

Notes on *Parnassius* LATREILLE, 1804 from Tian-Shan and Alai

Part 2: *Parnassius staudingeri* A. BANG-HAAS, 1882 -

*Parnassius delphi*us EVERSMANN, 1843

(Lepidoptera, Papilionidae)

by

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Summary: *Parnassius staudingeri vladimir subspec. nov.* is described from Inner Tian-Shan, where this species was found for the first time (TL.: Tian-Shan, Naryn reg., Baetovo distr., Bavachal R.). The new taxon is close to *P. staudingeri illustris* GRUM-GRSHMAILO, 1888 and flies together with *P. delphi*us EVERSMANN, 1843. The ♂ genitalia of the mentioned taxa are studied in detail as well as the genitalia of *P. maximinus* STAUDINGER, 1891 and *P. staudingeri infernalis* ELWES, 1886. The investigations do not confirm species status of the taxon *P. maximinus* STGR.; moreover, it was found on the Chatkal Range (Chanach Pass) flying together with *P. delphi*us Ev., and both taxa have extensive hybridization. On the contrary, *P. staudingeri illustris* GR.-GR. and *P. staudingeri infernalis* ELWES, have some small but important differences in the structure of valva inspite of the external similarity. The status and distribution of *P. delphi*us *albulus* HONRATH, 1889 is also discussed.

Резюме: Новый подвид *Parnassius staudingeri vladimir subspec. nov.* описан из Внутреннего Тянь-Шаня, данный вид обнаружен в пределах Тянь-Шаня впервые (типовое место - Нарынская обл., Баатовский р-н, р. Бавачал). Новый таксон близок к *P. staudingeri illustris* GRUM-GRSHMAILO, 1888 и летает вместе с *P. delphi*us EVERSMANN, 1843. Изучено детальное строение гениталий вышеперечисленных таксонов, а также *P. maximinus* STAUDINGER, 1891 и *P. staudingeri infernalis* ELWES, 1886. Результаты исследований не подтверждают видовой самостоятельности таксона *P. maximinus* STGR.; более того, найдено совместное обитание *P. maximinus* STGR. и *P. delphi*us Ev. на Чаткальском хребте (перевал Чанач), где идет интенсивная гибридизация. Таксоны *P. staudingeri illustris* GR.-GR. and *P. staudingeri infernalis* ELWES имеют небольшие, но важные отличия в строении вальвы, несмотря на внешнее сходство. Статус и распространение *P. delphi*us *albulus* HONRATH, 1889 также прояснены.

Introduction: *Parnassius staudingeri* A. BANG-HAAS, 1882 was found in Tian-Shan in 2007 together with *P. simonius* STAUDINGER, 1889 (see part I of the present paper). These species have never been recorded from Tian-Shan before. The butterflies fly on stony slopes. *Parnassius delphi*us EVERSMANN, 1843 was collected in the same place, flying on grassy slopes. Both species feed on the same small meadows between the higher biotope of *P. staudingeri* A. B.-H. and the lower biotope of *P. delphi*us Ev.

The study of the newly found populations provides an important information about both species and their relations with the taxa *infernalis* ELWES and *illustris* GR.-GR. populating Alai/Transalai. Another important source of the new data is a result of a detailed examination of the ♂ genitalia from many localities, which seem to have never been done before. As a whole, the complex (a

genus or a subgenus, that is out of the limits of the paper) *Koramius* MOORE, 1902 is characterized by a very complicated and confused taxonomic structure; the taxa mentioned above are combined in many different ways by different authors. Somebody treats *infernalis* ELWES as a subspecies of *P. delphius* EV. (TSHIKOLOVETS, 2005), somebody places *illustris* GR.-GR. as a synonym of *infernalis* ELWES (DIETZ, 2001), while both taxa are sometimes treated as subspecies of *P. infernalis* ELWES, bona species. In my opinion, it is senseless to discuss the main part of different opinions because they were published without arguments and investigations. I also will not discuss in detail the old works (AVINOV, GRUM-GRSHIMAILO, ELWES, BRYK, etc. - except in some cases), it seems not effectively now, until we have much more informations and some new important methodics.

The DNA-analysis data mainly agree with two positions: *P. staudingeri* A. B.-H. is a good species while *maximinus* STGR. must be included in *P. delphius* EV. Our study totally supports these conclusions. This paper is only a first step in the study of the *delphius*-group - and devoted only to some taxa distributed in the Tian-Shan and Alai systems. Below, I regard *illustris* GR.-GR. and *infernalis* EL. as subspecies of *P. staudingeri* A. B.-H., but this question needs the investigation of many other taxa, what is not possible now.

The holotype of the new subspecies is deposited in the Darwin State Museum (Moscow). The paratypes are preserved in the collections of the author as well as in those of K. ROSE (Mainz), B. KHRAMOV (S.-Petersburg), V. PLETNEV (Moscow), M. DAVYDOV (Moscow), and J. OUVAROFF (Paris).

Abbreviations: FW - fore wing; HW - hind wing; TL - type locality

1. *Parnassius delphius* EVERSMAHN, 1843: the status of *Parnassius maximinus* STAUDINGER, 1891

Parnassius delphius EV. was described from Tarbagatai where this butterfly has never been found again. According to KREUZBERG (1985), the type series (two ♂♂) were collected by L. SHRENK in Dzhungarsky Alatau. The lectotype is also designated by KREUZBERG (1985: 42).

The nominate subspecies occurs in the Dzhungarian ranges and West Borocho, but the eastern border of the areal is not clarified yet. It represents a well differentiated form, as well as *P. delphius namanganus* STAUDINGER, 1886 originating from Chatkal Mts. and populating the western part of North Tian-Shan (from Chatkal Range and Talassky Alatau to Kirgizsky Mts.).

A lot of taxa were described from the main territory of Tian-Shan; unfortunately, often there are no lectotype designations, and the type localities are not restricted. It seems impossible to clarify the subspecific structure without a long and difficult taxonomic work. Such a situation partly is a result of the position of KREUZBERG (1985) who placed nearly all names as synonyms of *P. d. albulus* HONRATH, 1889 in his well-known review of the complex. This review was a really outstanding work, the base for all other studies of *Parnassius* from the Russian Central Asia. However, it contains some mistakes, while the genitalia were not studied seriously.

KREUZBERG (1985) divided the *delphius*-complex into 4 species: *delphius* EV., *cardinal* GR.-GR., 1887, *staudingeri* A. B.-H. and *maximinus* STGR. The species status of *P. delphius* EV. and *P. staudingeri* A. B.-H. was confirmed by the characters of the genitalia, while this was not done for *P. maximinus* STGR. and *P. cardinal* GR.-GR. I suppose that no distinctions were found, because even for *P. staudingeri* A. B.-H. and *P. delphius* EV. only the structures of the uncus was shortly and superficially discussed.

According to KREUZBERG (1985), *P. maximinus* STGR. differs well by whitish colouration and some

differences in the black pattern, colouration of larvae and foodplants. However, it is known now that different subspecies of *P. delphi* Ev. have two different types of larvae (at least only two, because the actual geographical variability is not studied). The populations feeding on *Cysticorydalis fedtschenkoana* have greenish larvae with orange spots, the populations feeding on *Corydalis gortschakovi* - blackish larvae with reduced yellowish spots (TOROPOV & ZHDANKO, 2006). SENSU KREUZBERG (1985), the *P. maximinus* STGR. larvae are blackish with very small spots while the compared *P. delphi* Ev. larvae surely represent the light *Cysticorydalis*-variant.

The main argument for the species status of *P. maximinus* STGR. was sympatric (in the same habitat) occurrence of *P. maximinus* STGR. and *P. delphi* *namanganus* STGR. in Chatkal. KREUZBERG (1985: 30) based his conclusion on the series of both species collected by I. YANKOVSKIY in 1929 (11.-19. VII.1929, Shaar Pass, Chatkal; the butterflies were found in the Kiev Museum. It was marked that no hybrids were registered - but it was not mentioned how many specimens in total were preserved in the Museum. Certainly, there were not all specimens. KREUZBERG (1985) stated that *P. maximinus* STGR. should feed on *Corydalis ledebouriana* and *C. darwasica*, while *P. delphi* Ev. on *Cysticorydalis* (the actual foodplants were not known for the Chatkalian populations!).

Later the same author described *Parnassius patricius ludewigi* KREUZBERG, 1989 from Chanach Pass (Chatkal); this species always uses *Cysticorydalis* as a foodplant. It could be a serious signal, but nobody paid attention.

In 2001, together with A. ZHDANKO, I collected butterflies at Chanach Pass. The disposition of the Pass, where the elements of true Tianshanian fauna penetrate the territory of West Tian-Shan, was discussed in previous publications (see in: CHURKIN, 2002). *Erebia meta* STAUDINGER, 1886 was found at Chanach together with *E. mopsos* STAUDINGER, 1886 - as well as *P. maximinus* STGR. was found together with *P. delphi* Ev. In contrast to the case with *Erebia*, *P. maximinus* STGR. and *P. delphi* Ev. obviously use the same foodplant: I personally observed how the ♀♀ of both species laid eggs close to the same plant of *Corydalis gortschakovi*. Intensive hybridization was also registered. *Parnassius delphi* Ev. flies higher, from 3000 to 3600 m, mainly higher than 3200-3300 m, while *P. maximinus* STGR. flies from 2800 to 3400 m and is nearly absent at the tops of the Pass. *Parnassius delphi* Ev. flies early and prefers wet and grassy habitats; *P. maximinus* STGR. prefers drier and rocky places while the flight period is 5-10 days later. However, both taxa fly together in a wide area; the hybrids (i.e. specimens which cannot be referred with certainty to *P. maximinus* STGR. or *P. delphi* Ev.) represent more than 15% of the butterflies (several hundred specimens were collected).

Parnassius patricius ludewigi KREUZB. flies on the opposite northern slope of the Pass and uses *Cysticorydalis* as a food plant.

Note. TOROPOV & ZHDANKO (2006: 48) made a mistake when they published a note about *Cysticorydalis* as a food plant for *P. maximinus* STGR. in Chatkal with a remark that it is after "S. CHURKIN, personal communication". It is just a case of a wrongly transferred information.

