Chapter 23 Order Coleoptera

The Coleoptera, or beetles, has approximately 250,000 known species globally (Lawrence *et al*., 1999) and approximately 5,000 species are aquatic and semiaquatic. Two of four suborders and a total of 18 families are aquatic and semiaquatic. Most true aquatic beetle larvae live in water and may be aquatic or terrestrial as adults. Hydraenidae and Dryopidae have aquatic adults and terrestrial larvae. Research on Asian coleopterans is cited in Nilsson (1995), Balke & Hendrick (1997), Hendrick & Balke (1997) and Dudgeon (1995a, 1995b). The 'China Water Beetle Survey' was established in 1992, and it increased the knowledge of the 18 aquatic and semiaquatic beetle families of China (see details in Jäch & Ji (eds.), 1995). It is currently impossible to identify larvae to genus and species. The following keys to families of adult and larval stages of aquatic Coleoptera of Indochina are modified from those of White and Brigham (1996).

Key to Families of Aquatic Coleoptera Adults of Indochina

1 Hind coxae enlarged as broad flattened plates, completely covering 2 or 3 basal abdominal segments (Fig. 1) ..... Halipidae
1′ Hind coxae sometimes extended posteriorly but not as broad flattened plates 2

2(1′) Head with two pairs of compound eyes, dorsal and ventral pairs (Fig. 2a-b); meso- and metathoracic legs modified to short flat oar-like structures (adults move in little circle upon surface of the water) ..... Gyrinidae
2′ Head with 1 pair of compound eyes; meso-and metathoracic legs long 3

3(2′) Head anteriorly prolonged in front of eyes to produce a distinct snout (Fig. 3) .... Curculionidae
3′ Head anteriorly not prolonged to produce a snout 4

4(3′) Elytra long, covering entire abdomen or exposing only part of 1 terminal abdominal tergite 6
4′ Elytra abbreviated or short (Fig. 4a), exposing at least 2 entire abdominal tergites 5

5(4′) Antennae with 8 segments; minute, usually less than 2 mm long..... ..... Hydroscaphidae, in part
5′ Antennae with 11 segments (Fig. 4b); slender, usually longer than 5 mm..... ..... Staphylinidae

6(4) Tarsal segment III bilobed (Fig. 5) ..... Chrysomelidae
6′ Tarsal segment III not bilobed 7

7(6′) The first abdominal sternite divided into a right and a left part by proximal elevated metacoxal process (Fig. 6); tarsi with 5 segments 8
7′ The first abdominal sternite not divide into a right and a left part; tarsi with 3-5 segments 11

8(7) Hind tibia and tarsi more or less cylindrical in cross section and lacking conspicuous swimming setae..... Amphizoidae, in part
8′ Metathoracic tibia and tarsi flattened and bearing long swimming setae (Fig. 7a) .. 9

9(8′) Eyes protuberant; metasternum with a transverse suture ..... Hygrobiidae
9′ Eyes not protuberant; metasternum without a suture 10

10(9′) Metathoracic tarsus with a single claw (Fig. 7a) ; if there are two claws, mesoscutellum large and conspicuous (Fig. 7b)..... Dytiscidae, in part
10′ Metathoracic tarsus with two claws; mesoscutellum concealed (Fig. 8) .. Noteridae

11(7′) Metathoracic legs with swimming setae (Fig. 7a)..... 12
11′ Metathoracic legs without swimming setae..... 15

12(11) Antenna long and filiform..... Dytiscidae, in part
12′ Antenna club-shaped (Fig. 10, 11b, 13)..... 13

13(12′) Pronotum with 5 longitudinal grooves ..... Helophoridae
13′ Pronotum without longitudinal grooves 14

14(13′) Pronotum narrower than elytra..... Hydrochidae
14′ Pronotum as wide as elytra (Fig. 9)..... Hydrophilidae, in part

15(11′) Antennae club-shaped, with club-like segment at base of club (Fig. 10b,11b).... 16
15′ Antennae various shapes; if clubbed, tarsi and claw long (Fig. 12)..... 17

16(15) Antennal club with 3 segments (Fig. 10b); abdomen with 5 segments visible from ventral side (Fig. 10a)..... Hydrophilidae, in part
16′ Antennal club with 5 segments (Fig. 11a); abdomen with 6-7 segments visible from ventral side (Fig. 11b)..... Hydraenidae

17(15′) Tarsi with 3 segments ..... Hydroscaphidae, in part
17′ Tarsi with 5 segments 18

18(17′) Long legs with long claws; tarsal segment 5 elongate, as long as previous 4 segments combined (Fig. 12)..... 19

18′ Legs and claws not elongate; length of tarsal segment 5 less than 4 segments combined ..... (Fig. 14a) 20

19(18) Antennae variable, not with pectinate club .....ELMIDAE
19′ Antennae with pectinate club (Fig. 13) ..... DRYOPIDAE

