	*Helopus zdanski*	*Tienshanosaurus*	*Omeisaurus*	*Mamenchisaurus*
Humerus, Length	970	—	1,080	?900	910	680	845	—
Proximal breadth	360	470	450	?400	363	302	335	—
Distal breadth	330	—	350	?240	225	225	?230	—
Minimum breadth of the shaft	185	—	195	142	175	115	143	—
Radius, Length	690	—	—	—	—	—	—	—
Ulna, Length	695	—	—	—	—	—	—	—
Proximal breadth	315	—	—	—	—	—	—	—
Metacarpals IV, Length	—	150	—	—	—	—	—	—
II, Length	—	200	—	—	—	—	—	—
Ilium, Length	—	—	580	—	570	570	?723	—
Height above the acetabulum	—	—	260	—	274	300	325	—
Height above the pubis peduncle	—	—	455	—	485	475	584	—
Pubis, Length	—	—	—	795	630	—	649	—
Breadth at acet.	—	—	—	295	234	—	?350	—
Breadth at distal end	—	—	—	185	138	?185	194	—
Ischium, Length	—	850	—	750	647	560	683	—
Breadth at actab.	—	280	—	?280	211	285	?313	—
Breadth at distal end	—	175	—	170	190	115	?130	—
Femur, Length	1,230	1,280	1,170	?1,070	985	—	—	—
Proximal breadth	—	—	—	385	294	245	300	—
Distal breadth	—	—	—	—	102	—	—	—
Minimum breadth of the shaft	—	—	—	—	150	—	—	—
Tibia, Length	—	—	750	820	620	—	—	690
Proximal breadth	—	230	252	?265	204	—	—	270
Distal breadth	—	—	220	—	165	—	—	250
Minimum breadth	—	—	110	150	94	—	—	135
Fibula, Length	?734	875	?740	860	618	—	680	740
Proximal breadth	200	205	—	?245	150	—	?100	175
Distal breadth	—	190	—	155	102	—	114	165
Metatarsals II (left)	220	—	—	—	—	—	—	—
(right)	240	—	—	—	—	—	—	—
III (left)	255	—	—	—	—	—	—	—
(right)	275	—	—	—	—	—	—	205

There are two astragali from our collection, a right one, 5672 from Machiahukou and a left, 5671 from Shangyenkou. The former one is smaller and somewhat deformed and the latter one is intact. They are of the same shape and structure as the right astragalus from Shangyenkou described previously (1948, Pl. VI).

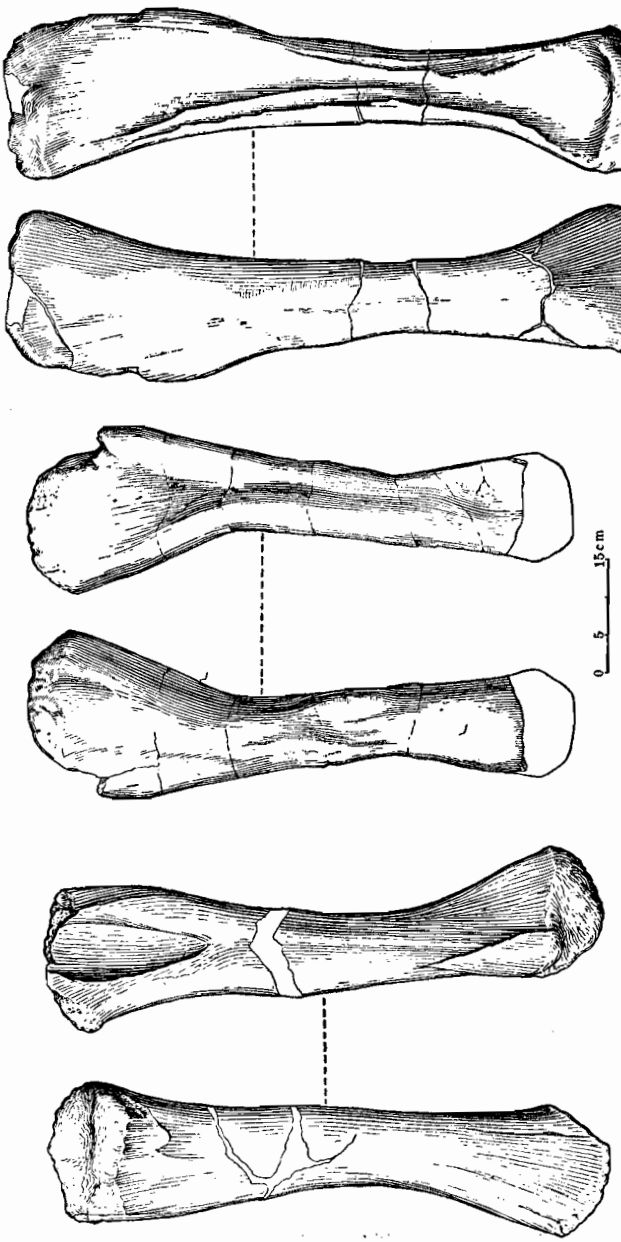


Fig. 9. *Mamenchisaurus constructus* Young. Left: right tibia in posterior and front views (Shangyenkou V 947); middle and right: left fibula (Shangyenkou V 946) and another left fibula (Machiahukou V 948) in external and inner views. All in 1/10 nat. size.

From Machiahukou four metatarsals (two left Mt. II, and two right Mt. III) and a claw collected by Mi and Liu and only a right claw I collected by Huang are present in our collection. The metatarsals are comparatively long stretched.

Table 3. Ratios of Various Limb-bones

Ratio between humerus and radius of Machiahukou specimen of Mi & Liu	71
Ratio between femur and fibula of Machiahukou specimen of Mi & Liu	59.7
Ratio between femur and fibula of Machiahukou specimen of Huang	68
Ratio between femur and fibula of Shangyenkou	63
Ratio between femur and fibula of Changshou specimen	80
Ratio between the anterior limbs (Humerus+radius) and posterior limbs (femur+fibula) of the Machiahukou specimen of Mi and Liu	85

From the tables 2 and 3, it is shown clearly that the specimen from the Haishihwan region are generally larger than the previously known sauropods including *Mamenchisaurus*. But the dimensions of the other genera are so close each other that it seems hard to classify the species merely by the size.

