ACTA PALAEOBOTANICA
Vol. XIII, Nr 2, 1972

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NEW DATA CONCERNING THE MORPHOLOGY OF THE FOSSIL GENUS *LILPOPIA* CONERT ET SCHAARSCHMIDT 1970 (= *TRISTACHYA* LILPOP 1937)

Nowe dane o morfologii kopalnego rodzaju *Lilpopia* Conert et Schaarschmidt 1970 (= *Tristachya* Lilpop 1937)

ABSTRACT

The author forms a new conception of the fossil genus *Lilpopia* Conert et Schaarschmidt 1970 (= *Tristachya* Lilpop 1937) completing its diagnosis and attempting a new reconstruction of this fossil plant.

INTRODUCTION

In 1937 Lilpop published a paper presenting a description of the new species *Tristachya raciborskii* designated as the type species of the new genus *Tristachya* belonging to *Sphenopsida*. The following diagnosis of these new taxa was given: „Stems articulated, sixangular. Leaves to 6 in one verticil, superposed, wedgeshaped, bilobed, with rounded lobes and denticulated frontal edge. Leafy bracts triangularly ovoid, 3 in one verticil. Sporophyllous cones 3 in one verticil. Sporophylls peltate, disposed in 4 verticils on the central axis, alternating".

The taxonomical characters of *Tristachya raciborskii* were very different from those of other species from the group of *Sphenopsida*, and thus it appeared possible to consider it as the type species of a new family called *Tristachyaceae*, which was characterized by Lilpop as follows: „Axis articulated. Leaves whorled with radiating and dichotomously divided venation, one leaf trace supplying one leaf. Sporophyllous cones to 3 in one verticil. Sporophylls peltate, whorled, alternating in the successive verticils". Generally speaking, this family comprises species with

Table 1. Synopsis of diagnostic morphological features of the genus *Lilpopia* Con. et Schaar. and of the species *Lilpopia raciborskii* (Lilpop) Con. et Schaar. (After Lilpop 1937 and according to the author's research)

Tabela 1. Zestawienie morfologicznych cech diagnostycznych rodzaju *Lilpopia* Con. et Schaar. i gatunku *Lilpopia raciborskii* (Lilpop) Con. et Schaar. (według Lilpopa 1937 oraz wyników badań autora)

Lilpopia Con. et Schaar.	Selected morphological features of the genus *Wybrane cechy morfologiczne rodzaju*	Number of cones and their relation to the leaves *Ilość kłosów zarodniowych i ich stosunek do listków płonnych*
	Diagnosis *Diagnoza*	Three cones occur in a node together with the leaves, alternating with them *Kłosy zarodniowe w liczbie trzech występują w tym samym węźle co listki, naprzemianlegle z listkami*
Lilpopia raciborskii (Lilpop) Con. et. Schaar.	Selected morphological features of the species *Wybrane cechy morfologiczne gatunku*	Morphology and number of leaves. Morphology of cones *Morfologia i ilość listków. Morfologia kłosów zarodniowych*
	Diagnosis *Diagnoza*	In the fertile verticil there occur three leaves with anterior margins rounded or with a heart-shaped concavity. In a sterile verticil there occur six leaves with the anterior margins rounded, incised or covered with teeth. Cones consist of 18 to 24 sporangiophores developed as peltate heads set perpendicularly to the cone and forming verticils *W okółku owocującym występują 3 listki o przednim brzegu zaokrąglonym lub sercowato wciętym. W okółku płonnym występuje 6 listków o przednim brzegu zaokrąglonym, wciętym lub pokrytym ząbkami* *Kłosy zarodniowe są złożone z 18 do 24 sporangioforów wykształconych w formie tarczek przyczepionych prostopadle do osi kłosa i tworzących okółki*

sterile stems having the shape of *Sphenophyllum*, and the reproductive organs forming cones resembling those of *Equisetum*.

The generic name *Tristachya* Lilpop 1937 was replaced for formal reason by Conert and Schaarschmidt (1970) by the name *Lilpopia*. These authors indicated that the name *Tristachya* was used in 1829 by Nees von Esenbeck to denote a recent African grass. Therefore, it was necessary to reject the name *Tristachya* Lilpop 1937 as a junior homonym of *Tristachya* Esenbeck 1829.

