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A NEW CRETACEOUS PALAEONISCOID FISH FROM YUMEN OF THE CHIUCHUAN BASIN, WESTERN KANSU

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INTRODUCTION

A small number of fossil fishes collected by Chen Ben and the late Sun Chien Chu in June 1941 from Peiyao, Kuantaishan, near Yumen of western Kansu were transferred to the Institute of Vertebrate Paleontology in Peking for study.

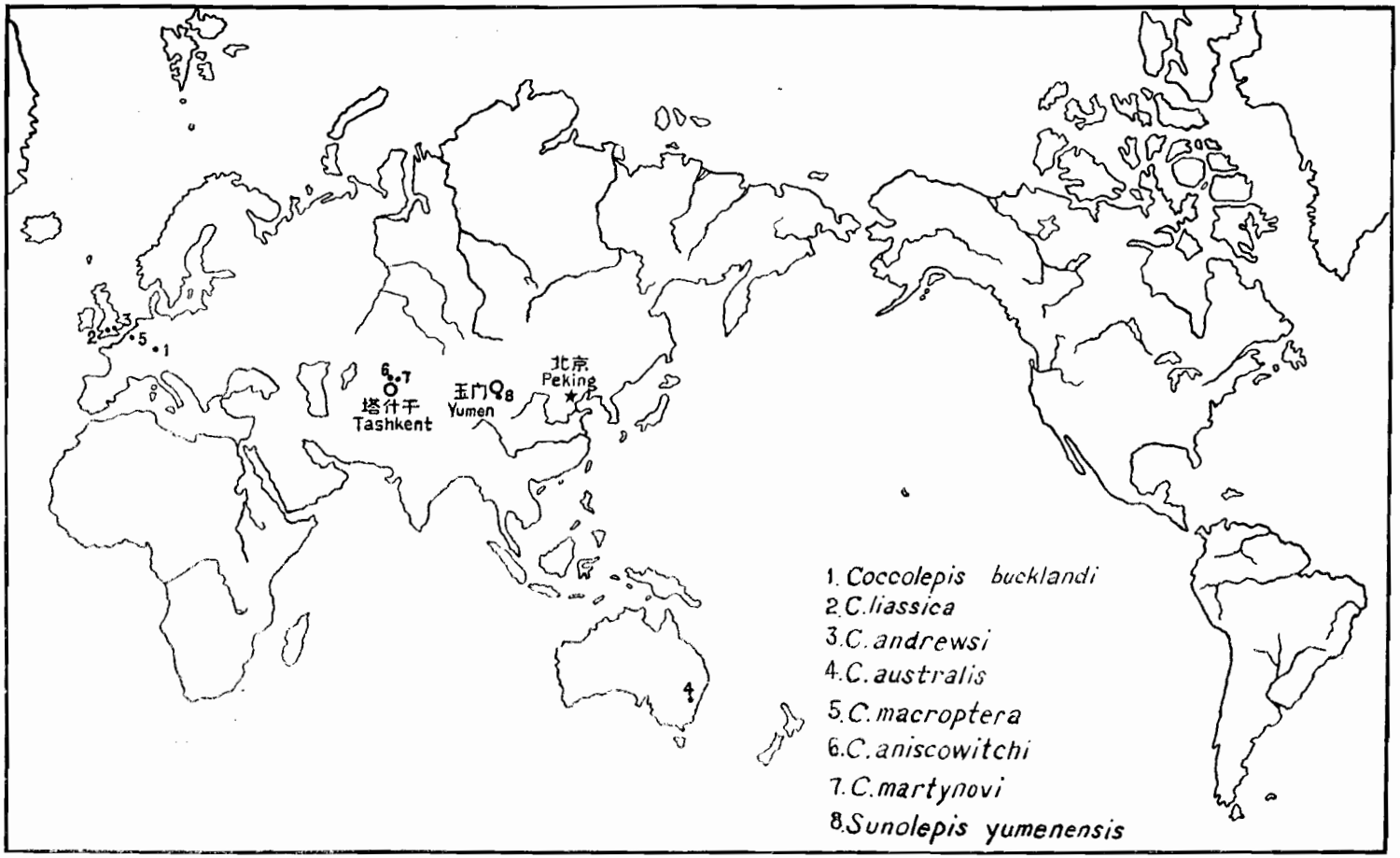
These fish remains were discovered from the Lower Huihuipou Series, which is composed mainly of greyish green shales with layers of conglomerates and volcanic rocks. At its upper part, in the thin greyish green shales many fossils were embedded. Among them plants, ostracods, insects, and fishes are most abundant. The fossil insects were studied by T. H. Yin (1948). The palynological studies were carried out by J. Hsü and H. Y. Chow in 1956 (Hsü and Chow, 1956a, b), nearly at the same time Y. T. Hou studied the ostracods (M. S.).

This fish collection was first studied by C. C. Young, who has given much effort in assembling and sorting the specimens. Later under his kind encouragements and supervision the writer undertook the completion of this work.

Though the studied materials of the insects, the ostracods and the fishes together with the palynological materials came from different sources, yet they all belong to the Lower Huihuipou Series of the Chiuchuan Basin. Studies of the insects and ostracods as well as spore and pollen analyses reveal that the Lower Huihuipou Series is Lower Cretaceous in age.

Mesozoic fishes, though not seldomly met with in recent years in this region are well preserved in very few cases. In this collection more than thirty specimens belonging to at least twenty individuals of a new form of the Coccolepidae Berg, (1940) were obtained. They are beautifully preserved, exhibiting many important features of the skull and the ossified bone elements, while most of these features in *Coccolepis*, the only known genus of the family Coccolepidae so far discovered, are unable to show, at least in the published literature.

Coccolepis has been for years, since Agassiz first established it in 1844 (Agassiz,



Map. 1. Map showing localities of known species of *Coccolepis* and *Sunolepis yumenensis* (gen. et sp. nov.)

1844), the only known genus of the family, which represents the last survivor of the most prevailing upper Palaeozoic Palaeonisciformes. Now a new form of the family, *Sunolepis yumenensis* (gen. et sp. nov.) is recorded from the Lower Cretaceous beds.

This new form is comparable with the Bernissart Wealden species *Coccolepis macroptera* (Traquair, 1911) but is zoogeographically closest to the east Turkestan, Kara Tau species *Coccolepis aniscowitchi* (Gor.—Kulcz., 1926) (see map 1), which is a smaller form of the Upper Jurassic (Berg, 1948). On account of the scantiness of material it is not advisable at present to engage in a phylogenic study of this group. Nevertheless these closely related forms discovered from successive geological formations at the Palaeo-Asiatic mainland are very enchanting.

The writer is very much obliged to Professor D. V. Obruchev of the Institute of Paleontology, Moscow, U.S.S.R., who has given much important information about the work on *Coccolepis* by the late Academician L. S. Berg and furnished the writer with a copy of Berg's "On Genus *Coccolepis* Agassiz (Pisces, Palaeoniscoidei)". To Dr. F. W. Booker of the Geological Survey of New South Wales the writer wishes to express his cordial thanks for his kind efforts made in sending him a photographic copy of Dr. A. S. Woodwards monography "The Fossil Fishes of the Talbragar Beds (Jurassic?)". The writer is greatly indebted to Professor Ping Chi for his untiring interest in this work, to Professor C. C. Young for his valuable guidance and constant encouragement, to Professors S. C. Chang, T. H. Yin, and C. H. Shaw, for their many stimulative criticisms. Most sincere thanks are due to Dr. Minchen M. Chow, who in many ways helped the writer and critically discussed the manuscript. The writer wishes to extend his warmest thanks also to some of his colleagues in the Institute of Paleontology, Academia Sinica, including Mr. M. T. Mu, who provided the writer with the data for the geological sections of the region, and Miss Y. T. Hou, who kindly sent a faunal list of the Ostracods from the Lower Huihuipou Series.

The drawings were made by Miss H. T. Hu and the photographes were skilfully prepared by Mr. C. F. Wang to whom the writer also wishes to express his thanks.

Geological Occurrence

The Lower Huihuipou Series is a part of the extensive continental Mesozoic sequence in the Chiuchuan Basin along the northern border of Mt. Nanshan in western Kansu.

