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Two new species of the genus *Diplothele* (Araneae, Barychelidae) from Orissa, India with notes on *D. walshi*

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Abstract. The genus *Diplothele* O. Pickard-Cambridge 1890 of the brush-footed spider family Barychelidae is represented in India by a single species, *D. walshi* O. Pickard-Cambridge 1890. In this paper, we describe two new species: *Diplothele gravelyi* from Angul and *Diplothele tenebrosus* from Ganjam, Orissa. We establish a neotype and provide additional characters for *D. walshi*, the types of which are lost. The neotype was collected from one of the previously described localities, Barkuda Island, Orissa. Spiders of this genus are known to build double-door trapdoor burrows, but the new species, *D. tenebrosus*, constructs a single entrance burrow with a trapdoor. Notes on natural history are provided for all species.

Keywords: New species, neotype, taxonomy, spider

The brush-footed spider family Barychelidae is represented worldwide by 44 genera and 300 species, of which four genera and five species—*Diplothele walshi* O. Pickard-Cambridge 1890, *Sason andamanicum* Simon 1888, *Sason robustum* O. Pickard-Cambridge 1883, *Sasonichus sullivani* Pocock 1900, and *Sipalolasma arthrapophysis* Gravely 1915—are reported from India (Siliwal & Molur 2007; Platnick 2008).

The genus *Diplothele* O. Pickard-Cambridge 1890 is endemic to South Asia and is represented by two species, namely *Diplothele walshi* O. Pickard-Cambridge 1890 from India and *Diplothele halyi* Simon 1892 from Sri Lanka. The trapdoor spiders we collected recently from Angul and Ganjam districts in Orissa have only two spinnerets, which after we consulted the literature (O. Pickard-Cambridge 1890; Pocock 1900; Raven 1985) were recognized as *Diplothele* spp. The description of *D. walshi* provided by O. Pickard-Cambridge (1890) is elementary and is not very helpful in comparative taxonomic work, as it lacks information on spermathecal structure. Most morphological characters of the new material from Orissa matched O. Pickard-Cambridge's description of *D. walshi* except for size. Specimens from Angul and Ganjam were much larger than reported for *D. walshi*. Even Gravely (1921, 1935) emphasized that *D. walshi* were small spiders (less than 10 mm), and he reported that the specimens from Horsleykonda, Chittoor district, in the Madras Museum collection were suspected to be new species because the size of these spiders was almost double that of *D. walshi*. Also, burrow structure of the *Diplothele* sp. observed at Angul and Ganjam did not match that reported for *D. walshi* by Gravely (1921).

To resolve the confusion, it was necessary to re-collect *D. walshi* from known localities. The type locality of *D. walshi* is the state of Orissa (O. Pickard-Cambridge 1890; Pocock 1900); fortunately, Gravely (1921) had also reported this species from Barkuda Island, Chilika Lake, Orissa. Therefore, Barkuda Island was surveyed rapidly in August 2007 for trapdoor spiders, and a few mature female individuals of *Diplothele* sp. were collected. These spiders were smaller, different in morphology as well as in habit, and matched the description of *D. walshi* (Gravely 1921). After examining the spermathecae of specimens from Barkuda Island and comparing them with those of specimens from Angul and Ganjam, it was clear that the latter were new species of *Diplothele*.

Unlike most of O. Pickard-Cambridge's type specimens preserved in the Hope Entomological Collection (OUMNH), Oxford, the holotype of *D. walshi* is currently missing (in litt., Zoe Simmons, Collections staff at OUMNH). Raven (1985) reported its absence and on a personal visit to the collection failed to locate the type. To further confirm its status, we inquired through major European museums, including NHM (London), about the type specimen of *D. walshi*, but could not locate it. It is confirmed now that the type specimen of *D. walshi* is lost. We therefore assign a *neotype* for this species from Barkuda Island, one of the confirmed localities of *D. walshi*.

In the present paper, we describe two new species: *Diplothele gravelyi* from the Angul district, and *D. tenebrosus* from the Ganjam district of Orissa, both based on mature females. We did a rapid survey and did not make a concerted effort to search for males. We also provide additional taxonomic details for *D. walshi* and notes on natural history for all the species. We compare important taxonomic characteristics for the three Indian species (Table 1).

METHODS

All specimens were deposited in the Wildlife Information Liaison Development Society, Coimbatore, Tamil Nadu, India. Measurements of body parts except for the eyes were taken with a Mitutoyo™ Vernier Caliper. Eye measurements were made with a calibrated ocular micrometer. All measurements are in mm. Spermathecae were dissected and cleared in concentrated lactic acid in a 100° C water bath for 15–20 min. Total length excludes chelicerae. All illustrations were prepared with the help of a camera lucida attached to a CETII™ stereomicroscope by MS.

Table 1.—Taxonomic characteristics of three *Diplothele* species.

Character	*D. walshi*	*D. gravelyi*	*D. tenebrosus*
Size range of spider	7.42–10.60 mm	14.70–16.90 mm	17.00–21.62 mm
Color of spider in life	yellowish-brown	brown	dark brown
PMS	absent	absent	absent
No. of maxillary cuspules	absent	3–4	3
Dorsal pattern on abdomen	chevron	chevron	chevron
Ventral pattern on abdomen	mottled	few small dots	pallid
Rastellum	9 short spines	27–30 short spines	39–42 short spines
Promarginal teeth (basomesal teeth)	7(12)	8(24)	9(20)
Patellae thorns III(IV)	present (absent)	present (absent)	absent (absent)
scopula metatarsi III(IV)	1/4(few scopuliform hair distally)	1/4(few scopuliform hair distally)	1/2(1/4)
Mt preening combs III(IV)	present	present	present
Shape of stalk of female spermathecae	digitiform	digitiform	broader at base and gradually narrowing towards apex
Shape of outer lobes of female spermathecae	lobe with sclerotized and twisted stalk	curved towards inner side with constriction at base and a notch towards distal end	balloon shape with constriction at base
Habitat	sandy soil, below shrubs, between roots	rocky, close to water body, dry deciduous forest	roadside, mango orchard with dense undergrowth
No. of burrow entrances (distance between the two entrances)	two (diameter of entrance)	two (two times entrance diameter)	one
Shape of burrow	flimsy short fork/'Y' shape	perfect fork/'Y' shape	bulb like
Distribution	Barkuda Island and nearby areas in Balugaon and Ganjam, Orissa	Satkosia WLS and nearby areas in Angul district, Orissa	Jadeshwar, Huma in Ganjam district; Berbera in Puri district, Orissa

Abbreviations.—ALE = anterior lateral eye, AME = anterior median eye, MOQ = median ocular quadrate, MS = Manju Siliwal, Neo = Neotype, NHM = Natural History Museum, PLE = posterior lateral eye, OUMNH = Oxford University Museum of Natural History, PME = posterior median eye, PLS = posterior lateral spinnerets, PMS = posterior median spinnerets, STC = Superior or paired tarsal claws, WILD = Wildlife Information Liaison Development Society. Abbreviations used for hair and spines count are d = dorsal, fe = femur, mt = metatarsus, p = prolateral, pa = patella, r = retrolateral, ta = tarsus, ti = tibia, v = ventral.

