

A RECONSIDERATION OF HESPERIS LEUCOCLADA BOISS. (CRUCIFERAE)

A. R. Khosravi

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By morphological and geographical evidences, it is showed that *Hesperis leucoclada* Boiss. and *Pseudofortuynia esfandiarrii* Hedge are the same species. The new combination *Pseudofortuynia leucoclada* (Boiss.) Khosravi is the correct name. The affinities of *Pseudofortuynia* are discussed.

Department of Biology, Faculty of science, Shiraz University, Shiraz 71454, Iran.

Key words. Flora of Iran, *Cruciferae*, *Hesperis*, *Pseudofortuynia*, *Gynophorea*, *Sisymbrium*, morphology, geographical distribution, affinity, Nomenclature.

توجه دوباره به گونه *Hesperis leucoclada* Boiss. (از تیره شب بو)

احمد رضا خسروی

با استفاده از شواهد مورفولوژیک و جغرافیایی، نشان داده می‌شود که *Hesperis leucoclada* Boiss. و *Pseudofortuynia esfandiarrii* Hedge مترادف‌اند.

ترکیب جدید *Pseudofortuynia leucoclada* (Boiss.) Khosravi نام صحیح تاکسون است. قرابت *Pseudofortuynia* مورد بحث فرار می‌گیرد.

INTRODUCTION

Cruciferae is one of the most difficult families in terms of the delimitation of genera (Hedge 1976; Al-Shehbaz 1984). In this regard *Hesperis leucoclada* is one of the most problematic cases. The plant included in *Hesperis* as *Hesperis leucoclada* by Boissier (1842) and *Sisymbrium* as *Sisymbrium hesperidiflorum* by Boissier and Buhse (1860). In *Flora Orientalis*, Boissier (1867) was named the plant as *Hesperis ? leucoclada*. Dvorak (1968) compared this species with closed genera from tribes *Hesperideae* and *Brassicaceae*. He showed that *H. leucoclada* has some shared characters with some genera of these tribes, but does not completely match any of them. The description of *H. leucoclada* was originally based on few incomplete specimens (without mature fruits). Finally Dvorak (1968) selected the presence of gynophore as a better shared character between *H. leucoclada* and *Gynophorea*, and transferred the former into *Gynophorea* as *Gynophorea leucoclada*. Except for the presence of gynophore and stipitate fruit, there are no any other important characters which correlate *H. leucoclada* and *Gynophorea*.

Hedge (1968) described his new monotypic genus, *Pseudofortuynia*, on the basis of material collected by F. Schmid in 1956 and later by Boroumand in 1966. He stated that *Pseudofortuynia* has an unusual aggregate of characters that makes its correct generic position hard to assess. It has similar habit to *Fortuynia*, sepals and petals similar in size, color and shape to *Moricandia*, sagittate anther bases occur in *Moricandia* and *Spryginia*, markedly stipitate fruit occurs in some *Brassica* and in *Diplotaxis*, 3-veined fruit valves are general in *Sinapis*, and the fruiting stigma similar to some *Brassica* species (Hedge 1968).

In this survey, by seeing a photo of type material of *H. leucoclada* Boiss. (4123 W!)

and comparison the description of *H. leucoclada* Boiss. with description, distribution and specimens of *P. esfandiarii* Hedge, I show that the *H. leucoclada* Boiss. and *P. esfandiarii* Hedge, are the same taxon.

INVESTIGATION OF THE MORPHOLOGICAL CHARACTERS

Habit: *P. esfandiarii* is a perennial herb with thick woody bases, from which numerous herbaceous shoot emerge. The branches are glaucous and glabrous. These characters correspond with the description of *H. leucoclada* in *Flora Orientalis* (Boissier, 1867) "a caulibus pluribus proceris erectis glabris glaucis inferne ramosis nodoso incrassatis" and in *Flora Iranica* (Hedge, 1968) "Perennis. Caulis jam inferne ramosus, erectus...., glaucus, glabra, c 50 cm altus".

