and apically detached. The siphonal tuft (1-S) is located well beyond the middle of the siphon.

The structure of the female genitalia and some male characteristics resemble the species of the subgenus *Stegomyia*; therefore a close relationship between the two subgenera is assumed. The subgenus *Aedimorphus* embraces approximately 110 species and subspecies. The majority of them can be found in the Ethiopian and Oriental regions. Only one species of *Aedimorphus*, namely *Ae. vexans*, occurs in Europe.

Aedes (*Aedimorphus*) *vexans* (Meigen 1830) [*Aedimorphus vexans*]

Female: Tarsomeres II and III of the fore legs, tarsomeres I–IV of the mid legs, and all the tarsomeres of the hind legs have narrow basal pale rings which usually do not exceed more than 1/4 of the length of the tarsomeres (Fig. 6.27a). Compared to other European *Ochlerotatus* species with pale rings on the legs, *e.g. Oc. annulipes*, *Oc. cantans*, *Oc. flavescens*, or *Oc. excrucians*, the rings are much narrower. The proboscis and palps are dark scaled, and the palps have some white scales apically. The head is covered with narrow curved decumbent pale and dark scales and numerous dark brown erect forked scales which extend anteriorly to the interocular space. The scutal integument is dark brown, and the scutum is covered with narrow curved dark scales and narrow pale scales forming indistinct patches on the anterior submedian, and prescutellar dorsocentral areas, as well as on the transverse suture. The acrostichal and dorsocentral setae are well developed. The postspiracular area has a large patch of narrow curved or moderately broad pale scales. The upper and lower mesepisternal scale patches are present. The mesepimeron has a patch of broad pale scales in the upper part. The tibiae are dark scaled dorsally and light scaled ventrally. The wing veins are covered with moderately broad dark scales and isolated pale scales at the bases of the costa (C) and subcosta (Sc). The abdominal terga have white basal bands with the distal parts dark scaled. The basal bands on terga III–VI are distinctly narrowed in the middle, forming a bilobed pattern (Fig. 6.27b). Old and worn females, which have lost most of their scales, can still unequivocally be identified by the distinct V-shaped notch at the apical margin of sternum VIII.

Male: Tergum IX is strongly bilobed with 6–11 setae on each lobe. The gonocoxite is long and moderately broad, with scattered scales on the lateral and ventral surfaces. The basal and apical lobes are absent. The gonostylus gradually expands towards the apex. The spine of the gonostylus is articulated subapically arising from a small tubercle, and is straight (Fig. 10.6). The claspette has a moderately broad basal part, and the apex is slightly expanded and rounded, with a crown of numerous spine-like setae, some of them curved apically. The claspette filament is absent. The paraproct has a pointed apex, and the aedeagus is strongly sclerotized, with lateral plates connected at the base.

Larva: The antenna is less than half as long as the head, with numerous spicules scattered over the shaft. The antennal seta (1-A) with 5–10 branches, is inserted below the middle of the antenna. The median setae of the labral brush are serrated apically, a valuable characteristic to distinguish *Ae. vexans* from the similar larvae of *Ae. rossicus* and *Ae. cinereus*, both of which have simple setae. The frontal setae (5-C to 7-C) are arranged in a triangular pattern (Fig. 8.21a), the median frontal seta (6-C) is situated in front of the inner frontal seta (5-C); 5-C has 1–5 branches, 6-C has 1–2 (rarely 3) branches, and 7-C has 6–12 (usually 7–9) branches. The comb with 7–13 scales is arranged in 1–2 irregular

Fig. 10.6 Hypopygium of *Ae. vexans*

rows (Fig. 10.7). Each comb scale has a long, stout pointed median spine and small spines at the base. The siphonal index is usually 2.3–3.0. The pecten has 13–18 teeth, the apical 2–3 teeth are larger than the others and detached. The basal teeth are with 1–3 lateral denticles. The siphonal tuft (1-S) is situated well beyond the middle of the siphon, with 3–8 short branches, and about half as long as the width of the siphon at the point of origin. The saddle reaches far down the sides of the anal segment, and the saddle seta (1-X) has 1–2 branches. The ventral brush has precratal setae (4-X). The anal papillae are distinctly longer than the saddle.

Biology: *Ae. vexans* is a polycyclic species predominantly breeding in inundated areas such as floodplains of rivers or lakes with fluctuating water levels. The preferred breeding sites are temporary water bodies with neutral to alkaline water, which are present only a few days to weeks after a flood, such as flooded meadows, poplar cultures, willow and reed areas. Usually the larvae hatch in large numbers if the water temperature exceeds 9°C. In central Europe they occur in springtime when the typical snow-melt mosquitoes, such as *Oc. cantans* are already hatched. After flooding, the larvae hatch within a few minutes to hours when the flooded water becomes stagnant and the content of oxygen decreases. The hatching behaviour of the larvae is adjusted to the temporary water conditions. After the completion of the embryogenesis, which may last 4–8 days (about 1 week at 20°C), not all the larvae hatch after flooding, but only a proportion of them ("hatching in installments"). If one population of larvae fail to complete the development due to drying out, a second population can develop during a following flood even if no additional eggs are laid. The hatching rate is particularly high at high water temperatures and after the completion of a diapause, which lasts from September to early March of the following year in temperate zones. If suitable hatching conditions fail to exist (*e.g.* lack of floods during summer), the eggs are capable of surviving for a long time (at least 5 years).