TAXONOMY

Diplothele O. Pickard-Cambridge 1890

Diplothele O. Pickard-Cambridge 1890:621; Simon 1892:123; Pocock 1900:174–175; Raven 1985:114, 145.

Adelonychia Walsh 1891:269; Gravely 1915:263; Raven 1985:145. First synonymized by Gravely (1915) and holotype considered lost by Raven (1985).

Type species.—*Diplothele walshi* O. Pickard-Cambridge 1890 is based on single female specimen. The holotype is lost; it was deposited at Hope Entomological Collections, Oxford University Museum of Natural History, Oxford, where most of the O. Pickard-Cambridge spider collection is deposited, and collection records in 1985 (I. Lansbury, in litt.) confirmed the type should be held by OUMNH.

The holotype female of *Adelonychia nigrostriata* Walsh 1891 from Khurda, Orissa state, India, is also lost. Since the species is considered synonymous with *D. walshi*, it does not constitute a nomenclatural problem requiring a neotype.

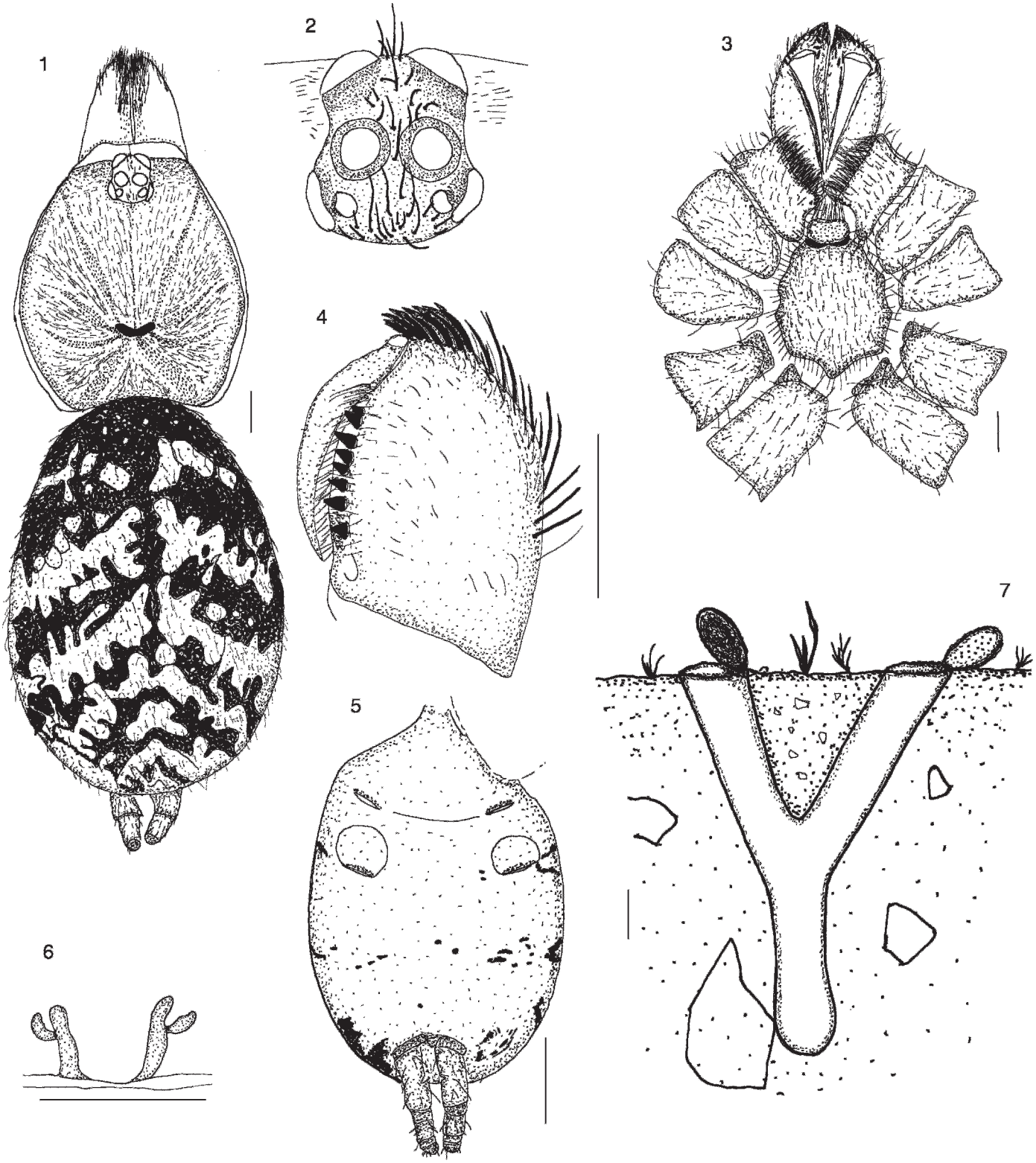
Diagnosis.—Two spinnerets. Anterior lateral eyes on clypeal edge, separated by less than their diameter, AME close to each other; ocular group wider behind than in front. Rastellum on low mound consisting of long, thick, curved, randomly arranged spines. Labium without cuspules, wider than long. Maxillae with few cuspules in anterior corner. Legs short, stout, anterior pair without spines; scopulae on metatarsi I–II and tarsi I–IV present, metatarsi III–IV weakly scopulated; STC of legs I and II clearly smaller than on legs III and IV (O. Pickard-Cambridge 1890, Pocock 1900, Raven 1985). Bilobed spermathecae.

Distribution.—Endemic to India and Sri Lanka.

Diplothele gravelyi new species
Figs. 1–7

Type specimens.—INDIA: *Orissa*: holotype female, near Satkosia Wildlife Sanctuary, Angul district, 93 m elev., 20°51′N, 84°91°E, 3 April 2007, M. Siliwal, S. Behera (WILD-07-ARA-161); 1 paratype female, same data as holotype (WILD-07-ARA-162).