New materials collected recently by the present author, and also the analysis of the collections previously made mainly of the holotype of *Lilpopia raciborskii* (Lilpop) Con. et Schaar., allowed a better understanding of its morphology. Therefore, the descriptions ot this species and genus are here revised, and a new reconstruction is attempted.

In the present paper certain terms used by Lilpop (1937) are replaced by others, now commonly used in palaeobotanical papers. In particular, instead of „cone bearing verticil" I use: „fertile verticil"; instead of „sporophyllous cone" — „cone"; instead „sporophyll" — „sporangiophore"; instead „leaf bearing verticil" — „sterile verticil"; instead „bract, or leaf bract" — „leaf".

ANALYSIS OF THE MORPHOLOGY OF THE FERTILE STEMS

Lilpop (1937; text-fig. 3, reproduced here in Fig. 1a) believed that each of the cones occurring in three successive fertile verticils were situated above the leaves. The relatively narrow leaves with entire margins are somewhat raised and turned with the convex side upwards. The fourth, and the lowest, verticil which is sterile consists of six leaves somewhat larger than the above described ones and morphologically different from the leaves occurring in the fertile verticils situated above.

Lilpop's reconstruction was based on the holotype, the photographs of which are presented in Pl. I, figs. 1—4 of his paper. In figs. 1 and 2 the part and the counterpart of the holotype may be seen; in fig. 3 — a gelatine cast of the specimen from fig. 1; and in fig. 4 — a fragment of fig. 3 magnified two times revealing one cone and a leaf belonging to the same verticil. The leaf seen in fig. 4 is turned with the convex side down; the cone is situated on the concave side of the leaf, i.e., above it. It may be seen in fig. 3 that the position of other leaves in relation to the cones is analogous.

I think, however, that both the reconstruction by Lilpop (see fig. 1a of the present paper, and also text-fig. 2 of Lilpop's op. cit.) and the direct observation of the holotype and of other specimens imply that the leaves of *Lilpopia raciborskii* are always turned with the convex side upwards. This follows from the author's observations of leaf-bearing stems in the outcrops, where several stems of *L. raciborskii* occurred in the na-

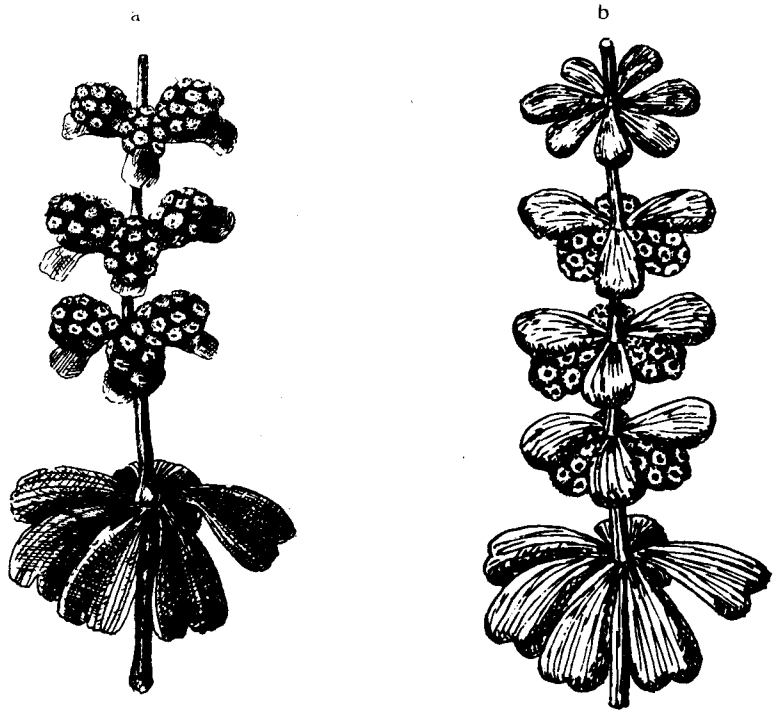

Fig. 1. Reconstruction of the species *Lilpopia raciborskii* (Lilpop) Con. et Schaar. a) reconstruction presented by Lilpop (1937), b) reconstruction of a fragment of the reproductive stem proposed by the present author