Determination and Discussion

From the foregoing description the following conclusions can be made:

1. All the specimens from Haishihwan, that is, from Machiahukou and Shangyenkou, belong to a single species, although they vary in size and show minor differences. At least three individuals are present in our collection.

2. Based on the precoelous structure of the anterior caudal vertebrae it seems highly probable that the present form may safely be referred to *Mamenchisaurus constructus*, although the chevrons of the middle part of the vertebra column are not preserved for an additional concrete proof. The size of the present form is of course a little larger.

3. The geological age of the fossils is certainly the same as that of *Sunosuchus* derived from the neighbouring valley, that is Upper Jurassic.

4. If the above determination is correct, the finding of *Mamenchisaurus* in Central Kansu would serve as a definite proof for the correlation between the Red Beds of Szechuan and the continental series of Kansu.

III. Sauropods from Changshou, Szechuan

A partly preserved skeleton of sauropod has been discovered at Moutzenhan, Szetzetan, Changshouhsien along the Yangtze River some 111 kilometers N. E. of Chungking. It was first noticed by the workers of Water Power Construction there. But it was already badly damaged when the members of Chungking Museum reached there for excavation. Yet, many bones were saved by them in 1955.

In 1956, the Institute of Vertebrate Paleontology sent Mr. Y. L. So there with the hope to collect some specimens *in situ*. Unfortunately the channel was so deeply cut that

the fossiliferous bearing level is difficult to approach. Mr. So was, however, able to bring back all fossils he could obtain, including those previously collected.

According to the observation made by the staff member Mr. H. M. Li, of the Chungking Museum, the fossils were derived from one of the basal part of the red shale on the top of a small hill composed of a series of intercalations of sand-stones and red shales, dipping 7—10 degrees southeast. He considers the beds to be the transitional part between the Chiating Beds and the Chungking Beds of the Middle Cretaseous.

In such case, it is obvious that the fossils collected are very fragmentary and incomplete. Yet. as shown below, nearly all the specimens belong to a single individual, since no duplicated part of skeleton was found. It is no doubt that what we saved now represents only the lesser part of a whole skeleton which was unfortunately destroyed before So went there.

The following specimens (Cat. No. V 930) are at my disposal for study: eleven disconnected neck and dorsal vertebrae, ?distal part of a right scapula, a right complete coracoid, a damaged left humerus, two partly articulated hand bones, two ischia (badly broken, one left and one right), a complete right pubis, proximal part of a left femur, nearly complete left tibia and fibula and a right astragalus. There are in addition some fragmentary bones which are undeterminable and may not belong to this skeleton or even to other dinosaurian remains.

Description

In size and in general features all the represented bones show more or less similarities to *Omeisaurus junghsienensis* from Jung-hsien, Szechuan, particularly the neck vertebrae and the general character of the other limb bones of the present specimen are decidedly more flat in construction.

Neck Vertebrae.—There are three neck vertebrae of which two are nearly complete. The best one is with the anterior ball preserved while the third one has only the posterior end preserved. The most complete one is 460 mm in length without the joint and seems to represent the seventh or eighth neck vertebrae while the other two seem to represent the one immediately in front and posterior to it. In size and in general structure they look very similar to those of *Omeisaurus junghsienensis* with the exception that the surface of the centrum is quite simply smooth. As there is no neural arch preserved, it is difficult to compare any further (Fig. 10).

The other eight *dorsal Vertebrae* (the last two may represent the first and the second caudal vertebrae) are also poorly preserved (by the centrums only, even not complete in some cases). The first six vertebrae seem to represent the anterior part of the dorsal column, and the much smaller one seems to represent the rather posterior part or the lumbar region. In all the vertebrae the lateral cavity is well preserved and in none of them is the parapophissal facet preserved. The isolated single vertebra looks too small and light as compared with the others to be the lumbar vertebra of the same individual. It is deeply opisthocoelous showing that it must not be far from the anterior ones. The

last two vertebrae are short and the centrum is weakly convex anteriorly and concave posteriorly. The first one is with the rooted part of the diapophisis preserved. They represent probably the first and second caudal vertebrae. In this case, it is impossible to compare the caudal vertebrae with those of *Omeisaurus* and *Tienshanosaurus*, because the very first ones of both genera are not preserved. Comparing those of *Mamenchisaurus*, it differs remarkably by the procoelous nature of the latter form.

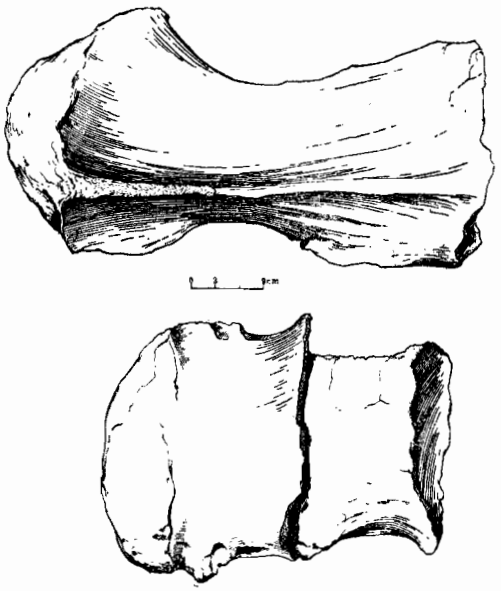


Fig. 10. *Omeisaurus changshouensis* Young, sp. nov. Upper: a damaged neck vertebra, probably seventh or the eighth one in left side aspect. Lower: two anterior dorsal vertebrae in left side aspect. All in 1/9 nat. size. V 930.

There are two neural spines which belong to the anterior part of the tail and a few fragmentary ribs.

Anterior limbs.—The supposed distal part of a right scapula is too poor for a description. On the contrary the *coracoid* is well preserved. It is short and broad with the coracoid foramen situated far apart from (60 mm) the scapula border at external side same as that of *Omeisaurus*. The scapula border is straight as in this genus too and differs from that of *Tienshanosaurus*. Maximum breadth along the scapula border, 465 mm; maximum transversal breadth between the scapula border and the lower margin, 300 mm and the maximum breadth of the glenoid surface, 92 mm (Fig. 11).