Diagnosis (female).—The new species *Diplothele gravelyi* differs from *D. halyi* and resembles *D. walshi* in having the metatarsi longer than the tarsi of all legs. It differs from *D. walshi* in being about 1.5–2.2 times larger, having more rastellar spines, the presence of 3–4 cuspules on maxillae (Fig. 3). Also, the spermathecae have cactoid lobes at 2/3 distal end of the stalk, outer lobe with constriction at the base and with a notch on inner side toward the distal end (Fig. 6); perfect 'Y' shape, deep burrow with firm silk lining inside the burrow, and distance between the two entrances of the trapdoor nest is twice their diameter (Fig. 7). Male unknown.



Figures 1–7.—*Diplothele gravelyi* new species, female from Angul. 1. Cephalothorax and abdomen, dorsal view; 2. Eyes; 3. Sternum, labium, maxillae and chelicerae; 4. Right chelicera, prolateral face; 5. Abdomen, ventral view; 6. Spermathecae; 7. Burrow. Scale bars: (1–6) 1 mm; (7) 10 mm.

Etymology.—The species is named after the famous arachnologist, Dr. Frederic Henry Gravely (1885–1965). He was Assistant Superintendent at the Indian Museum, Calcutta for a few years and later worked as the Superintendent of the Madras Museum from 1920–1940. He published several monographs and papers on various subjects. He was the first arachnologist to study spiders in the wild in southern and eastern India and described many new species. The specimens collected by him are deposited at the Indian Museum, Calcutta, and Madras Museum. This is a tribute to his contribution to studies on Indian mygalomorph spiders.

Description of female holotype.—Total length 16.90. Carapace 7.46 long, 6.00 wide. Legs (femur, patella, tibia, metatarsus, tarsus, total): I: 4.48, 3.86, 4.24, 2.48, 2.10, 17.16. II: 4.40, 3.52, 3.32, 2.46, 2.00, 15.70. III: 4.18, 3.00, 2.72, 3.12, 2.10, 15.12. IV: 6.20, 3.92, 4.72, 5.00, 2.52, 22.36. Palp: 4.10, 2.96, 2.28, –, 2.86, 12.2. Midwidths: femora I = 1.44, II = 1.70, III = 1.72, IV = 1.30, palp = 1.34; tibia I–II = 1.30, III = 1.48, IV = 1.26, palp = 1.28. Abdomen 9.44 long, 6.20 wide. Spinnerets: PLS, total length 2.90 (1.70 basal, 0.80 middle, 0.40 apical; midwidths 0.80, 0.50, 0.30 respectively), 0.30 apart.

Color in life: Carapace, legs and palp brown. Abdomen yellowish-green with brown chevron marking running from dorsal to lateral sides (Fig. 1). Ventral side, yellowish-green with few small black spots between spinnerets and book lungs (Fig. 5). Color in alcohol paler than fresh specimen.

Carapace covered with blackish-brown and small golden, curved hair; hair more concentrated along interstrial ridges, intermixed with few black bristles on caput. Bristles: 10 long on caput in mid-dorsal line; three long, five short anteromedially; six long, several short between PME; one long, two short between AME; one long, five short on clypeus edge. Fovea deep, slightly procurved. Two glabrous bands emerging from fovea and passing on either side of caput.

Eyes: Group occupies 0.30 of head-width; ocular group front width; midwidth; back width; length; 1.00, 1.15, 1.30, 1.30, respectively. Anterior row strongly procurved, posterior row straight; posterior eyes opaque, rest transparent. MOQ front width 0.70, back width 0.80, length 0.60. Diameter of AME 0.30, ALE 0.50, PME 0.10, PLE 0.40. Eye interspaces: AME–AME 0.05, AME–ALE 0.10, ALE–ALE 0.15, PME–PLE adjacent, PME–PME 0.60, ALE–PLE 0.40.

Chelicerae: 3.94 long. Prolateral face glabrous, yellowish-orange with few small hairs; eight promarginal teeth and 24 basomesal teeth in 2–3 parallel lines; rastellum on low mound, consists of 27–30 short thick curved spines, of which 20–23 the mound and seven in anterior line, several normal pointed thin spines on dorsal, and vertical face and upward; dorsally two glabrous bands for length.

Labium: 0.90 wide, 0.70 long; labiosternal groove broad with two sigilla joined medially. Cuspules absent.

Maxillae: 2.20 long in front, 2.70 long in back, 1.30 wide; 3–4 cuspules on inner angle. Posterior heel slightly produced, anterior lobe distinct.

Sternum: 3.90 long, 3.10 wide. Covered with hair and bristles. Sigilla indistinct.

Legs: brown, moderately hairy; femora III thicker than rest; all legs of similar thickness; preening comb spines on metatarsi III and IV; coxae IV widest; two glabrous bands longitudinal on femora, patellae and tibiae (very prominent on patellae); leg formula 4123.

Spines: Leg III: pa, p = 2; ti, p= 1, v = 15, r = 1; mt, p = 2, d = 2; leg IV: ti, v = 5+2 broken, r = 2; mt, p = 2, v = 14. Elsewhere absent.

Scopula: Metatarsi I, distal ¾, scopuliform hair intermixed with few bristles and hair but no clear division; tarsi I, full, division with 2–3 rows of hairs; metatarsi II, distal half, division with 2–3 rows of setae; tarsi II, full divided with single row of hairs; metatarsi III, ¼ distal, divided with 3–4 rows of bristles and spines; tarsi III–IV, full, divided with 5–6 rows of setae; metatarsi IV, few scopuliform hairs ¼ distally, intermixed with spines and bristles.

Trichobothria: Tarsi I, seven clavate, 10 short and long filiform in two rows; tarsi II, six clavate, 10 short and long filiform in two rows; tarsi III, seven clavate, 10 long filiform in distal half in two rows; tarsi IV, eight clavate, 8–10 long in distal half in two rows. Clavate trichobothria confined to basal ¼ of tarsi.

Claws: Claw tufts on all legs and palp. All claws edentate, claws of legs I and II clearly smaller than on legs III and IV.

Abdomen: Yellowish-cream with brown chevron mark from dorsal to lateral, uniformly covered with short brown hairs intermixed with few black bristles; ventral side, yellowish cream with few brown spots between spinnerets and book lungs, uniformly covered with short brown hair.

Spermathecae: Two, cactoid shape, each stalk with cactoid outer lobe of similar length at 2/3 distal end, outer lobe curved toward inner side with constriction at base and notch towards distal end (Fig. 6).

Spinnerets: PMS absent. PLS, apical segment dome shape. Covered with golden brown hair.