Ryc. 1. Rekonstrukcja gatunku *Lilpopia raciborskii* (Lilpop) Con. et Schaar. a) rekonstrukcja podana przez Lilpopa (1937), b) proponowana przez autora rekonstrukcja fragmentu pędu owocującego gatunku *Lilpopia raciborskii*

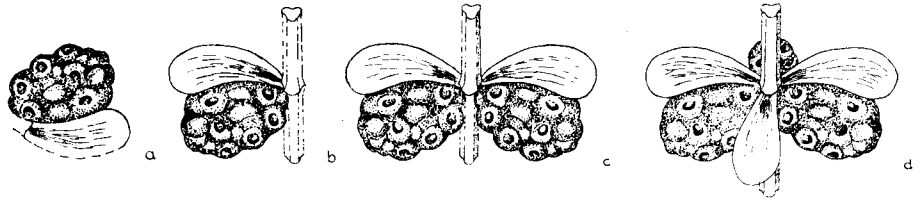

Fig. 2. Reconstruction of a fertile verticil of *Lilpopia raciborskii* (Lilpop) Con. et Schaar. a) drawing made from a photograph by Lilpop (1937, Pl. 1, fig. 4), b) fig. 2a turned upside down by an angle of 180° and completed by a drawing of a stem, c) as fig. 2b, with the second leaf added, d) reconstruction of the whole fertile verticil, ×1·2

Ryc. 2. Rekonstrukcja okółka owocującego badanego gatunku, a) odrys z fotografii przedstawionej w pracy Lilpopa (1937, Pl. 1, fig. 4), b) figura 2a z wkomponowaną łodygą po obrocie o kąt 180°, c) figura 2b uzupełnicna drugim listkiem (odrys z fig. 2a), d) rekonstrukcja pełnego okółka owocującego, ×1,2

tural position of growth, that is perpendicular to the bedding planes. It follows also from the different morphology of the two sides of the leaves: the upper side is relatively smooth with inconspicuous grooves to which distinct prominent veins correspond on the lower side. In several tens of specimens of this species seen there was not a single case of a leaf turned with the convex side down. This means that the specimen shown in Lilpop's op. cit. fig. 4, and also in figs. 1—3, is set incorrectly, namely, that it is turned upside down. This will readily appear if one draws an outline of the specimen presented in fig. 4 of Lilpop's op. cit. (fig. 2a of the present paper) completing it with the drawing of the stem and turning it by 180°. The remaining parts of the verticil are completed by repeating

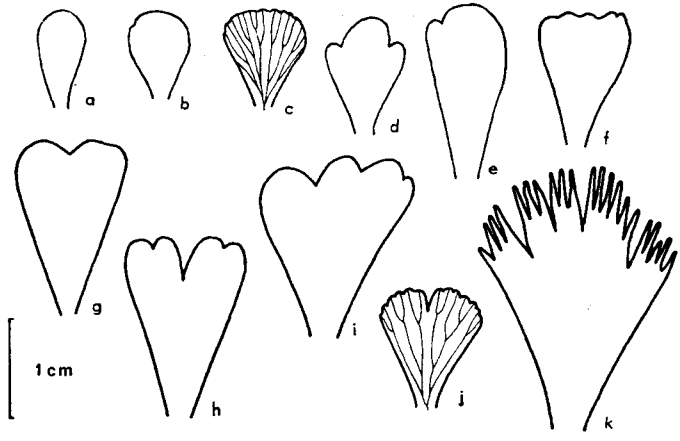

Fig. 3. Types of leaves of *Lilpopia raciborskii*, ×1·5

Ryc. 3. Typy listków *Lilpopia raciborskii*, × 1·5

the element shown in fig. 2a (fig. 2c, 2d). Therefore, in order to show the original position of the plant, Lilpop's photographs (op. cit., Pl. 1, figs. 1—4) should be turned upside down. This agrees with the following data, established by the direct observation of the holotype.