The left *humerus* is incomplete, the condyle part has no direct connection with the main beam so that the reconstruction is somewhat subjective. The distal end is also damaged and reconstructed. So far as we may make a comparison, the outline and the

general structure is close to that of *Omeisaurus* rather than other forms. The most characteristic feature of the humerus, as in other long bones described below, is the flatness of the bone; the antero-posterior diameter of the beam is much less than the transversal one. The deltoid crest is evidently much reduced as compared with that of *Omeisaurus*. In addition there is a prominent ridge at the posterior proximal part of the bone immediately below the condyle surface. The ridge itself is broken but its outline is clearly shown as indicated in the given figure. All these points seem to indicate that the humerus of the present form differs considerably from the named species and other sauropods (Fig. 11).

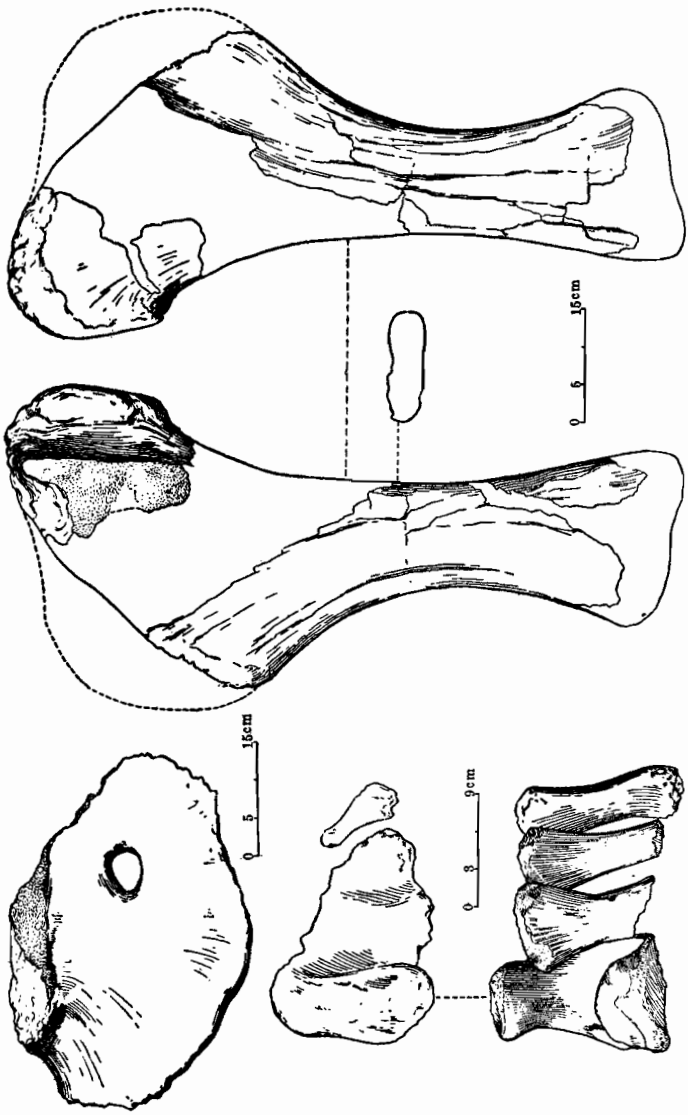


Fig. 11. *Omeisaurus changshouensis* Yiung, sp. nov. Upper left: right coracoid in external view; right: left humerus in posterior and anterior aspects with the cross-section of the shaft showing its flatness. All in 1/10 nat. size. Lower left: right Mtc. I—IV in ventral view with the first phalanx of Mtc. I. 1/6 nat. size. V 930.

For the measurements of the humerus and other long bones described below see table 2 above.

There is no sure presence of the lower arms but it is worthwhile to note here two partly articulated *hand bones*.

The better preserved right side has the Mtc. I—III and the phalanx one of Mtc. I in natural position, although they were more or less dislocated subsequently. One isolated metacarpal may be determined as Mtc.IV which belongs to the same side as shown in the given sketch. The flated and concaved lateral side of the Mtc. IV shows that there is still the fifth metacarpal missing and the total number of the metacarpal is composed of five as the other sauropods. The distal end of Mtc. II—III is broken. The whole bone looks much smaller and slender, characters fit rather with the other skeleton of this form. Length of Mtc., 117 mm, proximal breadth, 125 mm and distal breadth, ?85 mm.

The other hand bone is too imperfect for description.

Posterior limbs.—No sure presence of the *ilium*. There are two badly broken ischia and a nearly complete pubis belonging most probably to the same individual. The exact length is unknown. The given estimated length may not be far from the truth according to the breadth of the both ends. In general construction of the bone, it is very close to that of *Omeisaurus junghsienensis* except its flatness of the beam. The *pubis* shows the usually considerable expansion of the ischia border, although the margin of which is somewhat damaged. The pubic foramen is ovally rounded. No marked difference could be detected as compared with that of *Omeisaurus junghsiensis* (Fig. 12).

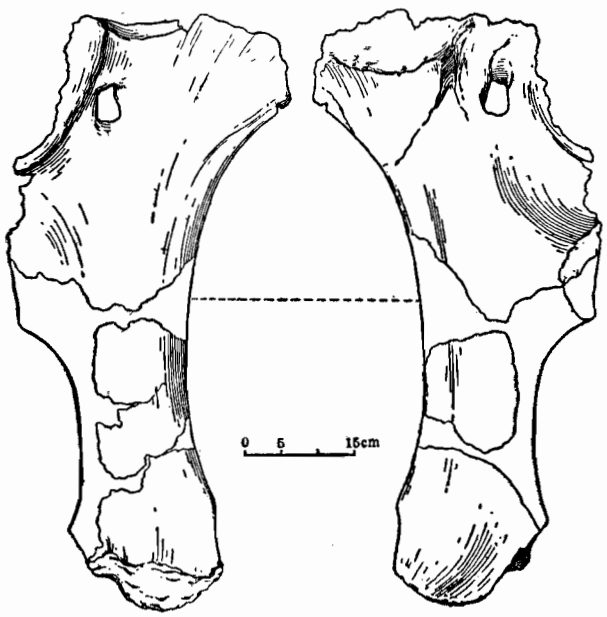


Fig. 12. *Omeisaurus changshouensis* Young sp. nov. Right pubis in external and internal views. 1/10 nat. size. V 930.