Morphometry of female paratype.—Total length 14.70. Carapace 5.70 long, 4.32 wide, chelicerae 2.82 long. Sternum, 2.96 long, 2.00 wide. Labium 0.70 long, 1.00 wide. Maxillae 2.40 back length, 1.80 front length, 1.30 wide, two cuspules in anterior corner. Legs (femur, patella, tibia, metatarsus, tarsus, total): I: 3.92, 2.32, 3.16, 1.52, 1.42, 12.34. II: 3.34, 2.40, 2.78, 1.48, 1.38, 11.38. III: 3.28, 2.22, 2.00, 2.16, 1.44, 11.10. IV: 4.22, 2.36, 3.52, 3.96, 2.16, 16.22. Palp: 2.86, 2.00, 1.74, –, 2.20, 8.80. Midwidths: femora I = 0.70, II = 0.84, III = 1.00, IV = 1.06, palp = 0.66; tibia I = 0.92, II = 0.80, III–IV = 0.92, palp = 0.88. Abdomen 9.00 long, 6.34 wide. Spinnerets: PMS, absent; PLS, 1.00 basal, 0.70 middle, 0.40 distal, 2.10 total length, midwidths 0.70, 0.50, 0.30, respectively.

Distribution.—Orissa: Satkosia WLS and nearby areas in Angul district.

NATURAL HISTORY

Diplothele gravelyi was first found along the perennial stream outside the check gate of Satkosia WLS. It was also found all along the trail from Tikarpada to Blaiput, parallel to the River Mahanadi inside the Satkosia WLS. The forest department had burned the vegetation all along this trail, and we noticed many empty trapdoors.

The spider burrows were located in disturbed habitat with teak trees along the trail, about 10–25 m away from the water body. All along the trails the mud embankments were sloped at about 45° with hard soil, rocky in most places (10–30%), and were covered with dry mosses and grasses (40–60%). The

embankments where these spiders were found faced south and west. Though the burrows were patchy in distribution, the patches were common all along the trails. We estimated six burrows per m^2. area on the mud embankment. Inside the Sanctuary, the burrows of these spiders along the fire line were more abundant, between 8–12 burrows per m^2.

The burrows (Fig. 7) of these spiders were forked or 'Y' shaped. They consisted of two entrances with individual short chambers leading to a common chamber that was slightly wider at the base like a bulb. Both entrances of the burrow were separated by a space about twice their own diameter and had a wafer-thin circular hinged door. The outer surfaces of the hinged doors were covered with bits of leaf, soil particles, mosses and lichens, camouflaged with the substrate. The mean length of the burrows was 75 mm (range 70–90 mm), of which the main chamber was 30–40 mm long and the rest was the length of the chambers leading to the entrances. The mean diameter of the entrances of burrows (four burrows excavated) of matured individuals was 15 mm (range 10–15 mm). The silk lining in the burrows was not as thick as found in members of the families Ctenizidae and Idiopidae.

Diplothele tenebrosus new species
Figs. 8–14

Type specimens.—INDIA: *Orissa*: holotype female, Jadeshwar, Huma, Ganjam district, 144 m elev., 19°44′N, 85°06E, 19 August 2007, S. Behera, G. Sahu, S. Kumar and M. Siliwal (WILD-07-ARA-244); 2 paratype females, same data as holotype (WILD-07-ARA-201, 245).

Other material examined.—INDIA: *Orissa*: 1 juvenile, near Berbera-Dhuanali reserve forest, Balugaon, Puri district, 17 April 2007, M. Siliwal, S. Kumar and S. Behera (WILD-07-ARA-189).

Diagnosis (female).—Differs from *Diplothele halyi* and resembles *D. walshi* and *D. gravelyi* by having metatarsi longer than tarsi of all legs. It differs from *D. halyi* and *D. walshi* by having large body size (about 1.6–2.9 times larger). It differs from *D. walshi* and *D. gravelyi* in spermathecal stalks being broader at the base and gradually narrowing towards apex with outer lobe at 2/3 distal end of the stalk, outer lobe of balloon shape with constriction at the base (Fig. 13); single entrance trapdoor burrow (Fig. 14). Male not known.

Etymology.—The word *tenebrosus* in Latin means 'dark', which refers to the darker color of the spider in life.

Description of female holotype.—Total length 20.66. Carapace 10.40 long, 7.72 wide. Legs (femur, patella, tibia, metatarsus, tarsus, total): I: 6.1, 4.7, 4.92, 3.8, 2.62, 22.14. II: 6.0, 4.36, 4.74, 3.52, 2.66, 21.28. III: 5.56, 3.6, 3.32, 4.06, 2.68, 19.22. IV: 7.94, 4.54, 6.08, 6.98, 3.34, 28.88. Palp: 5.2, 3.56, 3.0, – , 3.3, 15.06. Midwidths: femora I = 1.92, II = 2.04, III = 2.28, IV = 1.92, palp = 1.48; tibia I = 1.84, II = 1.62, III = 1.74, IV = 1.86, palp = 1.82. Abdomen 10.26 long, 7.00 wide. Spinnerets: PLS, total length 3.48 (2.00 basal, 1.00 middle, 0.48 apical; midwidths 1.12, 0.78, 0.62 respectively), 0.42 apart.

Color in life: Carapace, legs and palp brown. Abdomen dark brown with faint black chevron marking running from dorsal to lateral sides (Fig. 8). The ventral side is uniformly dark brown without any pattern (Fig. 12). Color in alcohol paler than fresh specimen and chevron marking clearly visible on dorsal and lateral side of abdomen.

Carapace covered with blackish-brown curved hair; hair more concentrated along the interstrial ridges intermixed with black short and long bristles on caput. Bristles: eight long, nine short on caput in mid-dorsal line; two long, two short anteromedially; 10 long, nine short between PME; nine long, eight short between AME; six long, one short on clypeus edge. Fovea deep, straight with procurved ends. Several hairs between PME and ALE. Glabrous bands radiating from fovea, very prominent along sides of caput.

Eyes: Group occupies 0.27 of head-width; ocular group front width, midwidth, back width, length, 1.20, 1.30, 1.50, 1.50 respectively. Anterior row strongly procurved, posterior row straight, posterior medians opaque, rest transparent. MOQ front width 1.00, back width 1.20, length 0.80. Diameter of AME 0.40, ALE 0.60, PME 0.10, PLE 0.70. Eye interspaces: AME–AME 0.20, AME–ALE 0.15, ALE–ALE 0.50, PME–PLE adjacent, PME–PME 0.80, ALE–PLE 0.50.