20(18′) Hind coxae extend laterally to margin of elytra; elytra covered with short setae ....AMPHIZOIDAE, in part
20′ Hind coxae not extending to margin of elytra (Fig.14a-b) elytra covered with long slender sensory setae ..... CARABIDAE

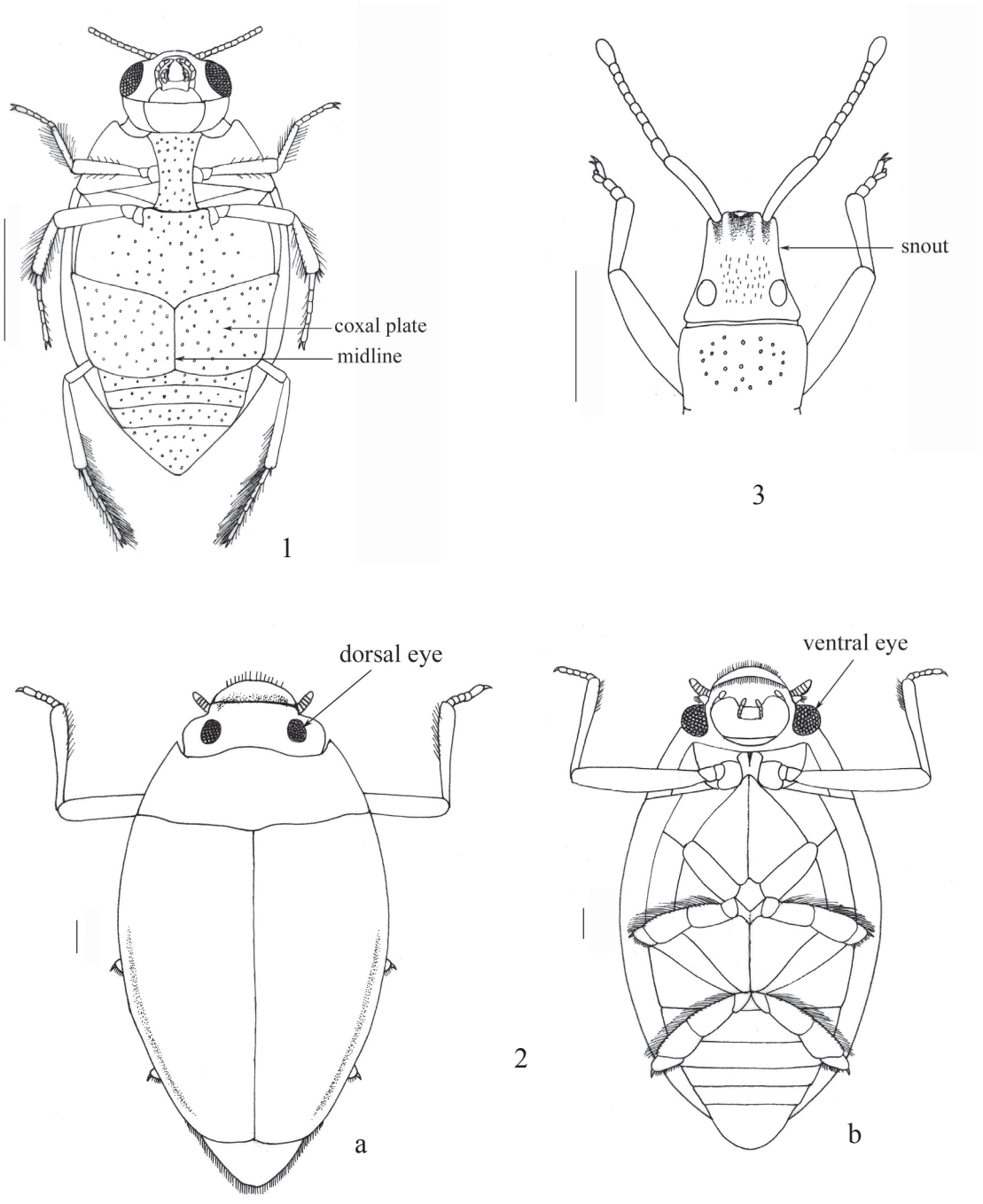


Fig. 1-3. 1. Ventral side of Halipidae; 2. Dorsal view (a) and ventral (b) of Gyrinidae;
3. Dorsal view of head of Curculionidae.
Scale = 1 mm.