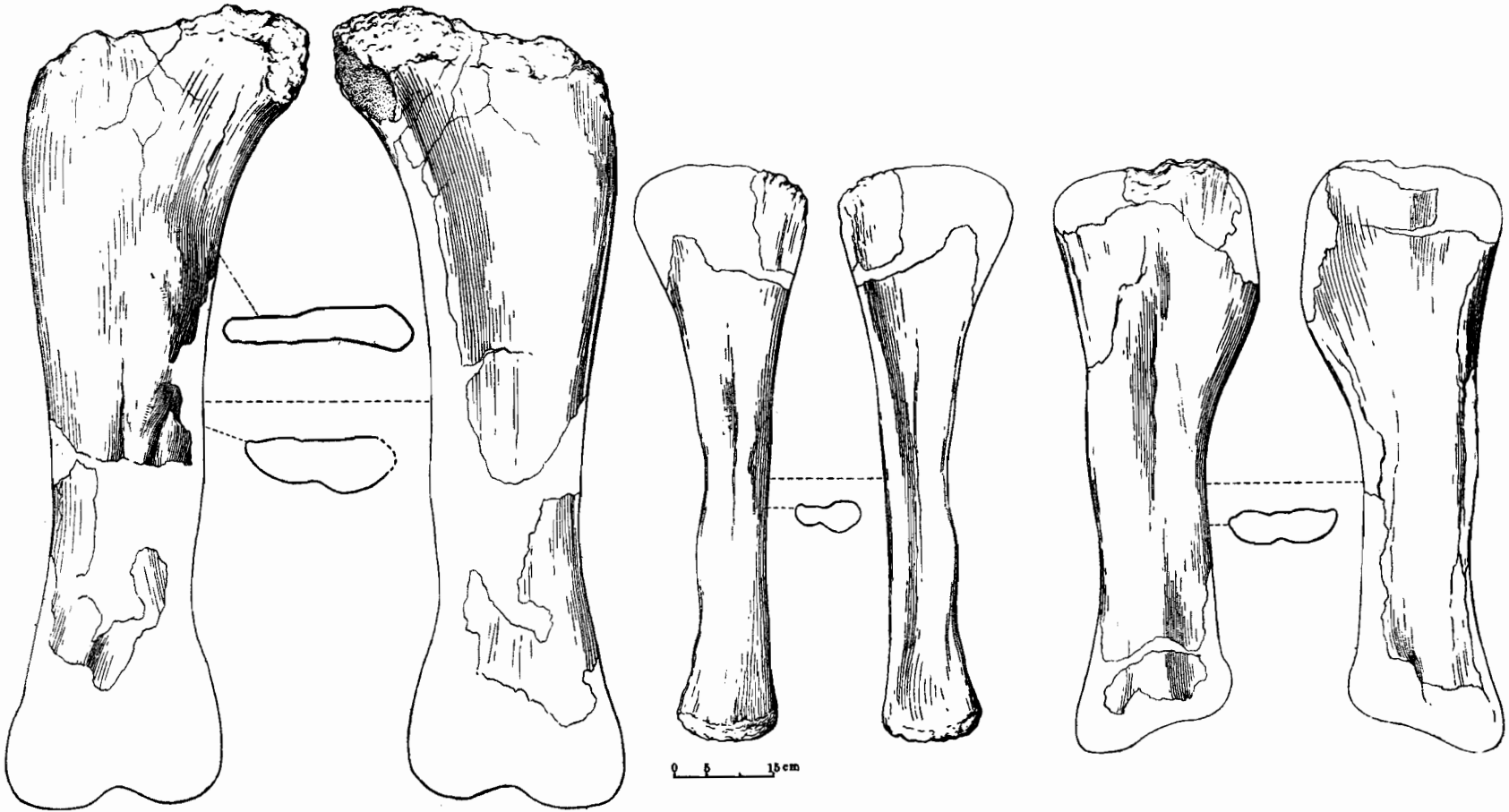


Fig. 13. *Omeisaurus changshouensis* Young, sp. nov. Left to right: Left femur, in posterior and anterior view; left fibula and left tibia in two views. All with the outlines of the cross-section of the shaft and 1/10 in nat. size (V 930).

The left femur is fairly well preserved in the proximal and middle part of the beam. The distal end is broken so that the length of which can only be estimated as 1070 mm. This bone is characterized by the extremely antero-posterior compression of the bone from the proximal end downwards throughout the whole preserved length of the bone. Only the medial part of the codyle is a little thickening, showing that its connection with pelvic girdle must be very feeble (Fig. 13).

The *tibia* and the *fibula* are nearly complete. They are comparatively long in ratio with the femur (set table 2). They are also rather slender, and the flatness of the beam is also well marked (Fig. 13).

The structure of the right *astragalus* is the same as that of the foregoing described one of the Kansu specimens but much smaller.