Leaves: About *H. leucoclada* we read in *Flora Orientalis* "follis glabris vel sparsim hirtis inferioribus petiolatis oblongis runcinato-pinnatifidis lobis rotundatis inaequalibus, superioribus sessilibus oblongo-linearibus, sinuatis, summis integris". The shape features of *H. leucoclada*'s leaves correspondence with *P. esfandiarii*. Besides, one of the specific features of *P. esfandiarii* is the presence of fasciculate hairs at the bottom of lower petioles that is not found on upper ones. Regarding Boissier (1842) on *H. leucoclada*, "caules praeter villum niveum ad ortum petiolorum infimorum copiosum, superius evanidum, glaberrimos".

Inflorescence: like other genera of subtribe *Moricandiinae*, *P. esfandiarii* has a lax and ebractate raceme and about *H. leucoclada* Boissier (1842) wrote "racemis elongatis laxis".

Flower: about hairs of pedicel and sepal Boissier (1842) stated

"pedunculi pilis sparsis patulis obsiti, saepius glabrescentes.... sepales extus pilis lanatis sparsis araneoso hirta".

The feature corresponds with *P. esfandiarii*. Sepals in *P. esfandiarii* are violet and erect and slightly saccate. Hedge (1968) suggested that *P. esfandiarii* has sepals and petals similar in size, color and shape to *Moricandia* and Dvorak (1968) based on the study of *H. leucoclada* (according to the study of isotype from K), suggested that with respect to shape of sepals *H. leucoclada* can not be differentiated from the species of the genus *Moricandia*. Boissier (1867) wrote on the petal of *H. leucoclada* "petalis violaceis obovata-spathulatis ungue subxserto" and we read in Flora Iranica, "unguis 9-10 mm longus; laminae c. 10x5mm". These characters are agreed with *P. esfandiarii*. Dvorak (1968) suggested that filaments of stamens in *H. leucoclada* are similar to *Moricandia* and Hedge (1968) said that sagittate anther bases of *Pseudofortuynia* coincide with *Moricandia* and *Spryginia*.

About stigma Boissier (1867) wrote "stigma capitato- subbilobo", so the shape of stigma in *H. leucoclada* is different from the other species of *Hesperis*. In *Hesperis* stigma is cylindrical, bilamellate with erect, exactly connivent lamellae. Dvorak (1968) said that the stigma of *H. leucoclada* is similar to *Conringia*. The shape of stigma in *P. esfandiarii* is depressed capitate which completely coincide with Boissier's description (1867) (Fig. 1).