Chelicerae: 5.86 long. Prolateral face glabrous, yellowish-orange with few small hairs; nine promarginal teeth and 20 basomesal teeth in 2–3 parallel lines; rastellum on low mound, consists of 39–42 short thick curved spines, of which 30–32 on the mound and 9–10 in anterior line, several normal pointed thin spines present on dorsal and vertical face and upward; two glabrous bands longitudinal on dorsal surface of chelicerae.

Labium: 1.46 wide, 1.32 long. Labiosternal groove shallow, broad with two indistinct sigilla on either side. Cuspules absent.

Maxillae: 3.04 long in front, 3.72 long in back, 2.42 wide; three (two large and one small) cuspules on inner angle. Posterior heel slightly produced, anterior lobe distinct.

Sternum: 5.40 long, 4.12 wide, covered with bristles. Sigilla indistinct, all marginal.

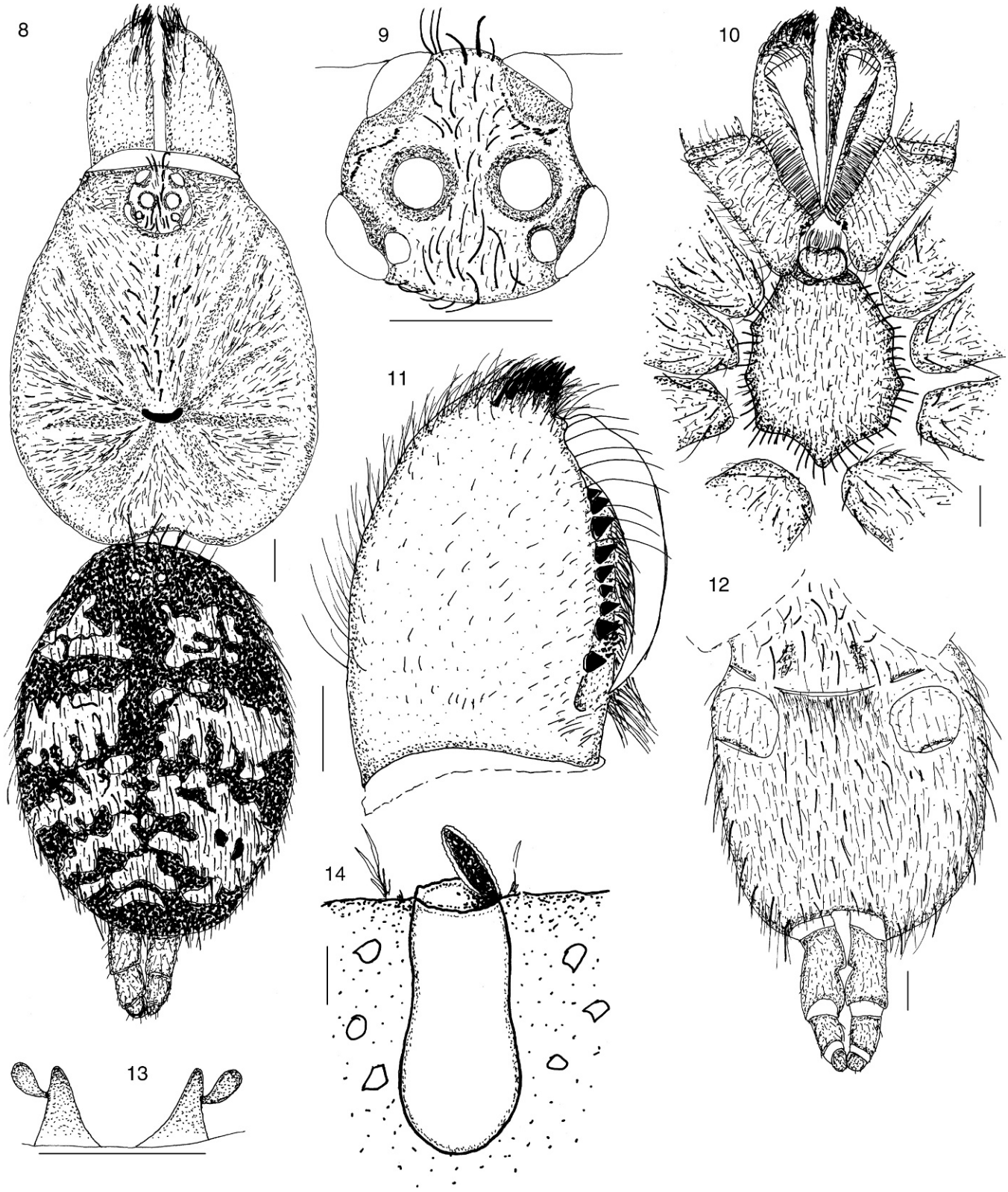
Legs: Uniformly brown, moderately covered with bristles and hairs; femora III thicker than rest; all legs of similar thickness; preening comb spines on metatarsi III and IV; coxae IV widest; two glabrous bands longitudinal on femora, patellae and tibiae (very prominent on patellae); leg formula 4123.

Spines: Leg III: ti, v = 4 + 6 distal, mt, p = 2, v = 8 + 9 distal, r = 2; leg IV: ti, p = 1, v = 4 + 6 distal, r = 2; mt, p = 2, v = 8 + 9 distal, r = 2. Elsewhere absent.

Scopula: Metatarsi I, distal ¾ with few bristles dividing at base; tarsi I, full, division with 2–3 rows of hairs in distal half; metatarsi II, ¾, division with single row of setae; tarsi II, full divided with single row of setae in distal half, basal half with hairless band; metatarsi III, ½ distal, divided with three rows of spines; tarsi III, full, divided with 5–6 rows of small setae; metatarsi IV, ¼ few scopuliform hairs distally, divided by 2–3 rows of setae; tarsi IV, full, divided with 8–9 rows of setae.

Trichobothria: Tarsi I, nine clavate, 12 long and short filiform in two rows in distal half; tarsi II, 11 clavate, 14 long and short filiform in two rows distal half; tarsi III, nine clavate, 10 long filiform in distal half in two rows; tarsi IV, nine clavate, 10 long filiform in distal half in two rows. Clavate trichobothria confined to basal ¼ of tarsi.

Claws: Claw tufts present on all legs and palp. All claws edentate, claws of legs I and II clearly smaller than on legs III and IV.



Figures 8–14.—*Diplothele tenebrosus* new species, female from Jadeshwar. 8. Cephalothorax and abdomen, dorsal view; 9. Eyes; 10. Sternum, labium, maxillae and chelicerae; 11. Left chelicera, prolateral face; 12. Abdomen, ventral view; 13. Spermathecae; 14. Burrow. Scale bars: (8–13) 1 mm; (14) 10 mm.

