



## The true identity of *Tectaria nesiotica* Holttum (Tectariaceae), with comments on the species identification in *Pleocnemia* (Dryopteridaceae)

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### Abstract

The species *Tectaria nesiotica* Holttum, described from New Guinea, is confirmed to be a member of the genus *Pleocnemia* and thus a new combination, *P. nesiotica*, is proposed here. It superficially resembles some species of *Tectaria* with large, finely dissected fronds and with veins anastomosing only along costae but differs in venation pattern. Within *Pleocnemia*, *P. nesiotica* is readily distinguished from other species by the blackish rachis and the sori confined to the apex of pinnule lobes. We fail to provide a key to all known species of *Pleocnemia* from New Guinea because for this group the species concept is currently very confusing, which was probably resulted from the incomplete herbarium specimens and the overemphasis of the character, sori indusiate or not, in recognizing species. Field observations are called for the clarification of species boundary in *Pleocnemia*.

**Key words:** *Pleocnemia*, new combination, New Guinea, taxonomy

### Introduction

*Tectaria* Cavanilles (1799: 115) (Tectariaceae) is a large and morphologically diverse genus with some 250 species in pantropical areas of the world. Recently phylogenetic studies indicated the *Tectaria* in a broad sense being a monophyletic group, which includes *Heterogonium* C. Presl (1851: 142), *Psomiocarpa* C. Presl (1851: 161) and *Tectaridium* Copeland (1926: 329), while excludes *Hypoderris* R. Brown ex Hooker (1838: t.1) and *Pseudotectaria* Tardieu (1955: 87) (Ding *et al.* 2014, Moran *et al.* 2014, Wang *et al.* 2014). The genera *Ctenitis* C. Christensen (1938: 544) and *Pleocnemia* C. Presl (1836: 183), which had long been regarded as being allied to *Tectaria* in traditional classifications (e.g., Ching 1978, Tryon & Tryon 1982, Kramer 1990, Holttum 1991b), were confirmed to be members of Dryopteridaceae (Ding *et al.* 2014, Liu *et al.* 2014). The monophyletic *Tectaria* defined by molecular data is morphologically highly polymorphic and two characters, i.e., the peculiar pattern of venation and the basal chromosome number  $x = 40$ , were inferred to be synapomorphic for *Tectaria* (Ding *et al.* 2014), while  $x = 41$  is most likely a synapomorphy of the entire eupolypods I (Zhang & Zhang 2015) and even the entire eupolypods (Sundue & Rothfels 2014). The peculiar pattern of venation refers to the basal veins of pinna lobes (or pinnule lobes) on the basiscopic side arising from the costa (or correspondingly costule) bearing the lobes but not from the midribs of lobes (there are veins, besides midribs of lobes, arising from costae or costules) (Fig. 1A–1D), which could be readily used to separate *Tectaria* from closely or remotely related genera.

### The true identity of *Tectaria nesiotica*

When preparing an account of *Tectaria* from New Guinea, we noticed that the species *T. nesiotica* Holttum (1991a: 553) is somewhat distinct from other species in *Tectaria*. Its holotype, Croft & Marsh LAE71234 (K), has amply 1-pinnated pinna which bears as many as 18 pairs of free pinnules (Fig. 2A). In contrast, for the species in *Tectaria* with large fronds the pinnules or segments of lateral pinna are generally adnate to pinna-rachis and the free pinnules are