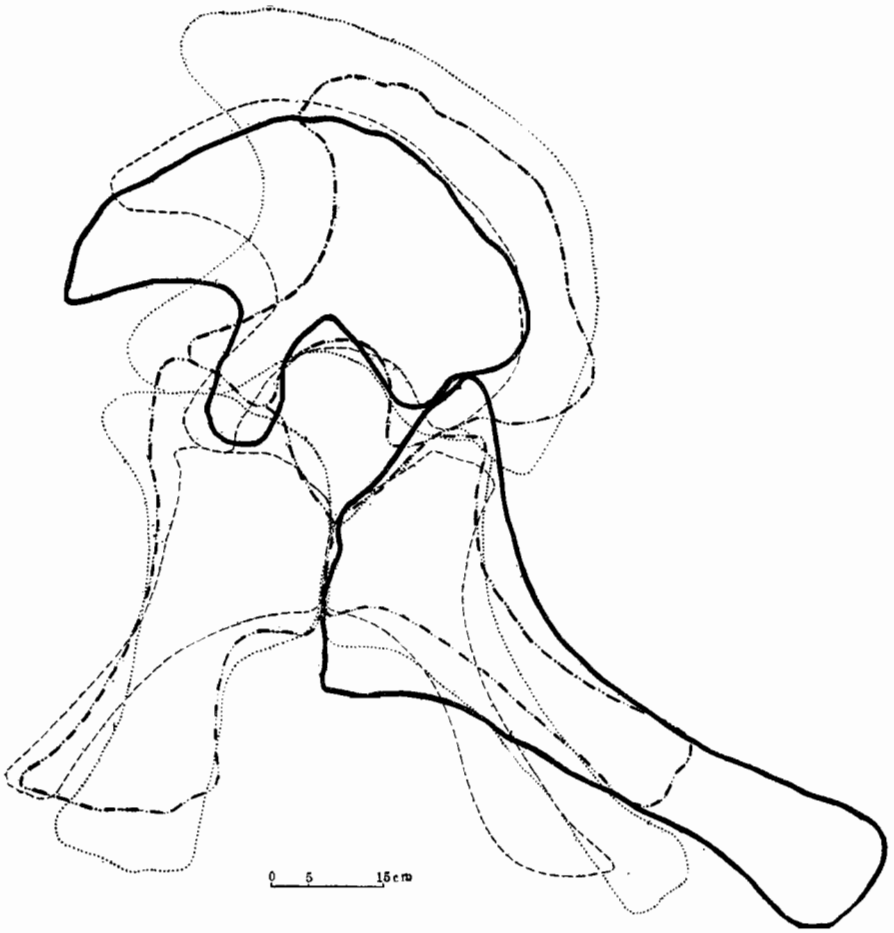


Fig. 14. Pelvic girdles of the known Chinese Sauropoda drawing to the same scale and orientation for comparison. Dotted line, *Omeisaurus;* broken line with two dots, *Tienshanosaurus;* broken line, *Helopus* and heavey line, *Mamenchisaurus.*

Determination and Discussion

That most of the above described remains belong to the same individual is obvious, only the very fragmentary pieces are somewhat doubtful about their real relationship. So far the detectable facts show clearly that the present skeleton differs from *Omeisaurus junghsienensis* described by the author some years ago from Junghsien western Szechuan by its larger size, the thinness and flatness of the long bones and the relative length between the femur and the tibia. The differences are so great that it will be

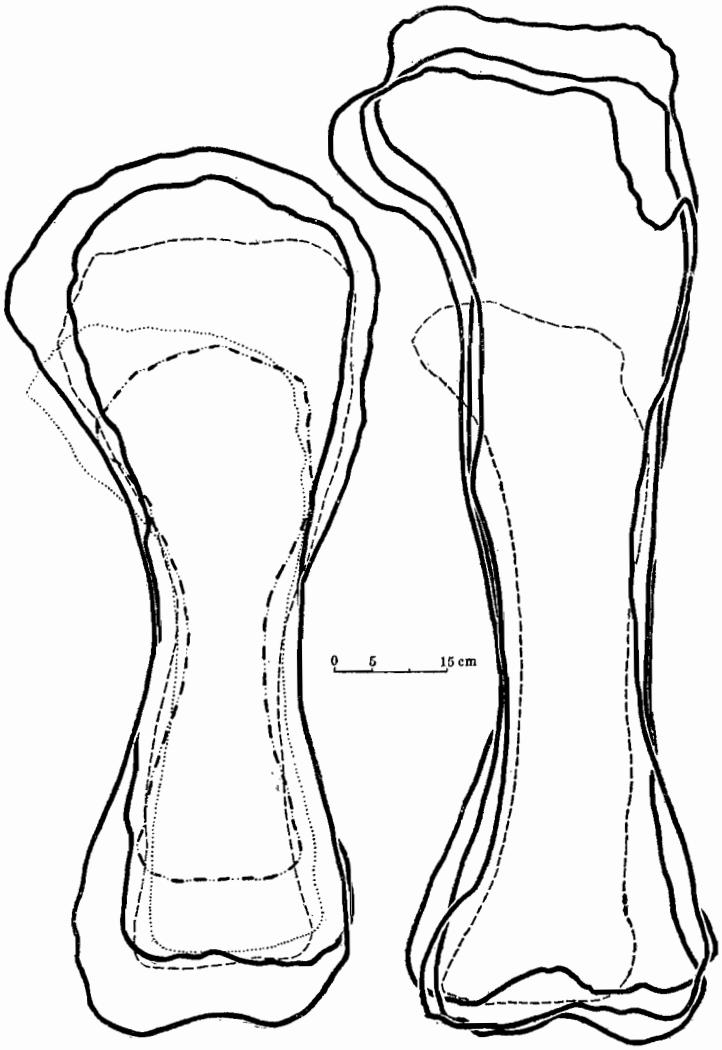


Fig. 15 Humerus (left) and femur (right) of various known Chinese Sauropoda drawing in the same scale and orientation for comparison. In both bones the point at the line of the minimum breadth is used as reference point. Explanation of the lines see last figure.

incorrect to refer our present specimen to the same species, although it belongs obviously to the same genus as based on the similarities mentioned above. The new name *Omeisaurus changshouensis* is thus proposed for the here described specimens.

Omeisaurus changshouensis has been unearthed during the construction of the water power and the detailed geological condition is not clear. According to the section kindly submitted by Mr. C. M. Li of Chungking Museum, the fossils were derived from the base of a layer of red "shale" of a series of intercalations of red clay shales and sandstones so well developed in the Red basin of Szechuan. As no trace of either Taanchai Limestone or Tzeliuching Limestone is observable we are unable to compare the sectuon with the other part of the basin especially that of Junghsien from where *Omeisaurus junghsienensis* was discovered. It is nevertheless probable that the level with *Omeisaurus changshouensis* belongs to the upper part of the Chungking Series of Upper Jurassic age same as that of *Omeisaurus junghsienensis*.

Anatomically, however, our new species display a somewhat specialized nature as indicated by the extreme flatness of all the limb bones. It represents the only sauropods, so far known, with such long tibia and fibula. We should not be surprised to find it from a somewhat younger horizons of the huge red series of the Szechuan basin. Our knowledge about the vertebrate life of this region is still too scant for getting a real picture of the geological and zoological history of this period, although sites of dinosaurian and other fossils are frequently reported. Systematic study of these fossils is very urgent.