1. The cones become smaller towards the top of the plant if the plant is set correctly, i.e. in the position shown in fig. 2b—d.

2. The length of the internodes becomes greater upwards, namely it is 12·5 mm between the first and the second fertile verticil, 14 mm between the second and the third, and 18 mm between the third and the fourth, the latter being the highest sterile verticil with six leaves visible in the specimen (fig. 1b).

3. The size of the leaves diminishes upwards; the smallest leaves occur in the last and uppermost sterile verticil with six leaves. It should be added that the only leaf preserved in the fragment of the fifth verticil situated below the first fertile verticil is larger than the leaves situated

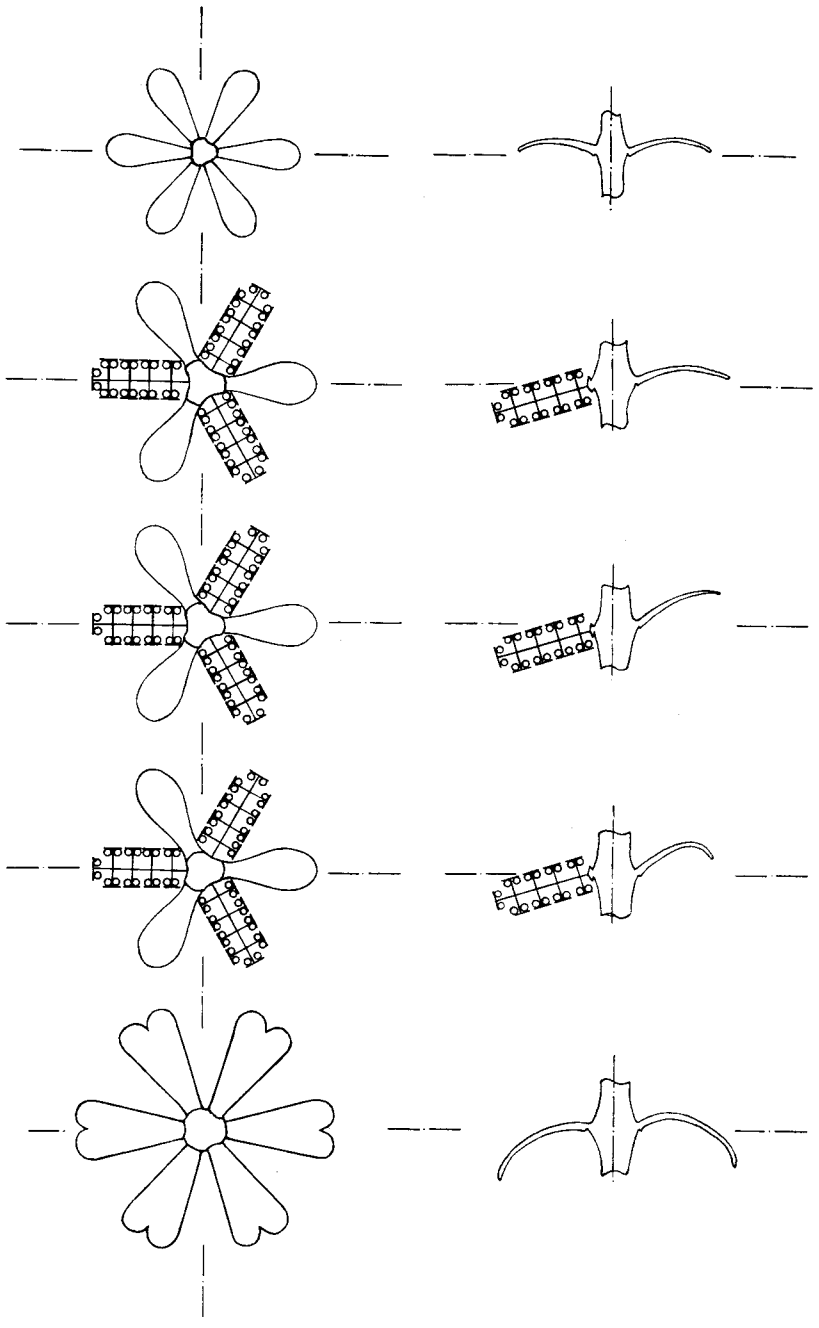

Fig. 4. Scheme of structure of stem of *Lilpopia raciborskii*, ×1·5

Ryc. 4. Schemat budowy pędu *Lilpopia raciborskii*, ×1·5

higher, both in the fertile verticil and in the sterile one, the latter being mentioned by Lilpop in the explanation of his figures, but omitted in his reconstruction (this leaf is visible in Pl. 1, figs. 1—2, as dark area at the top).

From further analysis of the correctly situated figures (fig. 2d) follows that the leaves in the fertile verticils do not occur above cones. Observation shows that at a node the leaves are turned sidewards in relation to the axis of the cone and are slightly raised upwards, while the cones are turned downwards. Thus it appears clearly that in a fertile verticil the leaves alternate with the cones. This is shown in fig. 1 b presenting the new reconstruction of the species here proposed.

CONCLUSIONS

The results of the investigations concerning the species *Lilpopia raciborskii* (Lilpop) Con. et Schaar. allow to complete Lilpop's diagnoses both of the genus *Lilpopia* Con. et Schaar. and of the species *Lilpopia raciborskii* (Table 1).

It may be suggested that a reinvestigation and possibly a revision of the species *Lilpopia crockensis* (R. et W. Remy) Con. et Schaar. (R. and W. Remy 1961) should be made. These authors, basing on Lilpop's (1937) work, believed that the cones of their species were situated above the leaves. It appears to me that it follows from the illustrations in the paper of these authors (op. cit.) that there are grounds for the correction of the diagnosis of the species *Lilpopia crockensis*. Taf. 1, and particularly in the drawing shown in p. 218, Abb. 1, the paratype 1 is probably figured in the life position, but, it seems, the holotype should be turned upside down. The schematical drawings of the holotype and of the paratype do not show clearly that the cones are situated above the leaves. Rather one may obtain the impression that the cones extend in another direction than the leaves, and therefore that they occur in the verticil between the leaves. This is just the character found in *Lilpopia raciborskii*.

However, if it would appear — in adequately preserved specimens — that the cones were situated above the leaves, as suggested by Lilpop, then such a species should be included to a separate genus of the family Lilpopiaceae.

REMARKS CONCERNING THE VARIABILITY OF THE LEAVES OF *LILPOPIA RACIBORSKII* (LILPOP) CON. ET SCHAAR.

This species is characterized by the fairly variable shape of the leaves. Remarks in this subjects were presented by Lilpop (1937) and Lipiarski (1969, 1971). Later investigations revealed a connection between the size of the leaf and the form of its blade (fig. 3).

The smallest leaves are only 5 mm long and 2 or 3 mm wide. The largest leaves attain a length of 30 mm and a width of 23 mm. The smaller leaves, i. e. those 10 to 15 mm long and 4 to 8 mm wide, are narrow, slender, with a rounded anterior margin (fig. 3a), or wider, with an indistinctly rounded or somewhat concave margin (fig. 3b, c). Leaves of medium size (15 to 25 mm long and 8 to 15 mm wide) possess a heart-shaped incision or a shallow lobe at the anterior margin. At the anterior margin there occur locally fairly distinct thickenings parallel to the veins. In the largest leaves 25 to 30 mm long and 15 to 23 mm wide the lobes in the anterior margin are dentate and thus the incision in the middle of the leaf becomes less clearly visible. In some leaves, several shallow incisions were seen in the anterior margin. In the largest leaves, the anterior margin is covered with teeth attaining a length of 5 mm (fig. 3k). These teeth commonly seem to be absent, being easily broken during the preparation of the specimen.

The exception from the above rules of the development of the leaves consists in a deeper dissection of the margin than would be indicated by its size (e.g. fig. 3d, j).