usually 5–6 pairs (never more than 9 pairs). Our examination of the venation showed that *T. nesiotica* is not a member of *Tectaria* because it has a different venation pattern as in *Tectaria*, i.e., the basal basisopic veins of pinnule segments arising from the midrib of segments but not from the costule bearing the segments (Fig. 1E). As we know, this type of venation is shared by all known species of *Pleocnemia* and could be regarded as a key character in distinguishing *Pleocnemia* from *Tectaria*. Another character, which was solely used to key out *Pleocnemia* from *Tectaria* by various authors, is the presence of sinus teeth between lobes of pinnae or pinnules (Holtum 1951, 1974, 1991b; Tagawa & Iwatsuki 1988; Kramer 1990). Further examination showed there does exist such sinus teeth on the type of *T. nesiotica*. Like in other species of *Pleocnemia*, the sinus teeth are generally more easily recognizable on sterile pinnae than on fertile ones kept in herbaria. We can observe only a few, very minute sinus teeth on the holotype at herbarium K (two sheets, one containing a fertile pinna and the other including a fertile pinna and a fragment of sterile one). In contrast, the sinus teeth are much clearer on the isotype kept in LAE (containing several sterile pinnae) (Fig. 2B, 2C). When confirming the two characters (the pleocnemoid venation and the sinus teeth between pinna-lobes) possessed by the types of *T. nesiotica*, we are sure that the so called *T. nesiotica* is actually a representative of *Pleocnemia*.

Compared to the all known species (19 in total) in *Pleocnemia* (Holtum 1974, 1991b), *T. nesiotica* is distinct in the stipe, rachis and costa being black and glossy on abaxial surface and in the sori confined to the distal part of pinnule lobes. Different from *T. nesiotica*, the rachis and costa in other species of *Pleocnemia* are dark brown or stramineous, never glossy, and sori are distributed in the full length of pinna or pinnule lobes. The unique color of axes and the different position of sori indicate *T. nesiotica* a distinct member in *Pleocnemia*. To accommodate this species in *Pleocnemia*, a new combination, *Pleocnemia nesiotica*, is formally proposed here.

### ***Pleocnemia nesiotica* (Holtum) H.G. Zhao & S.Y. Dong, comb. nov. (Figs. 1E, 2)**

Basionym:—*Tectaria nesiotica* Holtum (1991a: 553).

Type:—PAPUA NEW GUINEA. Milne Bay: Goodenough Island (Kalimatabutabu), 9°19' S, 150°15' E, alt. 950 m, 19 Dec. 1977, *J. Croft & J. Marsh LAE71234* (holotype K-000375362 & K-000375363!, isotype LAE-236265!).

