TAXONOMY OF FISHES FROM MIOCENE CLARKIA LAKE BEDS, IDAHO

G. R. Smith and R. R. Miller

Museum of Paleontology

and

Museum of Zoology

The University of Michigan

Ann Arbor, Michigan 48109

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Abstract

Clarkia fish fossils include three or four species belonging to the Salmonidae (trouts and salmon), Cyprinidae (minnows), and Centrarchidae(sunfishes). The trout belongs to a different genus than the recent North American salmonids. It has large jaws and teeth, coarse scales, and 12 dorsal rays. Preliminary studies indicate that it belongs to the Eurasian genus Hucho. The minnows, probably Gila turneri (Lucas), have 8 dorsal and 8 anal rays; dorsal origin over or behind pelvics, depth 15-20% standard length; 42 vertebrae; large mouth; pharyngeal teeth in two rows, with a grinding surface and a conical point; head about 0.27 in standard length, (S.L.=44-110 mm). These characters are generalized among North American minnows. The sunfish have 9-11 dorsal spines and 11-14 rays; 6-7 anal spines and 11-13 rays; 30-32 vertebrae (18-19 caudal); 4 predorsal bones; serrate preopercle and lacrimal; long pelvic spine; notched opercle (S.L.=63-200 mm). They are a species of Archoplites, known previously from the Miocene of Idaho and the Pliocene of the northwest, as well as the Recent fauna of the Great Valley in California.

Introduction

Miocene fresh water fishes from western North America are poorly known. Available samples indicate rather low diversity representing nine families. Among the most widely distributed are the Salmonidae (trouts and salmon), Cyprinidae (minnows), and Centrarchidae (sunfishes). Fishes collected from the lacustrine deposits in the St. Maries River Valley near Clarkia, in Latah and Shoshone ounties, Idaho, belong to one species of Salmonidae, one species of Centrarchidae, and one, possibly two, species of Cyprinidae. Several dozen specimens were collected by C. J. Smiley and his colleagues and made available to us for study. The specimens show remarkably detailed preservation of skeletons, allowing inferences about the early evolution of the western American fish fauna.

Most of the fossils are from the transitional brown, ashy silts and silty clays (level 376-397 cm) below the ash in the type section (P-33 - Smiley and Rember, 1979; Smiley et al., 1975), although they have been collected at other horizons (120-150; 206-236 cm) of locality P-33 and the Emerald Creek locality (P-37). In this paper we describe the fishes and discuss their relationships to other western American forms. Taphonomy is discussed by Smith and Elder (this volume).

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Order Salmoniformes, Family Salmonidae

Genus Hucho Günther

Fig.

A single large trout, nearly complete excepting some details of the skull, was collected at locality P-33 on June 12, 1980. The specimen is estimated to be 668 mm in total length and 588 mm to the end of the hypural bones (standard length). It was buried without disturbance - even the lateral line is discernable.

Characteristics of the trout are, in combination, unlike any other genus of North American salmonid. The jaws and teeth are large (Fig. 1), like trout and salmon, but unlike grayling. There are between 55 and 58 vertebrae and 22 or 23 rows of scales on the caudal peduncle posterior to the insertion of the anal fin. The scales are larger than in other trout. The pelvic fin has more than seven rays; its origin is below the center of the dorsal fin, which has 12 rays. A large, isolated salmonid pelvic girdle from the same locality has 10-10 pelvic rays. The anal and pectoral fins may be incomplete, but the anal had at least 9 rays and the pectoral at least 10. There were 14 predorsal bones and at least 11 branchiostegal bones in the left series. The caudal fin has 10/9 principal rays.