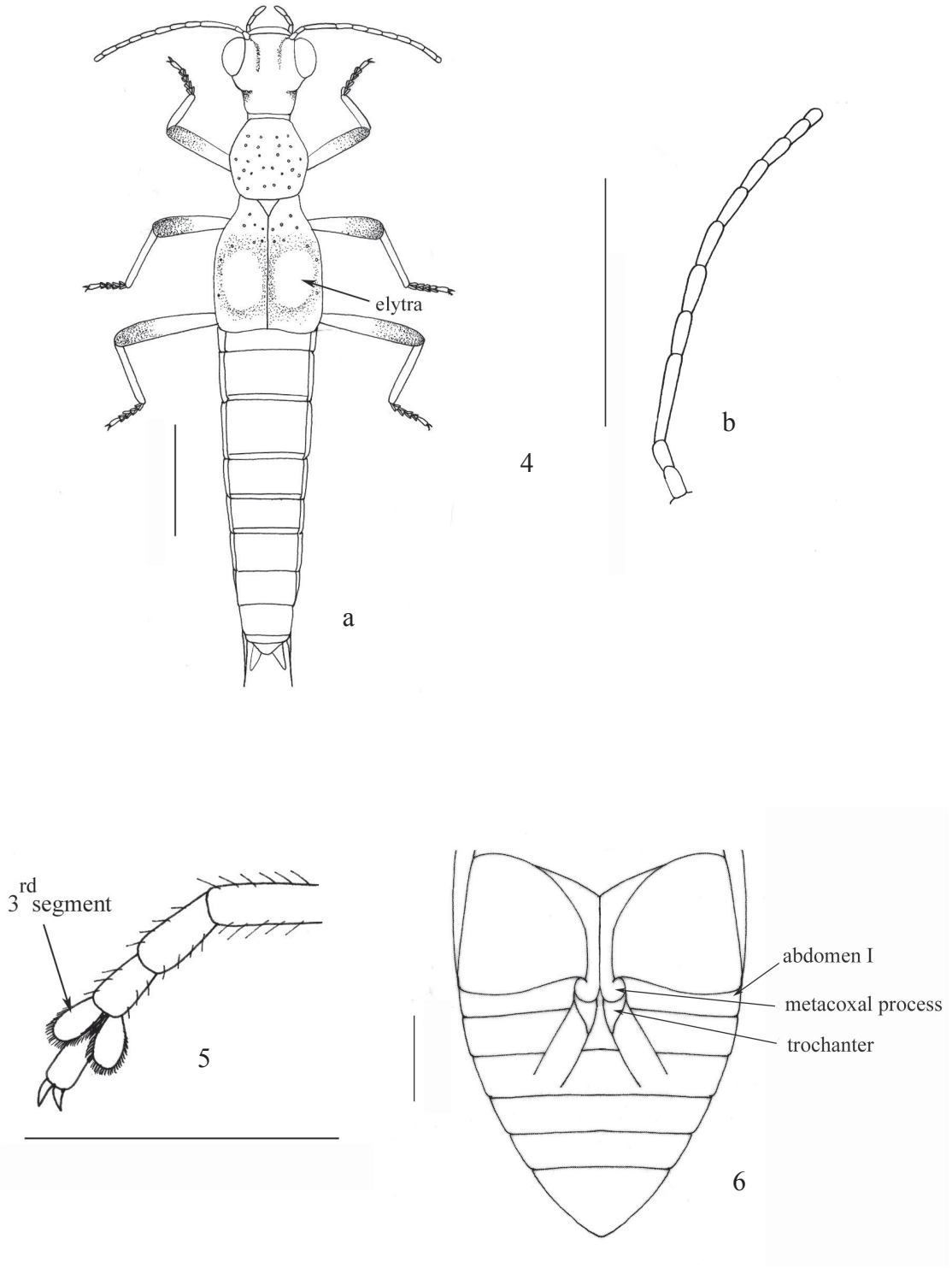


Fig. 4-6 4. Dorsal view (a) and antenna (b) of Staphylinidae; 5. Tarsal segment 3 of Chrysomelidae; 6. Ventral side of Dytiscidae.
Scale = 1 mm.

