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Egyptian Fossil Angiosperm Wood: A Guide to their Anatomical Identification

Zainab M. El-Noamani
El-Saadawi Lab., Botany Department, Faculty of Science, Ain Shams University, Cairo, 11566, Egypt.

A FEW of the existing publications on Egyptian fossil plants provide special aids to identifying fossil wood remains. Two dichotomous keys to the angiosperm petrified wood species reported to date from the Egyptian strata are presented here to facilitate the tentative identification of angiosperm fossil wood specimens. The first key includes 19 species of *Palmoxylon* which is the morphogenus for the petrified palm stem that is the common representative of monocotyledones (Arecaceae) in the Egyptian fossil flora and can be identified to the species level. The second key contains 46 species of dicotyledonous petrified wood of different families reported in the literature from different ages and locations in Egypt. These keys would benefit palaeobotanists who might find the literature on Egyptian fossil wood not easily accessible.

Keywords: Angiosperm, Dichotomous key, Egypt, Fossil wood, Wood anatomy.

Introduction

Identification of fossil wood to the species level has always been a difficult task as compared to modern wood. This is attributable foremost to the preservation state of fossil wood specimens as some specimens may not be in a sufficiently good condition to show important features. Some specimens may be so badly preserved that they cannot be identified to generic level or even assigned to a certain family. Another major difficulty is that some of the original descriptions of the taxa reported previously in the fossil flora of Egypt (e.g., Unger, 1823; Felix, 1883; Schenk, 1883; Stenzel, 1904; Kräusel & Stromer, 1924; Kräusel, 1939; Süss, 1987; etc.) are not easily available. Therefore, this paper is in essence an attempt to provide an easily accessible alternative for the accurate determination of unknown fossil wood specimens that might be encountered in Egypt. It presents two identification keys to the validly published 19 *Palmoxylon* species and the 46 fossil dicot wood species that have so far been recorded from the Egyptian strata. Unpublished taxa or those identified only to the family level are excluded from the present keys. The unidentified species of *Combretoxylon* which was referred to by Boureau et al. (1983) from an unknown early Miocene locality in the Western desert without any description or illustrations is also omitted.

Material and Methods

Data in keys I and II are based on descriptions of fossil wood species in original literature: (Unger, 1823; Felix, 1883; Schenk, 1883; Stenzel, 1904; Kräusel & Stromer, 1924; Bancroft, 1935; Kräusel, 1939; Sahni, 1964; Louvet, 1965; Müller-Stoll & Mädel, 1967; Lemoigne & Beauchamp, 1972; Mädel-Angeliewa & Müller-Stoll, 1973; Prakash & Bande, 1980; Süss, 1987; Cevallos-Ferriz & Barajas-Morales, 1994; Mehrotra et al., 1999; El-Saadawi et al., 2011; El-Saadawi et al., 2017; Nour-El-Deen et al., 2018) together with the additional references mentioned in Tables 1 and 2. Additional data was extracted from the insidewood database (InsideWood, 2004 onwards; Wheeler, 2011) for dicot wood species.

Results

The following are two strictly dichotomous bracketed keys for the 19 and 46 monocot and dicot wood species of Egypt, respectively:

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Key I

A dichotomous key to the 19 *Palmoxylon* species (monocots)

