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Some New Conodonts of the Mid-Carboniferous Boundary Deposits of Middle Asia

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With 1 Text-Figure and 2 Plates

Usbekistan
Kirgistan
Karbon
Conodonten
Taxonomie
Biostratigraphie

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Einige neue Conodonten aus den mittelkarbonen Grenzschichten Mittelasiens

Zusammenfassung

Vier neue Arten der Gattung *Gnathodus* werden beschrieben, und zwar *Gnathodus aisenvergi* n. sp., *Gn. dieteri* n. sp., *Gn. einori* n. sp. und *Gn. raisae* n. sp. aus dem obersten Unterkarbon (oberstes Serpukhov), ebenso die neue Gattung *Ferganaegnathodus* n. gen. mit zwei Arten: *Ferganaegnathodus ferganaensis* n. sp. und *F. mancus* n. sp. aus dem untersten Mittelkarbon (unterstes Bashkir) des südlichen Tianshan und aus Süd-Fergana (Usbekistan und Kirgistan).

Abstract

Four new species of the genus *Gnathodus* are described, i. e. *Gnathodus aisenvergi* n. sp., *Gn. dieteri* n. sp., *Gn. einori* n. sp. and *Gn. raisae* n. sp. from the uppermost Lower Carboniferous (uppermost Serpukhovian) and the new genus *Ferganaegnathodus* n. gen. with two species: *Ferganaegnathodus ferganaensis* n. sp. and *F. mancus* n. sp. from the lowermost Middle Carboniferous deposits (lowermost Bashkirian) of South Tianshan and South Fergana (Uzbekistan and Kirghizstan).

1. Introduction

We present here four new species of Gnathodus, i. e. *Gn. aisenvergi* n. sp., *Gn. dieteri* n. sp., *Gn. einori* n. sp. and *Gn. raisae* n. sp. and the new genus *Ferganaegnathodus* n. gen. with two new species *F. ferganaensis* n. sp. and *F. mancus* n. sp. They were found in the uppermost Lower Carboniferous (uppermost Serpukhovian) and lowermost Middle Carboniferous (lowermost Bashkirian) of the Gazskaya and Suffinskaya Formations. These deposits represent slope to basinal paleoenvironmental settings. Early and Middle Carboniferous conodonts of the genera *Gnathodus, Paragnathodus, Declinognathodus, Neognathodus* and *Idiognathoides* are common as well.

As it was accepted by the Carboniferous Subcommission (LANE & MANGER, 1985) the Mid-Carboniferous boundary is defined by the appearance of conodonts *Declinognathodus noduliferus* (ELLISON & GRAVES) as well as *Rhachistogna-*

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thus primus DUNN and *Adetognathus lautus* (GUNNELL) (near the base of the Homoceras ammonoid Zone). Our fauna was found below and above this boundary.

2. Geological Settings

The new species of *Gnathodus* were extracted from light grey and grey limestones of the carbonate Gazskaya Formation (Section Gaz-50 and section Akhuntan-50) together with *Gnathodus bilineatus bollandensis* HIGGINS & BOUCKAERT, *Gn. postbilineatus* NIGMADGANOV & NEMIROVSKAYA, *Paragnathodus commutatus* (BRANSON & MEHL), *P. mononodosus* (RHODES, AUSTIN & DRUCE), *P. multinodosus* (WIRTH), *P. nodosus* (BISCHOFF), *P. cruciformis* (CLARKE). The latest early Carboniferous foraminifers, brachiopods and ostracods were found in these deposits.

Section Gaz-50 is located in the Devatash Mountains and section Akhuntan-51 in the Akhuntan Mountains that are part of the Turkestanian Ridge (South Fergana). These carbonate sequences contain Serpukhovian through lower Moscovian deposits. *Gn. aisenvergi* n. sp. was found also at the Locality 7222 near the Gaz section in cherty limestones. No other fossils were found there.

Ferganaegnathodus ferganaensis n. sp. was recovered from grey limestone of the Gazskaya Formation, section Gaz-50, above the first appearance of *Declinognathodus noduliferus* (ELLISON & GRAVES) and below the occurrence of *Idiognathoides*. Earliest Middle Carboniferous foraminifers and ostracods are common. The assemblages with *Ferganaegnathodus* generally do not contain any other conodonts.