Abdomen: Dorsally dull cream with irregular dark-brown chevrons running from dorsal to lateral, uniformly covered with short brown hairs intermixed with few black bristles; ventral side, uniformly dull cream, covered with short brown hair.

Spermathecae: Two, stalk broader at base, gradually narrowing towards apex, each stalk with a pair of cactoid outer lobes of similar length at 2/3 distal end, outer lobe balloon shaped with constriction at base (Fig. 13).

Spinnerets: PMS absent. PLS, apical segment dome-shape. Covered with golden brown hair.

Morphometry of female paratypes, WILD-07-ARA-201 (WILD-07-ARA-245).—Total length 21.62 (17.00). Carapace 10.00 (8.68) long, 7.68 (6.44) wide, chelicerae 4.38 (3.70) long. Sternum, 5.00 (3.86) long, 3.76 (3.58) wide. Labium 1.12 (1.00) long, 1.48 (1.28) wide. Maxillae 3.74 (2.54) back length, 2.68 (2.00) front length, 2.22 (1.56) wide, 1–2 cuspules in anterior corner. Legs (femur, patella, tibia, metatarsus, tarsus, total): I: 6.0 (4.86), 4.32 (3.94), 4.7 (3.72), 3.08 (2.56), 2.48 (2.06), 20.58 (17.14). II: 6.0 (4.82), 4.22 (3.68), 4.1 (3.42), 3.08 (2.72), 2.48 (2.0), 19.88 (16.64). III: 5.06 (4.32), 3.34 (3.2), 3.04 (2.36), 3.96 (2.98), 2.58 (2.0), 17.98 (14.86). IV: 7.54 (5.94), 4.26 (4.0), 5.62 (4.66), 6.76 (5.38), 2.76 (2.42), 26.94 (22.4). Palp: 4.14 (3.64), 3.12 (2.72), 2.0 (2.16), – (–), 3.62 (2.32), 12.88 (10.84). Midwidths: femora I = 1.76 (1.32), II = 1.78 (1.5), III = 2.12 (1.78), IV = 1.62 (1.32), palp = 1.32 (1.0); tibia I = 1.74 (1.34), II = 1.74 (1.0), III = 1.42 (1.0), IV = 1.62 (1.38), palp = 1.64 (1.26). Abdomen 11.62 (8.00) long, 8.32 (5.46) wide. Spinnerets: PMS, absent; PLS, 2.00 (1.92) basal, 1.20 (0.90) middle, 0.72 (0.68) distal, 3.92 (3.50) total length, midwidths 1.12 (0.86), 0.78 (0.66), 0.70 (0.50) respectively.

Distribution.—Orissa: Jadeshwar, Huma in Ganjam district; Near Berbera-Dhuanali reserve forest, Balugaon, Puri district.

NATURAL HISTORY

These spiders were found in an undisturbed mango orchard with weeds covering 90% of ground. The burrows were constructed on the ground or roadside mud embankments; the soil was easy to dig because of recent rain. Due to dense undergrowth, we could not estimate the density of this spider in this area, but we estimated seven burrows per m^2 area on the roadside embankments.

The burrow structure (Fig. 14) was a simple trapdoor, a single entrance leading to a short chamber that was wider at the base. The burrow was lined with a thick layer of off-white silk as seen in the burrow of *D. gravelyi* new species; however, the silk was firm and did not break. We had to use a pair of scissors to take a cross-section of the burrow silk. The entrance had a circular wafer-thin hinged door, whose outer surface was covered with soil particles, camouflaging it in the surrounding. The mean length of the burrow (six burrows excavated) was 60 mm (range 60–80 mm). The diameter of the entrances of the burrows ranged between 15–20 mm (mean 15 mm). In Jadeshwar, these spiders were found making vertical burrows on ground, whereas in Balugaon, they were found in horizontal burrows on roadside embankments . At the slightest disturbance, these spiders jumped out of the burrow and disappeared in the nearby vegetation or leaf litter.

Diplothele walshi O. Pickard-Cambridge 1890
Figs. 15–21

Diplothele walshi O. Pickard-Cambridge 1890:621.
Adelonychia nigrostriata Walsh 1891:269. First synonymised by Gravely (1915).

Neotype.—INDIA: *Orissa*: neotype female, Barkuda Island, Chilika lake, Orissa, 133 m, 19°55′N, 85°15E, 18 August 2007, S. Behera, M. Siliwal and G. Sahu (WILD-07-ARA-195).

Other material examined.—INDIA: *Orissa*: 1 female, same data as neotype (WILD-07-ARA-196); 2 juveniles, same data as neotype (WILD-07-ARA-197, 241).

Diagnosis (female).—Differs from *Diplothele halyi* by having metatarsi longer than tarsi of all legs, distinct abdominal pattern and fovea larger (Pocock 1900). It differs from the two new species in absence of maxillary cuspules (Fig. 17); smaller in size; shallow, forked double entrance trapdoor burrow made up of very flimsy silk, which breaks while excavating the burrow (Fig. 21). Male not known.

Description of female neotype.—Total length 10.60. Carapace 4.86 long, 3.34 wide. Chelicerae 1.82 long. Legs (femur, patella, tibia, metatarsus, tarsus, total): I: 2.3, 1.76, 1.58, 1.0, 0.92, 7.56. II: 2.04, 1.5, 1.42, 1.0, 0.88, 6.84. III: 2.0, 1.38, 0.98, 1.0, 0.9, 6.26. IV: 2.58, 1.8, 2.0, 2.12, 1.32, 9.82. Palp: 1.46, 1.18, 0.9, – , 1.3, 4.8. Midwidths: femora I–II = 0.70, III = 1.0, IV = 0.8, palp = 0.6; tibia I–II = 0.62, III = 0.72, IV = 0.76, palp = 0.6. Abdomen 5.74 long, 4.00 wide. PLS, total length 1.66, (0.80 basal, 0.60 middle, 0.26 apical; midwidths 0.60, 0.40, 0.30 respectively), 0.20 apart.