IV. Other indeterminable Sauropodian remains

Recently the Institute obtained a number of fossils from the South-Western Geological Bureau and other Institutions for determination. They are all remains of sauropods and may be briefly described as follows:

1. Six disconnected anterior and middle caudal vertebrae and the proximal part of a left tibia collected from the Upper Jurassic Beds (Chungking Series) at Shihtikan, Shihshunhsiang, Kuangan[1] district, Szechuan. The site is located some 100 kilometers northwest of the above described Changshou locality with *Omeisaurus changshouensis*, but the procoelous character of the anterior caudal vertebrae leads us to believe that we have to deal with *Mamenchisaurus constructus*. The outline of the proximal end of the tibia differs from mentioned form in some details (mainly by its slenderness) but certainly has no systematic value. The size is also very close with each other too. Cat. No. V. 931.

2. Among the fragments of bones collected by the members of the South-western Geological Bureau from Nanchi district. only a caudal vertebra (about the twelfth) is determinable. It was derived from Hsien-ling-hsiang[2] and looks too small for a sauropod,

1) 廣安、石笋鄉、石梯坎.
2) 南溪、仙嶺鄉.

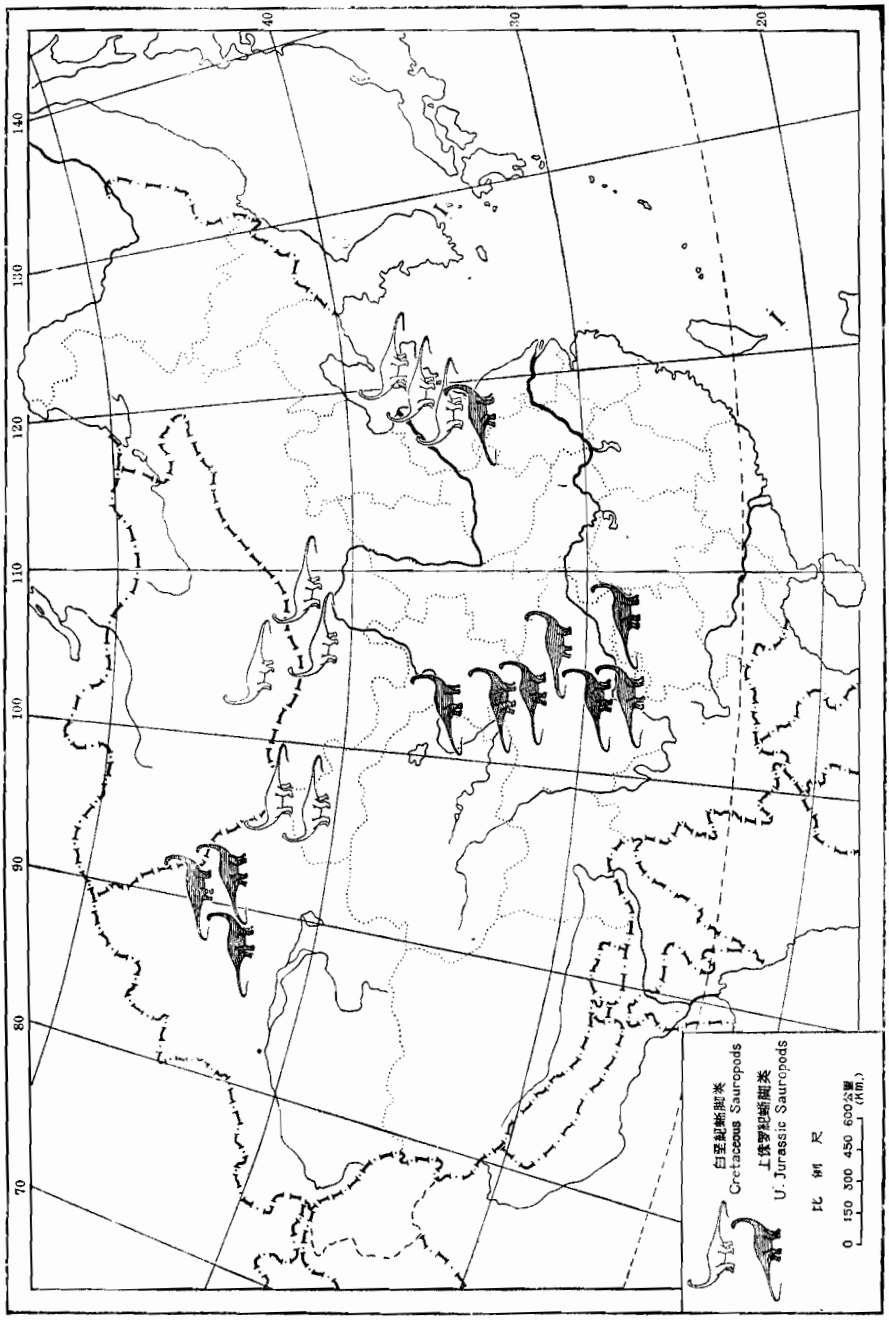


Fig. 16. Map showing the main localities and distribution of the Sauropod in China. Shaded, Upper Jurassic and most Upper Jurassic; white, Cretaceous.

but the general character agrees with the anterior caudal vertebrae of *Mamenchisaurus*. Its procoelous character is still observable, although the marginal part is somewhat damaged. The locality is very close to that of the type of Yiping. Cat. No. V. 933.

3. A middle caudal vertebra (about twentieth) was found from Lamalishan, Chitai, Singkiang[1] which belongs apparently to *Tienshanosaurus chitaiensis* as the vertebra in question is typically in sauropordian structure, and the type of the mentioned genus was found from the very district. The length of the centrum is 135 mm which is somewhat larger than the type specimen. Cat. No. V. 932.

Besides the above mentioned various localities with remains sauropodians which are kept in our Institute, a remarkable find was made recently in Szechuan province. A partly complete dinosaurian skeleton has been collected from Fushenhsiang, Taiho, Hochuanhsien[2]. It was discovered by a geological party for petroleum prospect and excavated by Mr. T. K. Chu of Chungking Museum. The excavated specimens include the nearly complete and consecutive vertebral column. The limb bones are, however, mostly lost, only part of the posterior limbs was saved. According to the natives the bones were exposed and subsequently digged out for years. In any way the excavation by Mr. Chu affords one of the best collections of dinosauria in China and we hope to describe it in detail later. Whether this find really represents a sauropoda needs further confirmation.