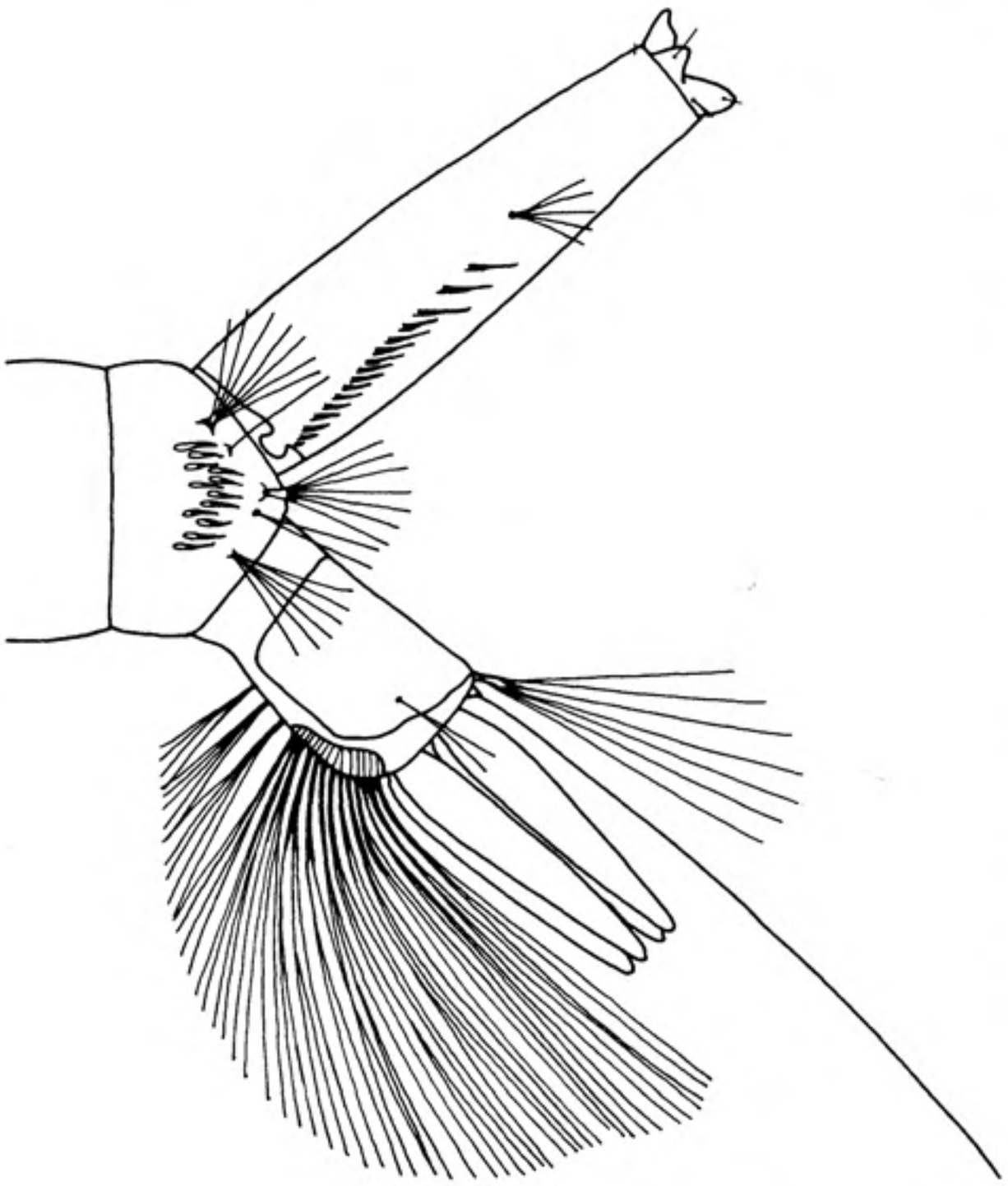

Fig. 10.7 Larva of *Ae. vexans*

Ae. vexans as a "summer species" has an optimum temperature of 30°C for its development. At a water temperature of 30°C, the development from hatching of the first-instars to emergence of the adults lasts 1 week; at a temperature of 15°C it is 3 weeks. *Ae. vexans* frequently becomes the dominant species during the summer months rich in floods and is often the most important nuisance mosquito in temperate climate zones. Often, hundreds of larvae per liter of water can be encountered, that is frequently >100 million larvae per hectare. Owing to the pressure of a large population, after mass emergence, the adults frequently migrate long distances from their breeding sites to find a host for the blood meal and thus may become a serious nuisance, not only close to the breeding sites, but also far away from their breeding waters. A migration of up to 15 km (according to the circumstances, the flight capacity is about 1 km/night), occasionally even a multiple of that, could be proven. The imigration of females into human settlements, *e.g.* gardens and parks, can cause a considerable nuisance. After the blood meal, the females lay the eggs 5–8 days at the earliest into damp depressions. A female can lay >100 eggs after a single blood meal; occasionally after repeated blood meals, multiple egg batches are laid. The preferred hosts are mammals. Both females and males imbibe plant juices in order to cover their energy requirements. However, no eggs are developed without a blood meal. Under optimum conditions, *Ae. vexans* needs less than 3 weeks from hatching of one generation to the hatching of the larvae of the next