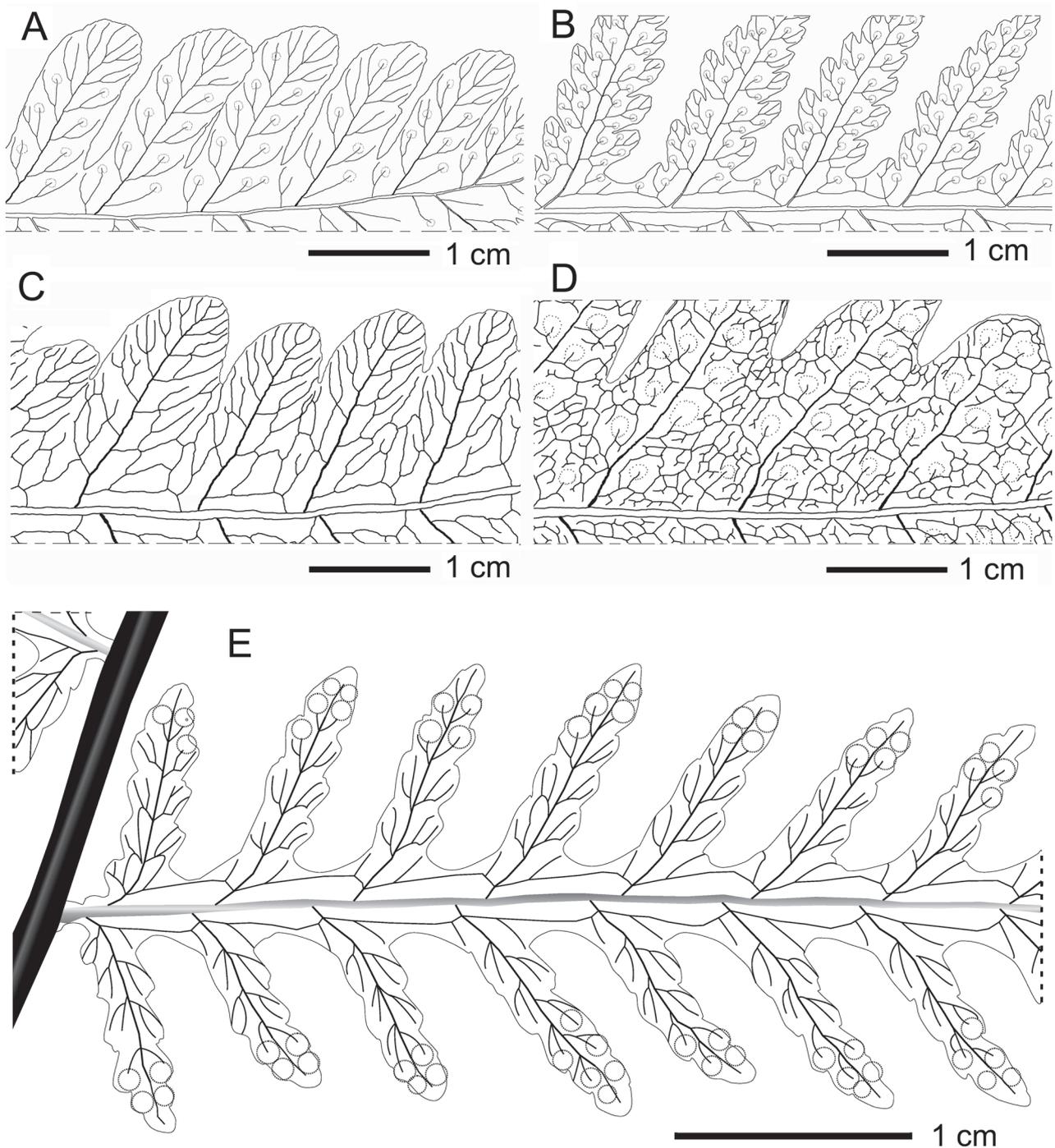
Morphology observations:—Rhizome erect, leaf 2 m long including stipe 0.8 m long (information from the field record by collectors); stipe black, glossy, nearly 10 mm in diameter; scales confined to the very base of stipe, narrow lanceolate, ca. 15–20 × 1.5 mm, dark brown, entire at margin; lamina 3-pinnatifid above base (the basal pinna not seen); middle pinna nearly oblong, sessile, ca. 40 × 17 cm, its base as the same wide as or slightly narrowed than the middle, bearing 18 pairs of free pinnules; pinnules alternate or subopposite on distal costae, sessile or very shortly stalked (1 mm), nearly linear, mostly in the same size, 7–8.5 × 1.5–2 cm, the distal 5 pairs of pinnules gradually shortened towards apex of pinna, all deeply lobed to the wing of costules (the wing ca. 1.2 mm wide on either side of costae); pinnule-lobes ca. 12 pairs, 8–10 × 2.5 mm, obtuse at apex, more or less crenate at margin, widely spaced from each other (the space ca. 3 mm wide between fertile lobes or 1–1.5 mm wide between the sterile ones); upper pinnae gradually shortened towards apex of lamina, 1-pinnate to 1-pinnatifid; rachis and costa black, glossy on abaxially surface, with copious short ctenitoid hairs on adaxial surface; veins forming a row of areole on either side of costule, others all free; sori rounded, on distal part of pinnule lobes, one row on either side of midrib of pinnule lobes, usually 2 or 3 pairs each lobe, adjacent each other when mature; indusia distinct, persistent or not.

Note:—This is a rather insufficiently known species, although the color of the axes and the position of the sori make it distinct from other species in *Pleocnemia*. For this species there is to date only one collection known to us, i.e., *Croft & Marsh LAE71234*. Like most species in this genus, the frond of *P. nesiotica* is very big and its type collection was cut into several parts. We have seen four parts of the collection deposited in herbaria, two sheets (holotype) in K and two sheets (isotype) in LAE. Other parts were probably lost. To know more about *P. nesiotica*, further collections from its type location are needed.