Ferganaegnathodus mancus n. sp. was extracted from micritic carbonates in cherty-argillaceous rocks with limestone interlayers of the Suffinskaya Formation in the section Aksu-I. This deep-water section is located in the southwestern part of the Surkhantan Ridge which is the southwestern part of the Gissar Ridge of the mountain system of South Tianshan (Uzbekistan). This sequence spans the interval of the Eumorphoceras 2 to the Homoceras 1 ammonoid zone and contains abundant conodonts and ammonoids that provide a reliable age control, and some ostracods and radiolarians. This section is proposed as a potential candidate for the Mid-Carboniferous boundary stratotype (NIKOLAEVA & NIGMADGANOV, 1990). *Ferganaegnathodus mancus* n. sp. was found together with *Declinognathodus praenoduliferus* NIGMADGANOV & NEMIROVSKAYA, *D. noduliferus, D. lateralis* (HIGGINS & BOUCKAERT), *Idiognathoides sinuatus* HARRIS & HOLLINGSWORTH, *Id. corrugatus* (HARRIS & HOLLINGSWORTH, *Id. sulcatus* HIGGINS, *Id. asiaticus* NIGMADGANOV & NEMIROVSKAYA and *Neognathodus symmetricus* LANE. Ammonoids *Isohomoceras ventrosum* NIKOLAEVA, *Is. notum* NIKOLAEVA, *Is. grandicostatum* NIKOLAEVA and *Cathranoceras badavense* NIKOLAEVA occur together with the above mentioned conodonts and indicate the Homoceras 1b age (NICOLAEVA & NIGMADGANOV, 1990).

The appearance of the new, latest species of *Gnathodus* just before the extinction may be taken as the beginning of an ecological crisis. All of these species are short range. The appearance of species of *Ferganaegnathodus* as well as *Declinognathodus, Idiognathoides* and *Neognathodus* indicates an adaptive radiation of the new Middle Carboniferous fauna after the Mid-Carboniferous extinction event.

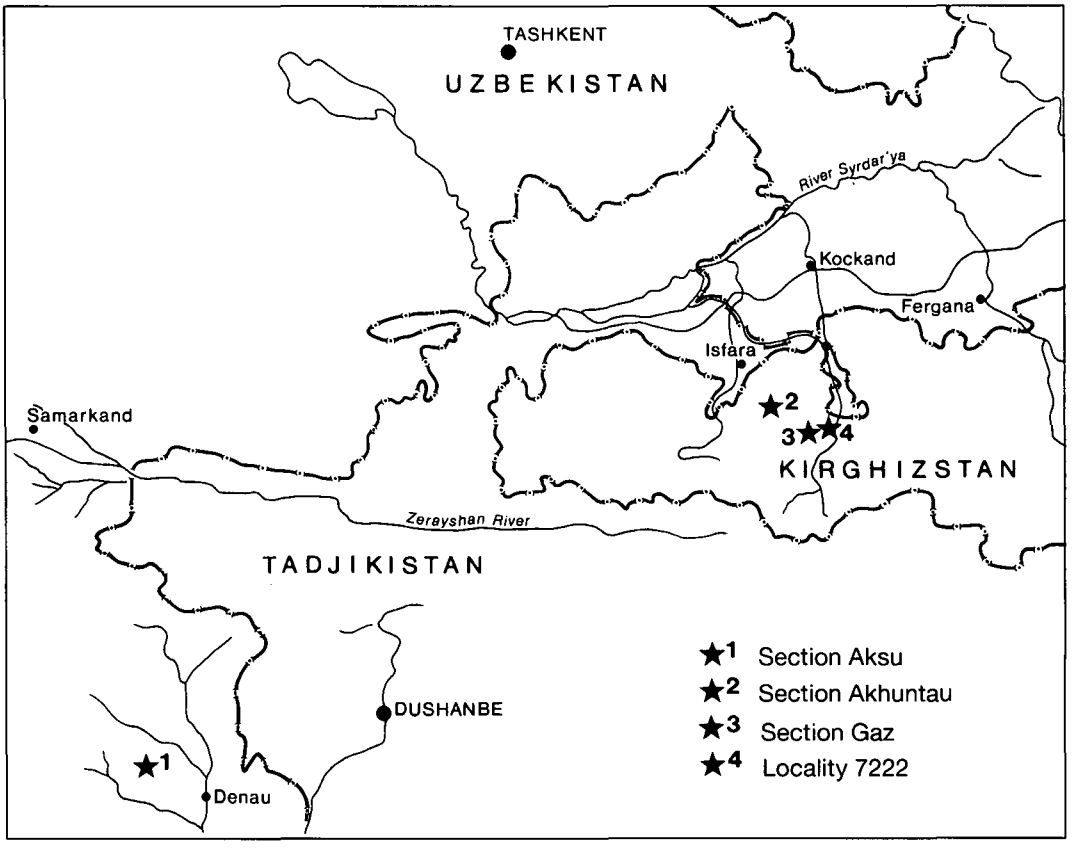
The fauna described below should be present in other Variscan areas as it is closely related to the common last representatives of the genus *Gnathodus* i. e. *Gn. bilineatus* (ROUNDY) s. l. and *Gn. girtyi* HASS s. l.