1a. Radiating parenchyma present **2**
b. Radiating parenchyma absent.. **8**
2a. Fibrous bundle present **3**
b. Fibrous bundle absent **6**
3a. Radiating parenchyma present around the whole bundle in an appendage-like manner .... ***Palmoxylon araneus* Nour-El-Deen, El-Saadawi & Thomas**
b. Radiating parenchyma locally present either around the fibrous or vascular part.. **4**
4a. Sclerenchyma reniform; stegmata present.. **5**
b. Sclerenchyma complanate; stegmata absent... .... ***Palmoxylon lacunosum* (Unger) Felix**
5a. General ground tissue extremely lacunar, cells very elongate rod-like, thick-walled; tabular parenchyma developed around the whole bundle; sclerotic nests present .... ***Palmoxylon qatraniense* Nour-El-Deen, El-Saadawi & Thomas**
b. General ground tissue lacunar, cells trabecular, thin-walled; tabular parenchyma developed around the fibrous part; sclerotic nests absent .... ***Palmoxylon elsaadawii* Nour-El-Deen & Thomas**
6a. Tabular parenchyma present; vascular part exerted.. **7**
b. Tabular parenchyma absent; vascular part included or partly exerted.. ***Palmoxylon deccanense* Sahni**
7a. General ground tissue slightly lacunar; tabular parenchyma 1–2 layers around the fibrous part and rarely over the whole bundle.. ***Palmoxylon indicum* Sahni**
b. General ground tissue compact, cells of simple shape with small air spaces; tabular parenchyma 2–3 layers around the fibrous part .... ***Palmoxylon sagari* Sahni**
8a. Fibrous bundle present **9**
b. Fibrous bundle absent **13**
9a. Stegmata present **10**
b. Stegmata absent **12**
10a. Sclerenchyma cordate; tabular parenchyma 2–3 layers around the whole bundle .... ***Palmoxylon prismaticum* Sahni**
b. Sclerenchyma lunate or lunate reniform; tabular parenchyma slightly developed either around the fibrous or vascular part **11**
11a. Fibrous bundles numerous; tabular parenchyma well-developed around the vascular part .... ***Palmoxylon zittelii* Schenk**
b. Fibrous bundles few; tabular parenchyma slightly developed around the fibrous part.. ***Palmoxylon pondicherriense* Sahni**
12a. Sclerenchyma complanate; general ground tissue compact .... ***Palmoxylon edwardsi* Sahni**
b. Sclerenchyma vaginate; general ground tissue lacunar .... ***Palmoxylon stromeri* Kräusel**
13a. General ground tissue compact or relatively compact **14**
b. General ground tissue lacunar or very lacunar **18**
14a. One large metaxylem vessel per bundle **15**
b. Two or more large metaxylem vessels per bundle **17**
15a. Sclerenchyma sagittate; diminutive fibrovascular bundles commonly scattered especially in the central zone; xylem exerted as a long narrow tongue-like process.. ***Palmoxylon pyriforme* Sahni**
b. Sclerenchyma lunate or cordate; diminutive fibrovascular bundles absent or less frequent.. **16**
16a. Sclerenchyma lunate; general ground tissue relatively compact with small air spaces; tabular parenchyma multilayered around the vascular part .... ***Palmoxylon aschersonii* Schenk**
b. Sclerenchyma cordate; general ground tissue compact; tabular parenchyma 2–3 layers around the fibrous part .... ***Palmoxylon compactum* Sahni**
17a. Sclerenchyma reniform, cordate and occasionally sagittate; xylem vessels included or partially exerted; tabular parenchyma 1–2 layers around the fibrous part.... .... ***Palmoxylon rewahense* Sahni**
b. Sclerenchyma reniform; xylem vessels at least two (up to 4), exerted; tabular parenchyma multilayered around the vascular part .... ***Palmoxylon libycum* (Stenzel) Kräusel**
18a. Sclerenchyma cordate; general ground tissue very lacunar, cells thin-walled with regular geometrical (Y or V) shapes; tabular parenchyma 1–2 layers around the fibrous part, interrupted by air spaces .... ***Palmoxylon geometricum* Sahni**

b. Sclerenchyma reniform; general ground tissue lacunar, cells of simple shapes and straight walls, scattered thick-walled cells present; tabular parenchyma several layers around the fibrous part..***Palmoxylon wadiai* Sahni**