From late Permian to the Quaternary successive continental sediments were deposited in this basin to a depth of about ten thousand meters. The Lower Huihuipou Series was well outcropped along the border of the Chiuchuan Basin except for the southeastern part. In most places it overlies conformably the Middle to Upper Jurassic Chihkingpu Series* or lies locally unconformably with older rocks. It is generally overlain by the Upper Huihuipou Series, or younger rocks.

The maximum thickness of the series measured from the Hanhsia** Gorge is 1,135

*赤金堡系， **旱峡.

meters, consisting at its lower part of about 300 meters of conglomeratic beds. Further up, there are layers of greyish black shales intercalated with some sandstones and conglomerates. Then comes a layer of basalt, about six meters thick. Above the basalt layer are thick beds of greyish black to greyish green shales intercalated with some sandstones and marly layers. The fish remains were discovered from the greyish green shales.

Palynological studies based on the materials collected from Chinshankou* (Hsü and Chow, 1956a) reveal that pollens of *Brachyphyllum*, Ginkoales, Bennettitales, and Cycadales are extremely abundant. *Cedrus*, *Pinus*, *Podocarpus* are also present. In analysing the specimens collected from Kaotai** (Hsü and Chow, 1956b) pollen grains of *Brachyphyllum*, *Cedrus Pinus*, *Sequioa*, *Podocarpus*, *Magnolia* and *Juglans* were found.

The microfossil remains studied by Y. T. Hou (M. S.) were collected from the Huangliuhsia*** Gorge. Among the Ostracoda the following gerera were present, *Cypridea* (*Pseudocypridina*), *Cypridea* (*Cyamocypris*), *Metacypris*, *Cypridea* (*Yumenia*), and *Darwinula*.

From the studies of the fossil insects (of which *Ephemeropsis* are very common), the Ostracoda and the spores and pollens of this series, many authors agree in that the geological age of the Lower Huihuipou Series is Lower Cretaceous, except the uppermost part of the Series which may have been a little younger in age as have been pointed out by Hsü and Chow (1956b). As far as the fish fauna is concerned, it is most likely to be Lower Cretaceous in age and can be compared with the Wealden Bed of Bernissart, though the fish bearing beds here might represent a higher horizon than that where the closely allied *Coccolepis macropter* was found.

According to M. T. Mu (oral communications), fossil fishes of the Lower Huihuipou Series have been discovered from three localities in the Chiuchuan Basin namely, 1) Peiyao, north of Kuantaishan, where the fishes here described were found, 2) west of the Chiayukwan**** Pass, and 3) at the entrance to Gorge Hanhsia. The fish bearing beds in these three localities are lithologically alike and have yielded the same fauna. Mu kindly sent the writer a detailed data for the section of the Lower Huihuipou Series measured by Wang Ping in 1954 at the entrance to Gorge Hanhsia, which is most helpful in getting a glimpse of the depositional nature of sediments and the stratigraphy of depostis where the fishes were found.

Geological Section of the Lower Huihuipou Series measured at the Entrance to the Hanhsia Gorge (Wang Ping and others)

Yumen gravels (Neogene)

.....unconformity.....

*青山溝， **高台， ***紅柳峽， ****嘉峪關.

		Thickness in meters
1)	Light grey shales, thin bedded, with numerous plant remains, *Estheria, Ephemeropsis* and fishes. The fishes here described came from this bed at Kuantaishan.	54
2)	Greyish green, thin and well bedded shales and conglomerates, with a few sandstone layers.	135
3)	Greyish green to brownish red shales interbedded with greyish green to yellowish grey sandstones.	30
4)	Greyish black shales, weathered to paper thinness, with abundant plant remains, and thin marly layers interbedded within the shales.	146
5)	Mainly greyish black shales, intercalated with abundant greyish green fine grained sandstones.	43
6)	Greyish black shales intercalated with many thin marly layers.	53
7)	Basalt, greyish black, amygdaloidal, with the cavities filled by calcite. the rocks beneath the basalt showing slight metamorphosis due to baking.	6
8)	Greyish black shales, with yellowish concretions, intercalated with a few fine grained sandstones and conglomerates.	195
9)	Thick greyish yellow conglomerates interbedded with greyish black shales.	135
10)	Greyish black shales with some thin layered conglomerates.	39
11)	Greyish white conglomerates interbedded with greyish black shales, thick bedded.	57
12)	Brownish red conglomerate beds, not well sorted and loosely cemented.	192
13)	Greyish white, thick bedded, conglomerates, boulders large and subangular.	50
	Total thickness	1,135

.....uncoformity.....

Yaokou Series* (Upper Permian)

Taxonomy and Description

Order Palaeonisciformes Berg, 1940
Suborder Palaeniscoidei Berg, 1940
Family Coccolepidae Berg, 1940
Genus *Sunolepis* (gen. nov.)

Diagnosis: Coccolepid fish attaining a length of about 45 cm, trunk elegantly fusiform, skull nearly four and one half of the total length. Suspensorium oblique,

*窑溝系.

preopercular-maxillary angle 33 degrees. Extrascapula triangular in shape, parietal nearly square, about one fifth the length of the frontal. Frontal long and narrow, meeting it fellow in a fairly straight line. Maxilla with a produced hinter inferior border and a slender bar beneath the orbit and extending much forward, mandible rather robust. Dentition consisting of one or more rows of sharp conical laniaries alternating with numerous minute teeth. Opercular deeper than wide, obliquely placed on side of head and wider at its lower portion. Subopercular large, wider and deeper than opercular. Preopercular with an anterior horizontal and a posterior vertical branch, and somewhat rounded at its posterior border. Dermohyal or antopercular bone presents. Dermal bones smooth or ornamented with tubercles or rugae. Supracleitherium broad and ornamented with tubercles at its anterior border, cleitherium strong.

Notochord persistent, with well developed basidorsals. Basiventrals also developed. Dorsal, pelvic and anal fins supported by radials much less in number than the lepidotrichia. Radials long and slender, represented by a single ossification, the axonost, its distal end closely connected with the base of the lepidotrichia. The distal end of the radials divided into Y-shape.

Fins large, the lepidotrichia situated close to each other, articulated and ramified dichotomically in their distal part. Fulcra present before the upper caudal lobe. Pectoral fin lepidotrichia articulated throughout, except the few rays at the commencement of the fin, which are distantly articulated and stronger. Lepidotrichia of the pectoral fin no less than 17 in number. Pelvic fins with extended base, triangular in shape, arising nearer to the origin of the anal than to the pectoral, each consisting of about 38 articulated lepidotrichia which are supported by about 18 radials. Dorsal fin triangular, and base extended arising behind the middle point of the back, number of lepidotrichia no less than 38 supported by about 22 radials. Anal fin small, consisting of no less than 22 lepidotrichia supported by about 17 radials. Caudal fin large and strongly heterocercal, deeply cleft and nearly equilobate, body axis extending to tip of dorsal lobe, angle of caudal inversion about 146 degrees, with no less than 80 lepidotrichia and a series of 40 fulcra.

Scale cycloid, thin and deeply imbricated, ganoine layer very thin or reduced, without tubercles, but with numerous fine striations ornamented on the surface.

Sunolepis yumenensis (gen. et sp. nov.)

Pl. I—VI, text-fig. 1—2

Holotype: Nearly complete medium sized fish. Laboratory of Vertebrate Paleontology. Catalogue Number V 584—1a.

Paratype: Head of a medium sized fish, V 584—7.

Specific Diagnosis: Same as for genus.

Horizon and Locality: Upper part of Lower Huihuipou Series, Lower Cretaceous. Peiyao, Kuantaishan, Yumen, Kansu Province.