Thus, the data or hypothesis used to prove the species status of *P. maximinus* STGR. are not confirmed now. Both taxa have identical genitalia (see below) and the same food plant in the contact zone, fly together but provide a lot of hybrids - this would be not possible if they represent true species. As a whole, according to the published data, the cohabitation (and, so, hybridization) zone includes also the whole Talass Alatau, up to the western end of this range (Aksu-Dzhhebagly natural reserve). Some hybridization is known for true species [for example, *P. tianschanicus* OBERTHUR, 1879 and *P. apollo* (LINNAEUS, 1758)], but the hybrids are very rare, representing less than 1% of both large populations. The characters

of larvae need further investigation while the known distinctions can not be treated as specific. These results fully agree with the results of the DNA-analysis: *P. maximinus* STGR. and *P. delphi* Ev. have no differences (MICHEL et al., 2008; OMOTO et al., 2009). Thus, the taxon *maximinus* STGR. has no species status but belongs to *P. delphi* Ev. However, the hiatus between *maximinus* STGR. and *delphi* Ev. is definitely larger than between other *P. delphi*-subspecies (except the situation with the “white” *albulus*, see below). The problem of the status of the taxa described as subspecies of *maximinus* STGR. is out of the limits of this paper - it needs much more material than I have at my disposal to make a decision.

2. *Parnassius delphi* EVERSMAHN, 1843: notes on *albulus* HONRATH, 1889

The taxon *albulus* HONRATH, 1889 was discovered by J. HABERHAUER in „Alai“, eastward from Osh (1 ♂, 2 ♀). All other authors treated this record as being wrong; *P. delphi* Ev. is not known from Alai and even from the western slopes of Fergansky Mts. (the same wrong situation as with the nominate *P. delphi* Ev.!). The type locality is always placed somewhere close to Naryn, but - and this is very important - nobody has conducted a detailed study of the types and geographical variability to limit the possible type locality.

Inner Tian-Shan as a whole represents a very difficult case of the distribution of different *delphi*-subspecies. The famous population (macropopulation) inhabits Narynsky Mts. and consists of white specimens with strongly reduced black pattern (especially the submarginal bands are strongly reduced); a lot of highly unusual forms and aberrations have been described from Naryn. The collected series includes 95% (even more) of whitish specimens - according to my own numerous material and studies of S. TOROPOV (Bishkek) who knows this locality and the butterfly better than anyone. The differences from the „normal“ *P. delphi* Ev. in the pattern are so strong that it looks like a distinct species - but, according to KREUZBERG (1985) and his followers, the white *P. delphi* Ev. is only an ecological form. On the other hand, exactly the white Narynian *P. delphi* Ev. is known among the collectors as the „true“ *albulus* HONR.

KREUZBERG (1985) stated that white forms sometimes observed in neighbouring populations and even far from Naryn - and, as I marked above, all populations from Inner, Central and Chinese Tian-Shan were united under the name „*albulus* HONR.“. The position of the recent authors seem to be out of logic: practically all of them treated *karascharica* O. BANG-HAAS, 1915, or *pulchra* EISNER, 1939, or *constans* O. BANG-HAAS, 1915, etc., as subspecies and, at the same time, confirmed KREUZBERG's position (for example, see in: DIETZ, 2001).

If we follow KREUZBERG (1985), *P. delphi* Ev. may include 3 subspecies only (the nominate one, *namanganus* STGR. and *albulus* HONR.) - that is obviously wrong because some other geographical races are distinctive. If we do not follow KREUZBERG (1985) and divide the united *albulus* HONR. to some taxa, we need to go back to the question about the so-called ecological variability of „*albulus* HONR.“. MICHEL (2007) published a paper in support of the idea about the ecological forms, but, as it always takes place, the author based on very small number of butterflies collected in a few localities (some statistics were done only for Dolon Pass), ignoring available data about the geographical variability in general. On the contrary, I do not know any serious Russian collectors (who have much more material and knowledge about Tian-Shan) who agrees with KREUZBERG's position. TSHIKOLOVETS supports KREUZBERG in his Kyrghyzian book, but his point of view must be ignored because he included even *P. (staudingeri) infernalis* ELW. in *P. delphi* Ev. and gave no arguments to support such a position.

I am not able to make the final conclusion about the *albulus*-problem, but it is possible to offer some logical hypothesis for further discussion.

Below I shall apply the name *albulus* HONR. to the Narynian population; this may seem to be wrong in the taxonomic sense: a syntype of *albulus* HONR. (the photo is published in many sources) does not present a white butterfly with strongly reduced postdiscal bands. This ♂ type is similar to the butterflies which are very common in the populations inhabiting At-Bashi or Baidulu Range - i.e. not far away from Narynky Mts. and not far from humid highlands (the so-called "syrts") of the eastern part of Inner Tian-Shan. Theoretically, such a form, as the above type, can be found among the Narynian specimens but it would be really a very rare case.

Recently, I found a population of *P. delphius* Ev. in Baibiche-Too Mts. (the westernmost known population, except *P. delphius* Ev., which flies together with a new subspecies *P. staudingeri* A. B.-H.- see below). The butterflies from Baibiche-Too are even more similar to the syntypes of *albulus* HONR. than those from At-Bashi (I have two large series for comparison, originating from two opposite ends of this Range: Karasu R. near Chatyr-Kel Lake and vicinity of Bosogo, very close to Narynky Range). They are not identical to other *delphius*-populations and may represent an undescribed taxon - or the true nominotypical population of *albulus* HONR. Unfortunately, the series is not sufficient, as well as the ♀♀ syntypes should also be studied.

So, the name "*albulus* HONR.", applied below, will be used as a mark of the white Narynian population, but not as a true taxonomic name.

First, the Narynian *albulus* HONR. is similar biologically to all populations known from the eastern part of Inner Tian-Shan (the species has not been known from the western part except my two findings, see above): it uses *Corydalis gortschakovi* as a food plant and flies on grassy slopes at comparatively low altitudes in warm places; the flight period usually starts from the end of June (later or earlier, depending on the year conditions). There are no differences between the butterflies collected in different years. There are no serious climatic differences between the tops of Narynky Range and other localities in Inner Tian-Shan (except the above mentioned "syrts" where the conditions are much severe as a total).

Secondly, nobody has paid attention that *albulus* HONR. has true similarity to *maximus* STGR. because it was treated as a species. However, both taxa belong to the *delphius* complex - thus, a possibility for productive contacts between the white *maximus* STGR. and the white *albulus* HONR. is of no doubts. The relations between West Tian-Shan and Inner Tian-Shan were pointed out and confirmed only recently, when some true elements of the West Tianshanian fauna were found in Inner Tian-Shan (CHURKIN, 2006).

In addition, white butterflies with strongly reduced pattern are known for the *pulchra*-populations from Kungei Alatau (where such specimens are rare and mainly look like aberrations) and Chinese Aksu River (where such specimens are not identical to the Narynian ones and represent the third variant of the white race).

In contrast to "*albulus* HONR.", the population from Dolon (5 km southward) includes not more than 5-10% of whitish specimens which often have more or less normal pattern without strong reduction of the black bands. The same is absolutely true for the Bosogo population (NE At-Bashi Range) - but *P. delphius* Ev. collected on the opposite side of this range (Chatyr-Kel Lake, Karasu R.) include only 2% of the true *albulus*-colouration (3 specimens of 150, the same data for 3 seasons with very different climatic conditions). A population important in this sense inha-

bits the northern slopes of Terskey Alatau not far from Dolon, at Sary-Bulak - it is very similar to *P. delphius* Ev. from Dolon, being even whiter statistically than the Dolonian butterflies.

In the third place, two subspecies (the status of which was confirmed by KREUZBERG) practically never include the true "*albulus* HONR." variant - and never include fully blackened specimens: these are *namanganus* STGR. and the nominate taxon. Moreover, true "*albulus* HONR."-butterflies are practically not known from Yulduz or the territory between Khan-Tengri and Ad-Unkur Pass in China.

The question is simple: why great "ecological variability" is concentrated at the western border of the main Tianshanian massive, in the area around Narynsky Range - but absent in the territories in China which were also included in the distribution area of *albulus* HONR. sensu KREUZBERG? Why the ecological variability is so different in Suusamyr Range and Sary-Bulak, near Song-Kel, two close localities with similar conditions (but different fauna)?

The conclusion is also simple: the term "ecological" was used only because the scientists had no material or wish to clarify a complicated taxonomic situation. The so-called "ecological variability" is often only a mask for the inability to study and explain natural phenomena (of course, I do not mean that this kind of variability is absent).

All facts mentioned above indicate that we have a white *P. delphius* Ev. macropopulation at Narynsky Mts., a hybridization zone at the neighbouring mountains and other, clearly different populations inhabit the highlands of Central Tian-Shan or Kungei Alatau. A simple historical reconstruction seems to be useful in this case.

Previously *P. delphius* Ev. was divided into two subspecies, ancestral for the recently distributed taxa: whitish with reduced black pattern, which populated comparatively warm mountains along the southern and western borders of Tian-Shan, and other race with fully developed black pattern and expressed dark suffusion, inhabiting some area which is transformed now to Eastern/Central Tian-Shan. Probably, the whitish ancestral subspecies of *P. delphius* Ev. originated under some press of natural selection because it had some contacts with dark neighbouring Alaian subspecies of *P. staudingeri* A. B.-H. It is possible to suppose that the whitish subspecies also populated the ranges bordering Issyk-Kul; the last macropopulation was connected with the Narynian one (we still observe the traces of former contacts). The existence of such a kind of the area (united Issyk-Kul and Naryn) is very important and was discussed for the first time for *Neolycaena medea* ZHDANKO, 1998 (CHURKIN, 2008).

After time, the united "whitish" distributon area was broken into several parts, *P. maximinus* STGR. lost contacts with "*albulus* HONR.". A detailed reconstruction of the glacial periods is not possible now, but the most important events can be outlined.

1. Dark *P. delphius*-subspecies survived and got adapted to severe cold conditions, the butterflies started to feed on *Cysticorydalis fedtschenkoana* (and pressed the local subspecies of *P. patricius* NIEPELT, 1911) - it is sure because now dark subspecies are much more distributed.