This is the earliest known North American trout

after the grayling-like ancestral trout, Eosalmo driftwoodensis (Wilson, 1977:15) from the Eocene of British Columbia. It differs from that form especially in the large jaws and teeth. The Clarkia fossils are distinguished from Pacific salmon (Oncorhynchus) by the small number of vertebrae, scales, and anal fin rays. It differs from Salvelinus in the large vertebrae, large scales, and 12 dorsal rays. The large vertebrae and scales also distinguish the Clarkia fossil from North American Salmo. In all of these features it is similar to the Eurasian genus Hucho. Circumstantial evidence for relationship to Hucho comes from the discovery of bones of this genus in the late Miocene sediments of Lake Idaho on the Snake River Plain (Smith, 1975:18, Fig. 6B; and Kimmel, 1975:71, Figs. 1, 2A). Additional material of the form from the Snake River Plain shows a transverse rather than longitudinal row of teeth on the prevomer, a large patch of basibranchial teeth, large vertebrae, and large scales - all characteristic of Hucho, not Salmo, Oncorhynchus, or Salvelinus.

There is no indication that the lineage represented by the Clarkia trout and its Miocene relative from southern Idaho was a descendant of Eosalmo or an ancestor of any living North American salmonids. Its relationships seem to be with Eurasian forms.

Order Cypriniformes, Family Cyprinidae

Genus Gila Baird and Girard

Fig. 2 A-C; Smiley et al., 1975, Pl. 1, Fig. 1;
Smiley and Rember, 1979, Pl. 4, Fig. 4;
Smith and Elder, 1981, Fig. 4 A, B, C

The osteological diagnosis of this group (Uyeno, 1960, unpublished; Smith, 1975) is not applicable to the material at hand. The name is also currently applied to Miocene and Pliocene specimens known only from lateral aspects of skeletons and body outlines on lacustrine slabs. These share the following (generally plesiomorphic) characters: minnows usually 10-30 cm in length, with terminal mouth, rather long jaws, slender body, usually 8 to 10 dorsal and anal rays, 36-42 post-Weberian vertebrae, forked caudal fin, and conical to slightly hooked pharyngeal teeth in one or two rows. (Several recent genera in western North America may be characterized similarly; several specialized species of Gila in the Colorado river drainage do not fit all of these characters.)

Gila milleri Smith from the Pliocene Glenns Ferry Formation in southwestern Idaho is known from detailed osteology and is related to the Recent Gila caerulea (Girard) of the Klamath drainage. Gila turneri (Lucas), G. esmeralda La Rivers, and G. traini Lugaski, from late Miocene and Pliocene lake slabs of Nevada, are not necessarily in the genus Gila and not obviously different

species; they and the forms from Clarkia fit the above diagnosis.

Because of the taxonomic uncertainty and the lack of suitable type material, the Clarkia cyprinids are' referred to as follows.

Gila sp.--Small (adults 12-18 cm), slender minnows with a large terminal mouth (reaching to below eye); 8 dorsal rays (8 in 11 specimens, possibly 9 in one); 8 or 9. anal rays (8 in seven specimens, 9 in one, possibly 7 in one); caudal with 19 rays; 12 or 13 pectoral rays; 9 or 10 pelvic rays (usually 9); 18-21 precaudal vertebrae; 21 caudal vertebrae; 42 post-Weberian vertebrae (in two); pharyngeal teeth (Fig. 2 B), conical, hooked, in two rows; caudal fin deeply forked, with equal lobes; caudal peduncle slender; .eye large, .27-.33 of head length.

The dorsal origin is over the pelvic origin in most, including the smallest specimen, 55 mm in total length (Fig. 2 A), but behind the pelvic origin in two larger specimens (Fig. 2 C). If the difference is a reflection of the morphology in life, it is an indication that two species of minnows were present. Although this character is frequently used, it is unreliable in fossils because of the possible shift of the abdominal wall and pelvic girdle during preservation.

Nineteen specimens have been studied; 17:are from

adults 9.5-18 cm, and two are small, 55-65 mm in length. The larger specimens lack well-preserved heads, but are proportionally and meristically similar to Gila turneri (Lucas) from the Miocene Esmeralda Group in Esmeralda Co., Nevada (see Lucas, 1900: Fig. 1). The observations on teeth are based on four specimens (Fig. 2 A, B).