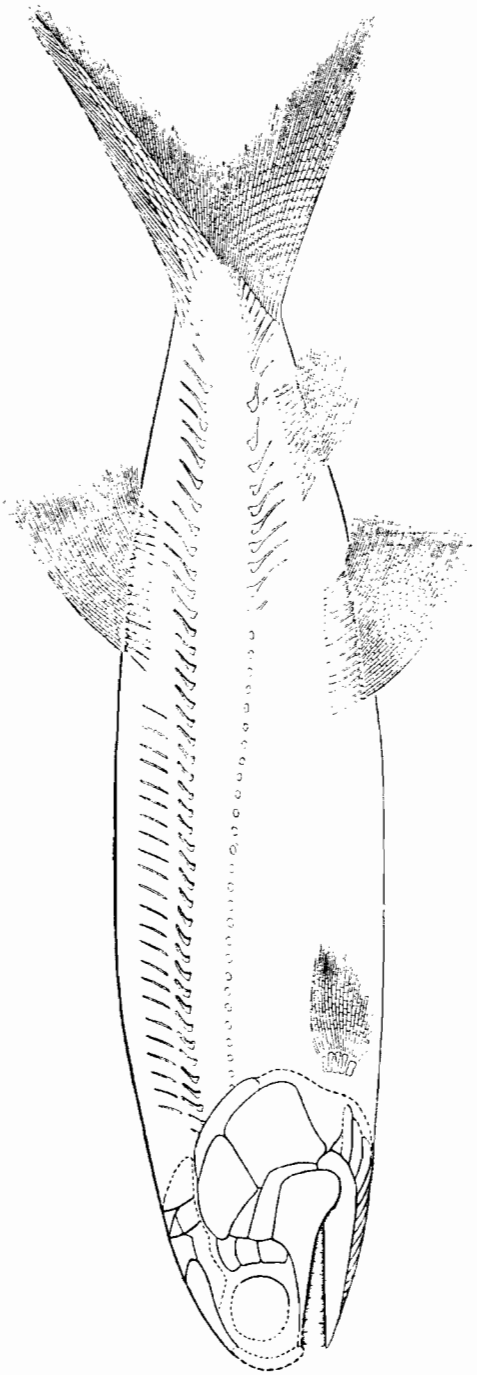


Fig. 1. *Sunaktichthys yumenensis* gen. et sp. nov. Reconstruction. Approximately $\times$ 1.

Materials: All specimens were collected from one locality, Peiyao, Kuantaishan. The fish remains were preserved in thick, fine greyish green shales. Remains of ostracods were also observed embedded in the rock matrix.

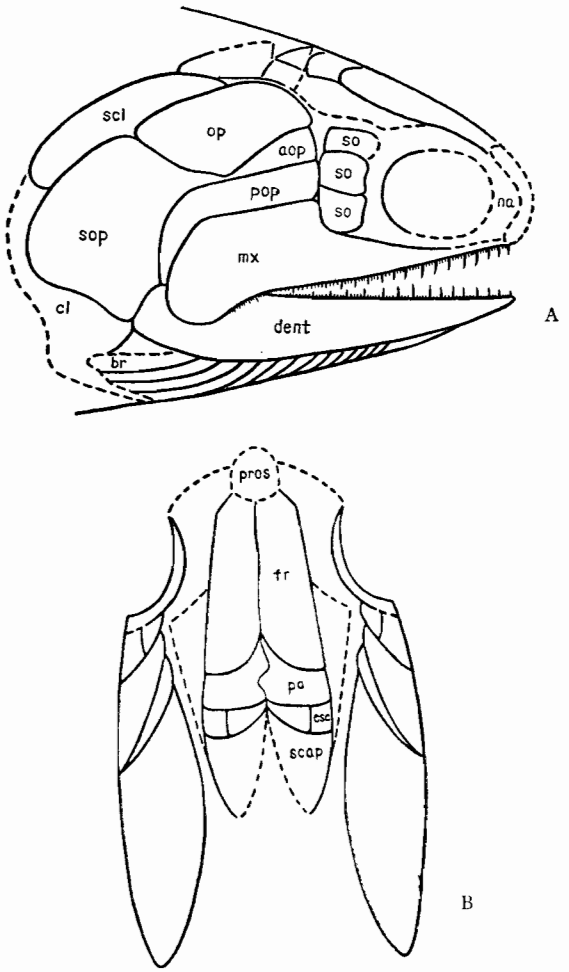


Fig. 2. *Sunolepis yumenensis* (gen. et sp. nov.)
Reconstruction of skull. A. Lateral view; B. Dorsal view.

Abbreviations: aop, antopercular; br, branchiostegal; cl, cleitherium; dent, dentary; csc, extrascapular; fr, frontal; mx, maxillary; na, nasal; op, opercular; pa, parietal; pop, preopercular; pros, postrostral; scap, suprascapular; scl, supracleitherium; so, suborbital; sop, subopercular.

1) Nearly complete fish, fins and axial skeletons fairly exhibited, but the skull encrusted by shaly matrix and therefore is not very well shown, the holotype specimen, V584—1a

with its counter part, V584—1b (Pl. I, fig. 1, Pl. II, fig. 1).

2) Broken specimen with head plates and a portion of the trunk preserved, V584—2a (Pl. II, fig. 2) with its counter part only the maxilla and mandible preserved, V584—2b.

3) Well preserved hinter part of a large sized individual, V584—3 (Pl. III, fig. 1).

4) A broken mandible, with teeth well exhibited, V584—4 (Pl. V, fig. 3).

5) An incomplete large individual with fins preserved but greatly damaged due to unskilful preparation before being sent to the laboratory, V584—5 (Pl. IV, fig. 1).

6) A portion of the trunk of a large individual, with dorsal, anal and a part of the one pelvic fins well exhibited, V584—6a (Pl. VI, fig. 1) and it counter part, V584—6b.

7) Well preserved medium sized individual with its skull bones exhibited, V584—7 (Pl. III, fig. 2). The paratype specimen.

8) Crushed skull of a large individual with several skull bones well displayed, V584—8a with its counter part, V584—8b (Pl. V, figs. 1—2).

9) A large individual exhibiting the shoulder girdle, V584—9.

10) An isolated cycloidal scale, V584—10 (Pl. IV, fig. 2).

11) Another isolated cycloidal scale, V584—11 (Pl. IV, fig. 3).

12) Incomplete large sized individual, V584—12.

13) Portion of the tail of a small sized individual, V584—13.

14) Portion of the trunk of a large individual, V584—14.

15) Incomplete fish with dorsal and caudal fins well displayed, V584—15.

Beside the above mentioned specimens there are a few broken pieces of the fish belonging to different individuals. They were catalogued as V584—16 to V584—20.

All these specimens were marked Loc. No. 2 by the collectors and on V584—15 there is number 7470606.

Measurements (in centimeters) of V584—1a and its counterpart V584—1b.

Total length	18.0
Approximate length along level of lateral lines to beginning of caudal inversion	14.0
Skull length (rostrum to posterior border of suboperculum)	4.1
Transvers diameter of the orbit	1.2 (?)
Depth of caudal pedencle	1.9 (?)
Distance from rostrum to anterior border of dorsal fin	9.6
Distance from rostrum to anterior border of pelvic fin	9.0
Distance from rostrum to anterior border of anal fin	11.9
Approximate maximum body depth	3.5

Description

Body Form: *Sunolepis* is a large Coccolepid like fish, which attains a length of about 45 cm. It has a body outline closely resembling *Coccolepis macroptera*, but is comparatively slender (text-fig. 1), the maximum depth at the level of the pelvic fins is about one fifth of the total body length. The skull measures somewhat less than one fifth of the total body length. The orbit is large and lies far forward. The snout is rounded and the jaws are long as usually seen in the Palaeoniseiformes. The dorsal fin arises behind the middle point of the back at the point about 6 mm behind the origin of the long based pelvics in the holotype V584—1a. The pelvics are large. Their maximum depth is not greater than that of the trunk at the point of origin. The pectoral fins were held in a nearly horizontal position. They are much smaller than the pelvic fins. The long based pelvic fins situated nearer to the anal than to the pectorals. The caudal pedencle is stout and a little constricted. The tail is deeply cleft, equilobate and completely heterocercal.

Skull: The interpretation of the dermal bone pattern of the skull is based on V584—2a, V584—7 and V584—8 (text fig. 2, Pl. II, fig. 2, Pl. III, fig. 2 and Pl. V, figs. 1—2). Since the dermal bones on the skull are either not very well exhibited due to the lateral compressed condition of preservation or having been broken, the present restored skull must be regarded as tentative in certain details.