It is very important to locate the place or places where the "future" fauna of the Tianshanian highlands survived: at present the main territory of the famous Tianshanian "syrts" is populated by a rather small number of species which are similar practically everywhere they can be found (or presented by several young subspecies). These are *Erebia mongolica* ERSCHOFF, 1888, *Melitaea solona* ALPHERAKY, 1881, *Erebia kalmuka* ALPHERAKY, 1881, etc. There is no doubt

that all of them distributed fast around the main highlands when the glaciers disappeared. The refugium was situated not far in the Chinese Tian-Shan, where other species of *Erebia* fly and subspecies of *P. patricius* NIEPELT, 1911/ *P. boedromius* PUENGELER, 1901 with the most old characters, i.e. with fully developed red eyes (ocelli).

2. The whitish subspecies lived in comparatively good conditions during the glacial times, because the western ranges of Inner Tian-Shan (especially across Naryn River) and the southern macroslopes of Kokshaal-Altyn-Tag presented a lot of available niches. On the contrary, during the warm interglacial period, exactly the area of the whitish *delphi*-race must have been seriously decreased.
3. At present the area of the recent whitish race ("*albulus* HONR.") covers only Narynsky Mts., *P. delphi* Ev. being extinct or practically extinct even at the tops of all other small ranges situated along the warm Naryn Valley in the western direction; dark races "cover" all possible niches, the whitish genes nearly disappeared around Issyk-Kul; white forms appear only as aberrations (recessive variants). The populations living in contact with the last whitish "*albulus* HONR." include a lot of hybrids and forms, its variability is much higher than usual, but only in the "whitish line" of forms. The line of variability of the "dark" forms is the same in many ranges of Inner and Central Tian-Shan. The connection with the whitish macropopulation living in the Chinese Aksu is broken, but this population is also still alive (the types of *constans* O. BANG-HAAS, 1915 clearly show it). In addition, the Aksu population gives also a lot of forms and named aberrations/taxa - the same case as with the Narynian *P. delphi* Ev. - and this seems to be absolutely logical. I expect that if numerous material from many localities in the Chinese Aksu (as a whole district) is available, we will see a pattern of hybridization similar to that, we observed in Inner Tian-Shan. It is easy to explain why true populations of the white *P. delphi* Ev. have disappeared around Issyk-Kul: there are no long and developed river valleys around the lake, not many niches and places where the populations might have survived during different periods of glaciations/deglaciations. Even the long and old Naryn Valley keeps now only one true white macropopulation.
4. *P. delphi namanganus* STGR. and the nominate *P. d. delphi* Ev. present another line of characters; the distribution of *P. d. namanganus* STGR. was later extended to the west, where it is in contact now with *P. maximinus* STGR.. In my opinion, *P. d. namanganus* STGR. demonstrates some features of *P. maximinus* STGR. - as a result of former close relations and new hybridization (see, for example, the figures of two light ♀♀ in DIETZ, 2001: 15). The contact zone covers part of Chatkal and the main part of Talassky Alatau.
5. In contrast to "*albulus* HONR.", *P. maximinus* STGR. also got adapted to the new conditions during the glacial-interglacial times, because of changing the foodplant in the main part of the area; some populations became low-altitude. As a result, the areal of *P. maximinus* STGR. was not considerably enlarged recently but not so decreased as in the *albulus*-case. Interesting, that in all cases, the genes of the dark-races are dominant compared to the genes of the whitish butterflies.

The study of the genitalia confirms this hypothesis. All above mentioned populations belong to a single species for sure. Moreover, *P. d. delphi* Ev. and the "white" Narynian *albulus* HONR. have some small statistical differences, while *P. maximinus* STGR. from Chatkal has the genitalia identical to *P. delphi* Ev. from Chatkal, Terskey Alatau, Dolon pass or At-Bashi. Such results are absolutely logical and fully confirm the historical hypothesis (see below in details).

Another question is that ecological variability is really expressed and very important in the un-

derstanding of the *P. delphius* Ev.-subspecies (in contrast to *P. staudingeri* A. B.-H., as I plan to discuss later). Indeed, this variability refers mainly to the degree of the black pigment development, i.e. *P. delphius* Ev. can vary, depending on the weather/climatic conditions from *styl/satanas*-like forms to comparatively whitish individuals with reduced blackish suffusion - but not to real white forms with reduced spots/bands pattern.

It is easy to prove the last suggestion by a comparison of the *satanas*-forms originating from Kungei Alatau and Baidulu Range (Dolon Pass) or Terskey Alatau (Bayankol River): fully blackened specimens can be identified because some slightly visible elements of the pattern clearly state that one specimen belongs to *pulchra* EISNER, 1939 (inhabiting Kungei) while another was collected at Terskey.

So, the full line of the variability of *P. delphius* Ev. combines two different parts: a dark ecological line and the results of the hybridization with a white geographical subspecies which has some small genetic differences. As a result, some *P. delphius* Ev. populations present all possible versions (Dolon Pass, Baidulu Range, practically - Western Terskey Alatau), while other populations include practically only the dark line (Bayankol, Eastern Terskey Alatau). This fact was marked even by KREUZBERG (1985), who, however, did not pay attention that it contradicts with his theory.

In my opinion, the main problem which stopped the investigations was the small areal of the Narynian race, "true *albulus* HONR." If the distribution area of *P. maximinus* STGR. included only the Chatkal Valley, its status would be also "an ecological form", I have no doubt in it - especially because the hybridization with *P. delphius* Ev. will be found, sooner or later. The same situation was with *Parnassius phoebus alpestris* VERITY, 1911: the formerly known distribution covered only a small area of SE Altai; recent studies showed that *P. ph. alpestris* VERITY and its relatives populate most part of the Mongolian Altai (CHURKIN, 2003).

It was not so far in the past when the white Narynian race was distributed over all mountain slopes along the great Naryn River. I can not exclude that some more populations will be found in future. At the same time, the darkened race had much more possibilities for expansion, so that it is also possible to find dark populations at the tops of the ranges situated to the west from Naryn.

It is not easy to make a final decision about the taxonomic status of the Narynian macropopulation. As I noted above, it seems not identical to the *albulus* HONR. A lot of names, based on whitish butterflies, must be carefully checked - if all of them are not valid in the taxonomic sense, it would be better to describe this population as a subspecies. Then it would be possible to start new investigations of the subspecific structure of the dark races inhabiting Inner, Central and Chinese Tian-Shan. *Parnassius delphius* Ev. from Narynsky Range represents a small fragment of a formerly widely distributed subspecies, which became nearly extinct and is slowly disappearing now under the pressure of "dark" populations - as it has happened in the past with the populations of this subspecies distributed around Issyk-Kul Lake.

3. Notes on *Parnassius staudingeri infernalis* ELWES, 1886 and *P. s. illustris* GRUM-GRSHIMAILO, 1888

As it was marked above, some authors treated *P. s. illustris* GR.-GR. just as a form of *P. s. infernalis* ELW., but this is a marginal point of view. Practically all scientists who had a possibility to collect both taxa or compare good series from different localities have no doubt that *illustris* GR.-GR. represents a subspecies other than *infernalis* ELW. However, it is not so easy to distinguish

them having 1 or 2 ♂♂ only - the external differences are much less than between the white and black *delphius* Ev. or *P. d. delphius* Ev. and *P. delphius namanganus* STGR. At the same time, an experienced entomologist can easily understand what he collected on the base of a series of ♂♂ and ♀♀ - the differences are small but practically constant and obvious in a series.

This fact was not so important before, because the real *P. s. illustris* GR.-GR. is represented in collections by the butterflies from only one place - Aram-Kungei (or other valleys situated in the Altun-Dara basin) - but now its relative is found in Tian-Shan, more than 270 km from this place, if we cross directly several very high ranges. However, the new butterfly has absolutely the same "illustris"-differences from *P. s. illustris* GR.-GR. - moreover, the distribution of the new taxon is connected exactly with the area of *P. s. infernalis* ELW. but isolated from that of *P. s. illustris* GR.-GR. These strange facts, and unusual stability of minor characters must be explained.

The best comparative analysis of the external differences between *P. s. infernalis* ELW. and *P. s. illustris* GR.-GR. was done by GRUM-GRSHIMAILO (1890: 198-199). I collected hundreds of individuals of both taxa in many localities (Dugoba, Tengizbai, Kichik-Alai, Ak-Bura, Taldyk, Aram-Kungei, Irkeshtam area) and have at my disposal more than 2 000 specimens - all the material examined confirms GRUM's opinion. The main characters of *P. s. illustris* GR.-GR. are as follows (*P. s. infernalis* ELW. has opposite features):

the semitransparent marginal blackish band is narrower (especially on the HW), it does not widely reach the anal angle at the FW where it is separated from the submarginal band (maximum, it just touches it) ;

the HW submarginal band is reduced (sometimes considerably), often presented by 2-3 small half-moon separate spots which are however distinctly separated from the marginal band by clear whitish space;

the butterfly is whitish as a whole, without non-dense but conspicuous dark suffusion which makes the ground colour in *P. s. infernalis* ELW. dirty and darker; this characteristic is emphasized by the contrasting and narrow (and often not full) submarginal band on the FW;

the typical ♀♀ of *P. s. illustris* GR.-GR. are similar to the ♂♂ being whiter with reduced black pattern, they are contrasting and whitish generally; the typical *P. s. infernalis* ELW. ♀♀ are darker, looking more dirty, with developed blackish suffusion in the discal area; series of the ♀♀ of both taxa are really different in spite of the fact that the *P. s. infernalis* ELW. ♀♀ are rarely whitish (1-10 %, depending on the locality) and the *P. s. illustris* GR.-GR. ♀♀ may be not so contrasting moreover, these exceptions have some geographical determination and could be a result of possible hybridization.

Some important details will be discussed below in the description of the new taxon.

The type locality of *P. s. infernalis* ELW. was restricted to the area near Taldyk Pass by KREUZBERG (1985). He also marked that the specimens from the western part of Alai are a little different because of some similarity to *P. s. illustris* GR.-GR. - but need no special name. I agree with this position. The population inhabiting Tengizbai Pass has the most tendency to show the characters of *P. s. illustris* GR.-GR., this tendency becoming weaker further to the west (the last conclusion needs confirmation, however).