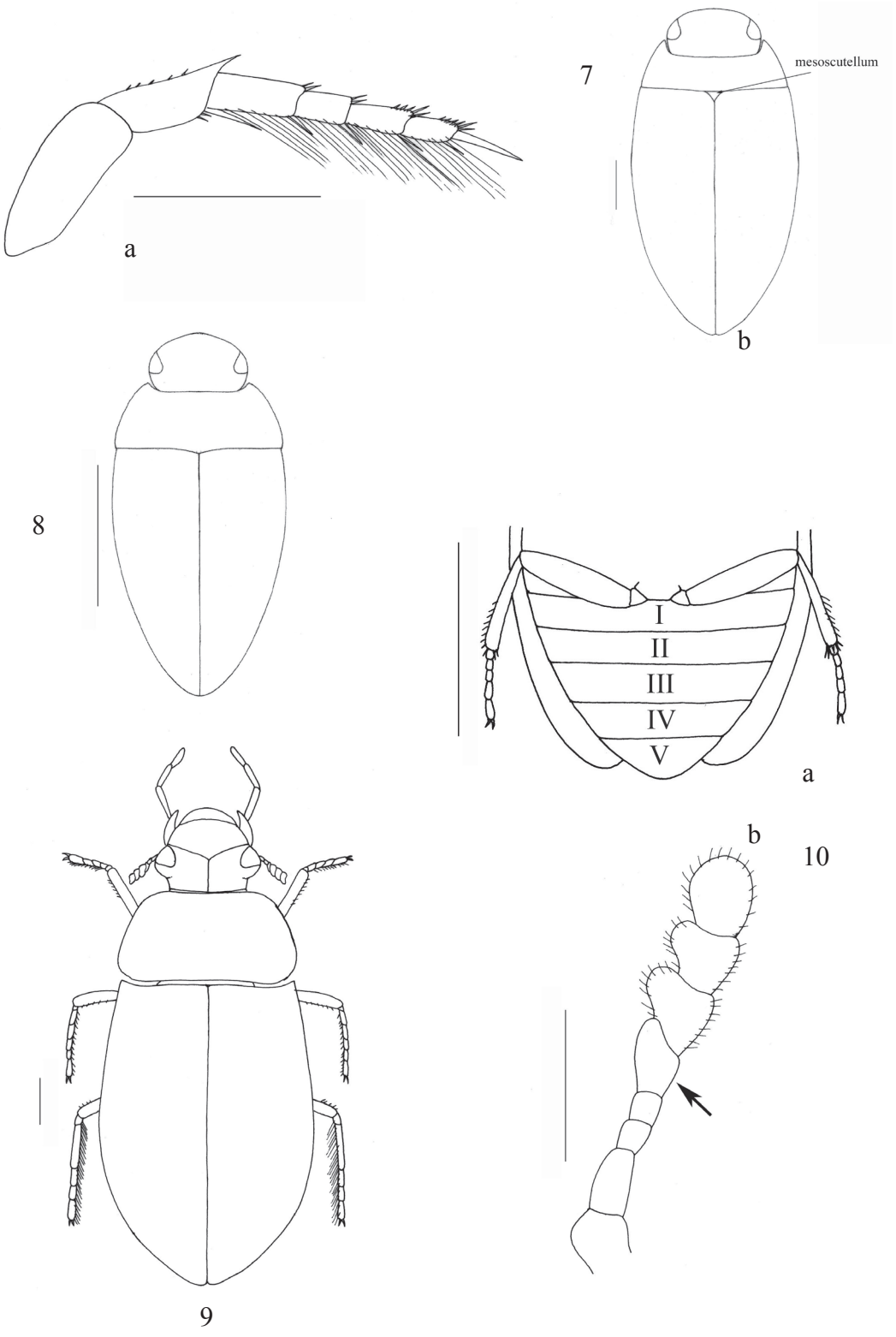


Fig. 7-10 7. Metathoracic leg (a) and dorsal view (b) of Dytiscidae; 8. Dorsal view of Noteridae; 9. Dorsal view of Hydrophilidae; 10. Ventral side of abdomen (a) and antenna (b) of Hydrophilidae.
Scale: (7b, 8, 9) 1 mm; (7a, 10a-b) 0.5 mm.