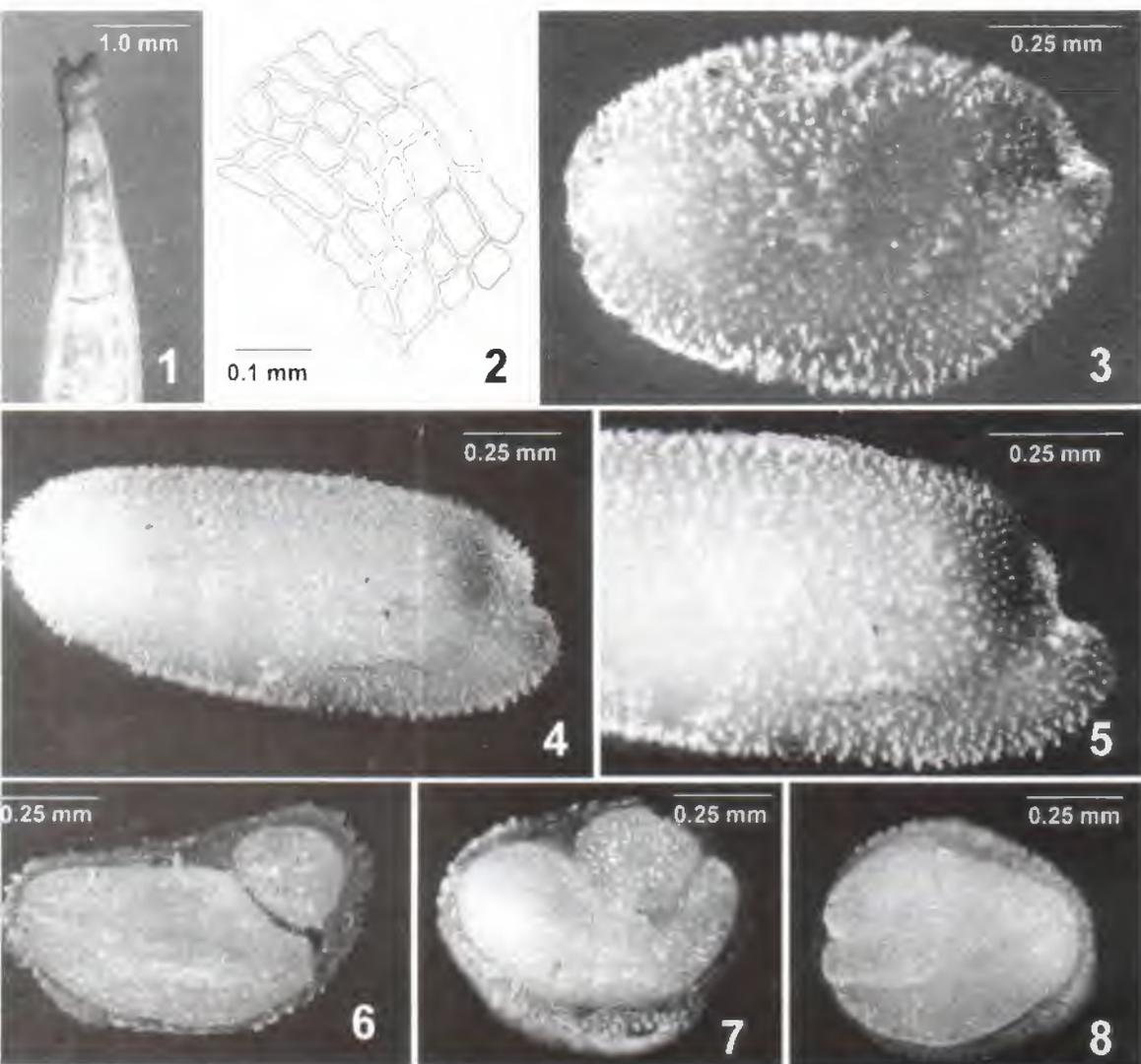
One of the most important shared characters between *H. leucoclada* and *P. esfandiarii* is the presence of gynophore in pistil. According to this character, Dvorak (1968) positioned *H. leucoclada* in the genus *Gynophorea* while there is many differential characters between these two taxa (Table 1).

Fruit: In *Cruciferae*, fruits present the most important diagnostic features and thus for delimitating taxa, especially at generic and specific levels. Dvorak (1968) explained the fruit features in *H. leucoclada* in detail. He reported the length of the pods: (2.1)-4.7-(6.7)

cm (on the basis of the two specimens collected by Stapf). The pods have a conspicuous gynophore 2-4 mm long. The pods are broadest at the bottom (some 2 mm), gradually tapering towards the top; they are about 1 mm broad below the stigma. The narrowed, thin, some 4 mm long portion, is seedless. The beak of the pods (ending in the valves) is quite short. It passes into a bigger globular didymous stigma. The valves of the pods separate easily. They have a distinct midrib, with thin veins on both sides joined by a reticulate venation with the median vein. All fruit characters described for *H. leucoclada* by Dvorak (1968) are completely coincide with fruit characters in *P. esfandiarii* especially in exhibiting of conspicuous stipe, short beak and 3-veined fruit valve (Table 1).

We examined the septum of fruit in *P. esfandiarii*. The shape and arrangement of cells are similar to *H. leucoclada* that was explained and drowned by Dvorak (1968) (Fig. 2).

Seed: When *P. esfandiarii* was described by Hedge (1968), the mature seeds were not available. For that reason the complete description of seed was not provided. We got mature seeds, which later were examined. The shape of seed is ellipsoid or oblong-ellipsoid, with light brown color and not winged. Surface of seeds is faintly papilate (like *Conringia orientalis* and *Sisymbrium loeselii*) and slightly mucilaginous produced when immersed in water (like *Sisymbrium loeselii*). Radicle is incumbent or obliquely incumbent (Figs. 3-5). Dvorak (1968) investigated seeds of one specimen of *H. leucoclada* and suggested that cotyledons are slightly conduplicate. The lower cotyledon had the shape of a flat saucer. The radicle of the embryo was situated in a shallow groove of the upper cotyledons. We also observed that in *P. esfandiarii*, radicle was immersed in shallow groove in one side of upper cotyledon (Figs. 6-8).