The extrascapular elements (V584—7, Pl. III, fig. 2) are situated at the posterior part of the skull roof above the position of the supracleitherium. It is very difficult to determine the definite outline of this bone, since the hinter margin of it seems to be broken. Judging from the preserved part on V584—7 it seems to be triangular in shape, same as that of the *Aeroleps* (Aldinger, 1937, P. 262) or *Pygopterus* (Aldinger op. cit. P. 313). From the preserved broken bone the sensory canals can be detected.

The parietals are not well shown from any of the preserved specimens, but at V584—7 (Pl. III, fig. 2) between the extrascapular and the frontal, there is a vacant place where the bones had fallen off and which must have been occupied by the parietals. Infered from the impressions of the bones and from the contact margins with the frontals infront, the parietal is a nearly quadrate shaped bone, a little more transversely elongated and the mesial contact lines is strongly wavy. Judging from the outline of the rounded posterior end of the frontal, the parietal must be a little lengthened at the mexial-anterior corner. It is about one fifth of the frontal in length.

The frontals are fairly well preserved in V584—7 (Pl. III, fig. 2) and also shown by impressions in V584—8a and —8b (Pl. V, figs. 1—2). They are narrow and elongated bones, bearing clusters of tubercles on the surface. The two frontals contacted in a fairly straight line and elongated liked that of the *Ptycholepis bollensis*, figured by Aldinger (op. cit. text-figure 85). The course of the sensory canals on the frontals judging from the impression on V584—8, is nearly straight and not much undulated. The dermosphanotic bones of these specimens are either broken or covered by matrix. At V584—7 in front

of the anterior end of the left frontal there is a square shape impression of a bone. It is still uncertain as to whether this is the dislocated left nasal bone or not.

The post rostral is preserved in V584—7, but covered by a film of matrix. So its exact shape is not clear. From the outline observed, it probably has kept its natural curve and is a rather large bone. This indicates that the snout of the fish is rounded and blunt.

The suborbitals are not very clearly shown in V584—1, but at least three of them can be observed from V584—7. Two of them on the upper part are quadratic in shape, while the third one beneath the first two has a larger depth as compared with its length.

The nature of the postorbital and the infraorbital is not quite clear. In V584—7, beneath the orbit and above the slender bar of the maxilla, there seems to be a piece of bone element which has an obliquely placed suture. Whether it represents the suture between the posterior infraorbital and the anterior infraorbital or just a rupture of the bone is not certain.

The most anterior tip of the maxillary bone is still embedded in the rock in V584—7. Therefore whether there is a premaxilla or not is not sure.

The shape of the maxilla (V584—2b, V584—7, V584—8), like most of the Palaeoniseiforme fishes has an expended posterior portion, produced at its lower margin, and a slender bar to the forward. From V584—7 it is rather elongated and extending anteriorly over the orbit, it does not end beneath the orbit as that of the *Glaucolepis* (Nielsen, 1942) and *Turseodus* (Schaffer, 1952, text-figs. 3—4). Teeth on the maxillary can be observed from V584—7. The well spaced larger teeth (laniaries) are conical with slightly curved sharp tips, while the minute teeth are very numerous.

The preopercular (V584—1, V584—2, V584—7, Pl. I, fig. 1, Pl. II, figs. 1—2, Pl. III, fig. 2) is not very well displayed on the specimens described here. It is strongly bended, with two branches, one anterior horizontal and the other posterior vertical. There is an indistinct angle on the posterior border, it is somewhat rounded. The lower end of the preopercular is about on the level with the subopercular. The hyomandibular seems to be exposed on V584—2, but it is broken, and is not described here.

The obliqueness of the suspensorium is well displayed in V584—2a. According to Bobb Schaffer (1952), "By a line drawn from the anterodorsal corner of the preopercular to the midpoint on its ventral border and a second line from the point on the ventral border to the anterior termination of the maxillary, an angle is obtained that approximates closely the inclination of the suspensorium in relation to the upper jaw". The measurements given by Schaffer for *Turseodus* is about 33 degrees, for *Palaeoniscus* about 35 degrees and for *Glaucolepis stensiöi* 32 degrees, for *Gyrolepis* 34 degrees and for *Cosmolepis* approximately 32 degrees. In this fish the angle measured from V584—2a is about 33 degrees.

The mandible is fairly robust, broader to the rear. The ventral margin is straight, V584—1a, V584—2b, V584—4 and V584—7. Teeth are well exhibited in V584—4 (Pl. V, fig. 3) and V584—7 (Pl. III, fig. 2). In V584—2b the very anterior tip of the mandible

is a little deepened.

The opercular is smaller than the subopercular, as that in the case of *Coccolepis liassica* (Woodward, 1890). It is nearly a rounded lozenge shaped plate in V584—2a.

The subopercular (V584—2a, V584—7, V584—8) is large, deeper and broader than the opercular, its depth is less than twice that of the opercular.

The branchiostegals, as exhibited by V584—9 are no less than 12 in number. They are rather long and broad in shape.

Along the broken preopercular of V584—2a the trace of the sensory canal is shown, which is now filled by white calcite.. But in none of the specimens here described the sensory canals are well defined. Their impressions on the frontals of V584—8 and the extrascapular of V584—7 have been mentioned already.

From V584—8a and —8b situated at a position above the preopercular, there are a pair of triangular calcified elements. They are concave-convex in form, each having a convex surface towards the mexial and a concave surface towards the lateral side of the skull. They are considered as the solid otolith of the fish. Otolith of the Palaeonisciformes, though seldom met with but has been observed by Traquair (1901) and others.

Axial Skeleton: Since the scales are thin, impressions of internal skeleton are visible underneath the body scales. The notochord seems well developed and persistent through the whole abdominal and caudal regions. It is not constricted and as in the Palaeonisciformes in general.

The basidorsals are preserved throughout the length of the fish. In the abdominal region they are both robust and elongated and appear to remain separated at their upper extremities. As in the case of Palaeonisciformes, the interdorsal cannot be defined in certainly, especially in those specimens the abdominal region of which is covered by scales.

The unpaired neural spines in the abdominal region are longer and more slender than the basidorsals. These neural spines are not very closely in contact with the basidorsals, but merely apposed by their forked base as that described by Stensiö (1921) in *Pygopterus de-geeri,* "These unpaired neural spines are not situated so as to form a distinct continuation of the basidorsal in the distal direction". In V584—3 at the anterior part of the caudal region, the case might be as that in *Pygopterus de-geeri* (Stensiö, 1921, P. 206), "they are replaced by the lengthened basidorsal themselves".

The presence of basiventrals in the abdominal region apposite to the basidorsal can be observed from V584—1b. They are represented by small oval shaped ossifications. The haemal spines are firmly fixed to the basiventrals in the caudal region. At the base of the caudal fin the haemals are enlarged for direct support of the lepidotrichia of the caudal fin and along the lower margin of the caudal axis for some distance.

The ossified ribs are not developed.

Paired Fins: The suprascapular is not well developed in specimens of this collec-

tion, but from V584—7 above the cleitherium and behind the extrascapular there is a broken bone with a tapering posterior end which might be the suprascapular.

The supracleitherium is an elongated plate. As observed from specimens V584—2a, V584—7, and V584—8 perhaps it is not greatly covered by the opercular.

The cleitherium, shown in V584—9, is not well defined but seems to be a rather strong bone.

The pectoral fins are composed of no less than 17 lepidotrichia (V584—2a) each. The first three of them have a heavy ganoid covering, which are distantly articulated. The third one from the commencement of the fin appears to be the longest. The remaining lepidotrichia are intimately segmented and bifurcated at their very distal ends. As can be observed from V584—2a, the pectoral fin lepidotrichia, except the first few ones are segmented from their very base and with radials supported. The radials are stout and expanded at their distal ends, no less than five in number.

The pelvic fins situated nearer to the origin of the anal than to that of the pectoral. These pelvic fins are long based and triangular. They are composed of no less than 38 lepidotrichia each and supported by 18 radials respectively (V584—1a, V584—3). The radials are generally like those which in the *Coccolepis* but with distinctly forked Y-shape distal ends. The lepidotrichia are closely set and completely segmented, only bifurcated at their very tip. No fulcra fringe the anterior border of the fins. The height of the fins is slightly smaller than their length.