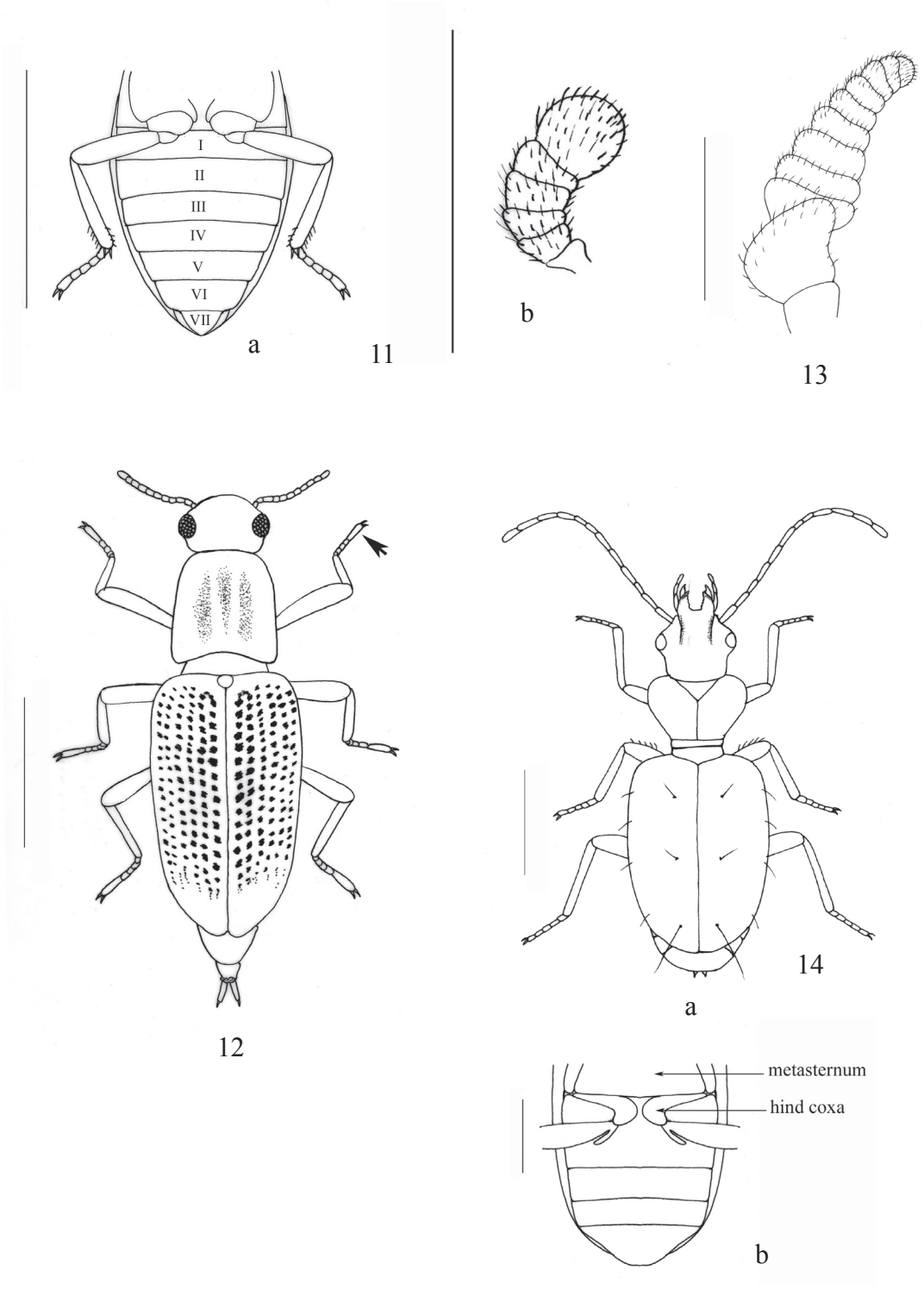


Fig. 11-14 11. Abdomen (a) and antenna (b) of Hydraenidae; 12. Dorsal view of Elmidae; 13. Antenna of Dryopidae; 14. Dorsal view (a) and abdomen (b) of Carabidae Scale: (12, 14a-b) 1 mm (11a-b, 13) 0.5 mm.

Key to Families of Mature aquatic Coleoptera Larvae of Indochina

1 Legs absent, or present with 3-4 segments; tarsi with single claw 2
1′ Legs with 5 segments; tarsi with 2 claws (except Halipidae have a single claw) .. 14

2(1) Labrum separated from clypeus (Fig. 19b) 7
2′ Labrum not separated (Fig. 16a) 3

3(2′) Legs present and well developed (Fig. 15, 19a) 5
3 Legs absent or reduced in size; thoracic and abdominal tergites not distinctly visible 4

4′ Legs well developed; thoracic and abdominal segments without hook ventrally ..... Circulionidae
4′ Legs minute; last abdominal segment with a pair of hooks ventrally ..... Chrysomelidae

5(3′) Body round or dorsoventrally subcylindrical; head projecting anteriorly from thorax and visible from above (Fig. 19) 6
5′ Body dorsoventrally flattened; pronotum expanded anteriorly, head not visible from above (Fig. 15) ..... Lampyridae

6(5) Palpiger of maxilla separated from stipe (Fig. 16b) ..... Hydrophilidae
6′ Palpiger of maxilla fused with stipe (Fig. 17) ..... Staphylinidae, in part

7(2′) Antennae with 2 segments ..... Hydroscaphidae
7′ Antennae with at least 3 segments 8

8(7′) Abdomen with 10 segments, segment 9 with articulated cerci having 1-2 segments 9
8′ Abdomen with 9 segments, segments 8 and 9 sometimes with immovable urogomphi; without articulated cerci 10

9(8) Mandibles small sickle-shaped, without molar lobe ..... Staphylinidae, in part
9′ Mandibles large, with molar lobe (Fig. 18) ..... Hydraenidae

10(8′) Antennae distinctly longer than head capsule (Fig. 19a), with many segments ..... Scirtidae
10′ Antenna short, with 2-3 segments 11

11(10′) Larva dorsoventrally very compressed; thoracic and abdominal terga expanded laterally covering head and legs (Fig. 20) ..... Psephenidae
11′ Larva round or subcylindrical; head and legs visible from dorsal view (Fig. 21a) 12