Figs. 1-8. *Pseudofortuynia leucoclada*. Fig. 1. Replem with stigma. Fig. 2. Cells of replem. Figs. 3-5. Shape and surface of seeds. Figs. 6-8. Cross section of seeds showing position of radicle relative to cotyledons.

Table 1. Comparison of four taxa based on literature: *Hesperis leucoclada*, *Gynophorea*, *Hesperis* and *Pseudofornaria*

Characters	<i>Hesperis leucoclada</i>	<i>Gynophorea</i>	<i>Hesperis</i>	<i>Pseudofornaria</i>
Trichomes	Glabrous except for simple trichomes on pedicels and sepales	Malpighiaceous	Forked, often with simple one	Glabrous except for simple trichomes on pedicels and sepals
Leaf margin	Lyrate pinnatifid	Entire	Variable, often deeply dentate	Lyrate pinnatifid
Inner sepals	Slightly saccate	Saccate	Saccate	Slightly saccate
Color of petals	Purple	Yellow	White to purple	Purple
Median nectar glands	Absent	Present	Absent	Absent
Stigma	Depressed capitate	2-lobed capitate	Deeply lobed, connivent	Depressed capitate
Fruit valve	3-nerves with the midrib most conspicuous	Without a distinct midrib	With a distinct midrib	3- nerves with the midrib most conspicuous
Gynophore	Present	Present	Absent	Present
Seed	?	Non-mucilaginous	Non-mucilaginous	Slightly mucilaginous
Size of chromosomes	?	?	Big	Small

INVESTIGATION ON GEOGRAPHICAL DISTRIBUTION

A critical comparison of distribution of *H. leucoclada* and *P. esfandiarrii* reveals that both taxa have the same distribution in Esfahan, Fars and Yazd provinces on the inner drier range of Zagros (Map 1). All collection of *P. esfandiarrii* are from center of Esfahan, north of Fars and south west of Yazd provinces. From few gathering of *H. leucoclada*, one was collected from Kuh-e Bul, in north of Fars, the place where we collected *P. esfandiarrii*. Unfortunately, other collectors did not mention precisely about location of their gatherings (Map 1).

AFFINITY OF PSEUDOFORTUYNIA

The intra-familiar classification of the *Cruciferae* has long been controversial (Hedge 1976; Al-Shehbaz 1984, 1997). The lack of agreement among the various classifications has resulted from different emphasis on various characters (Hedge 1976, Al-Shehbaz 1984, 1997). The highly stable flower and fruit structure of the *Cruciferae*, as well as the occurrence of parallelism in almost every morphological character, prevent to the construction of a practical supra-generic classification solely based on morphological data (Al-Shehbaz 1997). However, some tribes and subtribes of the family apparently represent natural, well-defined alliances. Such groups have often been based on single or few morphological characters that presumably evolved only once within these groups. Tribe *Brassicaceae* is one of such group. Two synapomorphic characters (conduplicate cotyledons and/or heterocarpic fruit) support the monophyly of tribe *Brassicaceae*. Based on some morphological characters such as presence of gynophore, short seedless beak and floral architecture, Hedge (1968) placed *Pseudofortuynia* in tribe *Brassicaceae* subtribe *Moricandiinae*. However *Pseudofortuynia* lack conduplicate cotyledon and true heterocarpic