Median Fins: The dorsal fin commencing behind the middle point of the back is rather large (V584—1a, V584—3, V584—6). There are no less than 38 lepidotrichia, intimately segmented from their base and bifurcated at their tips. No definite fulcra have been observed infront of the fin except the first three lepidotrichia which are covered by a heavy ganoine, less segmented and having a smaller length than those behind. The radials of the dorsal fin are well displayed in V584—3. They are slender and shorter as compared with those of the *Coccolepis*. Each radial is represented by only one ossification—the axonost. The distal ends of theirs, instead of being expanded as that of the *Coccolepis* are forked into Y-shape. This character can be observed from all well exhibited radials of the specimens. But whether the Y-shape distal end of the radials is forked anterior-posteriorly or forked lateraly (in left-right direction) is not certain. To the writer it seems that the former case is most probably true. For if it is in the latter case, then one has to explain that all the radials observed having been rotate from its original position to about ninety degrees, which is a phenomena quite peculiar.

The number of the radials of the dorsal fin is about 22.

Stensiö (1921, P. 247) has pointed out that "in a specimen of *Coccolepis bucklandi* Agassiz belong to the Alte Akademie of Munich, I think, I was able to find traces of baseost as well". But in this form, the presence of the baseost is not observed. Each radial with its forked Y-shape distal ends is closely connected with the bases of the lepidotrichia.

The anal fin is clearly shown in V584—3. It is shorter than both the pelvics and the dorsal. It is triangular in shape, nearly as high as long. The lepidotrichia are profoundly segmented and bifurcated at their extremities, as the dorsal and the pelvics. The number of the lepidotrichia is approximately 22 supported by 17 radials. The radials are long and slender. They are longer than the radials beneath the dorsal fin, but proportionally less in number than that of the dorsal as compared with the lepidotrichia which they support.

The caudal fin is also very well exhibited in V584—3. It is deeply cleft and nearly equilobate and completely heterocercal. The body axis extends to the end of the dorsal lobe. The lepidotrichia which total about 80 are bifurcated for two-third of their length in the dorsal lobe, while in the ventral lobe the lepidotrichia are bifurcated for half of the distal length. Lepidotrichia of the ventral lobe are strong and large, while those of the dorsal lobe are much slender.

The dorsal margin of the caudal axis is bordered by approximately 40 fulera scales. With the caudal inversion point as a center, two straight lines are drawn, one along the dorsal caudal axis towards its tip and the other along the body axis towards its foremost beginning behind the cleitherium. Thus a "caudal inversion angle" is obtained. If the axial lobe is strongly uplifted the angle thus obtained is smaller than those which are less strongly uplifted. This character is probably important in considering the structure of the heterocercal caudal fins.

A series of measurements of the most akin form, the *Coccolepis*, as compared with the fish here described show that the "caudal inversion angle" in *Coccolepis liassica* is about 160 degrees (Woodward, 1890, Pl. XVI, figs. 2, 4) in *C. andreusi* 175 degrees (Woodward, 1895b, Pl. VII, fig. 1), in *C. australis* 162 degrees (Woodward, 1895a, Pl. I, fig. 2, Pl. II, fig. 4) in *C. macroptera* 164 degrees (Traquair, 1911, Pl. I, fig. 4, text-fig. 2) and in *C. aniscowitchi* 163 degrees (White, 1934). Though the measurements thus obtained are entirely on account of the figures of the originals, slight inaccuracy must be counted for. But it is quite obvious that in *Coccolepis* the "caudal inversion angles" are greater than 160 degrees. (though in *Coccolepis bucklandi* figured by Agassiz this angle cannot be obtained due to the lack of the tip of the dorsal lobe). The "caudal inversion angle", measured from V584—1a, V584—3, is about 146 degrees. That is to say the fish here described has a more strongly uplifted dorsal caudal lobe, than that of the *Coccolepis* or that its caudal fin is more strongly clefted than that of the *Coccolepis*.

The Squamation: The squamation of this fish are mostly preserved. Except for the series of lancet-shaped ganoine scales covering the caudal body extension, they are thin, cycloidal and deeply imbricated. The scales are so thin that nearly all the internal bone elements are well displayed beneath the covering of the scales. There are about 50 vertical scale rows counted from the beginning of the pelvic fin to the caudal inversion in V584—3. The scales are uniform and not differentiated in shape. The ganoine layers on the scales are either very thin or highly reduced. Only in V584—3, scales on the position along the lateral line have slightly thicker ganoid coverings. Differing from *Coccolepis*, there are no tubercles developed on the surface of the scales. Concentric lines of growth are very

clearly shown on the scales of V584—10,—11, (Pl. IV, figs. 2—3). There are also numerous very fine striations ornamented on the scales.

The outline of the isolated scale is more elongated oval in shape in this fish as compared with that of the *Coccolepis*, which is generally sub-rounded in shape.

Remarks

In his book "Classification of Fishes both recent and Fossil" Berg (1940, a new edition of this book, enlarged and revised under the direction of Academician E. N. Pavlovsky was published in 1955) has established a new family Coccolepidae among the Palaeoniscoidei fishes on account of the fish "As Palaeoniscidae but only one row of dorsal radials ossified. Dorsal and anal rays not much more numerous than their corresponding radials. Scales cycloid." *Coccolepis* Agassiz is the only known genus of the family. The genotype *Coccolepis bucklandis* is a small form from the Solenhofen lithographic stone of Bavaria founded by Agassiz in 1844. Up to recent besides *Coccolepis bucklandi* five other species were known. *C. liassica* was described by Woodward (1890) from the Lymis Regis Lias in 1890. Later in 1895 another small form *C. andrewsi* was described by Woodward (1895a) from the Purbeck beds, at Teffont. In the same year Woodward described another species *C. australis* from the Jurassic Talbragar Bed of New South Wales (1895b). Traquair (1911) in his monograph on the Bernissart fishes had described a large Wealden species *C. macroptera*. In 1926 Gorizdro-Kulczyska (1926) had described the fish fauna from the Upper Jurassic of Kara-Tau, east Turkestan. She has founded a new species *Coccolepis aniscowitchi*. The *Coccolepis* discovered from the fossiliferous localities of Kara-Tau had been studied by different authors in the following years, and they had established several new species. About these the late Academician L. S. Berg (1948) had made a brief discussion, in which he considered *Coccolepis sociales* Gor-Kulcz. 1926, *Palaeoniscoides turkestanensis* Sewertzoff 1934, *Coccolepis cockerelli* White 1934 and *Coccolepis* sp. Eremeyeva 1940 to be the synonyms of *Coccolepis aniscowitchi*.

The above mentioned five species* of *Coccolepis* though different in several respects from the genotype, but they all agree with it on the important generic characters given by Agassiz (1844) and enlarged by Woodward (1895b): "Trunk elegantly fusiform. Mandibular suspensorium oblique: dentition consisting of an inner series of large laniaries flanked externally with minute teeth: external bones tuberculated or rugose. Fins large or of moderate size, all the rays articulated and branching distally: fulcra minute or absent. Pelvic fins extended: dorsal and anal fins triangular, the former opposed to the space between the latter and the pelvic fins: upper caudal lobe much elongated, the fin deeply cleft and

*R. F. Hekker (1948), in his paper on the Jurassic fauna and flora of Kara-Tau has mentioned a new species *Coccolepis martynovi* (sp. nov.), which was erected by the late Academician L. S. Berg. But no published record of this new species can be found, it is probably because Berg did not yet finished his work on it before his passing away.

somewhat unsymmetrical. Scales thin and deeply imbricating, ornamented with tuberculations of ganoine".

From the already mentioned characters of the fish here described, it is quite obvious that this fish is most akin to *Coccolepis*, and can be compared with *Coccolepis* by its oblique suspensorium, its one row of radials of the dorsal fin, its heterocercal caudal fin, its cycloidal scales and also by the size and relative position of the fins. But, however, it differs from the *Coccolepis* in several characters which are of generic importance. Such as the size of the fins and the number of their lepidotrichia, the structure of the caudal fin and the ornamentations of the scales.