Key II

A dichotomous key to the 46 dicotyledonous fossil wood species

1a. Rays of two distinct sizes...**2**
b. Rays of one size or with intermediate ray sizes...**5**
2a. Wood ring-porous...***Quercoxylon retzianum* Kräusel**
b. Wood diffuse-porous **3**
3a. Intercellular canals present...**4**
b. Intercellular canals absent.. ***Tamaricoxylon africanum* (Kräusel) Boureau**
4a. Vessel clusters common.. ***Proteoxylon chargeense* Kräusel**
b. Vessels solitary or in radial multiples of 2–3.. ***Hibiscoxylon niloticum* Kräusel**
5a. Ray exclusively uniseriate, rarely with biseriate portions as wide as uniseriate portion or completely biseriate...**6**
b. Rays multiseraite or uni- and multiseriate...**16**
6a. Axial parenchyma absent or rare (scanty paratracheal as narrow incomplete sheath around the vessels or sparsely diffuse)...**7**
b. Axial parenchyma abundant...**10**
7a. Rays heterocellular with enlarged ray cells ....***Terminalioxylon intermedium* (Kräusel) Mädel-Angeliewa & Müller-Stoll**
b. Rays homocellular, at most with upright marginal cells...**8**
8a. Vessels in radial multiples of 4 or more are common...**9**
b. Vessels solitary and sometimes in short radial multiples of 2–3............**? *Leguminoxylon albizziae* Kräusel**
9a. Parenchyma chambered, mostly with crystal.. ***Sapindoxylon stromeri* Kräusel**
b. Parenchyma non-chambered, without crystal. .... ***Ebenoxylon ebenoides* (Schenk) Edwards**
10a. Diffuse and diffuse in aggregate apotracheal parenchyma abundant...**11**
b. Diffuse and diffuse in aggregate apotracheal parenchyma absent or sparsely present.................................**12**
11a. Vessels predominantly solitary, 28–80/mm^2...**? *Celastrinoxylon* sp. of Kräusel**
b. Vessels solitary or in radial multiples of 2–8, 20–32/mm^2..........................***Ebenoxylon aegyptiacum* Kräusel**
12a. Axial parenchyma bands present...**13**
b. Axial parenchyma bands absent or present only as discontinuous bands surrounding small secretory canals...**4**
13a. Parenchyma band wide (>3cells), forming curved bands...............***Ficoxylon blanckenhorni* Kräusel**
b. Parenchyma band narrow (only 1–2 cells), at least in some zones......................**? *Ficoxylon* sp. of Kräusel**
14a. Vessels 28–68/mm^2, radial multiples of 4 or more are common ....***Terminalioxylon geinitzii* (Schenk) Mädel-Angeliewa & Müller-Stoll**
b. Vessels up to 16/mm^2, mostly solitary or in short radial multiples of 2–3...**15**
15a. Diffuse apotracheal parenchyma sparsely present ....***Terminalioxylon edwardsii* (Kräusel) Mädel-Angeliewa & Müller-Stoll**
b. Diffuse apotracheal parenchyma absent ....***Terminalioxylon primigenium* (Schenk) Mädel-Angeliewa & Müller-Stoll**
16a. Multiseriate rays at most 3 cells wide, exceptionally reach to 4 ....**17**
b. Multiseriate rays ≥ 4 cells wide...**36**
17a. Axial parenchyma absent or scanty...**18**
b. Axial parenchyma frequent to abundant...**19**
18a. Growth rings recognizable by the naked eye; rays homcellular, 6–40 cells high...***Atherospermoxylon aegyptiacum* (Schenk) Kräusel**
b. Growth rings indistinct; rays heterocellular, 6–12 (–25) cells high...***Schimoxylon dachalense* (Kräusel) Kramer**
19a. Apotracheal parenchyma abundant either diffuse or diffuse in aggregates...**20**
b. Apotracheal parenchyma absent or sparsely present...**21**
20a. Apotracheal parenchyma diffuse, paratracheal parenchyma vasicentric to aliform, confluent forming short irregular bands...............................***Tetrapleuroxylon acaciae* (Kräusel) Müller-Stoll & Mädel**
b. Apotracheal parenchyma diffuse in aggregates, paratracheal parenchyma absent or scanty ....