3. Systematic Palaeontology

The conodonts described and illustrated in this paper are housed in the Institute of Geological Sciences of the Ukrainian Academy of Sciences (IGSU), Kiev, Ukraine.

Genus *Ferganaegnathodus* n. gen.

Derivation of name: From the South Fergana Valley in Middle Asia (Uzbekistan and Kirghizstan) where these conodonts were found for the first time.



Text-Fig. 1.
Location of the sections in Middle Asia.

Type species: *Ferganaegnathodus ferganaensis* n. sp.

Diagnosis: Scaphate pectiniform elements with a small high platform, two unequal parapets and a long smooth slightly deviated carina which extends posteriorly a much greater distance than the parapets. The posterior prominent part of the carina is beak-like in shape.

Description: In upper view the laterally compressed blade is attached to the platform at mid-line and extends onto the platform as smooth carina that is very prominent posteriorly. In the anterior part of the platform the carina is a little lower than the parapets. It slightly deviates to the outer margin becoming beak-like in shape posteriorly. Two parapets are ornamented by distinct or fused nodes. The outer parapet is much shorter than the inner one and may be expressed by 1 or 2 large nodes. Laterally the upper surface is straight, the blade rises anteriorly, the carina is lower than the adjacent parapets. It is declined sharply to the posterior point of the element.

Aborally a typical gnathodid cavity is present.

Remarks: This genus differs from *Gnathodus* principally having a prominent smooth beak-like carina and high short nodular parapets.

Occurrence: Early Bashkirian of the Gazskaya Formation, section Gaz-50, South Fergana and Suffinskaya Formation, section Aksu-I, South Tianshan.

Ferganaegnathodus ferganaensis n. sp.

Plate 1, Figs. 1–3, 6

Holotype: Pl. 1, Fig. 1a–c, IGSU-50-83/1, sample 50-83, Section Gaz-50, Devatash Mountains, Turkestanian Ridge, South Fergana, Kirghizstan, Gazskaya Formation, Lower Bashkirian.

Derivation of name: From the Fergana Valley, Middle Asia.

Diagnosis: A species of *Ferganaegnathodus* (Pa-element) with small high oval platform and prominent slightly deviated carina extending posteriorly a much greater distance than the parapets, being beak-like in shape. Two nodular parapets are of different length. Outer parapet is much shorter than the inner one. Both of them are well developed at the anterior part of the platform.

Description: Laterally compressed blade is attached to the small high oval platform in a mid-line. The carina is long, extends posteriorly a much greater distance compared with the parapets. It is smooth, thin and low between the parapets becoming higher posteriorly. It is slightly curved from the posterior part of the inner parapet. The posterior part of the beak-like carina may be ornamented by widely spaced fused denticles (3–4) with very sharp top point. The inner parapet consists of 5 to 8 fused nodes. The outer parapet is much shorter, commonly about half a length of the inner parapet and consists of 3 to 4 fused nodes.

Laterally the upper surface is straight, declines sharply to the posterior end of the element.