Parnassius s. illustris GR.-GR. was described from Aram-Kungei, West Transalai. The status of the taxa *transiens* AUSTAUT, 1889 and *infumata* AUSTAUT, 1891 was clarified by KREUZBERG (1985): they are just forms of *P. s. illustris* GR.-GR. and originate from the western edges of Transalai (the

description of *transiens* AUST. includes one character of *P. s. infernalis* ELW. - this could be interesting, but the published photo of the syntypes presents normal forms of *P. s. illustris* GR.-GR.).

The taxon *interjecta* VERITY, 1911 was based on the specimens originating from Kyzyl-Art Pass (they were collected by GRUM-GRSHIMAILO but not in Aram-Kungei). GRUM-GRSHIMAILO characterized this population as transitional between *P. s. infernalis* ELW. and *P. s. illustris* GR.-GR.; VERITY (1911: 78) shared the same position: "var. *illustris* GR. trans. ad. var. *infernalis* STGR. [sic!]" Many scientists and collectors used this name as a subspecific for the populations of *P. staudingeri* A. B.-H. from the eastern part of Transalai as a whole (from Kyzyl-Art Pass to Irkeshtam) - according to the position of BRYK (1935), but this is wrong.

The types definitely show the characters of *P. s. illustris* GR.-GR. Unfortunately, I have only 2 freshly collected ♂♂ from the type locality for examination. I collected a lot of specimens at the upper stream of the Chinese Kyzyl-Su River ("Irkeshtam area", July 2000, 4300-4500 m); they, without any doubts, belong to *P. s. infernalis* ELW., being even smaller and darker - i.e. even more differ from *P. s. illustris* GR.-GR. than the typical *P. s. infernalis* ELW. from Taldyk. Another, but small series was collected by A. SOCHIVKO close to Nura village, at a lower altitude and in warmer conditions (the lower part of the Kyzyl-Su basin): these specimens are larger and similar to the typical populations of *P. s. infernalis* ELW. (see below); interesting that 2 of 4 available individuals have bluish scales in the HW anal spots (such an aberration has never been recorded for *P. s. illustris* GR.-GR.).

I suppose that the higher population needs no special name and represents an ecological form, but tendency of expressing the features of *P. s. infernalis* ELW. towards the area of *P. s. illustris* GR.-GR. may represent an important sign. I will return to this item after the discussion of the genitalia characters. Worth to note that the Irkeshtam area, upper basin of Chinese Kyzyl-Su River, is separated from the Alai Valley by a high watershed (3600 m.a.s.l.) - and this watershed could practically be an absolute barrier during the glacier period.

One more taxon was described from Transalai - *pontifex* BRYK & EISNER, 1932 from Kaindy Pass, close to Ters-Agar Pass at the upper stream of Altyn-Dara River (Aram-Kungei is a small tributary of this river). The status of this taxon is not clarified yet; only one broken type specimen is known at present. It may be also a form of *P. s. illustris* GR.-GR., but the relations with *inaccessibilis* J. J. SHCHETKIN, 1979 from Peter the Great Range have not been studied.

The taxon *hoareui* HANUS, 1996 described from the vicinity of Ters-Agar Pass as a subspecies of *P. s. infernalis* ELW. represents another problem. A small series collected on the tops of Transalai was divided into two taxa - *illustris* GR.-GR. and *hoareui* HANUS (*pontifex* BRYK & EISNER, was forgotten at all). The collectors did not find the Aram-Kungei valley; moreover, HANUS (1996) wrongly supposed that GRUM-GRSHIMAILO collected his type series not in Aram-Kungei but somewhere close to Ters-Agar. He ignored the direct notes about the trip published by the author as well as the simple fact that the type series of *P. s. illustris* GR.-GR. was collected together with the type series of *P. charltonius romanovi* GR.-GR.; the last species is absent in the high Ters-Agar Pass. Hanus also confused some characters of *P. s. illustris* GR.-GR., wrongly supposing that the material from Aram-Kungei (widely distributed in many collections) does not represent the true *P. s. illustris* GR.-GR. Such a position simply contradicts with the detailed description of the taxon published by GRUM-GRSHIMAILO (see above).

However, the material and data published by HANUS (1996) are of a serious interest. Surprisingly, "*illustris*" sensu HANUS from Ters-Agar is almost identical to *kiritshenkoi* AVINOV, 1910, origina-

ting from East Pamirs - actually, such very light forms of *P. s. illustris* GR.-GR. are known, but are very rare. Unfortunately, it was not marked how many *kiritshenkoi*-like specimens were collected in one place in total.

The photos of “*P. s. infernalis* ELW.” and “*infernalis hoareui*” were confused in the colour plate. The types of *hoareui* HANUS (if I recognized it correctly) look more similar to the typical *P. s. illustris* GR.-GR., while the ♀ of the typical *P. s. infernalis* ELW. from Taldyk represents a very rare white form of this taxon. It is marked that the darker “*hoareui* HANUS” fled early and were worn while the whitish “*illustris-kiritshenkoi*” were fresh.

The above data recalls another record from East Pamirs. A. SOCHIVKO, with colleagues, collected two different versions of *P. staudingeri* A. B.-H. in the vicinity of Dunkeldyk Lake: a darker and smaller form flying early and very locally - and a whitish form flying later and not locally. I have some more similar records from other places (I do not mean the confirmed records about the cohabitation of *jacobsoni* AVINOV, 1913 and *kiritshenkoi* AVINOV).

The original description of *P. i. hoareui* HANUS does not contain serious distinctions; thus, it is not possible to make any suggestions about the status of the taxon without examination of the type series or freshly collected material.

All data mentioned above demonstrate an extremely complicated pattern of the distribution of taxa in the *P. staudingeri*-complex. It is possible to interpret it using several hypotheses - but, fortunately, the genitalia characters can clarify some serious problems (see below).

It is necessary to add that the presence of the true *P. s. infernalis* ELW. at the tops of West Transalai is possible: this taxon inhabits the tops of the eastern part of this range - and, so, its distribution may be expanded to the western part. Such a hypothesis is based on the recent finding of *Paralasa hades* (STAUDINGER, 1882) in Ters-Agar [very different from *Paralasa nero* (STAUDINGER, 1884) even if the last taxon is only the subspecies of *P. hades* (STGR.)]. *Erebia progne* GRUM-GRSHIMAILO, 1890, formerly known only from the eastern edges of Transalai, was also found in Ters-Agar, while it is totally absent in Aram-Kungei or other places at the lower stream of Altyn-Dara R. It means that *P. s. infernalis* ELW. might disperse rather fast from North Alai to the tops of Transalai via the Irkeshtam area, where both ranges are connected, and where an *P. s. infernalis* ELW.-population exists for sure. In this case *P. s. infernalis* ELW. represents recently settled populations while *P. s. illustris* GR.-GR. lives along the borders of the Alai Valley and represents an element of the old fauna which originated here.

4. *Parnassius staudingeri vladimiri* subspec. nov. (col. pl. 3: 1a, 1b)

Holotype ♂: Tian-Shan, Naryn reg., Baetovo distr., Bavachal R., 3600 m, 10.-12.VII.2007, S. CHURKIN leg.

Paratypes: 75 ♂♂, 55 ♀♀, same loc., 3500-4100 m, S. CHURKIN, V. PLETNEV & S. SALUK leg.; 2 ♂♂, 3 ♀♀, same loc., 7.VII.2008, S. CHURKIN leg.; 28 ♂♂, 16 ♀♀, same loc., 3600 m, 16.-17.VII.2009, S. CHURKIN leg.; 32 ♂♂, 8 ♀♀, same data, J. OUVAROFF leg.;

Description and diagnosis: The new subspecies is similar to *P. staudingeri illustris* GR.-GR., distributed in the western part of Transalai, being readily different from the neighbouring *P. staudingeri infernalis* ELW. in the same distinctions as *P. staudingeri illustris* GR.-GR..

Male: FW length is 32.5 mm in the holotype, 28-34 mm in the paratypes. The ground colour is whitish, with contrasting blackish pattern, dark suffusion (dusting) is not developed.

FW: the semitransparent marginal band is narrow and usually is not joined with the submarginal blackish band even at the anal corner of the FW. Only 5% of the collected specimens have these two bands shortly merged. The submarginal band is not widened (as a rule), contrasting, narrower than the band of white spots situated externally. In rare cases the submarginal band is widened and not so contrasting, but the white band is never reduced to a row of small pale triangular spots as it often occurs in the typical *P. s. infernalis* ELW. The white M2-M3 spot is removed towards the discal area as well as the blackish M2-M3 spot (a typical species character of *P. staudingeri* A. B.-H. sensu lato). The postdiscal band is sharply contrasting, complete (as a rule) but not joined with other bands or touching them: it is narrow, not widened or enlarged - in contrast to *P. s. infernalis* ELW. The M3-Cu2 spots are often enlarged and dense (only 15% of the ♂♂ do not have a fully completed band, differing in this from *P. s. illustris* GR.-GR.), but its inner border does not widely touch the cell - in contrast to *P. s. infernalis* ELW. (in *P. s. infernalis* ELW. the M3-Cu2 spots - even if they are not so dense and deep in colour - are joined with, or touch, the cell; this is one of the most constant characters). As a result, *P. s. infernalis* ELW. has a wavy postdiscal band compared to *P. s. illustris* GR.-GR. and *P. s. vladimir subspec. nov.*, in which this band is narrow and straight in the typical case. The discal spots are similar to those of *P. s. illustris* GR.-GR.: the first spot is reduced and does not touch the cell border, while the spot at the cell end is enlarged with comparatively unclear borders.