....*Bombacoxylon owenii* **(Carruthers) Gottwald**
21a. Normal axial canals present……………………………………………………....................................…**22**
b. Normal axial canals absent……………………………………………………….......................................**24**
22a. Axial canals diffuse or in short tangential lines……………….......***Dipterocarpoxylon africanum*** **Bancroft**
b. Axial canals concentric (in long tangential lines)……………………………......................................…**23**
23a. Paratracheal parenchyma lozenge-aliform, confluent; rays heterocellular …..
....……***Copaiferoxylon matanzensis*** **Cevallos-Ferriz & Barajas-Morales**
b. Paratracheal parenchyma vasicentric, slightly aliform, sometimes confluent; rays homocellular. ....
....……***Copaiferoxylon migiurtinum*** **(Chiarugi) Müller-Stoll & Mädel**
24a. Axial parenchyma and fibers arranged in concentric alternate bands……….…..**25**
b. Axial parenchyma and fibers without specific pattern………………………..…..**33**
25a. Parenchyma in narrow bands up to 3 cells wide………………………….....................................……**26**
b. Parenchyma bands more than 3 cells wide…...……………………………......................................……**28**
26a. Vessels 70–120/mm^2...………….................................... ***Celastrinoxylon celastroides*** **(Schenk) Kräusel**
b. Vessels up to 14/mm^2…………………………………………………………...................................…**27**
27a. Prismatic crystals present in chambered axial parenchyma cells…...........***Euebenoxylon saharicum*** **Süss**
b. Prismatic crystals absent…………………….. ***Guttiferoxylon fareghense*** **Kräusel**
28a. Parenchyma bands wider than the alternating fiber bands, 6–25 cells wide…..
....***Glutoxylon symphonioides*** **(Bancroft) Lemoigne**
b. Parenchyma bands narrower than or at most as wide as the alternating fiber bands, 3–9 cells wide.......…..**29**
29a. Fibers septate; tyloses present………………….…..................................***Ficoxylon cretaceum*** **Schenk**
b. Fibers non-septate; tyloses absent………………………………………….…....................................…**30**
30a. Ray height > 1mm, up to 90 cells high…***Cynometroxylon*** **sp. cf.** ***C. holdenii*** **(Gupta) Prakash & Bande**
b. Ray height < 1mm, up to 40 cells high………………………………………….....................................…**31**
31a. Rays storied……………………….................................... ***Cynometroxylon tunesense*** **Delteil-Desneux**
b. Rays non-storied……………………………………………………………….….......................................**32**
32a. Vestured pits present…......................................… ***Cynometroxylon holdenii*** **(Gupta) Prakash & Bande**
b. Vestured pits absent………………..….. ***Cynometroxylon*** **sp. of El-Saadawi et al.**
33a. Axial parenchyma paratracheal as vasicentric, aliform, confluent; and also in irregular tangential bands…**34**
b. Axial parenchyma only paratracheal as vasicentric, aliform, sometimes confluent; tangential parenchyma absent or present only as marginal bands delineating the growth rings …...
.... ***Mimosoxylon calpocalycoides*** **Lemoigne**
34a. Ray height > 1mm, up to 100 (usually 30–40) cells high …...
....***Sterculioxylon giarabubense*** **(Chiarugi) Kräusel**
b. Rays at most 20 cells high……………………………………….................................…………….....**35**
35a. Axial banded parenchyma mostly in narrow bands or lines up to 3 cells wide; prismatic crystals usually present either in ray or in axial parenchyma cells………….. ……….........**?** ***Leguminoxylon*** **sp. of Kräusel**
b. Axial banded parenchyma mostly more than 3 cells wide; prismatic crystals absent …...................................
....***Dalbergioxylon dicorynioides*** **Müller-Stoll & Mädel**
36a. Multiseriate rays at most 5 cells wide…………………………………….......................................…...**37**
b. Multiseriate rays >5 cells wide ……………………………………….............***Cordioxylon barthelii*** **Süss**
37a. Normal axial canals present…...………………………………………….......................................…...**38**
b. Normal axial canals absent……………………..…………………………......................................….**39**
38a. Axial canals in concentric rings; axial parenchyma mostly paratracheal as vasicentric, aliform, in addition to marginal parenchyma bands surrounding axial canals…….......***Detarioxylon aegyptiacum*** **(Unger) Louvet**
b. Axial canals diffuse; axial parenchyma forming irregular bands (2–8 cells wide)….......................................
....***Andiroxylon aegyptiacum*** **Ziada**
39a. Axial Parenchyma not well-developed, only narrow vasicentric, weakly aliform or rarely confluent, sometimes narrow marginal parenchyma bands also present……..…**40**
b. Axial Parenchyma more developed, broadly aliform, confluent or banded, sometimes apotracheal diffuse parenchyma also present……...**43**
40a. Axial Parenchyma only narrow vasicentric, rays 2–27 (mostly 15) cells high…..
....***Mimosoxylon tenax*** **(Felix) Müller-Stoll & Mädel**
b. Axial Parenchyma narrow vasicentric to weakly aliform, in addition to marginal parenchyma bands........**41**