generation (development in water: approx. 6 days; copulation: approx. 2 days; blood meal: approx. 2 days; egg development: approx. 5 days and embryogenesis about 4 days). It is suspected that only a part of the emigrated population returns to the original breeding sites after the blood meal, while a considerable part of the population do not return and lay eggs far away from their original breeding sites. Therefore, the migration leads to a natural regulation of the population densities.

Distribution: *Ae. vexans* is distributed almost worldwide and can be found in nearly every country in Europe.

Medical importance: *Ae. vexans* has many attributes of an ideal vector species. It is widely distributed, can become very abundant, often at the same time when virus activity is at its peak, it feeds readily on humans and domestic animals, and it has been found naturally infected with various arboviruses (Reinert 1973). Natural infections with western equine encephalomyelitis (WEE) virus, eastern equine encephalomyelitis (EEE) virus and California encephalitis (CE) group viruses have been reported from North America (Wallis et al. 1960; McLintock et al. 1970; Hayes et al. 1971; Sudia et al. 1971). In Europe, *Ae. vexans* is involved in the transmission of Tahyna virus (Aspöck 1965; Mattingly 1969; Gligic and Adamovic 1976; Lundström 1994).

Note on systematics: Three subspecies of *Ae. vexans*, ssp. *arabiensis* (Patton 1905), ssp. *nipponii* (Theobald 1907) and ssp. *vexans* (Meigen 1830), have been described (Reinert et al. 2009).

10.1.3 Subgenus *Fredwardsius* Reinert

The establishment of the monotypic subgenus *Fredwardsius* is based on the type species, *Ae. vittatus* (Reinert 2000a). The species has long been recognised to not fully conform to any recognised subgenus of *Aedes*. Edwards (1932) included *Ae. vittatus* in the subgenus *Stegomyia* Theobald and placed it in a monotypic group (Group D), apart from other species of the subgenus. Later on, Huang (1977) transferred *Ae. vittatus* from subgenus *Stegomyia* Theobald to subgenus *Aedimorphus* Theobald, mainly based on the structure of the male hypopygium. After a comparison of *Ae. vittatus* with all currently recognised subgenera and genera in the tribe Aedini, Reinert (2000a) found the species shared some characteristics with the subgenera *Stegomyia* and *Aedimorphus*, but possessed unique and unusual characteristics, that are of subgeneric rank. The combination of these characteristics distinguishes *Fredwardsius* from all other subgenera and genera within the tribe Aedini, *e.g.* 2–6 well developed lower mesepimeral setae in the female, the greatly expanded distal portion of the gonostylus in the male hypopygium, and the position and development of head setae 4-C to 7-C in fourth-instar larvae. For a more detailed morphological description of the subgenus, see Reinert (2000a).

Aedes (*Fredwardsius*) *vittatus* (Bigot 1861) [*Fredwardsius vittatus*]

Female: The proboscis is as long as the fore femur. Its median part has a band of whitish scales of varying width, which is better developed ventrally than on the dorsal surface. The palps have a few white scales in the middle and the apex is broadly pale scaled. The clypeus has lateral patches of white scales. The antennae are shorter than the proboscis, and the pedicel and first flagellomere are white scaled on the median and lateral parts. The vertex has decumbent curved blackish brown scales and black, erect forked scales. There are two dorsolateral patches of white decumbent scales behind the eyes. The scutum is mainly covered with narrow, curved, blackish brown scales. Three pairs of prominent silvery whitish spots are present, located close to the dorsocentral areas (Fig. 6.24a). The anterior two pairs are usually larger than the posterior pair, which is situated close to the wing roots. All three lobes of the scutellum have broad white scales, and a few black scales may be present at the apex of the middle lobe. Broad white scale patches are present on the ante- and postpronotum, propleuron, postprocoxal membrane, and sub- and postspiracular areas. The mesepisternum has upper and lower scale patches. The mesepimeral patch is located in the upper part of the mesepimeron. The femora of all the legs have a white ring close to their apices and white knee spots, and the hind femur is more extensively white scaled at the base. The hind tibia has a distinct median white ring. The tarsi of the fore and mid legs have narrow white basal rings on tarsomeres I–III, and tarsomeres IV and V are entirely dark. The tarsi of the hind legs have broad white basal rings on tarsomeres I–IV, but tarsomere V is entirely white scaled. The wing veins are mainly dark scaled, with a few broad white