The basal cavity is wide, deep, slightly asymmetrical.

Remarks: *Ferganaegnathus ferganaensis* n. sp. differs from *F. mancus* being much shorter and having much better developed parapets.

Ferganaegnathodus mancus n. sp.

Plate 1, Figs. 4–5,7

Holotype: Pl. 1, Fig. 4; IGSU-68/2131, sample NN–24, Section Aksu-1, Gissar Ridge, South Tianshan, Uzbekistan, Suffinskaya Formation, Lower Bashkirian, Homoceras 1 Zone.

Derivation of name: *mancus* = weakly developed.

Diagnosis: A species of *Ferganaegnathodus* (Pa-element) with very narrow elongate platform and prominent beak-like carina extending posteriorily much greater distance than the parapets. The inner nodular parapet is much better developed, the outer parapet is expressed by one or two nodes developing in the middle part of the platform.

Description: Long free blade is attached to the platform in mid-line and extends onto the platform as smooth carina slightly deviated posteriorly. Its posterior beak-like part is ornamented by widely spaced three or four small sharp denticles. The inner parapet is generally better developed and consists of 4 to 5 large distinct nodes. Outer parapet is expressed mainly by 1 or 2 distinct nodes that are lower than the inner parapet and located in the middle part of the platform. Laterally the upper surface is straight, declines steeply to the posterior end of the element. Aborally the basal cavity is long, deep, slightly asymmetrical.

Remarks: This species is similar to *Ferganaegnathodus ferganaensis* n. sp. having long beak-like deviated carina and nodular parapets developed to different degree. It differs from the latter being much narrower and longer and having an inner parapet extended a much greater distance anteriorly compared with the outer parapet that is much less developed than that of *Ferganaegnathodus ferganaensis*.

Occurrence: Early Bashkirian (Homoceras 1 zone) of the Suffinskaya Formation, section Aksu-I, Gissar Ridge, South Tianshan.

Material: 36 specimens.

Genus *Gnathodus* Pander, 1856

Type species: *Gnathodus mosquensis* Pander, 1856 or *Gnathodus texanus* Roundy, 1926 as proposed by Lane & Ziegler, 1979.

Gnathodus aisenvergi n. sp.

Plate 2, Figs. 9–11, 13

Holotype: Pl. 2, Fig. 9. IGSU-7222/3, locality 7222, Devatash Mountains, Turkestanian Ridge, South Fergana, Kirghizstan, Gazskaya Formation, uppermost Serpukhovian.

Derivation of name: For Prof. Dr. D. Y. Aisenverg, Institute of Geological Sciences, Kiev, Ukraine, a famous Carboniferous stratigrapher, teacher and brachiopod worker in the Ukraine. He was the first who introduced Carboniferous conodont studies in the Ukraine (Donets Basin).

Diagnosis: A species of *Gnathodus* (Pa-element) with two unequal parapets, the inner parapet is much shorter than the outer one and is developed only in the middle part of the small wide platform.

Description: Laterally compressed short blade is attached to the small nearly round platform in a mid-line. The carina consists of fused nodes in the anterior part of the platform and distinct large nodes posteriorly. The inner parapet is higher and much shorter than the outer one, consists of fused denticles or nodes which deviate from the carina in a middle part of the platform. It may be expressed by 2 or 3 distinct nodes. The outer parapet consists of fused nodes in the anterior third of the platform. Then it deviates from the carina, nodes are replaced by short ridges posteriorly. It joins the carina in the posterior point of the platform. The troughs between parapets are deep, widest in the middle line.
Laterally the element is gently convex, lowering posteriorly.
The deep wide basal cavity is slightly asymmetrical.

Remarks: *Gn. aisenvergi* n. sp. resembles *Neognathodus higgins* GRAYSON, 1984, but differs from the latter by nodular deviated parapets.

Occurrence: Latest Serpukhovian of the Gazskaya Formation, locality 7222, Devatash Mountains, and section Akhuntau-51, Akhuntau Mountains, Turkestanian Ridge, South Fergana.

Material: 12 specimens.

Gnathodus dieteri n. sp.