41a. Percentage of solitary vessels up to 70%..
....*Dichrostachyoxylon palaeonyassanum* **Lakhanpal & Prakash**
b. Percentage of solitary vessels 50–55% ……………………………………..…**42**
42a. Tangential diameter of vessels 100–200µ; prismatic crystals abundant in chambered axial parenchyma cells…………………………………………........*Dichrostachyoxylon zirkelii* **(Felix) Müller-Stoll & Mädel**
b. Tangential diameter of vessels 50–100µ; prismatic crystals absent or less frequent ....
.... *Dichrostachyoxylon royadeurm* **Privé**
43a. Diffuse apotracheal parenchyma abundant …..
....*Tetrapleuroxylon zaccarinii* **(Chiarugi) Müller-Stoll & Mädel**
b. Diffuse apotracheal parenchyma absent……………………………………......................................…...**44**
44a. Axial banded parenchyma mostly in narrow bands or lines up to 3 cells wide; sometimes more than 3 cells wide; rays heterocellular……... *Acacioxylon vegae* **Schenk**
b. Axial banded parenchyma present only as marginal bands delineating the growth rings; rays homocellular....**45**
45a. Paratracheal parenchyma lozenge-aliform and confluent…....................……*Afzelioxylon kiliani* **Louvet**
b. Paratracheal parenchyma vasicentric, lozenge-aliform and confluent …..
....*Afzelioxylon welkitii* **(Lemoigne & Beauchamp) Lemoigne**

TABLE 1 . An alphabetical list of the 19 *Palmoxylon* species (Arecaceae) recorded so far from the Egyptian strata with their geological ages, data source reference(s) and numbers in key I.

Palmoxylon species	Geological age	Reference	Key №
P. araneus Nour-El-Deen, El-Saadawi & Thomas	Oligo	Nour-El-Deen et al. (2018)	**3(a)**
P. aschersonii Schenk	Oligo, Oligo/Mio, Mio, Plio	Stenzel (1904), Kräusel & Stromer (1924), El-Saadawi et al. (2002, 2010)	**16(a)**
P. compactum Sahni	Mio	Sahni (1964), El-Saadawi et al. (2004)	**16(b)**
P. deccanense Sahni	Mio	Sahni (1964), Kamal El-Din et al. (2013)	**6(b)**
P. edwardsi Sahni	Mio	Sahni (1964), Kamal El-Din et al. (2013)	**12(a)**
P. elsaadawii Nour-El-Deen & Thomas	Oligo	Nour-El-Deen et al. (2018)	**5(b)**
P. geometricum Sahni	Oligo, Mio	Sahni (1964), El-Saadawi et al. (2004)	**18(a)**
P. indicum Sahni	Mio	Sahni (1964), El-Saadawi et al. (2004)	**7(a)**
P. lacunosum (Unger) Felix	Oligo, Mio	Unger (1823), Felix (1883), Stenzel (1904), Kräusel & Stromer (1924)	**4(b)**
P. libycum (Stenzel) Kräusel	Oligo, Oligo/Mio, Mio	Stenzel (1904), Kräusel & Stromer (1924), El-Saadawi et al. (2002)	**17(b)**
P. pondicherriense Sahni	Oligo, Mio	Sahni (1964), El-Saadawi et al. (2004)	**11(b)**
P. prismaticum Sahni	Mio	Sahni (1964), Kamal El-Din et al. (2013)	**10(a)**
P. pyriforme Sahni	Oligo, Mio	Sahni (1964), Kamal El-Din et al. (2013)	**15(a)**
P. qatraniense Nour-El-Deen, El-Saadawi & Thomas	Oligo	Nour-El-Deen et al. (2018)	**5(a)**
P. rewahense Sahni	Mio	Sahni (1964), El-Saadawi et al. (2004)	**17(a)**
P. sagari Sahni	Mio	Sahni (1964), Kamal El-Din et al. (2013)	**7(b)**
P. stromeri Kräusel	Cretaceous	Kräusel & Stromer (1924)	**12(b)**
P. wadiai Sahni	Mio	Sahni (1964), El-Saadawi et al. (2004, 2010)	**18(b)**
P. zittelii Schenk	Cretaceous	Stenzel (1904), Kräusel & Stromer (1924)	**11(a)**