Similar but not necessarily identical late Miocene or Pliocene fossils from the following areas are being studied by Ted Cavender, R. R. Miller, and G. R. Smith: Madison 'Valley, Gold Creek, and Drummond, Montana; Sentinel Butte, North Dakota; Bear Valley,California; Cache Valley, Utah; Stewart Valley, Cedar Mountain, Black Valley, Jersey Valley, and Big Smokey Valley, Nevada. Related forms were described from the Bidahochi Formation, in eastern Arizona, by Uyeno and Miller (1965).

In summary, the Gila from the Clarkia beds are members of a widespread group. It is not a particularly primitive cyprinid, notwithstanding its early place in the history of North American minnows. It is a generalized, midwater fish with body form and dentition remarkably similar to its widespread relatives now living in lakes and streams throughout the Basin and Range Province south into Mexico. Compared with the Pleistocene and Recent distribution, the Miocene distribution of the group was broader to the north and east.

Order Perciformes, Family Centrarchidae

Genus Archoplites Gill

Fig. 2D, 3; Smith and Elder, 1981, Fig. 3 A, B, C, 4D.

Diagnosis.--Miocene to Recent sunfish with the combination of teeth on the endopterygoid, ectopterygoid, and posterior basibranchial; vomer with small teeth; premaxilla with short ascending process; dentary truncate with tooth patch expanded anteriorly and teeth small; opercle weakly notched; preopercle angular, normally with 6 distinct pores, a deep adductor fossa, strong serrae ventrally, and weak serrae posteriorly; lacrimal serrate but rounded posteriorly; 3 or 4 predorsal bones; long pelvic spine; and 5 to 8 anal spines (Smith, 1975).

Relatives of this genus are known from several Miocene and Pliocene localities in western North America. Cope (1883) described Plioplarchus sexspinosus and whitei from Sentinel Butte, North Dakota, and in 1889 described Plioplarchus septemspinosus from the John Day Basin, Oregon. Schlaikjer (1937) described Boreocentrarchus smithi from Alaska (its status is uncertain according to Uyeno and Miller, 1963:17-18). Bailey (1938, unpublished) described specimens from Trout Creek, Oregon, and recognized (as did Schlaikjer) that the Oregon specimens represented a genus different from Plioplarchus (see Table 1).

Plioplarchus whitei has a short pelvic spine, 5 anal spines, and 9 dorsal spines. Other nominal forms of this genus, plus Boreocentrarchus, have longer pelvic spines and more spines in the dorsal and anal fins. Archoplites is similar to the latter group, but has stronger serrations on the preopercle and lacrimal. Specimens from Trout Creek, Oregon, are intermediate. Relatives of this group from the Humboldt Formation, Nevada, and from Bear Valley, California, are recognized on the basis of the opercle shape, strongly serrate preopercles, long pelvic spines, and meristic characters. On the basis of our continuing studies, it would appear that one or two genera and three or four species are represented in the diversity of fossil sunfishes outlined above. The species from Clarkia is sufficiently distinct and well represented to be described.

Archoplites clarki, new species

Holotype UMMP V 74202 (Fig. 2D), an imprint of a sunfish 123 mm in standard length, 155 mm in total length, and 50 mm in body depth, 42 mm in head length, and 17 mm in caudal peduncle depth. The eye diameter is 9.5 mm, maxillae 16 mm, lower jaw 22 mm, pelvic spine 17 mm, longest anal spine (6th of 6) 17.2 mm, and longest dorsal spine (7-10 of 10) 18.2 mm. The specimen has 13 dorsal rays, 13 anal rays, 17 caudal rays, 19 - 1 caudal vertebrae,

15 - precaudal vertebrae (with 13 bearing primary ribs), and 4 predorsal bones. The specimen has an estimated 44-48 scales in the lateral line.

The following description is summarized from 21 specimens .plus the holotype. Sizes range from 63-200 mm in standard length; dorsal spines 9(2), 10(12), 11(2); dorsal rays 11(1), 12(4), 13(4), 14(1); anal spines 6(9), 7(3); anal rays 11+(4), 12(1), 13(5), 14(1); precaudal vertebrae 14(3), 15(9); caudal vertebrae 18(2), 19(6); principal caudal rays 9/8(7); pectoral rays 13-15(7); pelvic fin with long spine (equal to the 4th D spine) and 5 rays (7); predorsal bones 3(1), 4(11); supramaxilla large; lacrimal strongly serrate; preopercle strongly serrate; opercular margin weakly notched dorsal to longitudinal strut; branchiostegals at least 6.