HW: The marginal band is very narrow, the submarginal line includes 4 thin linear spots, the black submarginal 2A-Cu2 spots are small and have no blueish scales, with rare exceptions; the marginal band disappears near these spots. The eyes (ocelli) are red (not pale) and medium-sized; very rarely they are orange-yellowish. Sometimes a linear black spot is developed between the eyes (f. *conjuncta*); this form is not rare but not numerous: only 15% of the ♂♂ have this character really expressed (i.e. have the intermediate linear spot long and complete). Worth to note that the dark basal spot (blackish suffusion) at the corner of the HW is well developed and covering the cell while in *P. s. illustris* GR.-GR. it is narrowed, as a rule, and does not occupy the external and upper parts of the cell, such a form being rare in *P. s. vladimir subspec. nov.*; this distinction practically does not depend on the development of other elements of the black pattern. This character was marked by GRUM-GRSHIMAILO as very important in the identification of *P. s. illustris* GR.-GR. and *P. s. infernalis* ELW. - however, *P. s. vladimir subspec. nov.* has practically intermediate feature.

The underside is whitish, with more or less reduced red spots (with some rare exceptions).

The new taxon also differs from *P. s. illustris* GR.-GR. in the mode of the reduction of the black pattern: while *P. s. illustris* GR.-GR. with a reduced pattern becomes similar to *P. s. kiritshenkoi* Av. (the FW postdiscal band is developed only near the costal side of the wing, the HW anal spots almost disappear, the HW submarginal band is also reduced), *P. s. vladimir subspec. nov.* with a reduced pattern shows similarity with *P. s. kiritshenkoi* Av. only in the FW, but the HW anal spots and submarginal band are normal or only slightly reduced. In other words, the degree of the FW and HW pattern reduction is obviously different, while both wings are equally subject to it in *P. s. illustris* GR.-GR..

The whole type series contains 6 ♂♂ rather similar to the typical *P. s. illustris* GR.-GR. and 1 ♂ similar to the typical *P. s. infernalis* ELW.

Female: FW length as in the ♂. Two main forms can be identified: a whitish one, with a considerable reduction of the pattern (especially of the FW postdiscal band) and a ♂-like one, with a develop-

ped and even enlarged pattern which is however always contrasting with the white ground colour lacking dark suffusion (in contrast to the well-known *P. s. infernalis* ELW. ♀♀). The second version of the ♀ coloration often represents f. *conjuncta* (as a result, 20-25% of the ♀♀ can be stated as *conjuncta*). The sphragis seems to be very similar to that of *P. s. illustris* GR.-GR. and *P. s. infernalis* ELW.

Forms/ aberrations: Several specimens (2 ♂♂, 3 ♀♀) having orange-reddish eyes. Three ♀♀ have some bluish sheen in the oval 2A-Cu2 spots on the HW. Several ♂♂ have wide and dense post-discal band (all spots are totally merged). One ♀ is strongly suffused with black scales, but not semi-transparent as the *P. s. infernalis* ELW. ♀♀, being more similar to the totally darkened ♂. No forms with fully darkened eyes on the HW have been found (such forms - similar to *P. patricius* NIEPELT - are uncommon among *P. s. illustris* GR.-GR. and represent a well-known and even usual aberration exactly for this taxon).

Note: I can not exclude some hybridization between *P. s. vladimir subspec. nov.* and the local race of *P. delphius* Ev. (which has very different genitalia, however). Several specimens which could be treated as hybrids were collected - but these are only worn ♀♀, because the identification of the ♂♂ does not present a problem after dissection. I did not find any ♂♂ with wrongly developed genitalia - or with the genitalia combining the characters of both species. It confirms that even if the cases of hybridization is possible, it must be very rare and represents an abnormal exception without offspring.

Biology: The habitat is absolutely typical for *P. s. illustris* GR.-GR. and *P. s. infernalis* ELW. - stony slopes with *Cysticorydalis fedtschenkoana*. It flies together with *P. simonius* STGR., 1889, most numerous at the altitudes 3500-3600 m, having a two-year life-circle.

Parnassius delphius Ev. was also found in the same place but lower, inhabiting grassy slopes at 3400-3500 m, with *Corydalis gortschakovi* as a foodplant. The flight period of *P. delphius* Ev. is definitely earlier than in *P. s. vladimir subspec. nov.*, and *P. delphius* Ev. is obviously not numerous here - so, only 3 more or less fresh specimens were collected (1 ♂, 2 ♀♀; other specimens were completely worn). This series is not sufficient to analyse the subspecific level, but it is similar to the specimens which were collected at Baibiche-Too Range (15 km in the eastern direction from the locality of *P. s. vladimir subspec. nov.*; see notes about this population above). *Parnassius delphius* Ev., as well as its foodplant, have not been found at lower altitudes in this locality. Unfortunately, the weather is often very bad and we could collect butterflies only for few hours, having spent a total of 6 days during the 2007 and 2008 seasons.

Distribution area: Known only from the type locality. Presumably, the subspecies should be more or less distributed at the tops of the ranges situated in the south-western part of "Inner" Tian-Shan. This area is separated from *P. s. illustris* GR.-GR. living in the Alai Valley by the *P. s. infernalis* ELW. populations inhabiting the upper basin of the Chinese Kyzyl-Su River in the Irkeshtam area, i.e., the eastern edges of Alai and Transalai.

Etymology. The subspecies is named after VLADIMIR A. PLETNEV, a professional entomologist, permanent member of all *Parnassius*-expeditions and my friend.

5. Male genitalia

A detailed study of the genitalia of the complex (together with the muscle system) was published by STEKOLNIKOV & KUZNETSOV (1995, 1998, 2003); they studied exactly the specimens of *P. delphi-*

us Ev. However, detailed comparative studies of the genitalia of different taxa (with numerous material, described variability and marked important distinctions) are practically absent. I dissected 70 specimens, mainly belonging to different subspecies of *P. delphius* Ev., *P. s. illustris* GR.-GR. and *P. s. infernalis* ELW. A few individuals of other taxa were also studied: *cardinal* GR.-GR., 1887, *hunza* GR.-GR., 1888, *hissaricus* EISNER, 1968, *daniil* GLUSCHENKO, MARTYENKO & CHURKIN, 2001, etc., in order to understand the degree of the variability and the “working” sclerites.

KREUZBERG (1985) described the differences between *P. delphius* Ev. and *P. staudingeri* A. B.-H. for the first time. He marked that the sclerites of the uncus (blades of uncus) are more widely moved apart in *P. delphius* Ev. and the general size of the genitalia is smaller in *P. staudingeri* A. B.-H. In addition to these uncertain features, he published only two figures: a dorsal view of the uncus and tegumen of his “*P. delphius albulus* HONR.” (looking too strange and not so similar to the real uncus) and *P. staudingeri staudingeri* A. B.-H. - no true localities were given. *P. delphius albulus* HONR. sensu KREUZBERG, populates nearly all Tian-Shan, from Naryn and Zailiysky Alatau to Yulduz and Khami but its area does not contact that of the *P. staudingeri staudingeri* A. B.-H. inhabiting the western part of Ghissar; the selection of the taxa studied was certainly wrong - it is not possible to clarify a species status after examination of the most geographically divided material. No figures of other taxa, including *P. cardinal* GR.-GR. and *P. maximinus* STGR., are given.

Unfortunately, the best *Parnassius* study published by SAKAI et al. (2002), which contains more figures of the genitalia of the *delphius-staudingeri* complex, was based on wrong methods: some sclerites were flattened during dissection (actually, crushed) - as a result, the shapes of the valva and harpe are so deformed that they become useless and look always very similar. The figures of the uncus are also inadequate. After a careful study of the published figures, I decided that I can not use them neither for a critical review nor as additional data.

It is completely true that the ♂ genitalia of *Parnassius* are too large and thick: it is not easy to prepare figures or photographs, because the actual structure is too complicated. For this reason, I made some figures in slightly different views to show the actual shape and structure of the sclerites (see below). All sclerites are figured without hairs, because the latter have no taxonomic value but can mask some distinctions.

5a. *Parnassius delphius* EVERSMANN, 1843 and *P. staudingeri* A. BANG-HAAS, 1882.

The most valuable taxonomic characters were found in the structure of the uncus - as it is known for other complexes of *Parnassius* - for example, the *simo*-group (part I of the present paper) or *Kailasius* (CHURKIN, 2006).

The uncus of *P. delphius* Ev. (fig.4) consists of two lobes, each of them presented by a long triangular sclerite with thick and widened base, while the distal part is a plate, curved ventrally; this plate slightly recalls a half-tube in the cross-section, because the margins (left and right) are bent down (ventrally). Moreover, the lobes are not straight from the dorsal side too, the distal ends being curved outwards (so, that the superficial characters given by KREUZBERG, seem to be even wrong). Such a structure is very complicated, and the figures of it look different even when the angle of vision is only slightly changed. At the same time, this structure is easily recognizable and readily differs from the uncus of *P. s. illustris* GR.-GR. and *P. s. infernalis* ELW. (fig.5). The last two taxa demonstrate the flattened triangular lobes, each having a very widened base and comparatively pointed distal end from the dorsal view, no half-tube shape; the distal end is only very slightly curved ventrally, so that the general shape of the sclerite looks like an isosceles triangle.

Both species, *P. delphius* Ev. and *P. staudingeri* A. B.-H., have some variability in the uncus, but it is absolutely impossible to confuse their identification.

The aedeagus (fig.7) of *P. delphius* Ev. has a widened base, looking like a bulb - while *P. staudingeri* A. B.-H. has a smaller base, represented by a long rectangular structure which is only 2-3 times wider than other parts of the aedeagus. In addition, the “tube-like” part is definitely wider in *P. delphius* Ev.

The valva is slightly larger in *P. delphius* Ev. (fig.1, fig.3) than in *P. staudingeri* A. B.-H., but only statistically. It consists of two parts, the proximal part having a simple structure, while the distal part bears the harpe and is ending in a wide semi-membraneous (actually, less sclerotized) distal blade. In contrast to the blade, the strongly sclerotized formation lies at the dorsal side of the valva. This is a plate joined basally with the harpe and bearing long “whalebone” along the dorsal side of the membranous distal blade. The harpe has two strong “legs”, one of which is connected with the plate-formation, as I marked, while the other is joined with the inner surface of the ventral margin of the distal part of the valva. The distal part of the harpe is thick and heavy. It is sure that both strong “hooks” - the harpe and the plate formation with the “whalebone” work together during the copulation.