A Review of Sauropodian Remains in China

In the past decades numerous finds of fossil sauropods were recorded in China. Unfortunately, most of them are only fragmentary in preservation and no further excavation was made. The so far known sauropodian remains may be summarized in the folloding table (See P. 24).

From the listed six genera with seven species and other five sites with poorly known remains of sauropods it shows how rich fossil sauropods are recorded in China. Those finds include no less than 23 individuals distributed in China from the coast to the slopes of Tienshan and from Mongolia to the southern bank of the Yangtze River. Their distribution is diagrammatically shown in the given map, figure 16.

Most of the six known genera are obviously rather clearly defined, especially the genus *Mamenchisaurus* with its characteristic precoelous caudal vertebrae. The relationship of *Helopus, Tienshanosaurus* and *Omeisaurus* is less clear. But their structure and orientation of the pelvre girdle the humerus and femur are rather different to each other. Their size and outlines are given in figures 14 and 15 for comparison. Their validity seems to be doubtless.

Unfortunately, most of them are rather poorly known. Even the determinable forms like *Mongolosaurus, Asiatosaurus* and *Chiryuesaurus* are only known by the teeth or even

1) 新疆的奇台和拉美理山.

2) 合川縣太和區宮願鄉.

Table 4 A list of known Sauropods in China

Genus and species	Locality	Horizon	Preservation	remarks
Helopus zdanski Wiman	Ningchiakou, Mengyin, Shantung	Mengyin Series, Lower Cret.	Two sets of partial skeleton.	Probably Upper Jurassic supplementary specimens were added by Young 1935.
Mongolosaurus hoplodon Gilmore	Hukhung Ulan, Western Inner Mongolia. Huihuipu, Kansu	On Gong Formation Lower Cret.	Fragmentary teeth and limbs only	
Asiatosaurus, mongolicus Osb.	Oshih, Mongolia	Oshih Formation	Two teeth only	Locality in Mongolian Repubilc
Omeisaurus junghsienensis Young	Junghsien, Kuangyuan Szechuan Kanhsien, Kansu	?Upper Jurassic	Partial skeleton Isolated teeth	
Omeisaurus changshouensis Young	Changshou, Szechuan	?Upper Jurassic	An incomplete skeleton	
Chiayuesaurus lacustris Bohlin	Tatasotan, and Huihuipu Chiayuekuan, Kansu	Cretaceous	Type, one tooth only	The specimen of Huihuipu is also a tooth only.
Sauropoda indet.	Ug-tokhoi, western Inner Mongolia	Cretaceous	Fragment of a vertebra only	
Mamenchisaurus constructus Young	Mamenchi Yiping. Shihshunhsiang, Kuanan, Szechuan. Hsienlinghsiang, Nanchi, Szechuan. Haishihwan, Kansu.	Upper Jurassic	Partial skeleton. Vertebrae etc. One vertebra. Three or more vertebrae partial skeletons.	
Sauropoda indet Young	Sungkan, Tungtze hsien, Kweichow	Upper Jurassic	Vertebra and fragments of bones	
Sauropoda indet, Young	Chingkankou Shangtung	Upper Cretaceous	Vertebrae and fragments of bones	The presence of the sauropod is also recorded in other parts of E. Shangtung by Wiman
Sauropoda indet Young	Ikeshaomeng, S. W. Ordos Inner Mongolia	Cretaceous	A single tooth	
Tienshanosaurus chitaiensis Young	Paikushan, Chitai, Singkiang	Upper Jurassic	Partial skeleton. A single vertebra is recorded from the same district in this paper	

a tooth, while part of the skull is only known in *Helopus*. The reason is chiefly due to the fact that most of the finds were made by chance and very few or inadequate excavations were made. Therefore it is very likely that by better known material some of the forms may prove to be synonymous. Of course the less known localities may also prove to be rich with new forms of sauropods.

As far as the systematic position of the Chinese Sauropoda is concerned, I agree with the two-divisioned classification made recently by V. Huene after Janensch. In both family groups the Chinese forms are richly represented. They may be given in the following table:

Family group Bothrosauropodidae
Family Astrodontidae
Teeth spatulated, caudal vertebrae platycoelius.
Helopus
Tienshanosaurus
Omeisaurus

Family group Homalosauropodidae
Teeth peg-like, anterior caudal vertebrae procoelous.
Family Titanosauridae
Mamenchisaurus
Chiayuesaurus

Family Diplodocidae
Asiatosaurus
Mongolosaurus.

It must be noted, however, that the genera *Mongolosaurus, Asiatosaurus* and *Chiayuesaurus* are very poorly known and their validity is rather doubtful. It is certainly premature to have a satisfactory conclusion based upon such fragmentary documents, although the future study of this field is very promising.