### **Comments on the species identification in *Pleocnemia***

We would like to sort out the specimens and provide a key to all known species of *Pleocnemia* from New Guinea. When checking all specimens of *Pleocnemia* available to us, including the type of most species recognized by Holtum (1974, 1991b), however, we realize it to be presently an impossible task, because the species concept in *Pleocnemia* is so far away from clear. As mentioned above, the leaves of this group tend to be very big, up to 2 m or more long, and the specimens kept in herbaria are various parts of leaves for a given species. Based on such herbarium specimens we

cannot get a clear concept on a species of *Pleocnemia* because we do not know the morphology of all parts of a species neither the characters' variation within a species. Holttum had ever revised *Pleocnemia* based on herbarium specimens in 1951 and in 1974, respectively. The species recognized by Holttum seems to be arbitrary because the keys to species provided by him are very difficult to use in practice. He was apt to use a minor difference of a seemingly variable character, such as the size of pinnules, the depth of pinnae or pinnules lobed, the shape of pinnules (short- or long-acuminate), and so on, to separate species.



**FIGURE 1.** Comparison of venation pattern between *Tectaria* (A–D) and *Pleocnemia* (E). For *Tectaria* the basal basicopic veins of pinna lobes (or pinnule lobes) arise from costae (or correspondingly costules) but not from the midrib of lobes (A–D); while for *Pleocnemia* the basal basicopic veins arise from the midrib of lobes (E).—A. *Tectaria sagenioides* based on Dong 1599 (IBSC).—B. *T. devexa* based on Dong 1500 (IBSC).—C. *T. multicaudata* based on Clarke 18427 (holotype, K).—D. *T. griffithii* based on Griffithii s.n. (holotype, K).—E. *Pleocnemia nesiotica* based on Croft & Marsh LAE71234 (holotype, K) (Drawn by S.Y. Dong).