The valva of *P. s. infernalis* ELW. and *P. s. illustris* GR.-GR. (fig. 2, 3) shows several significant differences: the harpe is not so heavy, the distal part is not thickened, looking longer and slim; the plate-formation is considerably reduced, just slightly widened, while the “whalebone” is often longer (see below).

Some important notes must be added. The valva has a convex structure, while the harpe is strong and massive as well as the plate formation is, so that the efforts to make the whole armature flattened result in deformations. A separated, and partly flattened valva, provides a possibility to see the actual shapes of its different elements. However, it is not possible to figure all the valvae examined in an identical position because they are not identical in their 3-dimensional structure after separation.

Thus, some differences between the figures published here, do not reflect the actual distinctions: for example, figures 3a, 3b and 3c demonstrate different shapes of the plate formation - while in reality they are much more similar (but not identical!). The distal margin of the distal membranous blade of the valva must be compared from the external view as it is in fig. 3 - the inner point of view (fig.1, 2) is better to see the general shape of the valva, harpe and to estimate the general size of the formation.

It is worth to note, that these are not all distinctions of the valvae: their proximal parts also have a different structure, which is not so easy to be explained and figured. This could look not serious in view of the mentioned distinctions - but it indicates another type of the differences which seem to be very important for the taxa belonging to the *staudingeri*-complex (*hunza*, *cardinal*, etc.).

The proximal parts of the valvae are joined at the ventral side of the genitalia: the ventral marginal parts of each valva are widely and strongly bent upwards and inwards being connected with each other as well as with the juxta. It seems that the distance of this connection is different in *P. delphius* Ev. and *P. staudingeri* A. B.-H.; moreover, the size of these marginal curved parts of the valva is also different. It is almost impossible to measure and compare such characters, but, as a result, it is easy to “open” the valva of *P. delphius* Ev. after its separation from the other parts of the genitalia, while the proximal part of the valva of *P. staudingeri* A. B.-H. is not possible to be “opened” without serious damage. This is easy to observe in the figures: of the *P. delphius* Ev. valvae from the inner side (fig.1)” they look more rectangular and wider because the margins of their proximal parts are narrow – they were “opened” by the preparator. Fig.2 shows the same view for

P. s. illustris GR.-GR. and *P. s. infernalis* ELW.: the proximal part of the valva looks triangular, the ventral-proximal margins are obviously larger and wider (only fig. 2c presents a structure similar to that of *P. delphi* Ev. but this is a result of the efforts to flatten the whole valva, which led to the break of the basal end of the valva, the fact being not reflected in the figure).

In addition, the ventral margin of the distal part of the valva is larger and wider in *P. staudingeri* A. B.-H., so that the corresponding corner (leg) of the harpe in the figure is situated much further from the border of the valva. It means that the harpe of *P. staudingeri* can move in another way than in *P. delphi* Ev. Thus, *P. delphi* Ev. and *P. staudingeri* A. B.-H. show differences even in the mechanical work of the valva-harpe complex.

Other parts of the genitalia also have some minor differences, but it seems not important to describe them - they are more variable and faintly sclerotized, while the full description of the genital sclerites and muscles was published by STEKOLNIKOV & KUZNETSOV (1995, 1998, 2003).

5b. The variability in *Parnassius delphi* EVERSMAAN, 1843

I have examined the specimens collected at Chanach Pass, Chatkal Mts. (series of both, *P. (d.) maximinus* STGR. and *P. d. namanganus* STGR.), *P. d. namanganus* STGR. from Merke R. (Kirgizsky Range), *P. (d.) maximinus* STGR. from Yangiabad (Chatkal Valley), white "*albulus* HONR." from Narynsky Range (series, including 2 rare forms with normally developed black pattern), some specimens from Kungei Alatau, Dolon Pass, Sary-Bulak, Bayankol (East Terskey Alatau, the so-called "*candidatus*" - including a totally black form), *P. d. delphi* Ev. from Burchansarytau Mts., specimens from the north-eastern and south-western ends of the At-Bashi Range (series, Karasu River near Chatyr-Kel Lake and Bosogo vic., accordingly), Baibiche-Too Mts. and Bavachal R. (the two most western populations, unknown before).

In general, I was not able to find significant differences between the Chatkalian *P. delphi* Ev. (figs. 1b; 4 e,f) and *P. maximinus* STGR. (fig. 1 c; 4 d) - only the uncus is slightly larger statistically in *P. maximinus* STGR., while the plate formation is larger and more rectangular (fig. 1 c). It would be important to study some series of *P. delphi (maximinus) legezini* BERGMANN, 1995 living at low altitudes.

The aedeagus, the harpe and the shape of the valva, including membraneous distal blade are identical in the specimens from all the localities. The plate formation shows some variation, but individually, it is always very wide and strong. As I noted above, the actual border of the membraneous area is figured in fig. 3 (a-b); it always lacks a developed distal projection.

The uncus (fig. 4) has some geographical variability. It is comparatively small and slim in the nominate subspecies as well as in *P. d. namanganus* STGR. White individuals from Naryn often have the uncus sclerites with widened bases, more massive and thick compared to all other material examined (fig. 4 b). However, one specimen of the "white" *albulus* HONR. had a "normal" (common) structure (fig. 4 a), while another similar specimen was with a massive uncus. One typical individual from Dolon was with a massive uncus - an unusual form for this population. Moreover, one of the two *satanas-syxx* specimens from Bayankol also has a comparatively massive and widened uncus.

I suppose that these facts indicate a simple thing: white *albulus* have some differences in the structure of the uncus (the most important sclerite for the species identification - and, thus, must be most important for the isolation) but a possibility for copulation with dark individuals has not been lost. The genes responsible for the colour pattern were not the same as the genes responsible for the genitalia structures. So, after hybridization, some *P. delphi* Ev. populations include normal specimens with "wrong" genitalia and some individuals abnormal for the population

which, however, can have normal possibility to copulate and leave offsprings. According to the data mentioned in above, the hybridization is more or less intensive, but *P. maximinus* STGR. and the white *albulus* HONR. still exist and keep the main characters in the local populations even very closely to the contact zone with the dominant black subspecies - some differences in the structure of the genitalia can explain this phenomenon.

A ♂ of *P. delphius* Ev., collected together with *P. s. vladimir subspec. nov.*, shows the normal variant of the uncus (without very widened bases) as well as the ♂♂ from Baibiche-Too.

It will be necessary to do numerous dissections of some more *P. delphius* Ev. subspecies (also of the Chinese taxa) in the case of preparation of the full review of the species. As a whole, all characters and relations which were found in the course of the examination of the genitalia confirm the conclusions made after the analysis of colouration and geographical distribution of different *P. delphius* Ev. forms.

5c. Comparison of *Parnassius staudingeri illustris* GR.-GR. and *P. staudingeri infernalis* ELW.

The main characters of the genitalia of this complex were described above. I examined specimens from Aram-Kungei (the main part of the valley; another, but small, series was collected at the upper stream of the Aram-Kungei spring, near the pass), Tengizbai Pass, Taldyk Pass, Dugoba River, Kuruk-Sai Range (only 1 specimen), Kichik-Alai (only 2 specimens), upper stream of Alaiku River (at the border with Fergansky Range), Irkeshtam area (from the eastern ends of both ranges - Alai (high altitudes) and upper stream of Kyzyl-Su in Transalai, and 4 specimens collected near Nura by Sochivko) and Bavachal in Inner Tian-Shan. In addition, some specimens from different localities in the East and West Pamirs were examined, as well as representatives of *cardinal* GR.-GR., *hissaricus* EISNER, *daniil* GLUSCHENKO, MARTYNYENKO & CHURKIN and the nominate *P. s. staudingeri* A. B.-H.

First of all, I did not find taxonomically important differences between *P. s. illustris* GR.-GR. and *P. s. infernalis* ELW. in the structure of the uncus, aedeagus and general shape of the valva; the harpe (fig. 6 c, d) seems to be statistically longer and stronger in *P. s. illustris* GR.-GR. (and *P. s. vladimir subspec. nov.*). Only one but serious and constant distinction was found: the shape of the distal end of the valva. All *P. s. illustris* GR.-GR. and *P. s. vladimir subspec. nov.* individuals examined have a membraneous (actually, semi-membraneous) distal blade with a long distal projection on the dorsal side. This character can be seen very easily while observing two different variants together, but it is not so easy to produce a figure: the end of the distal projection and the distal end of the "whalebone" is curved inwards - so, that their real length is not obvious. The efforts to make the valva flattened, lead to its full deformation, as I marked above. Unfortunately, the best way to compare these characters is the lateral view - a position in which it is very hard to make drawings. However, the external view is very useful, too (fig. 3 c, d, t, f). Opposite to the case of *P. delphius* Ev., the inner view is also not bad for *P. staudingeri* A. B.-H. because the enlarged part of the valva around the second corner (leg) of the harpe makes the valva not so convex, and the harpe does not cover the important part of the membraneous blade (fig.2).

All studied *P. s. infernalis* ELW.-populations have no developed distal projection - the distal part of the valva is very similar to that of *P. delphius* Ev.! Thus, in the contact zone in Inner Tian-Shan, *P. delphius* Ev. contacted with the subspecies of *P. staudingeri* A. B.-H. which has maximum differences in the genitalia (i. e. *P. s. vladimir subspec. nov.*).

The marked distinction is so serious and permanent, that it looked as a species-level distinction

during the main period of the work with the genitalia. However, after the dissection of a relatively large series, I found the exceptions: some specimens with the *illustris*-characters of the valva were recorded from Tengizbai Pass and Kichik-Alai; such specimens are very rare, according to the number of dissections. It seems very important that such a “wrong” character correlates with the colouration, i.e. such specimens are often comparatively similar to *P. s. illustris* GR.-GR. However, I did not find full correlation between the characters of the valva and the black pattern. One specimen with a “wrong” valva was found among the dissected ♂♂ from the main valley of Aram-Kungei. This butterfly has normal *P. s. illustris* GR.-GR. colouration and a valva of *P. s. infernalis* ELW., but the uncus is strongly curved ventrally - so, that copulation seems impossible. Worth to note, that I found only this one individual unable to copulate.