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中 國 的 新 蜥 脚 類

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摘 要

自 1954 年四川宜賓的建設馬門溪龍發表以後，古脊椎動物研究所又積累了很多蜥脚類的材料，有必要加以敍述。

I. 內蒙自治區伊克昭盟阿托克(譯音)(詳細地點不詳)

有一不能仔細鑑定的肩胛骨和一個牙齒，均歸蜥脚類。牙齒雖已破，但其构形尙可辨認，其大小與一般構造均與廣元的蜥脚類牙甚相近(前定爲可能歸峨嵋龍)；時代爲上白堊紀。

II. 甘肅永登海石灣蜥脚類

共有三批材料，一併加以敍述：

A. 部分關節之脊椎與肢骨，乃 1948 年米泰恆與劉東生所採，主要標本來自馬家戶溝，少數自上鹽溝。

B. 西北石油局 1955 年所採之部分骨骼。上鹽溝。

C. 黃爲龍 1956 年所採之部分骨骼主要是馬家戶溝 (5672)，一部分爲上鹽溝 (5671)。

以上材料至少代表三個個體的存在。因爲馬家戶溝有兩條左股骨，而上鹽溝的化石當然爲另一個體。

在脊椎骨方面，保存最好的爲尾椎骨，幾乎上述每一批材料中都有幾個，奇怪的是並不重復，排列起來可代表尾脊椎的根部中部的大部分。可以當作綜合的標本裝架。前部幾個尾脊

椎是前凹式，與馬門溪龍相同，是我們把它當成馬門溪龍的一個理由。

前肢骨方面至少有兩個肱骨完整，相當碩大，但在構造上與盤足龍區別不大。下前肢骨、尺骨與撓骨均各有完整者，爲其他已知蜥脚類所無。手掌骨也有兩個爲代表。

後肢部分：關於盤骨有上鹽溝的一個左腸骨和馬家戶溝的一對坐骨。腸骨與天山龍的相近，但也有一定的區別，前端凹入的角度小於 90°，後恥骨柄和以上的腸骨後稜十分退化而小。坐骨末端比峨嵋龍和天山龍以及盤足龍均較爲擴廣而末端作斷切狀。股骨爲中國蜥脚類之最大者，性質方面與一般蜥脚類無大區別。腓骨較碩大，脛骨之頂端與建設馬門溪龍稍有不同，較爲碩大。

以上各骨的尺度與比例見本文表 1 與表 2。

由這批材料所得的結論如下：

1．所有海石灣的蜥脚類化石均可歸入一種，至少有三個個體。

2．基於前幾個尾椎骨，這些化石非常可能屬於建設馬門溪龍。進一步的證明還有待中部尾脊椎的脈弧是否分岔。就大小言海石灣的標本比正型爲大。

3．產建設馬門溪龍的地質年代應當與隣近一溝所發現的孫氏鱷同一時代，也就是上侏羅紀。

4．如以上各點可靠，在甘肅發現建設馬門溪龍說明四川紅層與甘肅的中生代地層之比較，有相當重要關係。

III．四川長壽的蜥脚類化石

這一化石原先由水力發電站工程局發見於長壽獅子灘帽子山，後經重慶博物館同志做了一些採集。後來古脊椎動物研究所又派人前去續加採集，得到了可以歸于一個個體的部分骨骼，計有若干脊椎骨、肩胛骨、烏喙骨、左肱骨、手掌骨、坐骨、恥骨、股骨、脛骨、腓骨、距骨等。另有些骨骼破碎而不能鑑定，可能不歸於此種。

全部發見的骨骼與榮縣峨嵋龍很相近，但所有各肢骨都比較扁平。尾脊椎肯定不是前凹式的(如果那兩個尾脊椎可靠的話)。肱骨與榮縣峨嵋龍特別相像。

現有標本，除了肢骨比榮縣峨嵋龍爲扁外，也稍微大一些，非常可能不歸於一種，但肯定地歸於同屬，所以定名爲長壽峨嵋龍(新種)。

長壽峨嵋龍的詳細層位不詳。有可能與榮縣峨嵋龍同層或上下差不多。

但從構造上講，這個新種比榮縣峨嵋龍似乎更爲特殊化一些，所以也可能年代稍後一些。總而言之，我們對於四川紅層的知識還大大有待提高。

IV．其他蜥脚類

除以上所描述的蜥脚類之外，古脊椎動物研究所還收到以下的蜥脚類化石標本：

(1) 由西南地質局送來的四川廣安石筍鄉石梯坎的六個不連續的脊椎骨和一個脛骨上端，它們可歸於建設馬門溪龍。

(2) 由南溪縣仙嶺鄉採來的若干化石，但只有一個尾脊椎(大約第 12 個)可以鑑定，也可能歸於建設馬門溪龍。

(3) 從新疆奇台收到的一個尾脊椎(大約爲第 20 個)，可能歸於天山龍。

(4) 新近從四川合川發現之恐龍化石，尙未看到眞正的標本，也還未修理出來。但就所發表的照片看，有可能歸於蜥脚類。

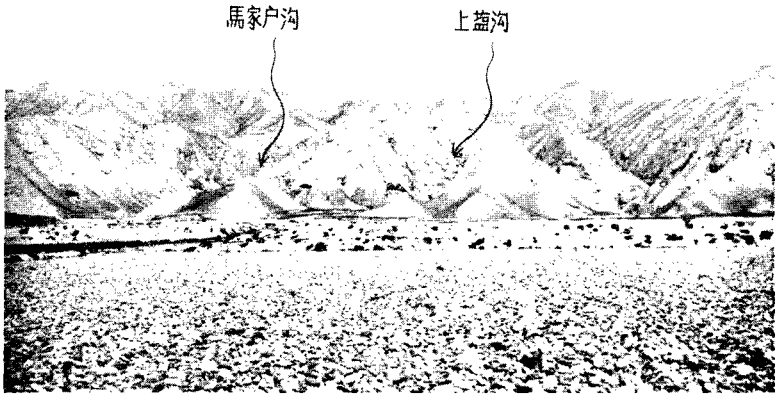
中國蜥脚類研究之回顧

由本文研究，把中國發見的蜥脚類知識作一總結，計有六屬七種，有二十多個個體爲其代表，分布地區甚廣，東自山東海岸西到天山，北自內蒙南到長江南岸（貴州）。可參看外文表 3。

但雖然蜥脚類化石很多，由於大多數未經過仔細的或系統的採集，以致材料大部很破碎，有的僅由一個牙或一個脊椎骨爲代表。即較好的材料，除了盤足龍有部分頭骨外，均無頭骨發見。

從分類上講，中國已發見的蜥脚類也可分爲兩類，一類近於圓頂龍，它的尾脊椎骨呈扁平式，盤足龍、天山龍、峨嵋龍均可歸之；一類近於梁龍，尾前脊椎作前凹狀，馬門溪龍可歸之。詳見外文不贅。

中國的蜥脚類限於材料破碎，當然還有許多問題未能解決，故未來的發見，對於證實以上的說法，或者否定以上說法的可能性都是存在的。



1. General view of the fossiliferous sites (Left—Machiahukou; right—Shangyenkou)
由甘肃永登縣海石灣北望恐龍化石產地

2. Excavation in progress in Machiahukou under directorship of W. L. Huang, 1956.
在馬家戶溝(5672 地點) 發掘的情況

3. Excavation in progress in Shangyenkou by Huang.
在上盖溝 (5671 地點) 發掘的情況

(All pictures taken by W. L. Huang, 1956.)