The four largest specimens (ca. 200 mm S.L.) have scales 4-5 mm in diameter. Single isolated scales, 6.0 and 7.9 mm long, are referrable to the same species; they appear to have six and nine growth rings respectively. The largest scale is the size of those belonging to a Trout Creek specimen ca. 300 mm S.L..

This species is named for Capt. William Clark of the Lewis and Clark Expedition.

In summary, Archoplites clarki is the most abundant of the three species in the Clarkia beds. It was a rather large sunfish whose ecology probably included

predatory habits like bass (Micropterus) in the Recent fauna of eastern North America. Its lineage represented the more primitive and most western of known sunfish groups in the Miocene, just as it does today.

Discussion

The lake in which the Clarkia beds were deposited was inhabited by a fish fauna of low diversity by modern standards. Two of the three (possibly four) species--Gila sp. and Archoplites clarki--belonged to groups widely distributed in the Miocene of western North America. They occurred in warm-water faunas of low species diversity in other western localities, as well.

The centrarchids occupied ranges far to the north (probably to Alaska) of their present distribution in the Miocene. Miocene cyprinidae extended from southern Nevada to northern Idaho and will probably be found in the Miocene of Alaska as well, since they probably reached North America from Asia across the Bering Straits in the early Miocene or late Oligocene.

The Clarkia salmonid, Hucho sp., belongs to a Eurasian genus and is especially similar to Hucho perryi of Japan. Hucho was probably also present in fresh waters of Alaska during the Miocene.

A warm-temperate climate analogous to that of the southern Appalachians is inferred from the Clarkia flora

(Smiley and Rember, 1979). Fish evidence is similar. The Miocene distribution of Archoplites indicates warm winters in northwestern North America, but the salmonid indicates moderately cool summers at Clarkia. Salmonids are not present in most Recent lakes dominated by centrarchids except at the latitude of the Great Lakes. However, Hucho is a rather southern salmonid, being found in southern Europe and Japan. Later in the Miocene, three genera of salmonid fishes, including Hucho, were sympatric with Archoplites in southern Idaho. By late Pliocene, following a cooling trend, Archoplites was restricted in the western U. S., Hucho was extinct in Lake Idaho, and other salmonids were abundant and widespread (Smith, 1975).

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TABLE 1. Summary of characteristics of several fossil centrarchids for which meristic data are available. **Modal** counts in boldface type.

Character	Archoplites		Boreocentrarchus	Plioplarchus			
	clarki	interuptus	smithi	septemspinosus		whitei	sexspinosus
				John Day	Trout Cr.		
Dorsal spines	9, 10, 11	12, 13, 14	11	10, 11	9, 10	9	10, 11
Dorsal rays	11, **12**, 13, 14	10, **11**, 12	12, ?13	12	11, 12	11, 12	10, **11**
Anal spines	6, **7**	6, **7**, 8	7	7, 8	5, 6	5	6
Anal rays	11, 12, 13, 14	9, 10, 11, 12	12, 13	?	11-14	14	11-13
Preopercular serrae	+	+	-?	-?	+	?	?
Precaudal vertebrae	13, 14	13	?	?	13, 14	?	?
Caudal vertebrae	18, 19	18	?	?	18	?	?
Pelvic spine	**long**	**long**	?	?	**long**	**short**	**long**
Predorsal bones		3	?	?	4	?	?

Figure Legends

Fig. 1. Hucho sp. (locality P-33) Head (A), trunk (B), caudal (C) of specimen 668 mm long. Note lateral line on caudal peduncle scales below vertebrae. Photograph by C. J. Smiley.

Fig. 2. Gila sp. from Clarkia lake beds. (A) Small form 55 mm S.L. with dorsal origin over pelvic fins; (B) Enlarged (x10) view of head of (A) showing pharyngeal teeth scattered between preopercle and pectoral fin; (C) Large form (x.8) with dorsal origin behind pelvic origin; (D) Holotype of Archoplites clarki, natural size.

