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Taxonomy and Morphology of the West African Army Ant, *Aenictus asantei* n. sp. (Hymenoptera: Formicidae)[1]

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ABSTRACT A new species of West African army ant, *Aenictus asantei*, is described from the worker caste and queen. The worker can be distinguished from other African species by the combination of the following characteristics: its large size, the presence of denticles on the anterior margin of the clypeus, and the rugous nature of the posterior two-thirds of the alitrunk. The queen is only the fourth in the genus from sub-Saharan Africa to be described and is unique thus far among the queens in its possession of a median ocellus. Other *Aenictus* queens lack both eyes and ocelli. A detailed histological description of the internal morphology of the worker is provided.

The army ant genus *Aenictus* is widely distributed throughout the Old World tropics and subtropics. This genus of small, virtually monomorphic, ants comprises the Aenictini, a tribe currently placed in the Old World army ant subfamily Dorylinae. Wilson (1964) recorded 34 species of *Aenictus* from tropical Asia, Australia, and New Guinea and estimated that there were approximately 15 species in Africa. Because most species of *Aenictus* are based on unassociated phena, two classifications for the genus actually exist, one for the worker caste and one for the males. Among African species a third classification exists, this one based solely on unassociated queens (Gotwald and Leroux 1980).

The taxonomy of the African species of *Aenictus* can only be described as chaotic. The long history of species being based on isolated phena and the fact that the African forms have not been reviewed since 1910 (Emery) contribute substantially to this confusion. The species *A. asantei* described here is a relatively conspicuous species from West Africa. It represents a fourth sub-Saharan species for which the queen and workers are known, and is unique thus far among these species because the queen possesses a single, medially placed ocellus. Other queens lack both compound eyes and ocelli.

One of us (W.H.G.) is currently revising the genus, and this paper is a contribution to the revision. The purpose of the paper is to describe a new species of *Aenictus* based on two associated phena, the worker and the queen, and to provide a detailed histological description of the internal morphology of the worker.

Materials and Methods

The species described was collected on five occasions in Ghana, four times in coastal scrub and grassland at Legon, and once in moist, semideciduous forest at Jukwa. The species description is based on specimens from a colony selected because the queen was collected as the colony emigrated from one nesting site to another. The colony was discovered on 27 June 1971.

Sectioned specimens were embedded either with a modified methylbenzoate-celloidin or by Salthouse's double embedding technique (Chesterman and Leach 1949, Salthouse 1958). Sections were stained with Delafield's hematoxylin I (progressive method) or Gomori's chrome alum hematoxylin. All sections were mounted in Permount.

Histological preparations were photographed with a Nikon microflex automatic photomicrographic attachment on a Nikon phase-contrast microscope. An International Scientific Instruments (ISI-40) scanning electron microscope was used.

Species Description

Aenictus asantei Campione, Novak, and Gotwald, n. sp.

Worker, composite description. Habitus as in Fig. 1 A and B; total length 3.47–3.89 mm; head, alitrunk, waist, and gaster dark reddish brown to reddish orange; legs and antennae orange-brown to yellow-orange; bullae of metapleural glands yellow, especially conspicuous in darkly pigmented individuals. Pilosity moderately abundant, consisting of erect to suberect setae.

Head as in Fig. 1C; head length 0.63–0.77 mm; head width 0.63–0.72 mm; cephalic index (HW/HL × 100) 93.5–107.9. Head glossy, without obvious punctures; parafrontal ridges (elevated lines extending longitudinally from clypeus laterad to the antennal fossae) well developed, each terminating in a minute spine. Frontal carinae expanded anteriorly to form thin flanges projecting dorsally; clypeus bearing distinct serial teeth (Fig. 1C and 3 A and B); occipital collar present; eyes absent. Antenna 10-segmented, scape length 0.54–0.63 mm. Mandible flattened, linear, striolate, with sharp apical tooth; subapical teeth absent, although some denticles may be present (Fig. 2B). Labrum bilobed with smoothly rounded median cleft (Fig. 2A); maxillary palpus two-segmented (Fig. 2C); lateral shoulder of stipes bearing three stout setae (Fig. 2C); stipes without transverse stipital groove; galeal crown flattened, invested with numerous setae (Fig. 2C); maxillary comb typical (Fig. 2C); lacinial apex bearing numerous, irregularly placed, fine setae (Fig. 2C); labial palpus two-segmented (Fig. 2D).

Alitrunk as in Fig. 1 A and B and 3C; alitrunk length 1.10–1.26 mm; without conspicuous suturing. Pronotum

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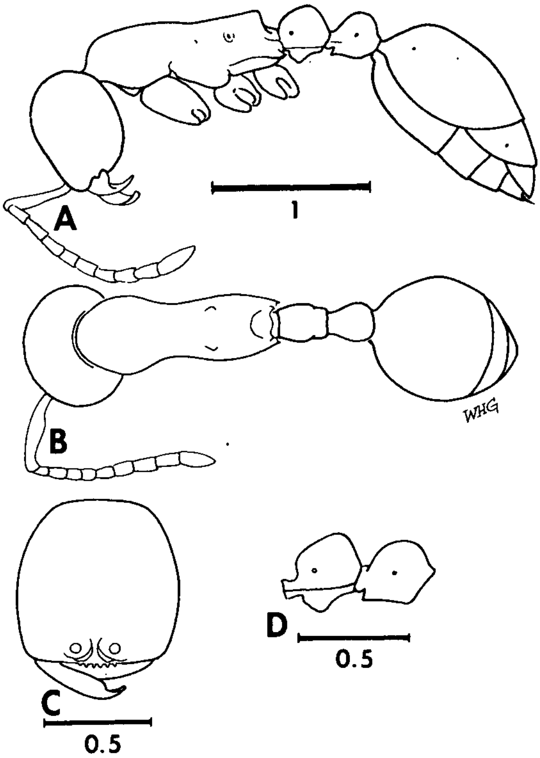