Plate 2, Figs. 6, 8

Holotype: Pl. 2, Fig. 6, IGSU-N-114/1. Section Gaz-50, sample NN-114, Devatash Mountains, Turkestanian Ridge, South Fergana, Kirghizstan, Gazskaya Formation, uppermost Serpukhovian.

Derivation of name: For Prof. Dr. Dieter MEISCHNER, Göttingen University, Germany, whose studies aided in recognition of the species stratigraphic significance.

Diagnosis: A species of *Gnathodus* (Pa-element) with one parapet (*Gn. bilineatus* group) and expanded convex outer cup that may be smooth or ornamented by few nodes situated close to the carina in the middle part of the cup.

Description: The short laterally compressed blade is attached to the wide and asymmetrical platform. The carina is ornamented by nodes that are fused in the anterior half of the platform. The only parapet is nodular and high. Its anterior part consists of fused nodes. It may be slightly declined to the carina anteriorly. Generally it extends onto the platform parallel to the carina. It can reach the carina at the posterior end or be a little shorter. The trough between parapet and carina is deep and narrow. The expanded oval or subquadrate outer cup is convex, high and ornamented by few nodes that are located centrally. The greatest node is confused with the carina.
Laterally the element is high and gently convex.
Wide deep basal cavity is asymmetrical.

Remarks: *Gn. dieteri* n. sp. resembles *Gn. raisae* n. sp. having nodular parapet but differs from the latter by almost lacking ornamentation of the outer cup. *Gn. dieteri* differs principally from the other species of the *Gn. bilineatus* group having a nodular not ridged parapet.

Occurrence: Latest Serpukhovian of the Gazskaya Formation, section Gaz-50, Devatash Mountains, Turkestanian Ridge, South Fergana.

Gnathodus einori n. sp.

Plate 2, Figs. 4–5

Holotype: Pl. 2, Fig. 4. IGSU-N-110-1, Section Gaz-50, sample NN-110, Devatash Mountains, Turkestanian Ridge, South Fergana, Kirghizstan, Gazskaya Formation, uppermost Serpukhovian.

Derivation of name: For Prof. Dr. O.L. EINOR, Kiev State University in memory of his outstanding work on the Carboniferous of the USSR and Carboniferous brachiopods of the Urals and teaching.

Diagnosis: A species of *Gnathodus* (Pa-element) with two parapets, one of these is weakly developed, mainly at the posterior half of the platform.

Description: Laterally compressed blade is attached to the elongate platform in a mid-line. The carina consists of fused nodes that may be distinct posteriorly. The parapets are long but shorter than the carina. They do not reach the posterior point of the element. The inner parapet is longer and higher than the outer one. It consists of fused nodes and slightly deviates from the carina at the anteriormost part. The outer parapet is weakly developed, it consists of distinct nodes, they may be fused in places. This low parapet is usually developed at the posterior half of the platform, may extend anteriorly but never reaches the anteriormost part of the platform. The outer cup is smooth, may be ornamented by few nodes; situated in the central part of the cup.
Laterally the element is slightly convex, gently lowering posteriorly.
The basal cavity is wide, deep, asymmetrical.

Remarks: *Gn. einori* n. sp. differs from the *Gn. bilineatus* (ROUNDY) group by having two parapets. From *Gn. girtyi* HASS it differs by nodular parapets.

Occurrence: Latest Serpukhovian of the Gazskaya Formation section Gaz-50, Devatash Mountais, Turkestanian Ridge, South Fergana.

Material: 8 specimens.

Gnathodus raisae n. sp.

Plate 2, Figs. 2, 3

Holotype: Pl. 2, Fig. 3, IGSU-50-99/2. Section Gaz, sample 50–99, Devatash Mountains, Turkestanian Ridge, South Fergana, Kirghizstan, Gazskaya Formation.

Derivation of name: For Dr. Raisa KOZITSKAYA, Institute of Geological Sciences, Kiev, Ukraine, Upper Carboniferous conodont worker.

Diagnosis: A species of *Gnathodus* (Pa-element) with oval convex strongly ornamented platform and one nodular parapet.