Note: Mio= Miocene, Oligo= Oligocene, Plio= Pliocene.

TABLE 2. An alphabetical list of the 46 fossil dicot wood species recorded so far from the Egyptian strata with their possible botanical affinities, geological ages, data source reference(s) and numbers in key II.

Acacioxylon vegae Schenk	Fabaceae	Oligo	Kräusel (1939)	**44(a)**
Afzelioxylon kiliani Louvet	Fabaceae	Oligo	Louvet (1965), El-Saadawi et al. (2011)	**45(a)**
Afzelioxylon welkitii (Lemoigne & Beauchamp) Lemoigne	Fabaceae	Oligo, Mio	Lemoigne & Beauchamp (1972), Kamal El-Din & El-Saadawi (2004)	**45(b)**
Andiroxylon aegyptiacum Ziada	Fabaceae	Oligo	El-Saadawi et al. (2017)	**38(b)**
Atherospermoxylon aegyptiacum (Schenk) Kräusel	Monimiaceae	Oligo	Kräusel (1939)	**18(a)**
Bombacoxylon owenii (Carruthers) Gottwald	Malvaceae	Oligo, Oligo/Mio, Mio, Plio, Quaternary	Kräusel (1939), El-Saadawi et al. (2014b)	**20(b)**
Celastrinoxylon celastroides (Schenk) Kräusel	Celastraceae	Cretaceous	Kräusel (1939), Kamal El-Din (2003)	**26(a)**
? *Celastrinoxylon* sp. of Kräusel	Celastraceae	Cretaceous	Kräusel (1939)	**11(a)**
Copaiferoxylon matanzensis Cevallos-Ferriz & Barajas-Morales	Fabaceae	Oligo	Cevallos-Ferriz & Barajas-Morales (1994), El-Saadawi et al. (2017)	**23(a)**
Copaiferoxylon migiurtinum (Chiarugi) Müller-Stoll & Mädel	Fabaceae	Oligo	Müller-Stoll & Mädel (1967), El-Saadawi et al. (2011)	**23(b)**
Cordioxylon barthelii Süss	Boraginaceae	Palaeocene	Süss (1987)	**36(b)**
Cynometroxylon holdenii (Gupta) Prakash & Bande	Fabaceae	Mio	Prakash & Bande (1980), Mehrotra et al. (1999), Kamal El-Din & El-Saadawi (2004)	**32(a)**
Cynometroxylon tunesense Delteil-Desneux	Fabaceae	Oligo	El-Saadawi et al. (2011)	**31(a)**
Cynometroxylon sp. cf. *C. holdenii* (Gupta) Prakash & Bande	Fabaceae	Mio	Mehrotra et al. (1999), Kamal El-Din et al. (2015)	**30(a)**
Cynometroxylon sp. of El-Saadawi et al.	Fabaceae	Mio	El-Saadawi et al. (2014b)	**32(b)**
Dalbergioxylon dicorynioides Müller-Stoll & Mädel	Fabaceae	Oligo, Oligo/Mio, Mio	Schenk (1883), Kräusel (1939), Müller-Stoll & Mädel (1967), El-Saadawi et al. (2011)	**35(b)**
Detarioxylon aegyptiacum (Unger) Louvet	Fabaceae	Eoc, Oligo, Oligo/Mio, Mio, Plio	Kräusel (1939), Kamal El-Din & Refaat (2001)	**38(a)**
Dichrostachyoxylon palaeonyassanum Lakhanpal & Prakash	Fabaceae	Oligo	El-Saadawi et al. (2017)	**41(a)**
Dichrostachyoxylon royaderum Privé	Fabaceae	Oligo	El-Saadawi et al. (2017)	**42(b)**
Dichrostachyoxylon zirkelii (Felix) Müller-Stoll & Mädel	Fabaceae	Oligo	Müller-Stoll & Mädel (1967), El-Saadawi et al. (2017)	**42(a)**
Dipterocarpoxylon africanum Bancroft	Dipterocarpaceae	Mio	Bancroft (1935), Kamal El-Din et al. (2015)	**22(a)**
Ebenoxylon aegyptiacum Kräusel	Ebenaceae	Oligo, Oligo/Mio	Kräusel (1939)	**11(b)**
Ebenoxylon ebenoides (Schenk) Edwards	Ebenaceae	Cretaceous	Kräusel (1939)	**9(b)**
Euebenoxylon saharicum Süss	Ebenaceae	Palaeogene	Süss (1987)	**27(a)**