A small series originating from Aram-Kungei Pass, which I have at my disposal, also includes both variants of the valva. This series consists of 3 ♂♂ belonging to *P. s. illustris* GR.-GR., according to the colouration and valva - but also 3 pairs with the external characters of *P. s. infernalis* ELW. (which however look very similar to the typical *P. s. infernalis* ELW. and not to *hoareui* HANUS). The two ♂♂ examined from the last group have two different variants of the valva: one with a distal blade, the other without it. In my opinion, the series examined is too small for a final confirmation of the presence of *P. s. infernalis* ELW. at the cold tops of West Transalai. A profound comparison of this series with new and numerous material from Ters-Agar (“*hoareui* HANUS”) is needed.

A comparison of *P. s. vladimir subspec. nov.* and *P. s. illustris* GR.-GR. shows that the new taxon has obviously larger genitalia, with even more developed distal projection, in contrast to the *P. delphius* Ev. valva which looks much more short and blunt.

The specimens of *P. s. kiritshenkoi* Av. and *P. s. darvasicus* Av., 1916 examined demonstrate genital structures very similar to those of *P. s. illustris* GR.-GR., while *P. staudingeri* A. B.-H. - *P. s. hissaricus* EISNER have some differences. The close relatives of *P. s. infernalis* ELW. were not found at all, but the position of *P. s. daniil* GLUSCHENKO, MARTYSENKO & CHURKIN and *P. s. difficilis* MURZIN, 1989 is still unclear to me and needs further investigation. It seems that some other taxa (for example, *hunza* GR.-GR.) have different variant of the working “mechanism” harpe-valva, differing from other representatives of the *P. staudingeri* A. B.-H.-group by another type of distinctions compared to those observed above for *P. delphius* Ev., *P. s. illustris* GR.-GR., and *P. s. infernalis* ELW.

I can not exclude that the species status of *P. s. infernalis* ELW. will be confirmed later, but I do not support this idea. The hiatus between *P. delphius* Ev. and *P. staudingeri* A. B.-H. as a whole is much deeper: the genitalia are so different that both taxa may be regarded as consisting of several good but younger species. However, a single and not sharp difference seems to be not sufficient to provide a full isolation in nature. More probably, that *P. s. infernalis* ELW. and *P. s. illustris* GR.-GR. are two strong subspecies - the copulation between its representatives must be difficult, limited. Moreover, the distribution of each of them may be even of a mosaic character because of the copulation problems and because they had expansions at different time in the past.

Discussion and conclusions

At first, it is necessary to repeat some preliminary conclusions.

1. “*maximinus* STGR.” represents a subspecies (or a complex of subspecies) which belongs to *P. delphius* Ev. This taxon is related to other white populations of *P. delphius* Ev. known from Naryn and Chinese Aksu. The situation with the valid name for the Narynian white *P. delphius* Ev.

needs further careful clarification.

2. White populations (i.e. not only whitish but with a reduced black pattern) represent an old line of taxa which lived along the Tian-Shanian mountain platform in the past; the butterflies have recessive genes, in contrast to the younger "dark" line of subspecies which originated finally only during the glacier period and became adapted to colder conditions. The dark *P. delphius* Ev. is characterized by a possibility to live on *Cysticorydalis*, the basic food plant of *P. patricius* NIEP. and *P. staudingeri* A. B.-H. The dark *P. delphius* Ev. is much more plastic ecologically and provides a lot of ecological forms.
3. The total variability of *P. delphius* Ev. is very dependent on the geographical position of the populations: some of them have only "black" ecological line of forms, while the others are much more variable because of the hybridization with the old whitish individuals. The latter may be found in some other populations because some recessive individuals can appear.
4. The taxa *P. s. illustris* GR.-GR. and *P. s. infernalis* ELW. can not be only ecological forms, because of distinctive distribution pattern and differences in the valva; the ecological variability of both taxa is obviously less than in *P. delphius* Ev. - it confirms that both taxa are comparatively old and are not so plastic ecologically.
5. The uncus presents the most important species characters in the complex, while the role and taxonomic weight of the position of harpe and the shape of the valve needs further study. *P. delphius* Ev. and *P. staudingeri* A. B.-H. sensu lato have significant differences in the ♂ genitalia, practically all sclerites bearing the distinctions.
6. The areals of *P. s. illustris* GR.-GR. and *P. s. vladimir* **subspec. nov.** are widely separated by the *P. s. infernalis* ELW. populations inhabiting the eastern edges of Alai and Transalai in the basin of the Chinese Kyzyl-Su R.; the status of the last populations needs further clarification; the same is true for *houreaui* HANUS (which could belong to *P. s. illustris* GR.-GR. in spite of the fact that the *infernalis*-forms are now recorded from Aram-Kungei for sure). The taxon *interjecta* VERITY, 1911 belongs to *P. s. illustris* GR.-GR.
7. The populations of *P. s. infernalis* ELW. and *P. s. illustris* GR.-GR. can live very close together but are not fully merged because of some copulation problems - in such a case a possibility to find two different forms or one mixed population will depend on the actual situation in the locality. *P. s. illustris* GR.-GR. prefers warmer slopes, while *P. s. infernalis* ELW. easily survives in colder habitats, not necessarily at higher altitudes but, for example, on slopes of another exposition or situated closely to the ridge or glaciers. In case these two habitat types are neighbouring but separated (by sheer rocks, moraine, fragments of mountain tundra and so on), we may theoretically see the situation resembling cohabitation of two species. However, detailed study should reveal as active hybridization as variability of the genitalia. Important to note that we can also suppose such relations for other taxa of the *staudingeri*-complex, and the status of the taxa (species or subspecies) in each case should be determined only after special investigations.

P. simonius STGR. and *P. staudingeri* A. B.-H. live at the most high altitudes and must have more or less similar history in the Alai/Transalai system - this hypothesis is confirmed by the new Tianshanian finding of both taxa. Thus, basing on the distribution of *P. simonius* STAUDINGER, 1889 and historical reconstructions (see the first part of the present paper) we can suppose that the southern slopes of Alai are populated by *P. s. illustris* GR.-GR., and the Tengizbai specimens show a result of some hybridization. The efforts to check it were successful: I have a confirmed record from S. TOROPOV (Bishkek) that a *P. s. illustris* GR.-GR. population was recently found at Kyzyl-Eshme gorge, the southern direction from Tengizbai. Unfortunately, I did not examine the collected material personally - it would be

important to check the genitalia. These data agree with the most probable hypothesis that *P. s. illustris* GR.-GR. and *P. s. infernalis* ELW. represent only two subspecies.

Important to note, that in contrast to the case with *P. simonius* STGR., the Tengizbai population does not belong to *P. s. illustris* GR.-GR. but to *P. s. infernalis* ELW. However, in a logical addition to this difference in the distribution pattern, the areal of *P. s. infernalis* ELW. covers the whole territory of North Alai and is not divided into several parts as it is in the *P. simonius* STGR. pattern: *P. staudingeri* A. B.-H. is not local here and does not provide local forms.

On the other hand, “wrong” representatives of both taxa can represent not a result of the hybridization but some rare and disappearing now “wrong” genetic variants.

The observed pattern of the distribution of *P. s. illustris* GR.-GR. and *P. s. infernalis* ELW. shows that these taxa became distributed over the neighbouring territories at different times. It is logical to suppose that *P. s. illustris* GR.-GR. was distributed early towards the east and reached SW part of Tian-Shan.

Note. Close relatives of *P. s. illustris* GR.-GR. inhabit Peter the Great Range (*P. s. inaccessibilis* J. J. SHCHETKIN, 1979), NW Pamir (*darvasicus* AVINOV, 1916) and the East Pamirian Plateau (*kiritshenkoi* AVINOV, 1910) forming 3 distinct subspecies - it means the *illustris*-forms have older and widely distributed characters. Important to add that the recent DNA-studies confirm close relations between all *illustris*-forms mentioned above (MICHEL et al., 2008).

Then, *P. s. infernalis* ELW. made its eastern expansion at some other time and reached at least the eastern Transalai. So, somewhere close to Irkeshtam both taxa or a mixed population can be found (some variability in the structure of the valva was marked above).