Fig. 3. Archoplites clarki (A) Small adult (x.75) showing four predorsal bones, dorsal spines and rays, and some scale pattern (above anal fin); (B) serrate lacrimal; (C) serrate lower limb of preopercle.

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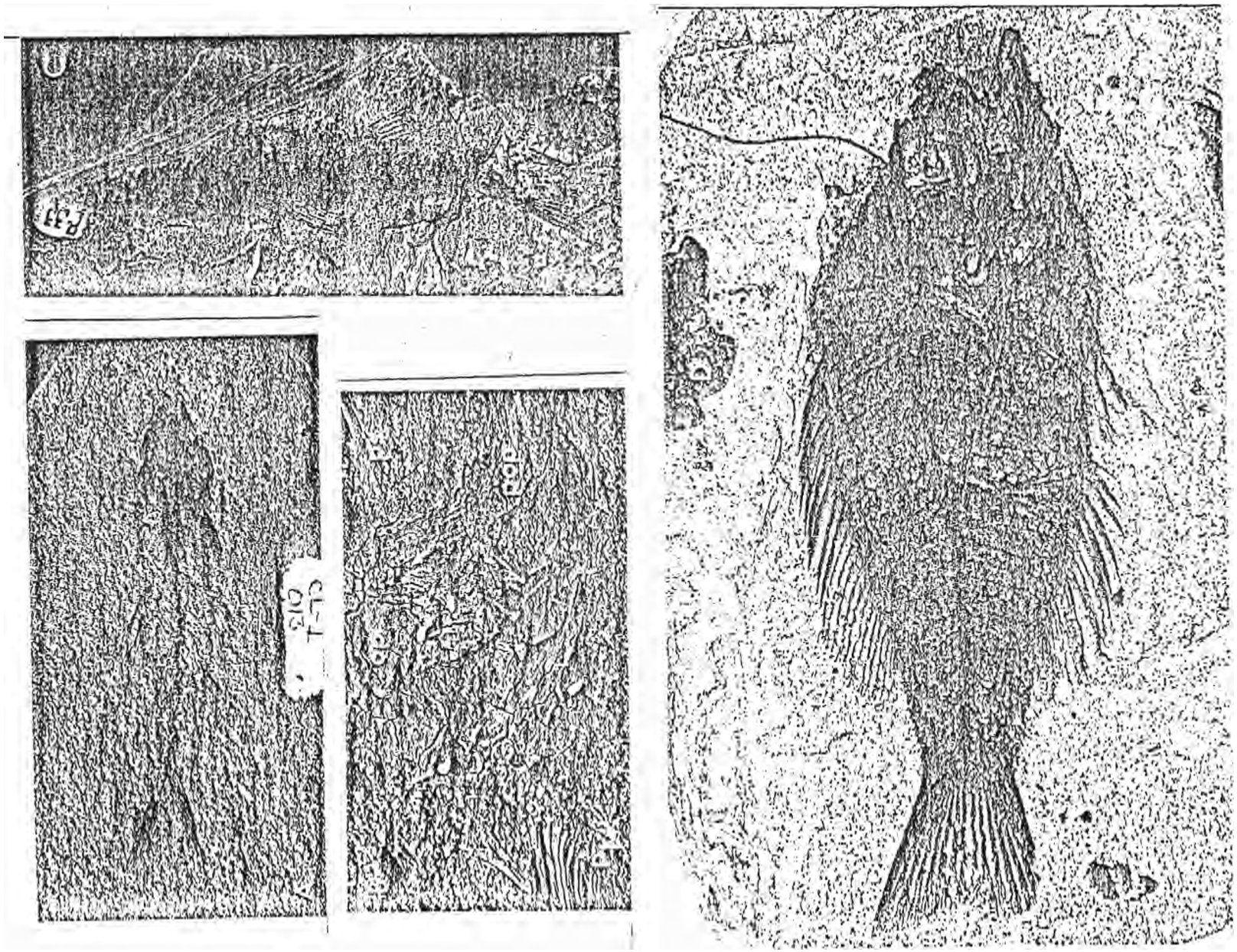