TABLE 2. Cont.

Fossil taxa	Family	Geological age	Reference	Key №
Ficoxylon blanckenhorni Kräusel	Moraceae	Oligo, Oligo/Mio, Mio	Kräusel (1939)	**13(a)**
Ficoxylon cretaceum Schenk	Moraceae	Oligo, Oligo/Mio, Mio	Schenk (1883), Kräusel (1939), Kamal El-Din (2003)	**29(a)**
? *Ficoxylon* sp. of Kräusel	Moraceae	Cretaceous	Kräusel (1939)	**13(b)**
Glutoxylon symphonioides (Bancroft) Lemoigne	Anacardiaceae	Oligo/Mio, Mio	Kräusel (1939)	**28(a)**
Guttiferoxylon fareghense Kräusel	Clusiaceae	Mio	Kräusel (1939)	**27(b)**
Hibiscoxylon niloticum Kräusel	Malvaceae	Cretaceous	Kräusel (1939)	**4(b)**
? *Leguminoxylon albizziae* Kräusel	Fabaceae	Mio	Kräusel (1939)	**8(b)**
? *Leguminoxylon* sp. of Kräusel	Fabaceae	Oligo	Kräusel (1939)	**35(a)**
Mimosoxylon calpocalycoides Lemoigne	Fabaceae	Oligo	El-Saadawi et al. (2011)	**33(b)**
Mimosoxylon tenax (Felix) Müller-Stoll & Mädel	Fabaceae	Oligo, Mio	Müller-Stoll & Mädel (1967)	**40(a)**
Proteoxylon chargeense Kräusel	Proteaceae	Cretaceous	Kräusel (1939)	**4(a)**
Quercoxylon retzianum Kräusel	Fagaceae	Oligo	Kräusel (1939)	**2(a)**
Sapindoxylon stromeri Kräusel	Sapindaceae	Oligo, Oligo/Mio, Mio	Kräusel (1939), El-Saadawi et al. (2014a)	**9(a)**
Schimoxylon dachalense (Kräusel) Kramer	Theaceae	Cretaceous	Kräusel (1939)	**18(b)**
Sterculioxylon giarabubense (Chiarugi) Kräusel	Malvaceae	Oligo, Mio	Kräusel (1939)	**34(a)**
Tamaricoxylon africanum (Kräusel) Boureau	Tamaricaceae	Oligo	Kräusel (1939)	**3(b)**
Terminalioxylon edwardsii (Kräusel) Mädel-Angeliewa & Müller-Stoll	Combretaceae	Oligo, Oligo/Mio, Mio	Kräusel (1939), Mädel-Angeliewa & Müller-Stoll (1973), El-Saadawi et al. (2013)	**15(a)**
Terminalioxylon geinitzii (Schenk) Mädel-Angeliewa & Müller-Stoll	Combretaceae	Oligo, Mio	Kräusel (1939), Mädel-Angeliewa & Müller-Stoll (1973), El-Saadawi & Kamal El-Din (2004)	**14(a)**
Terminalioxylon intermedium (Kräusel) Mädel-Angeliewa & Müller-Stoll	Combretaceae	Cretaceous, Oligo	Kräusel (1939), Mädel-Angeliewa & Müller-Stoll (1973), El-Saadawi & Kamal El-Din (2004)	**7(a)**
Terminalioxylon primigenium (Schenk) Mädel-Angeliewa & Müller-Stoll	Combretaceae	Oligo, Oligo/Mio	Kräusel (1939), Mädel-Angeliewa & Müller-Stoll (1973)	**15(b)**
Tetrapleuroxylon acaciae (Kräusel) Müller-Stoll & Mädel	Fabaceae	Oligo, Oligo/Mio, Mio	Kräusel (1939), Müller-Stoll & Mädel (1967)	**20(a)**
Tetrapleuroxylon zaccarinii (Chiarugi) Müller-Stoll & Mädel	Fabaceae	Oligo	Müller-Stoll & Mädel (1967), El-Saadawi et al. (2011)	**43(a)**