Description: Platform is high, oval, asymmetrical. Carina is ornamented by large nodes, fused at the anteriormost part and distinct and more widely spaced posteriorly. The only long parapet is thick and nodular. Its anterior part may be smooth. It generally joins the carina node at the posteriormost part of the element. Trough between carina and parapet is deep. Outer cup is high, oval-rounded, convex. It is ornamented by strong large nodes that are randomly scattered or arranged in longitudinal rows.
In lateral view the element is nearly straight. Basal cavity is wide, deep, strongly asymmetrical.

Remarks: *Gn. raisae* n. sp. differs from the species of the *Gn. bilineatus* group by having a nodular parapet. It resembles *Gn. dieteri* n. sp. by this feature but differs from the latter by strong ornamentation of the outer cup.

Occurrence: Latest Serpukhovian of the Gazskaya Formation, section Gaz-50, Devatash Mountains, Turkestanian Ridge, South Fergana.

Material: 8 specimens.

Acknowledgements

We thank Dr. Alexandra DZHENCHURAEVA, Kirghizian Geological Survey, who has shown us the section Gaz-50 and made her collection available for us. We also gratefully acknowledge highly useful discussions bearing on the evolution of Carboniferous conodonts with Prof. Dr. Dieter MEISCHNER, Göttingen University, and his help in preparing paleontological plates with the SCAN microscope. We wish to thank Dr. Hans P. SCHÖNLAUB (Geological Survey Austria) for important discussions on the distribution of Carboniferous conodonts in connection with paleoenvironmental settings and his helpfulness with the publication of this manuscript. The authors' thank extends to the geologist Yurij TIKHONOV (Kirghizian Geological Survey) for his help in sampling and treating samples.

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Plate 1

Figs. 1–3,6: ***Ferganaegnathodus ferganaensis* n. sp.**
Fig. 1a–c: Holotype 1GSU-50-83/1; upper, lower and lateral views.
Section GAZ-50, sample 50-83, Devatash Mountains, Turkestan Ridge, South Fergana.
Fig. 2a–b: IGSU-50-83/2; upper and lower views.
Same localities.
Fig. 3: IGSU 50-83/3; upper view.
Same locality.
Fig. 6a–b: IGSU-50-83/4; upper and lateral views.
Same locality.

Figs. 4–5,7: ***Ferganaegnathodus mancus* n. sp.**
Fig. 1a–b: Holotype IGSU-68/2131; upper and lateral views.
Section Aksu-I, sample NN-24.
Gissar Ridge, South Tianshan.
Fig. 5a–b: IGSU-68/2132; upper and lateral views.
Same locality.
Fig. 7: IGSU-68/2133; upper view.
Same locality.

All illustrated specimens are Pa-elements and are × 100.