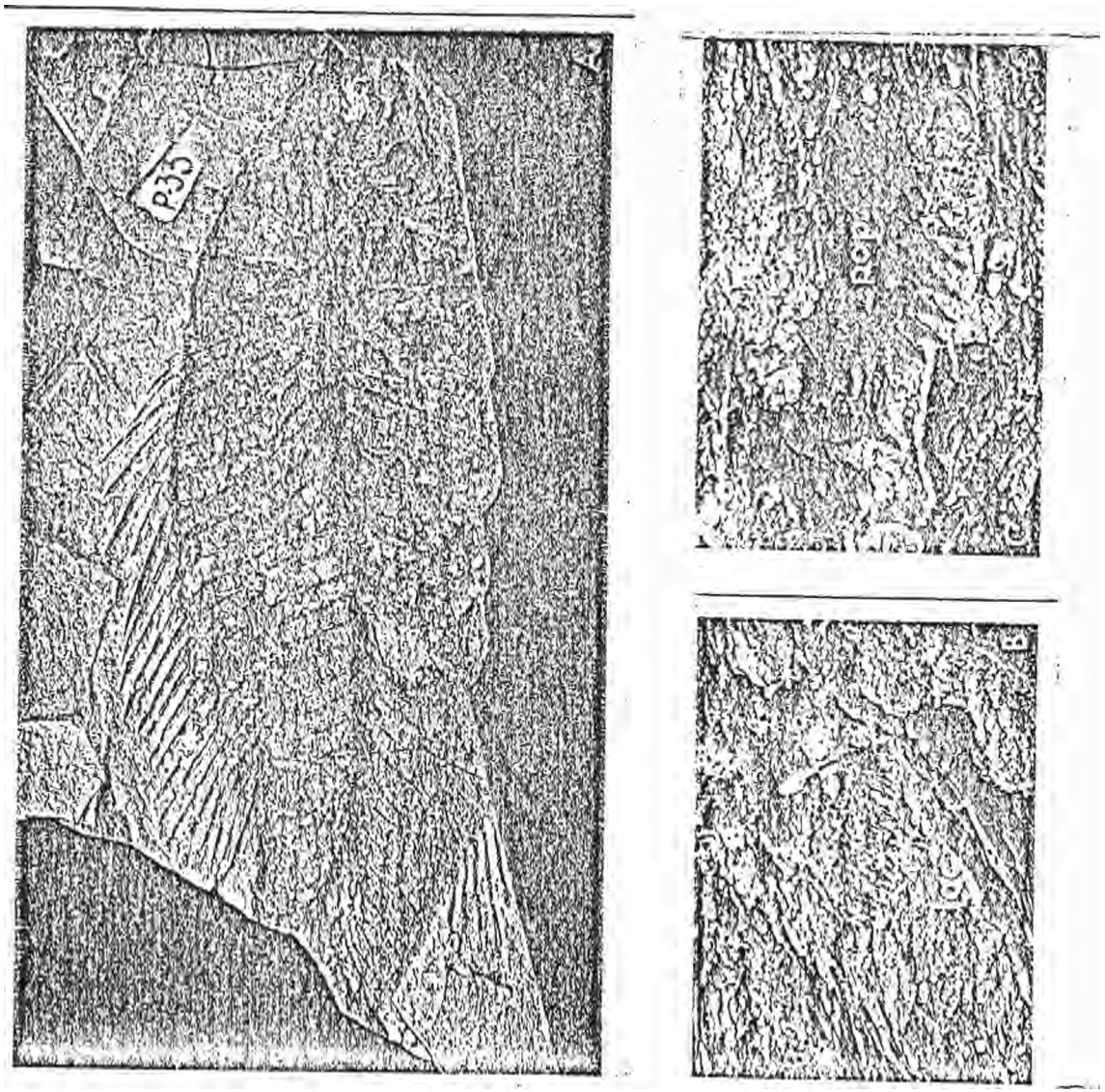
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