From different species of the *Coccolepis* (except those of *C. bucklandi* and *C. liassica* which were not recorded in the literature) lepidotrichia of the dorsal fin are less in number than that of the pelvic fin, but equals or slightly numerous than that of the anal (see table 1).

Comparison of number of fin lepidotrichia (above) and radials (below) between different species of ***Coccolepis*** and ***Sunolepis yumenensis*** (gen. et sp. nov.)

	Pectoral fin	Dorsal fin	Pelvic fin	Anal fin	Caudal inversion angle (degrees)
Sunolepis yumenensis (1) (gen. et sp. nov.)	17	38 20	38 18	22 17	146
Coccolepis andrewsi (2)		16	20+	16 14	175
C. liassica (3)					160
C. australis (4)		D>A	40+	A<D	162
C. macroptera (5)		25 19—20	30	25 19	164
C. aniscowitchi (6)		35+ 30+	32	25+	163

(1) *Sunolepis yumenensis* base on specimen V584—1a and —1b (Holotype), V584—3.

(2) *Coccolepis andrewsi* Woodward (1895b, Pl. VII, fig. 1). "The dorsal fin, ... seems to exhibit five endoskeletal supports for the six formost articulated rays". (Woodward, 1890, P. 48).

(3) *C. liassica* Woodward (1890, Pl. XVI, figs. 2, 4).

(4) *C. austrulis* Woodward (1895a, Pl. I, fig. 2, Pl. II, fig. 4). "The supports are ..... only slight less numerous than the latter (rays), about seven supports corresponding to nine rays". (Woodward, 1895a,P. 7).

(5) *C. macroptera* Traquair (1911, Pl. I, fig. 4, text-fig. 2)*.

(6) *C. aniscowitchi* Gorazdro-Kulczycka (White, 1934, P. 396. fig.).

* The pelvic fin of *C. macroptera* in Traquair's restoration is inaccurate.

But in *Sunolepis yumenensis* the number of the dorsal fin lepidotrichia nearly equal that of the pelvic fin and more numerous than that of its anal.

That is to say *Sunolepis* as compared with the *Coccolepis* has a comparatively larger dorsal fin and smaller anal fin than the latter. The dorsal radials as well as that of the pelvic and the anal fins, as have stated above which are much less in number to the supporting lepidotrichia in *Sunolepis* than that of the *Coccolepis* (see table 1). The ratio of the radials to their corresponding dorsal fin lepidotrichia in *Coccolepis macroptera* is about 4/5, and in *Sunolepis yumenensis* is about 1/2.

The radials in *Sunolepis,* with their forked Y-shape distal ends are relatively shorter and slender than that of the *Coccolepis.*

On the morphology of the cleft heterocal caudal fin, the "caudal inversion angle" of the *Coccolepis* is larger than 160 degrees, but in *Sunolepis* the "caudal inversion angle" is about 146 degrees. Therefore the caudal fin of *Sunolepis* is more strong forked than that of the *Coccolepis.*

Ornamentations on the scales are also different between the two genera. The ganoid tubercles on the free surface of the scales of the *Coccolepis* has been observed from all known species, except whether there are tubercles on the scales of *C. aniscowitchi* or not s un certain. But in *Sunolepis* the writer has sought in vain for any ganoid tubercles on the scales of all the specimens. Instead of the presence of ganoid tubercles, there are numerous fine striations ornamented on the scales of *Sunolepis,* which probably not well developed on the scales of the *Coccolepis.*

Apart from the above mentioned distinguishing differences between the *Sunolepis* and the *Coccolepis,* the skull bone elements of the former are now fairly well known, but the knowledge about the skull bones of the *Coccolepis* is still very limited.

Therefore *Sunolepis yumenensis* though resembles *Coccolepis* but differs from it greatly and represents a new genus of the family Coccolepidae. The generic name is dedicate to the late geologist Sun Chien Chu, eminent pioneer worker in the field of petroleum geology in China, and also one of the discoverers of the here described fossil remains. The species name is after the city Yumen.

As for the geological age of the fish bearing Lower Huihuipou Series, since *Sunolepis* is closely related to the *Coccolepis,* which is a form exclusively of the Jurassic but a few extended to the Lower Cretaceous (Wealden). It is better to regard this formation as Lower Cretaceouss, this is also not oppose the conclusion drawn from the study of the invertebrate fossils and also the plant remains.

P. S. (1) In 1953 Bohlin described a few dinosaur remains from the locality Huihuipou, the type locality of the Huihuipou Series, not very far from Kuantaishan, (Hui-Hui-P'u, Bohlin, 1953, P. 62—67) where teeth of Theropoda and Sauropoda and a new Stegosaurides, *Stegosaurides excavatus* Bohlin, were founded by him. Since the fossils are fragmentary and their stratigraphical position uncertain, it prevents to make any correlation between the two localities, but, anyhow, it is very interesting to note here that dinosaur remains also present in the Huihuipou Series (Lower of Upper ?).

(2) Together with the fish remains collected from Kuantaishan there is a pretty well preserved leptolepid fish on a piece of hard greenish black shale. The rock differs from that which yielding *Sunolepis yumenensis* and no labels accompanied with the specimen or marks on the specimen can makes sure that it came from the same layer with *Sunolepis*. Therefore provisionally the writer mentioned it here as *Leptolepis* sp. (Pl. VI, fig. 2). (V585).

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甘肅酒泉玉門下惠回鋪系中的一種新古鱘類

(摘 要)

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本文所述酒泉盆地下惠回鋪系上部灰綠色粘土質頁岩中的魚化石,係孫健初和陳賁於 1941 年在玉門寬台山北麓所採。標本共有三十個,大約分屬於十九個個體,同屬於一種。

這些魚化石形態上的特徵是: 尾爲全歪形 (heterocercal), 脊索未見骨化椎體。頭骨的上顎骨後部直接和前鰓蓋骨連接, 上顎骨的後部寬大成板狀向前在眼眶下變細, 成爲薄條向前到達吻端 (見附圖 2)。前鰓蓋骨爲彎曲形, 上部位置近水平與上顎骨相接, 下部則近直立。上鰓蓋骨 (antopercular 或 dermohyal) 位於前鰓蓋骨和鰓蓋骨之間,可知其懸掛骨 (hyomandibular) 傾斜向後。若自前鰓蓋骨的上前端畫一直線到前鰓蓋骨的下末端,和自此下末端所畫一直線沿上顎骨向前到其前端成一夾角, 則這夾角的度數相應的表示其懸掛骨傾斜的程度。寬台山魚標本的前鰓蓋骨——上顎骨夾角是 33° 和其他古鱘亞目中 (Palaeoniscoidea, Берг, 1940) 各屬的情況相似,由以上各點可知它屬於古鱘亞目。

這魚的背鰭位始於體長的中點線之後,腹鰭基線甚長,背鰭、腹鰭和臀鰭鰭條的數目多於相應的內支持骨 (radials) 且鰭條自基底即分節,在近末端時才開始分叉。背鰭的內支持骨由一排鰭軸骨 (axonost) 形成, 未見鰭條基骨 (baseost),鱗爲圓鱗 (Cycloidal)。這些特徵和古鱘亞目中的粒鱗魚科 (Coccolepidae, Берг, 1940) 中的唯一的一屬粒鱗魚 (*Coccolepis* Agassiz, 1844) 相近,所以可和粒鱗魚比較。

除上述的一些特徵在此所記述的標本和粒鱗魚 (*Coccolepis*) 的構造上相似外, 二者的不同是, 粒鱗魚的背鰭鰭條數目大致與其臀鰭的相等或稍大之, 但小於其腹鰭的數目。而寬台山魚標本上所見則是背鰭鰭條數目幾等於其腹鰭的而大於其臀鰭鰭條數目(見附表 I)。亦即按比例來說粒鱗魚的背鰭小於腹鰭而等於臀鰭, 但在寬台山的魚背鰭等於其腹鰭而大於其臀鰭。

背鰭的內支持骨數目在粒鱗魚中略少於其所支持的鰭條其比率約成 4/5 (見附表 I) 但在此魚則內支持骨少於其鰭條很多,其比率約爲 1/2。

在尾鰭構造上可以以尾轉折點(Caudal Invesrion 即其中軸在尾柄末向上翹起的轉折處)