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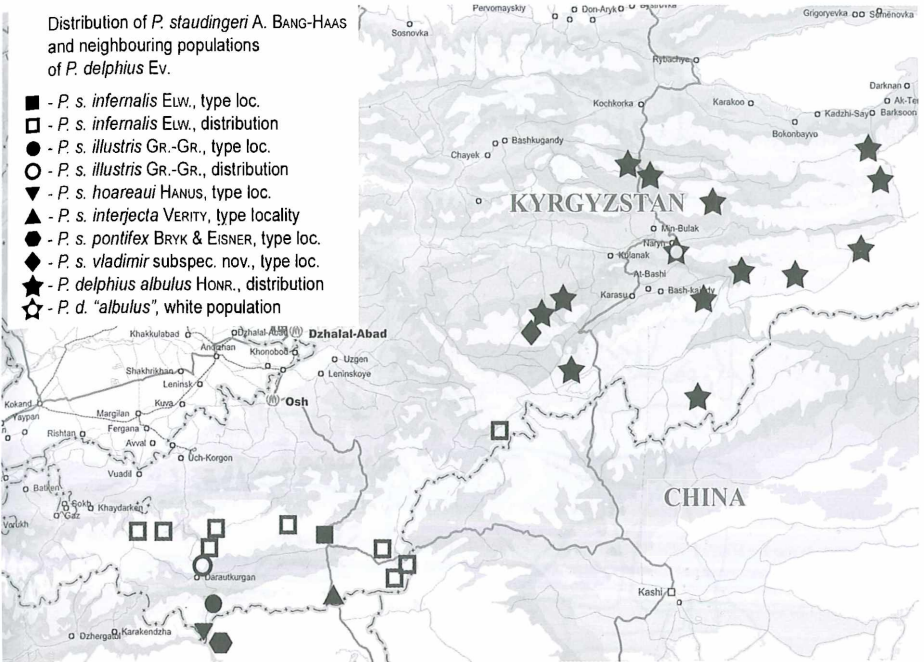
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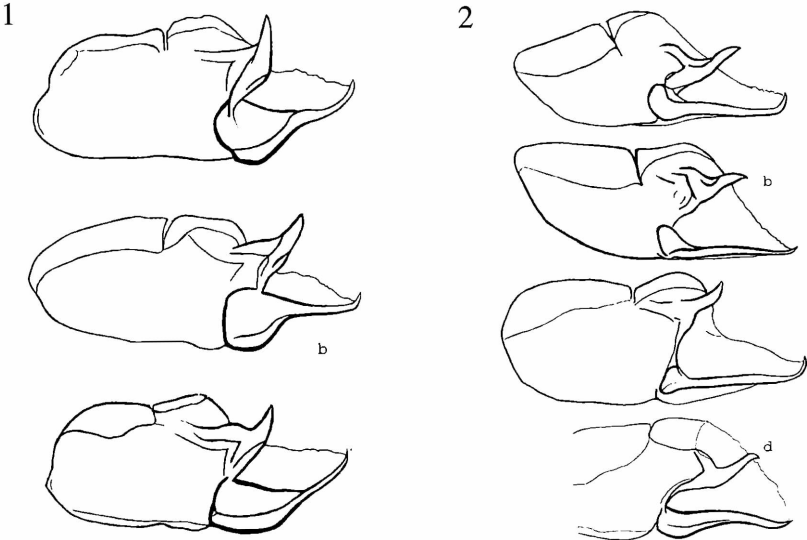
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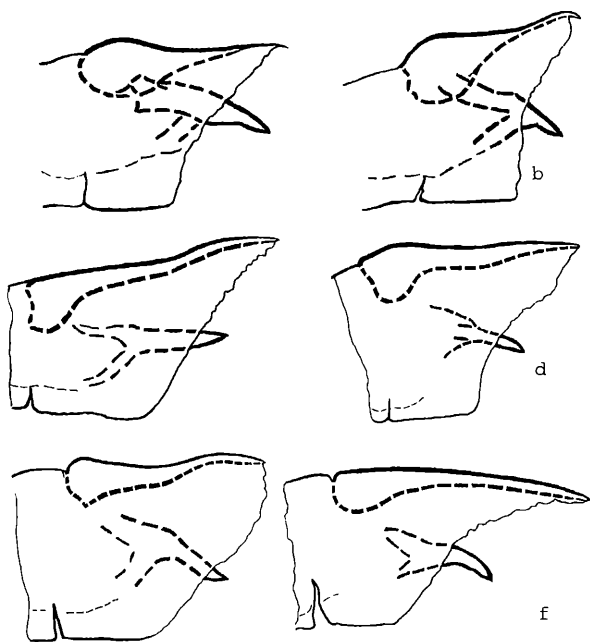
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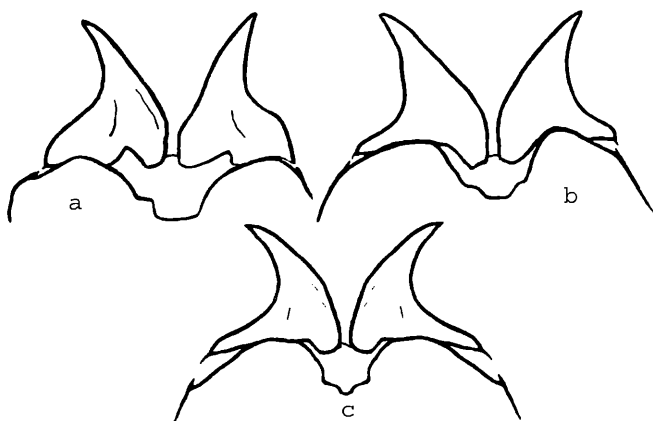
Distribution map of the *Parnassius staudingeri* A. BANG-HAAS, 1882 subspecies.



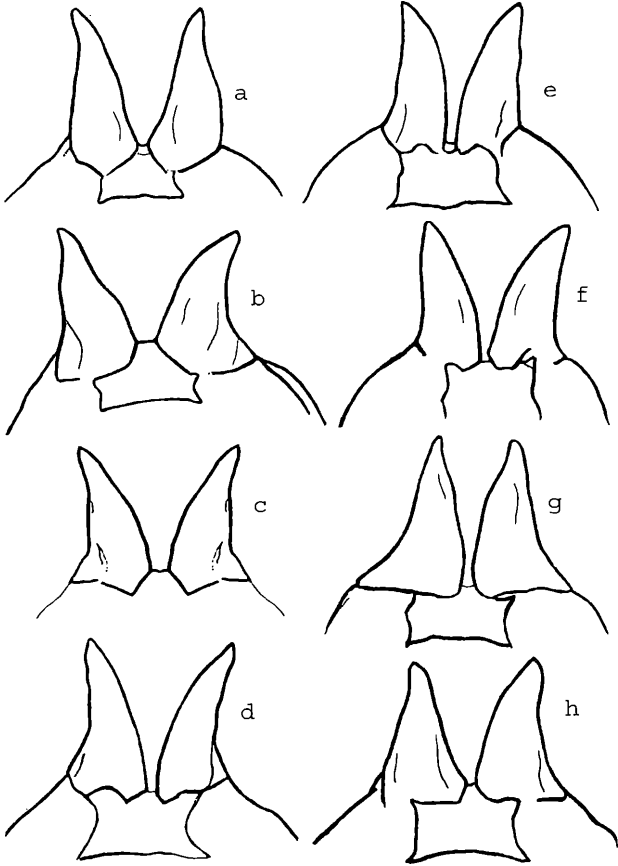
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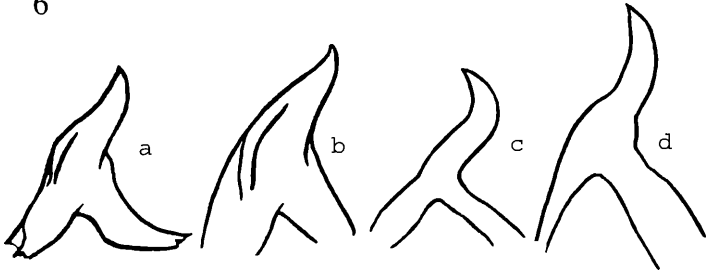
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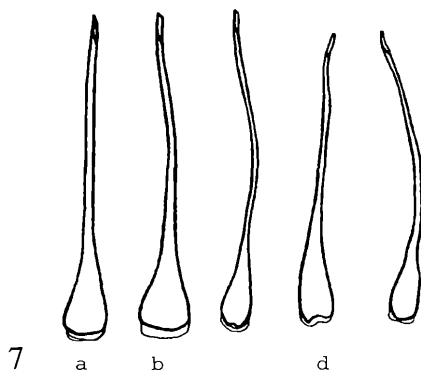


Fig. 1: Valva and harpe, inner view. a: “*P. delphius albulus* HONRATH, 1889” (white form), Narynsky Range; b: *P. delphius namanganus* STAUDINGER, 1886, Chatkal Range, Chanach Pass; c: *P. maximinus* STAUDINGER, 1891, Chatkal, Yangyabad.

Fig. 2: Valva and harpe, inner view. a: *P. staudingeri illustris* GRUM-GRSHIMAILO, 1888, W. Transalai, Aram-Kungei; b: *P. staudingeri infernalis* ELWES, 1886, E. Alai, Taldyk Pass; c: *P. staudingeri vladimir subspec. nov.*, Inner Tian-Shan, Bavachal R.; d: *P. staudingeri infernalis* ELWES, 1886, E. Transalai, Chinese Kyzyl-Su R. (upper stream).

Fig. 3: Valva and harpe, external view. a: “*P. delphius albulus* HONRATH, 1889” (white form), Narynsky Range; b: *P. delphius albulus* f. *satanas* A. BANG-HAAS, E. Terskei Alatau, Bayankol R.; c-e: *P. staudingeri infernalis* ELWES; a: 1886, E. Alai, Taldyk Pass; d: Tengizbai Pass; e: E. Transalai, Chinese Kyzyl-Su R. (upper stream); f: *P. staudingeri illustris* GRUM-GRSHIMAILO, 1888, W. Transalai, Aram-Kungei.

Fig. 4: *P. delphius* EVERSMAAN, 1843, uncus, dorsal view (except f: ventral view). a, b: *P. delphius albulus* HONRATH, 1889; a: (specimen with developed pattern), Narynsky Range; b: Narynsky Range (white specimen with reduced pattern); c: *P. delphius* EVERSMAAN, 1843, South Dzhungaria, Burchansarytau Mts.; d: *P. maximinus* STAUDINGER, 1891, Chatkal, Yangyabad; e, f: *P. delphius namanganus* STAUDINGER, 1886, Chatkal Range, Chanach Pass; g: *P. delphius albulus albulus* f. *satanas* A. BANG-HAAS, E. Terskei Alatau, Bayankol R.; h: *P. delphius albulus* HONRATH, 1889, Inner Tian-Shan, Bavachal R.

Fig. 5: *P. staudingeri* A. BANG-HAAS, 1882, uncus, dorsal view. a: *P. staudingeri illustris* GRUM-GRSHIMAILO, 1888, W. Transalai, Aram-Kungei; b: *P. staudingeri vladimir subspec. nov.*, Inner Tian-Shan, Bavachal R.; c: *P. staudingeri infernalis* ELWES, 1886, E. Alai, Taldyk Pass.

Fig. 6: Harpe (separated). a: “*P. delphius albulus* HONRATH, 1889” (white form), Narynsky Range; b: *P. delphius namanganus* STAUDINGER, 1886, Chatkal Range, Chanach Pass; c: *P. staudingeri infernalis* ELWES, 1886, E. Transalai, Chinese Kyzyl-Su R. (upper stream); d: *P. staudingeri vladimir subspec. nov.*, Inner Tian-Shan, Bavachal R.

Fig. 7: Aedeagus. a, b: *P. delphius albulus* HONRATH, 1889; a: (specimen with developed pattern), Narynsky Range; b: Inner Tian-Shan, Bavachal R.; c: *P. staudingeri vladimir subspec. nov.*, Inner Tian-Shan, Bavachal R.; d: *P. staudingeri illustris* GRUM-GRSHIMAILO, 1888, W. Transalai, Aram-Kungei; e: *P. staudingeri infernalis* ELWES, 1886, E. Alai, Taldyk Pass.

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