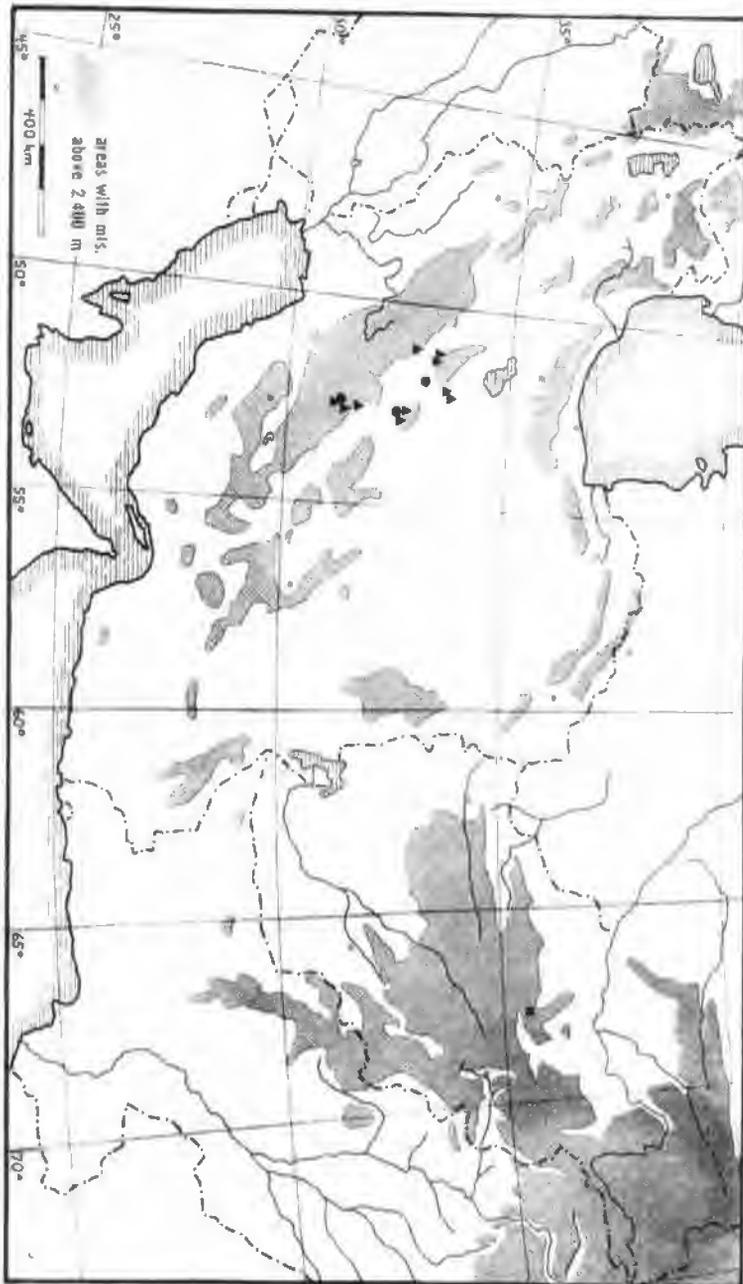
fruit. Al-Shehbaz (1985) and Gomez-Campo (1980) have proposed that the boundaries of the tribe should be readjusted with exclusion of *Calepina*, *Conringia*, *Orychophragmus* and *Spryginia* from the tribe, because they lack the typical features of the tribe. *Pseudofortuynia* should be added to this group. Using Chloroplast restriction site variation from members of the eleven tribes of *Cruciferae*, Khosravi (2001) concluded that *Pseudofortuynia* does not belong to *Brassicaceae*, and *Sisymbrium* is the closest allies of *Pseudofortuynia*. Boissier and Buhse (1860) described *H. leucoclada* as *Sisymbrium hesperidiflorum* Boiss. & Buhse. I can find many synapomorphic characters for close relationship between *Pseudofortuynia* and *Sisymbrium* (Table 2).

Synonymy of *H. leucoclada* and *P. esfandiarrii*

As a result of this study it is no doubt that *H. leucoclada* represents the same taxon as *P. esfandiarrii*. As it was cited above, this taxon can not be considered as belonging to the genus *Hesperis* or any other related genera. Therefore, the monotypic genus *Pseudofortuynia* with close relationship to *Sisymbrium* is considered here as a distinct taxon and therefore a new combination is made.

Pseudofortuynia leucoclada (Boiss.) Khosravi, **comb. nov.**

Basionym. *Hesperis leucoclada* Boiss., Ann. Scienc. Nat. Ser. 2, 17: 69 (1842); *type.* Esfahan, Auch. 4123 (W). - *Other synonyms.* *Pseudofortuynia esfandiarrii* Hedge, Flora Iranica no. 57: 57 (1968); *type.* Between Abadeh and Dowlatabad, 1500-2000 m, 26.4.1956, Schmid 5335 (holotype W, isotype G); *Gynophorea leucoclada* (Boiss.) Dvorak, Feddes Repert. 77, 2: 111 (1968); *Sisymbrium hesperidiflorum* Boiss. & Buhse, Mem. Soc. Nat. Mosco. 18: 22 (1860).