12(11′) .Posterior abdominal segment apically bifid; (Fig. 21b); head capsule with 5 ocelli ..... Elmidae
12′ Posterior abdominal segment apically round; eye absent or with 6 ocelli 13

13(12′) Abdominal segment IX with operculum (as Fig. 21a); abdominal segments I-VIII without gills ..... Dryopidae
13′ Abdominal segment IX without operculum; abdominal or anal gills present ..... Ptilodactylidae

14(1′) Abdominal segment X with 2 pairs of terminal hooks (Fig. 22b), segments I-IX with lateral gills (Fig. 22a) ..... Gyrinidae
14′ Abdominal segment X without terminal hooks, abdomen without lateral gills 15

15(14′) Abdomen with more than 8 segments 16
15′ Abdomen with 8 segments 17

16(15) Each leg with a single tarsal claw (Fig. 23a-b) ..... Halipidae
16′ Each leg with 2 tarsal claws ..... Carabidae

17(15′) Abdominal segment VIII with spiracle (Fig. 24)..... 18
17′ Abdominal segment VIII without spiracle ..... Hygrobiidae

18(17) Cerci as long as or longer than length of abdominal segment I (Fig. 25) ..... Dytiscidae, in part
18′ Cerci absent or shorter than length of abdominal segment I 19

19(18′) Legs short and modified for digging; mandibles stout and never sickle-shaped..... Noteridae
19′ Legs long, well-developed for walking; mandibles long narrow and sickle-shaped.. ..... Dytiscidae, in part