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STRESZCZENIE

NOWE DANE O MORFOLOGII KOPALNEGO RODZAJU *LILPOPIA* CONERT ET SCHAARSCHMIDT 1970 (= *TRISTACHYA* LILPOP 1937)

W 1937 r. Lilpop opisał nowy gatunek *Tristachya raciborskii*, który został uznany za typ nowego rodzaju *Tristachya* Lilpop, z grupy *Sphenopsida*. Nazwa rodzajowa *Tristachya* Lilpop 1937 ze względów formalnych została zastąpiona przez Conerta i Schaarschmidta (1970) nazwą *Lilpopia*. Według informacji wymienionych autorów terminu *Tristachya* użył już w 1829 r. Nees von Esenbeck dla określenia rodzaju współczesnej trawy afrykańskiej. W związku z tym termin *Tristachya* Lilpop 1937, jako homonim nazwy *Tristachya* Esenbeck 1829, zgodnie z 64 paragrafem Kodeksu Nomenklatury Botanicznej, został zastąpiony innym.

Materiały i obserwacje dotyczące gatunku *Lilpopia raciborskii*, zebrane w ostatnich latach, dały podstawę do pełniejszego poznania jego budowy morfologicznej, a w konsekwencji do uzupełnienia diagnozy rodzaju *Lilpopia*.

Z treści pracy Lilpopa (1937) wynika, że kłosy zarodniowe występujące w okółkach owocujących w liczbie trzech są położone ponad listkami. Pogląd ten w świetle nowych spostrzeżeń, których wyniki są przedstawione w niniejszej pracy, powinien, jak się wydaje, ulec modyfikacji. Opierając się na rysunkach podanych w pracy Lilpopa (l. c.) oraz wynikach własnych obserwacji licznych okazów, w tym oryginalnego okazu holotypu, można bez żadnych wątpliwości stwierdzić, że listki w okółkach płonnych są stroną wypukłą zwrócone do góry (Lilpop l. c., ryc. 2. 3). Inną sytuację przedstawiają natomiast fotografie okazu holotypu (Lilpop l. c., Pl. 1, fig. 1—4). Fig. 4 na Pl. 1 (l. c.) przedstawia powiększony dwukrotnie fragment fig. 1 i 3 ilustrujący część okółka owocującego w formie jednego listka i jednego kłosa. Listek ten jest zwrócony stroną wypukłą do dołu, kłos zarodniowy zaś jest położony w stosunku do listka od strony wklęsłej, czyli — w stosunku do fotografii — od góry. W ten sam sposób są usytuowane wszystkie listki płonne w stosunku do kłosów na pozostałych figurach (1. c. Pl. 1, fig. 1—3). Fakty te moim zdaniem skłaniają do wysunięcia twierdzenia, że fig. 4, a tym samym fig. 1—3 na Pl. 1 (l. c.) mają niewłaściwy kierunek, tzn. są obrócone o kąt 180° w stosunku do naturalnej pozycji rośliny. Łatwo się o tym przekonać wykonując na kalce odrys fig. 4 (l. c., fig. 2a w niniejszej pracy), a następnie wkomponowując łodygę z równoczesnym obrotem figury 2a o kąt 180° (fig. 2b w niniejszej pracy) oraz uzupełniając okółek brakującymi dwoma listkami (fig. 2c i 2d). Z rysunków tych wynika, że naturalną pozycję rośliny uzyskuje się dopiero po obrocie o kąt 180° fotografii załączonych w pracy Lilpopa (l. c.).

Na poprawnie ukierunkowanym okazie holotypu kłosy nie występują, moim zdaniem, ponad listkami (fig. 1b, 2d, 4), jak przypuszczał Lilpop. Wyrastają one naprzemianlegle z listkami z tego samego węzła. Przemawia za tym wzajemny stosunek listków do kłosów występujących w tym samym okółku (fig. 2d). Listki są odchylone w bok w stosunku do osi kłosów i są nieznacznie wzniesione do góry, podczas gdy kłosy są skierowane ukośnie do dołu. Układ ten podano na fig. 1b, przedstawiającej proponowaną rekonstrukcję gatunku, oraz na fig. 4.