Note: Eoc = Eocene, Mio = Miocene, Oligo = Oligocene, Plio = Pliocene.

Discussion

The two keys provided in this article help to facilitate the tentative allocation of an unknown fossil angiosperm wood specimen to an appropriate species using simple dichotomous keys, thus saving researchers precious time and providing them with easily accessible and accurate mean of identifying fossil angiosperm wood. With the two provided keys, students of fossil wood anatomy seeking to identify unknown specimens will no longer have to search for the protologues and/or diagnostic illustrations of individual taxa in rare and outdated literature.

The provided keys follow the standard dichotomous conventional format in which characters are sorted in a sequential order. They are mainly dependent, as much as possible, on the most distinctive, unambiguous and constant qualitative features of high taxonomic weight and avoid too much focus on quantitative features which are of variable nature. However, after the preliminary identification, it is advisable to proceed to the next confirming step by returning to more comprehensive catalogues providing full generic and specific descriptions.

A major advantage of Key I and II is that they comprise collectively all 65 fully recognized angiosperm fossil wood taxa reported so far from Egypt. Therefore, if any unknown specimen of fossil wood is uncovered locally in the future proves difficult to identify with the help of these two keys, it stands a good chance of belonging either to a new record to the fossil flora of Egypt or to a taxon new to science pending a more detailed study of it.

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الخشب الأحفوري المصري من كاسيات البذور: دليل التعريف اعتماداً علي الصفات التشريحية

زينب محمد النعماني
معمل السعداوي - قسم النبات - كلية العلوم - جامعة عين شمس - القاهرة - مصر.

استهدف هذا البحث تصميم مفتاحين تعريفيين لأنواع الخشب المتحجرالتابعة لكاسيات البذور والتي تم تسجيلها حتي الآن من مصر وذلك من أجل تسهيل التعريف المبدئي لأي عينة غيرمعرفة من الخشب المتحجر بالطبقات الرسوبية المصرية وتنتمي إلى كاسيات البذور. أشتمل المفتاح الأول على عدد 19 نوعاً من جنس *Palmoxylon* وهو جنس شكلي لجذوع النخيل المتحجر والذي ينتمي إلى النباتات ذوات الفلقة الواحدة ويتمثل بوفرة في الطبقات الرسوبية المصرية ويتم تعريفه على مستوي النوع؛ بينما تناول المفتاح الثاني عدد 46 نوعاً من أنواع الخشب المتحجر التابعة للنباتات ذوات الفلقتين والتي تنتمي لفصائل متعددة وسجلت من أعمار جيولوجية ومواقع مصرية مختلفة. تعود مثل هذه المفاتيح التعريفية بالنفع على دارسي الحفريات النباتية المهتمين بدراسة الخشب المتحجر وبخاصة إذا كانت هناك صعوبة في الوصول إلى المراجع الأصلية الخاصة بتعريف مثل هذه الأنواع المسجلة قديماً.