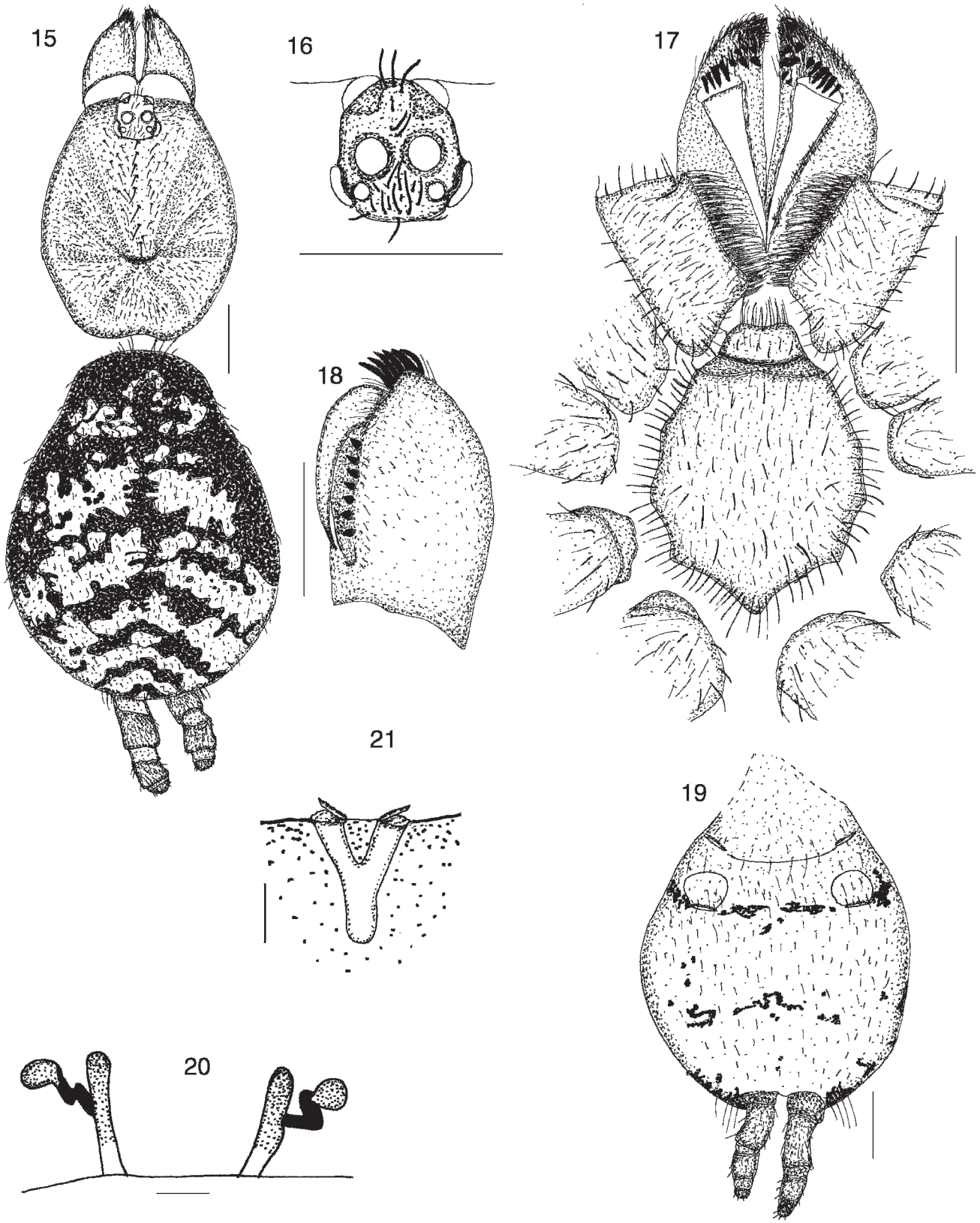
Color in alcohol: Carapace, legs and palp yellowish-brown. Abdomen yellowish-cream, dorsally with irregular brown chevron marking running from dorsal to lateral sides (Fig. 15). Ventral side, yellowish-cream with few small brown spots and blotches between spinnerets and book lungs (Fig. 19).

Carapace covered with blackish-brown hair; few short and long black bristles on caput. Bristles: nine long, two short on caput in mid-dorsal line; two long, one short anteromedially; eight long, 12 short hairs between PME; four long, two short between ALE and clypeus edge. Fovea deep, straight with procurved ends. Interstrial ridges prominent, radiating from fovea.

Eyes: Group occupies 0.30 of head-width; ocular group front width, mid width, back width, length, 0.70, 0.90, 1.10, 0.80 respectively. Eyes in three rows, posterior row almost straight; posterior eyes opaque, rest transparent. MOQ front width 0.70, back width 0.80, length 0.50. Diameter, AME 0.30, ALE 0.40, PME 0.10, PLE 0.50. Eye interspaces: AME–AME 0.05, AME–ALE 0.10, ALE–ALE 0.20, PME–PLE adjacent, PME–PME 0.60.

Chelicerae: 2.36 long intact. Prolateral face glabrous, yellowish-orange with few small hairs; seven promarginal teeth and 12 basomesal teeth in 2–3 parallel lines. Rastellum on low mound, consists of nine short, thick, curved spines of which seven on mound and two in anterior line, accompanied by several pointed thin spines on dorsal, vertical face and upwards; two glabrous bands longitudinal on dorsolateral surface of chelicerae.

Labium: 0.60 wide, 0.40 long. Labiosternal groove shallow, broad with inconspicuous sigilla on either side, raised in center. Cuspules absent.



Figures 15–21.—*Diplothele walshi*, female from Barkuda Island. 15. Cephalothorax and abdomen, dorsal view; 16. Eyes; 17. Sternum, labium, maxillae and chelicerae; 18. Right chelicera, prolateral face; 19. Abdomen, ventral view; 20. Spermathecae ; 21. Burrow. Scale bars: (8–13) 1 mm; (14) 10 mm. Scale bars: (15–19) 1 mm; (20) 0.1 mm; (21) 10 mm.

Maxillae: 1.10 long in front, 1.50 long in back, 0.80 wide; cuspules absent. Posterior heel slightly produced, anterior lobe short.

Sternum: 1.90 long, 1.60 wide. Sigilla indistinct.

Legs: uniformly yellowish-brown, covered with bristles and hairs; femora III thicker than rest; all legs of similar thickness; preening comb present on metatarsi III and IV; coxae IV widest; two glabrous bands running longitudinal on femora, patellae and tibiae (very prominent on patellae); leg formula 4123.

Spines: Leg III: pa, p = 5; ti, p = 1; mt, p = 3, r = 1, v = 6+10 distal; leg IV: mt, p = 2, r = 2, v = 10 distal. Elsewhere absent.