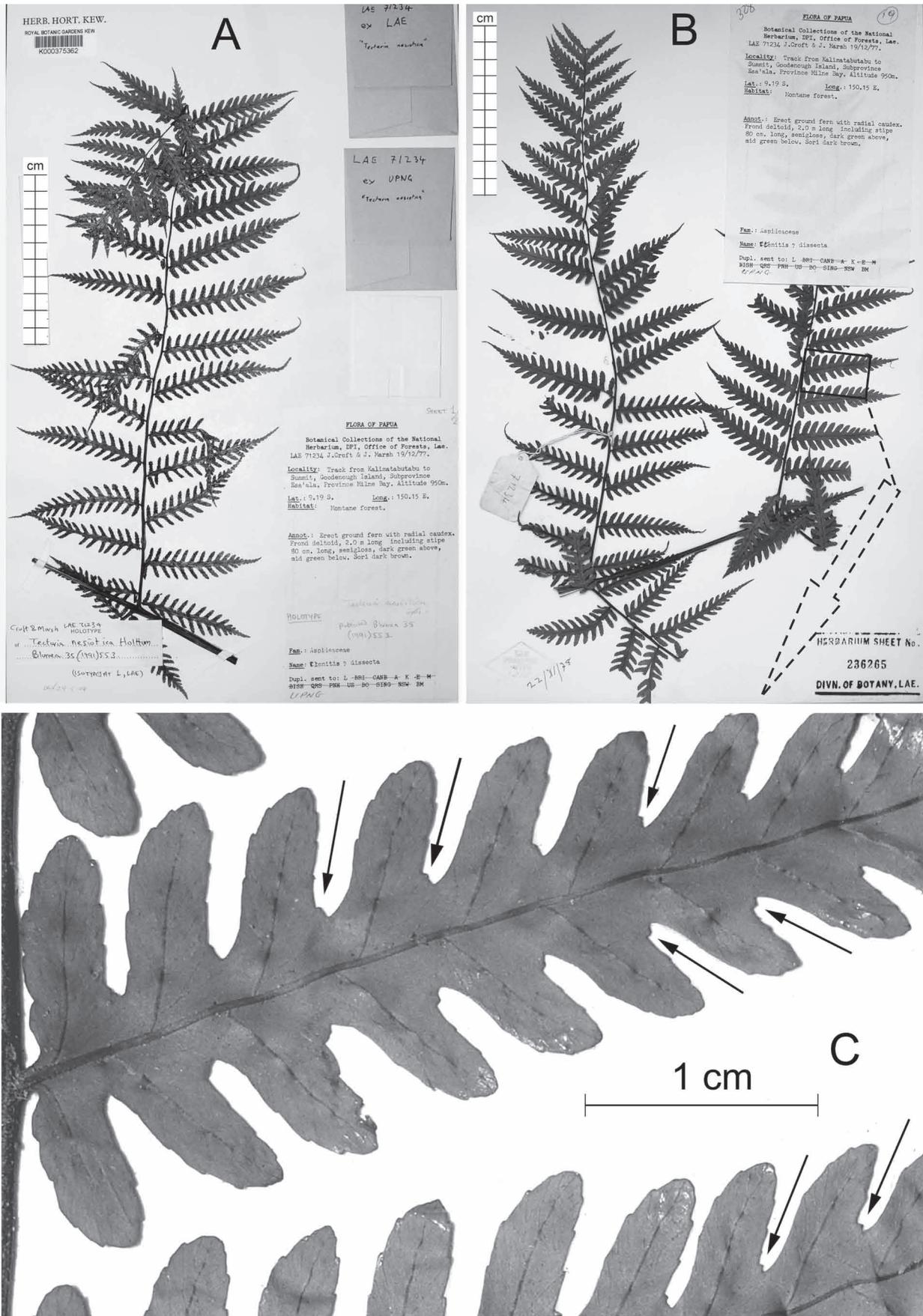


FIGURE 2. Type specimens of *Pleocnemia nesiotica*.—A. Holotype at K-000375362.—B. Isotype at LAE-236265.—C. Detail of B, showing sinus teeth between lobes of pinnules (arrows pointing).

Besides the incomplete herbarium specimens (each containing only a small part of a leaf), one reason for the confusion of species concept in *Pleocnemia* is that the character, sori indusiate or not, is overemphasized in recognizing species. Viewing herbarium specimens, we can find quite a few specimens which are highly similar in overall morphology, but were treated as representing different species based solely on the sori indusiate or not. One impressive example is the identification of the specimens, *Cuming 33* (BR, P) and *Cuming 34* (BR, P), both from Luzon of the Philippines. The *Cuming 33* was determined as *Pleocnemia presliana* because of the frond having indusiate sori while the latter (*Cuming 34*) as *P. conjugata* for the sori exindusiate (Holttum 1974). Another example involves the observation of the indusia (present or not) in *P. winitii* from Hainan Island, southern China. *Pleocnemia winitii* was described as sori exindusiate, with distribution in NE India to southern China (Holttum 1951, 1974). Based on herbarium specimens, as well as our wide observation in the field, there seems only one species in Hainan and the collections therein are confirmed mostly without indusia on sori. However, we can detect the indusia present in a few collections, such as *Dong 156* (IBSC, PE), *Li 1549* (IBSC), and *Xing 5891* (IBSC). It is necessary to mention that the collection *Dong 156* includes two leaves, one with sori indusiate and the other with sori naked. This indicates that the presence of indusia is not very stable within a given species of this group and it cannot be used as a reliable character in recognizing species of *Pleocnemia*.

Doubtlessly it is the field work only by that we are possible to clarify the species boundary in *Pleocnemia*. We are needed to collect information on the configuration and the size variation of mature leaves in a given population in the wild, and pay more attention to gather complete leaves as specimens. The morphology of perispores was considered significant in separating species of this group (Holttum 1951) but so far we have very few data of this kind. So the mature sori containing well developed spores are extremely desirable in the wild. In addition, the scales on basal stipe seem to be a potentially useful character (e.g., narrow lanceolate vs. filiform in outline, entire vs. toothed at margin) in recognizing species. However, the stipe scales were rarely presented in existing herbarium specimens and thus we should deliberately collect the scales (together with the basal part of stipe) in the field. Of course the DNA materials from fieldworks are badly needed. As shown in the phylogenetic analyses conducted by Ding *et al.* (2014) where eight samples of *Pleocnemia* were included, molecular data can provide positive systematic information and some clues on the species recognition for this group.

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