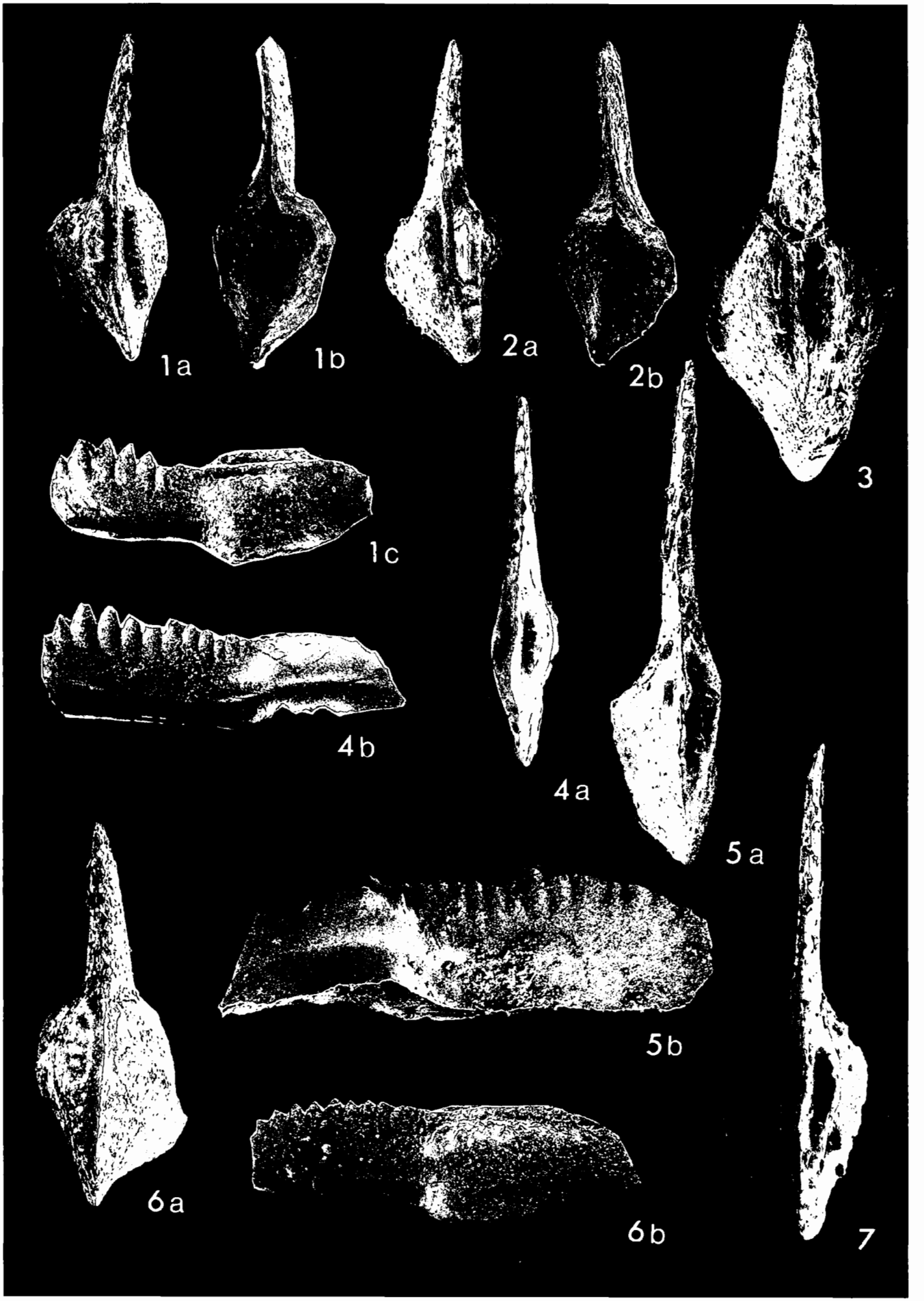

Plate 2

Fig. 1: ***Gnathodus bilineatus bollandensis*** **HIGGINS & BOUCKAERT.**
IGSU-50-138A/3, section Gaz-50, unit 50-138, Devatash Mountains, Turkestanian Ridge, South Fergana.

Figs. 2–3: ***Gnathodus raisae*** **n. sp.**
Fig. 2: IGSU-50-99/3.
Fig. 3: Holotype IGSU-50-99/2.
The same locality; sample 50–99.

Figs. 4–5: ***Gnathodus einori*** **n. sp.**
Fig. 4: Holotype IGSU-N-110/1.
Fig. 5: IGSU-N-110/2.
The same locality; sample NN-110.

Figs. 6,8: ***Gnathodus dieteri*** **n. sp.**
Fig. 6: Holotype IGSU-N-114/1.
Fig. 8: IGSU-114/2.
The same locality; sample NN-114.

Fig. 7: ***Gnathodus postbilineatus*** **NIGMADGANOV & NEMIROVSKAYA.**
IGSU-51-47/1, section Akhuntan-51, sample 47, Akhuntan Mountains, Turkestanian Ridge, South Fergana.

Figs. 9–11,13: ***Gnathodus aisenvergi*** **n. sp.**
Fig. 9: Holotype IGSU-7222/3 11.
Fig. 11, Fig. 13: IGSU-7222/2 and Fig. 9: 7222/3 locality 7222, Devatash Mountains, Turkestanian Ridge, South Fergana.
Fig. 10: IGSU-51-47/2, section Akhuntan-51, sample 47. Akhuntan Mountains, Turkestanian Ridge, South Fergana.

Fig. 12: ***Gnathodus*** **sp.**
IGSU-N-111/1, section Gaz-50, sample NN-111, Devatash Mountains, Turkestanian Ridge, South Fergana.

All illustrated specimens are Pa-elements, upper views, ×60.