Scopula: Metatarsi I, ½ distal, scopulae not dense intermixed with few bristles; tarsi I, full, division with 2–3 rows of thin bristles; metatarsi II, distal half, rudimentary, scopuliform hair intermixed with few bristles; tarsi II, full, divided with 3–4 rows of bristles; metatarsi III, ¼ distal, few scopuliform hairs intermixed with bristles and spines; tarsi III, full, divided with 6–7 rows of setae; metatarsi IV, few scopuliform hair distally; tarsi IV, full, divided with 6–7 rows of setae.

Trichobothria: Tarsi I, six clavate, 10–12 long and short filiform in two rows, for length; tarsi II, five clavate, 10 long and short filiform in two rows in v-shape; tarsi III, one (rest broken) clavate, 10 long filiform in distal half in two rows; tarsi IV, four clavate, 10 long in distal half in two rows. Clavate trichobothria confined to about basal ¼ length of tarsi. Filiform in distal half on all tarsi in v-shape.

Claws: Claw tufts present on all legs and palp. All claws edentate, claws of legs I and II clearly smaller than on legs III and IV.

Abdomen: Cream with prominent irregular chevron marking running from dorsal to lateral sides; uniformly covered with short brown hairs. Ventrally cream with brown spots and blotches between spinnerets and book lungs.

Spermathecae: Two, finger-like, each stalk with outer lobe at distal half, outer lobe with sclerotized and twisted stalk (Fig. 20).

Spinnerets: PMS absent. PLS, covered with golden brown hair, apical segment dome-shaped.

Morphometry of female (WILD-07-ARA-196) (Table 1).—Total length 7.42. Carapace 2.94 long, 2.46 wide. Chelicerae 1.26 long. Sternum, 1.50 long and 1.30 wide. Labium 0.40 long, 0.60 wide. Maxillae 1.20 back length, 0.98 front length, 0.64 wide. Legs (femur, patella, tibia, metatarsus, tarsus, total): I: 1.68, 1.40, 1.24, 0.94, 0.88, 6.14. II: 1.46, 1.22, 1.12, 0.92, 0.86, 5.58. III: 1.24, 0.96, 0.88, 0.9, 0.86, 4.84. IV: 1.94, 1.20, 1.56, 1.66, 1.12, 7.48. Palp: broken. Midwidths: femora I = 0.64, II = 0.50, III = 0.78, IV = 0.64, palp = broken; tibia I = 0.56, II = 0.52, III = 0.64, IV = 0.62, palp = broken. Abdomen 4.48 long, 3.40 wide. PLS, total length 1.20 (0.60 basal, 0.40 middle, 0.20 apical; midwidths 0.50, 0.40, 0.20, respectively), 0.18 apart.

Distribution.—Orissa: Barkuda Island, Chilika Lake; Ganjam; Andhra Pradesh: Waltair (=Visakhapatnam) in Madras Presidency.

Remarks.—Roewer (1942:217, 218) incorrectly reported that Pocock (1900:175) had males of both *D. walshi* and *D. halyi*, whereas a male is known only for the latter.

Raven (1985) reported that the holotype of *D. walshi* was lodged in the Hope Collection, Oxford University but in checking with the current curator at the time, Ivor Lansbury, reported it could not be found. Raven, in 1983, also looked for it in a number of other European museums, including the Natural History Museum. We rechecked with the collections manager of the Hope Collection and it was reconfirmed that the type was lost. Our discovery of three species in the state of Orissa made the correct identification of *D. walshi* essential. The original locality given by O. Pickard-Cambridge (1890) was ''Orissa, Calcutta'' and the holotype was an immature female; the neotype is from that state. However, Calcutta is not in Orissa state, but as with many of these early collections, it is assumed that the published locality is a combination of the port of exit or the home of the collector. In this case, the collector was at the Calcutta Hospital (in West Bengal) and thus it is assumed that the spider's locality was the adjacent state of Orissa.

NATURAL HISTORY

These spiders were collected from Barkuda Island, Chilika Lake, southern Orissa. The vegetation on the Barkuda Island mainly consists of thorny shrubs (mainly *Acacia* spp. and *Ziziphus* spp.), cactus, and a few young trees. The burrows were constructed at the base of shrubs on the ground, amongst the roots in the loose soil. Burrows were very easy to dig as the soil was sandy. This spider seems to be very common on the island; in 30 minutes we found four spiders. Due to dense vegetation, we could not estimate the density of this spider population on the island.

The burrow structure (Fig. 21) was fork-shaped with two entrances leading to a short common chamber. The burrow was lined with silk, not as thick as that of *D. gravelyi* and *D. tenebrosus*, and being weak, broke on digging. Both entrances had circular, wafer-thin, hinged doors, their distance apart being about the diameter of an entrance. The outer surface of these hinged doors was covered with soil particles and bits of dry leaves, camouflaging it in the surrounding. The mean length of the burrow was 25 mm (range 15–25), of which the main chamber was about 8–10 mm long and the remainder was the length of the chambers leading to entrances. Diameter of the burrow entrances ranged between 6–7 mm (mean = 7 mm), similar to that reported by Gravely (1921).

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LITERATURE CITED

Gravely, F.H. 1915. Notes on Indian mygalomorph spiders. Records of the Indian Museum, Calcutta 11:257–287.

Gravely, F.H. 1921. The spiders and scorpions of Barkuda Island. Records of the Indian Museum, Calcutta 22:399–421.

Gravely, F.H. 1935. Notes on Indian mygalomorph spiders. II. Records of the Indian Museum, Calcutta 37:69–84.

Pickard-Cambridge, O. 1890. On some new species and two new genera of Araneida. Proceedings of the Zoological Society of London 1890:620–629.

Platnick, N.I. 2008. The World Spider Catalog, Version 8.5. American Museum of Natural History, New York. Online at http://research.amnh.org/entomology/spiders/catalog/index.html

Pocock, R.I. 1900. The Fauna of British India, Including Ceylon and Burma. Arachnida. Taylor and Francis, London. Pp. 1–279.

Raven, R.J. 1985. The spider infraorder Mygalomorphae (Araneae): cladistics and systematics. Bulletin of the American Museum of Natural History 182:1–180.

Roewer, C.F. 1942. Katalog der Araneae von 1758 bis 1940. Paul Budy, Bremen. Pp. 1–1040.

Siliwal, M. & S. Molur. 2007. Checklist of spiders (Arachnida: Araneae) of South Asia including 2006 update of Indian spider checklist. Zoos' Print Journal 22(2):2551–2597 (plus 84 p. web supplement).

Simon, E. 1892. Histoire naturelle des araignées. Librairie Encyclopédique de Roret, Paris 1:1–256.

Walsh, J.H.T. 1891. A new trap-door spider from Orissa. Journal of the Asiatic Society of Bengal 59:269–270.

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