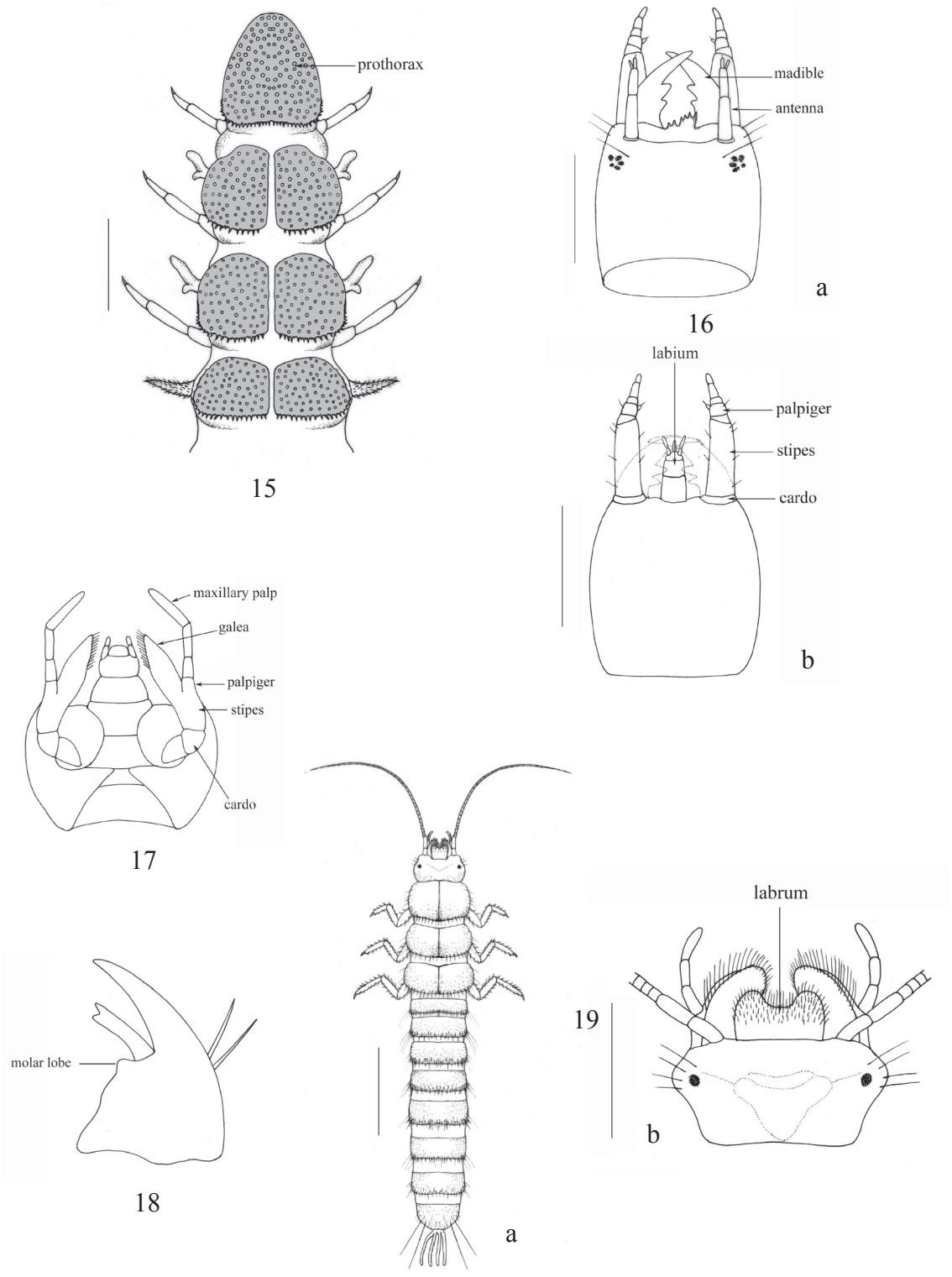


Fig. 15-19 15. Dorsal view of thoracic segments of Lampyridae; 16. Dorsal view (a) and ventral view (b) of head of Hydrophilidae; 17. Ventral view of head of Staphylinidae (redrawn from White & Brigham, 1996, fig. 20.7); 18. Mandible of Hydraenidae (redrawn from White & Brigham, 1996, fig. 20.168); 19. Dorsal view (a) and head (b) of Scirtidae.
Scale: (15, 19a) 1 mm; (16a-b, 19b) 0.5 mm.

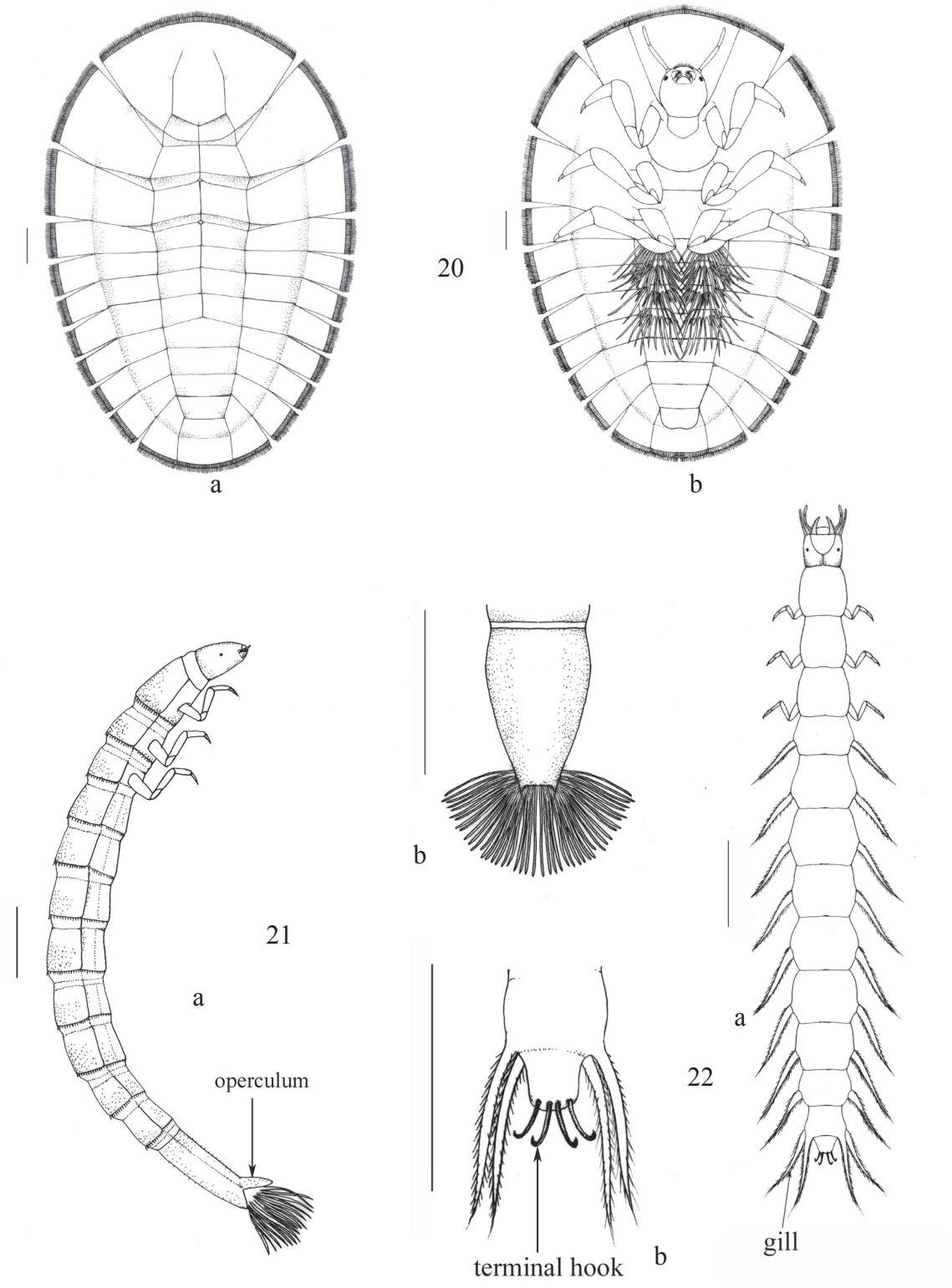
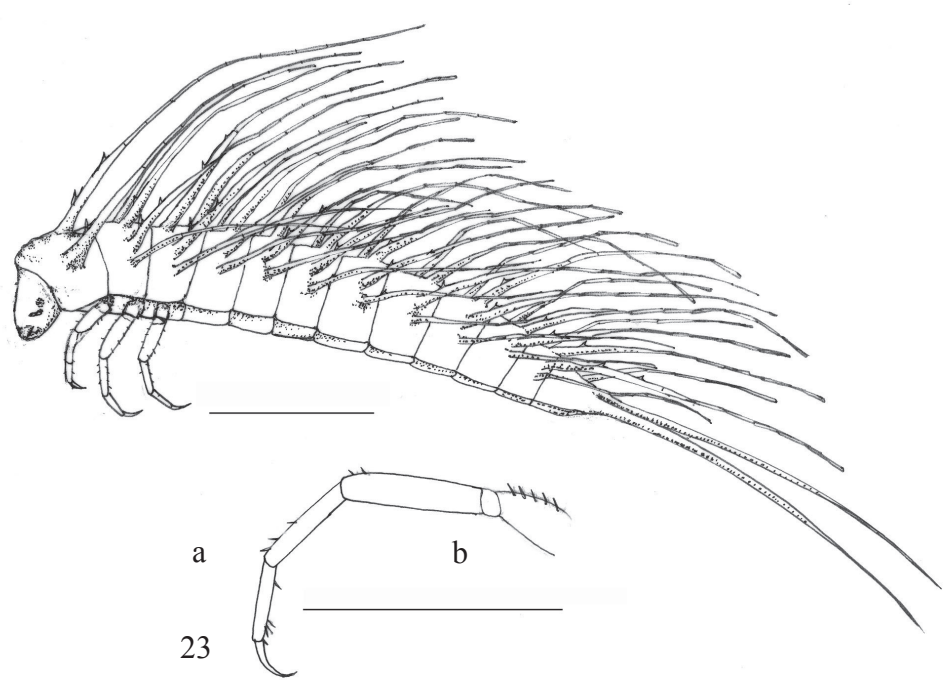
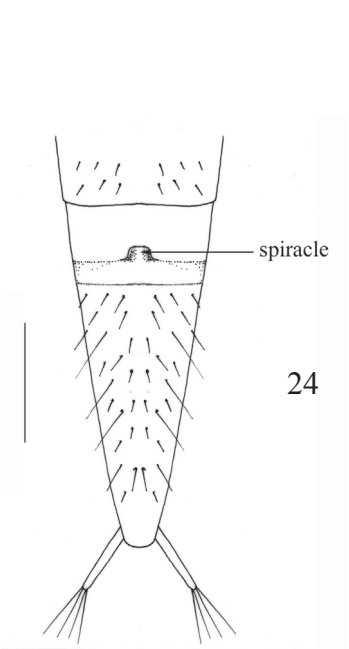