爲中心向前沿中軸畫一直線，再從尾轉折點向後沿尾軸向其末端畫一直線。由此兩線形成一夾角，角度的大小反映其尾軸向上翹起的程度。一般角度愈大翹起愈小，角度愈小則翹起愈大。量得結果粒鱗魚爲 160° 或稍大，而在本文所描述的標本上所測得的角度是 146°。由此可知寬台山的這種魚尾軸向上翹起比粒鱗魚要高，也就是其尾鰭的分叉的程度大於粒鱗魚。

在鱗的構造和它浮飾上所有的粒鱗魚（除在安氏粒鱗魚 *Coccolepis aniscowitchi* 一種記述現尙不清楚外）在鱗的露出部分都有琺瑯質（Ganoine）的粒狀凸起，這也是阿格茲氏（Agassiz）訂名爲粒鱗魚時所取名的涵意。但寬台山的魚則不見此種琺瑯質的粒點，是其琺瑯質層有減少的趨向。

由於上述的特徵和比較，著者將寬台山的魚訂名爲玉門孫魚（*Sunolepis yumenensis* gen. et sp. nov.）。這一新屬新種的屬名是爲了紀念對中國石油地質有很大貢獻的已故的孫健初先生，種名以其產地名之。

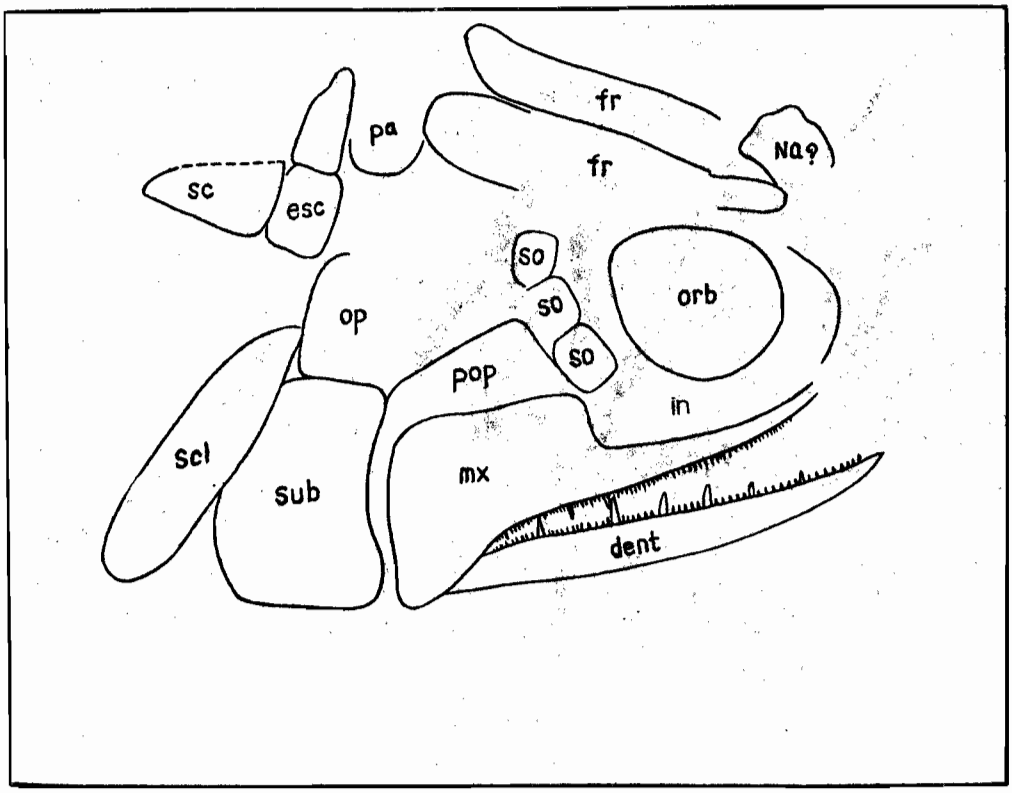
Explanation of the plates I.

Fig. 1. *Sunolepis yumenensis* (gen. et sp. nov.) The Holotype. V584-1a. ×1.

Explanation of the plates III.

Fig. 1. *Sunolepis yumenensis* (gen. et sp. nov.). Well preserved fish, without head. V584-3 ×1/3.
Fig. 2. *Sunolepis yumenensis* (gen. et sp. nov.) skull. The para type. V584-7 ×2.

aop, antopercular (Dermohyal); br, branchiostegal; cl, cleitherium (?); dent, dentary (mandible); esc, extrascapular; fr, frontal; in., infraorbital; mx, maxillary; na, nasal (?); orb, orbit; op, opercular; pa, parietal; pop, preopercular; ro, rostrum; scap, suprascapular; scl, supracleitherium; so, suborbital; sop, subopercular.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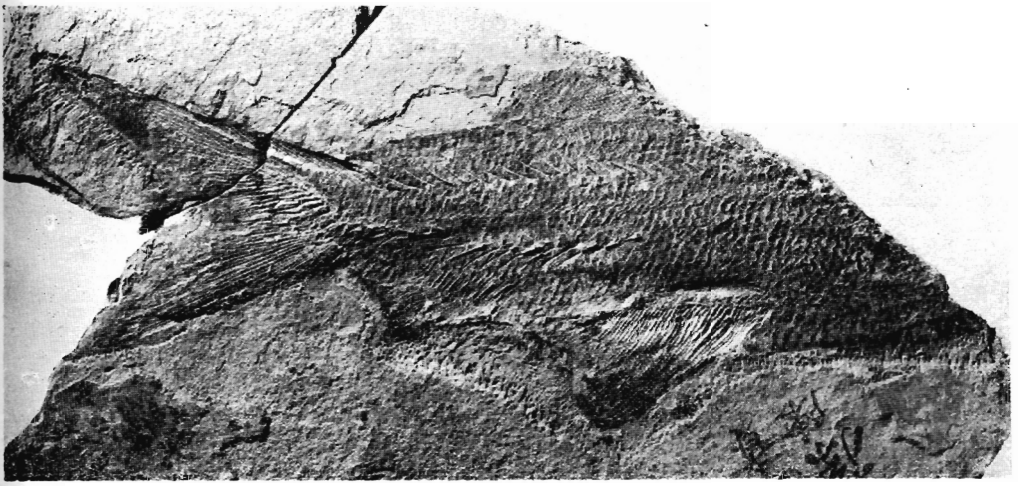


Fig. 1

Fig. 2

Explanation of the plates IV.

Fig. 1. *Sunolepis yumenensis* (gen. et sp. nov.) imcomplete fish, V584-5 ×1/3.
Fig. 2. *Sunolepis yumenensis* (gen. et sp. nov.) isolated scale, V584-10 ×9 ca.
Fig. 3. *Sunolepis yumenensis* (gen. et sp. nov.) isolated scale, V584-11 ×9 ca.