Map 1. Total distribution of three *Cruciferae* taxa based on the literature ● *Hesperis leucoclada*; ▲ *Pseudofortuynia*; ■ *Gynophorea*

Table 2. Comparison of *Pseudofortuynia* and *Sisymbrium*.

	<i>Pseudofortuynia</i>	<i>Sisymbrium</i>
Habit	Perennial or subshrub	Annual, biennial or perennial, rarely subshrub
Trichomes	Simple	Absent or simple
Leaf margin	Lyrate pinnatifid	Entire or variously pinnately dissected
Sepals	Erect	Erect or spreading
Shape of sepals	Oblong	Ovate or oblong
Inner sepals	Subsaccate or not	Sometimes subsaccate
Color of petals	Purple	Yellow, white, pink or purple
Shape of petals	Obovate, spatulate	Obovate, spatulate, oblong or suborbicular
Claw	long	Often subequaling or longer than sepals
Filament	not dilated at base	not dilated at base
Anther shape	Sagittate	oblong, obtuse at apex
Median nectar glands	absent	present
Ovules	40-100	6-160
Stigma	Depressed capitate	Depressed capitate
Fruit	Dehiscent siliques	Dehiscent siliques
Fruit valve	3- nerves with the midrib most conspicuous	3- nerves with the midrib most conspicuous
Gynophore	present	absent
Septum	complete, membranous	complete, membranous
Seed arrangement	uniseriate	uniseriate
Seed margin	wingless	wingless
Seed shape	ellipsoid or oblong ellipsoid	oblong or ovate
Seed mucilage	slightly mucilaginous	non-mucilaginous or slightly mucilaginous
Seed surface	faintly papillate when wetted	in some species faintly papillate when wetted
Cotyledons	incumbent or obliquely incumbent	incumbent or obliquely incumbent
Chromosome no.	n=7	n=7, 14, 21, 28

Specimens examined by the author. **Fars:** Abadeh, Nadjaf-Abad, 11.6.1967, Sharafeh (IRAN); Abadeh, Eghlid, Kuh-e-Bul, 2700–3600 m, 4.6.1969, Terme and Izadyar. (IRAN); Near Abadeh, 23.5.67, Pabot (IRAN); 6 km N Abadeh Kuh-e Ravand, 2000 m, 2.5.1992, Khosravi & Farrokhi 1845, 1892, 1893 (Shiraz University Herbarium); 16 km N Abadeh 2000 m, 2.5.1992, Khosravi & Farrokhi 1987, 1894 (Shiraz University Herbarium); Eghlid, Kuh-e Bul, 2950m, 5.5.1996, Khosravi & Hatami 10469 (Shiraz University Herbarium); Abadeh, Shoorjestan, 2110 m, 5.5. 2000, Hatami (Shiraz Research Institute of Forests and Rangelands Herbarium); **Esfahan:** Nadjafabad, Ghameshlou, 2050 m, 2.5.1974, Aryavand (IRAN); Varzaneh to Oshan, Shiraz Kuh,

1900–200 m, 21.5.1986, Feyzi 4126 (Esfahan Research Institute of Forests and Rangelands Herbarium); Chaleh-Seyah to Hoseynabad, 1920–2000 m, 8.4.1989, Nowroozi & Feyzi 5849 (Esfahan Research Institute of Forests and Rangelands Herbarium); Tiran, Ghameshlou, 2100 m, 4.5.1988, Nowroozi & Samnpowr 5141 (Esfahan Research Institute of Forests and Rangelands Herbarium); Nain, Razan-Abad, 1630 m, 2.5.1993, 9152 Feyzi (Esfahan Research Institute of Forests and Rangelands Herbarium); 100 km E Esfahan to Nain, Badafshan, 2000–2200 m, 6.5.1982, 1722 Aryavand & Sahebi (Esfahan University Herbarium); **Yazd:** 90 km NW Yazd, Kuh-e Galuyok, 2600 m, 1.6.2000. Baghestani (Yazd Research Institute of Forests and Rangelands Herbarium); Yazd: Shirkuh, 3600 m, 6.6.2002,

Soltani (Yazd Research Institute of Forests and Rangelands Herbarium).

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