Fig. 20-22 20. Dorsal view (a) and ventral view (b) of Psephenidae; 21. Lateral view (a) and posterior end (b) of Elmidae; 22. Dorsal view of larva (a) and abdominal segment X (b) of Gyrinidae.
Scale = 1 mm.





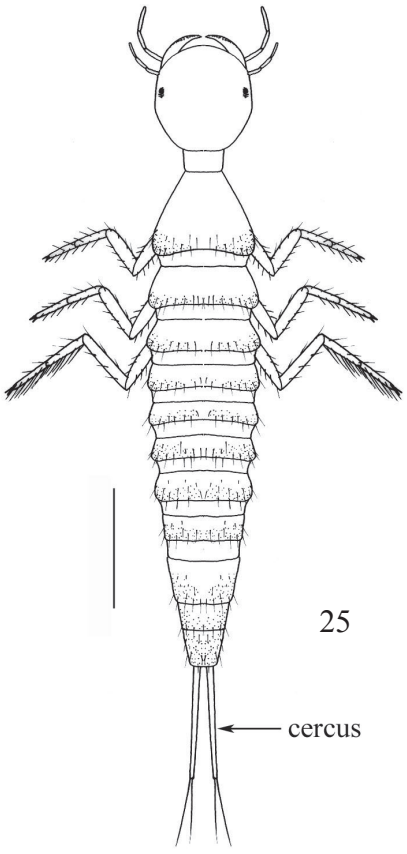


Fig. 23-25 23. Lateral view of larva (a) and foreleg (b) of Halipidae; 24. Dorsal view of abdominal segment 8 of Dytiscidae; 25. Dorsal view of larva of Dytiscidae Scale = 1 mm.