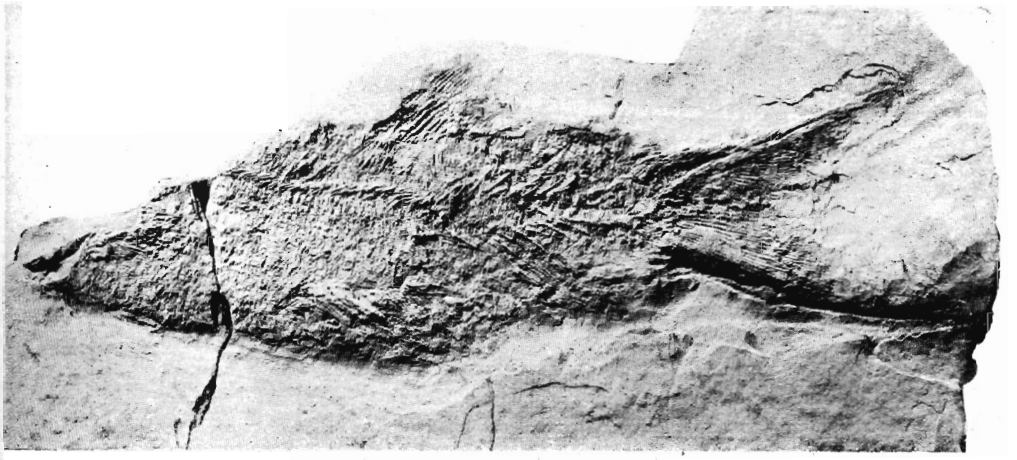


Fig. 1

Fig. 2

Fig. 3

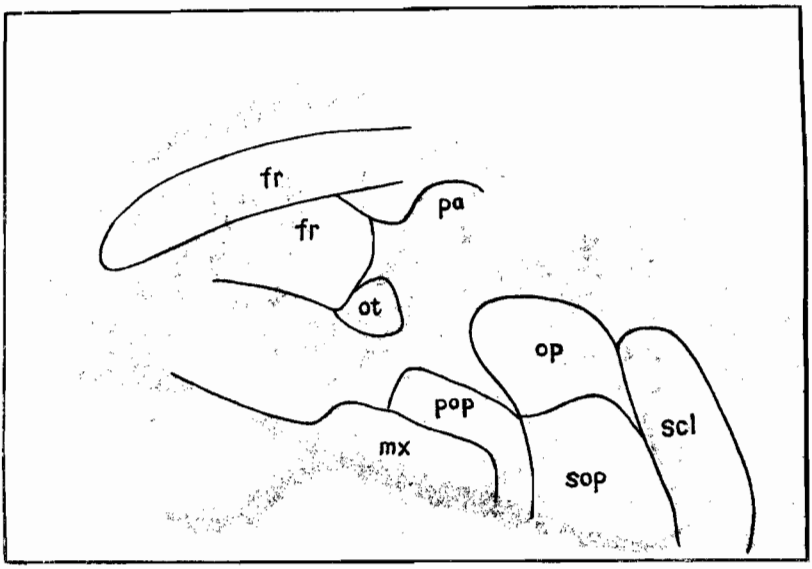
Explanation of the plates V.

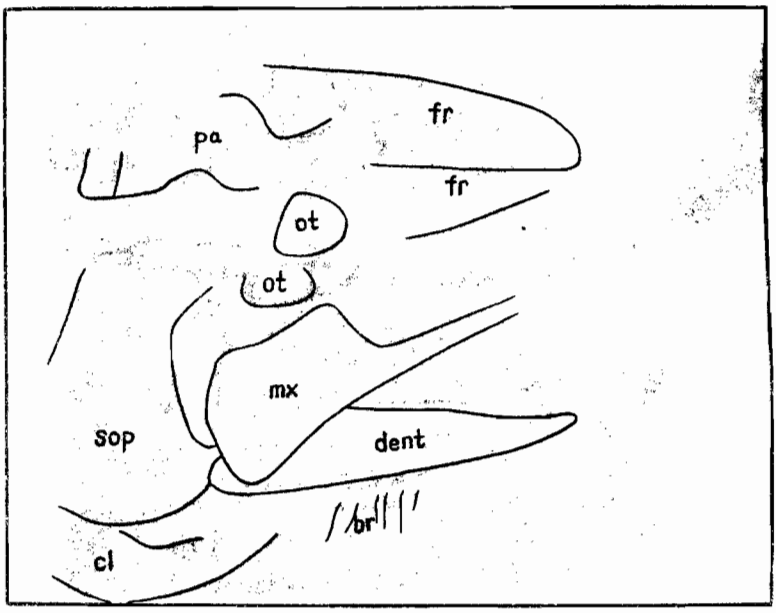
Fig. 1. *Sunolepis yumenensis* (gen. et sp. nov.) crushed skull, V584-8a ×1.

Fig. 2. *Sunolepis yumenensis* (gen. et sp. nov.) counter part of V584-8a, V584-8b ×1.

Fig. 3. *Sunolepis yumenensis* (gen. et sp. nov.) Dentary showing teeth in it V584-2b ×2.

aop, antopercular (Dermohyal); br, branchiostegal; cl, cleitherium; dent, dentary (mandible); fr, frontal; mx, maxillary; ot, otolith; pa, parietal; pop, preopercular; so, suborbital; scl, supracleitherium; sop, subopercular.


fr
fr
pa
ot
op
pop
scl
mx
sop


pa
fr
fr
ot
ot
mx
sop
dent
br
cl

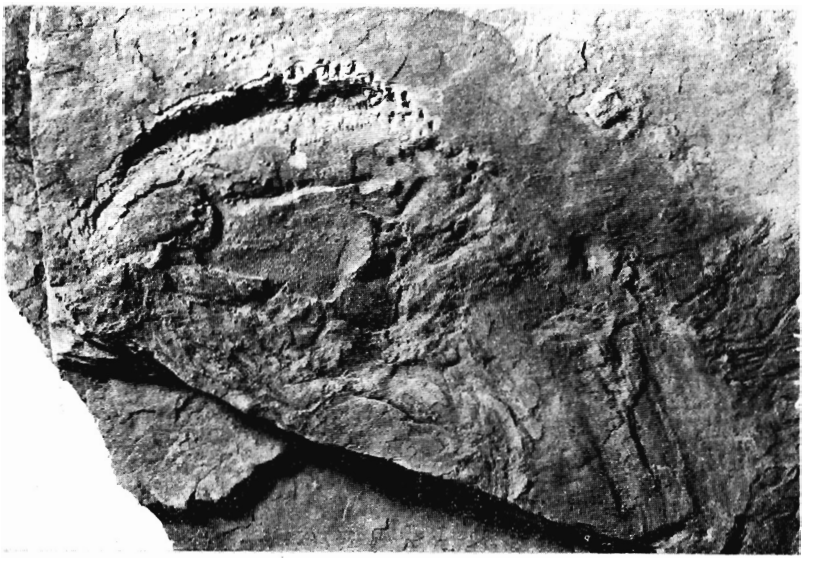


Fig. 1

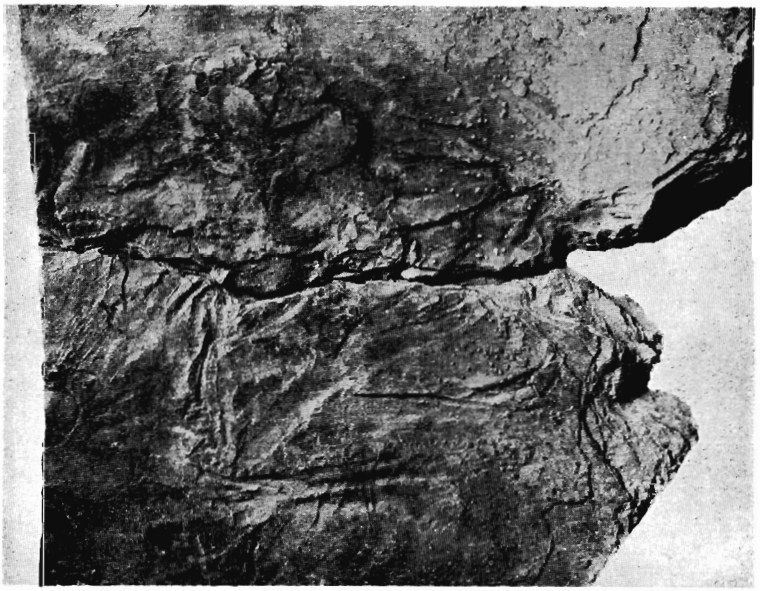


Fig. 2

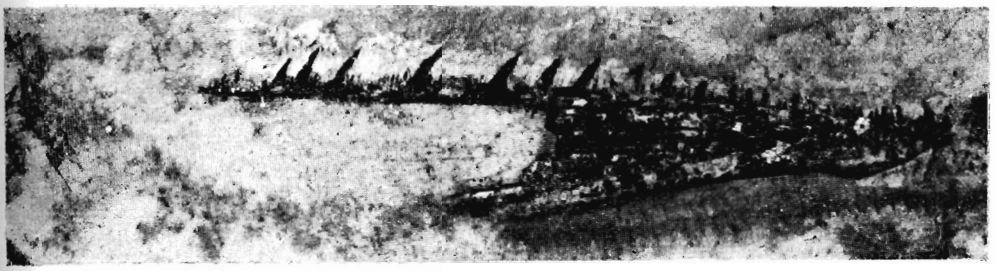


Fig. 3