FIG. 1. External morphology of the worker (pilosity omitted). (A) General habitus, lateral view, legs omitted. (B) General habitus, dorsal view, legs omitted. (C) Head, dorsal view, antennae omitted. (D) Petiole and postpetiole (waist), lateral view. Scales in mm.

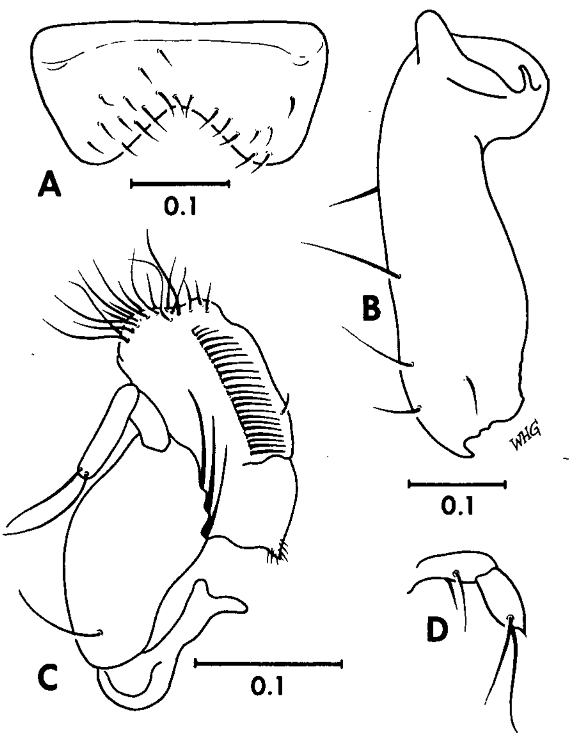

FIG. 2. Mouthparts of worker. (A) Labrum, external view. (B) Right mandible, dorsal view. (C) Left maxilla, external view. (D) Left labial palpus, medial surface. Scales in mm.

glossy except for anterior dorsal slope, this densely punctate; posterior two-thirds of alitrunk subopaque with well-developed longitudinal rugae, especially on pleurae (Fig. 3C); propodeal junction marked by sharply produced ridge extending laterally and bordering declivitous face of propodeum; declivitous face densely punctate.

Petiole and postpetiole as in Fig. 1D; waist (petiole plus postpetiole) length 0.63–0.68 mm; petiole node length 0.29–0.36 mm, width 0.18–0.27 mm; postpetiolar node length 0.27–0.36 mm, width 0.20–0.27 mm. Waist opaque, densely punctate; subpetiolar process triangular with rounded apex, usually directed ventrally or posteriorly (Fig. 1D).

Gaster as in Fig. 1 A and B; gaster length 1.13–1.26 mm. Gaster glossy, lacking obvious punctures.

Tarsal claws simple.

Type specimens were collected at the University of Ghana, Legon, on cultivated land in what constitutes the University farm system. Legon is located 8 mi north of Accra in a savanna region referred to as coastal scrub and grassland. The holotype worker, from type colony GC-047, and some paratypes are deposited in the Museum of Comparative Zoology at Harvard University, Cambridge, Mass. Other paratypes are deposited in the Musée Nationale d'Histoire Naturelle, Paris; the British Museum (Natural History), London; the Royal Ontario Museum, Toronto; and with the collection of the Department of Zoology, University of Ghana, Legon.

The species is named for the Asante people of Ghana.

Queen description. Habitus as in Fig 4 A and B; total length 9.86 mm; head, alitrunk, waist, and gaster reddish orange; legs yellow-orange. Pilosity moderately abundant.

Head as in Fig. 4C; head length (excluding mandibles) 1.44 mm; head width 1.50 mm; cephalic index 104.1. Head glossy, without obvious punctures; frontal carinae forming flanges on antero-mesal boundaries of antennal fossae; clypeus bearing teeth irregular in shape and length; one median ocellus present. Antenna 10-segmented, scape length 0.72 mm. Mandible linear without subapical teeth; labrum bilobed with smoothly rounded median cleft.

Alitrunk as in Fig. 4 A and B. Alitrunk glossy without obvious punctures. Pronotum carapace-like, continuous, with slightly elevated mesonotum; metanotum not distinguishable; alitrunk without conspicuous suturing; propodeal junction smoothly rounded.

Petiole as in Fig. 4D; petiole length 0.90 mm; petiole width 0.90 mm; petiolar node length 0.72 mm. Petiole glossy without obvious punctures; subpetiolar process triangular with rounded, posteriorly directed apex (Fig. 4D).

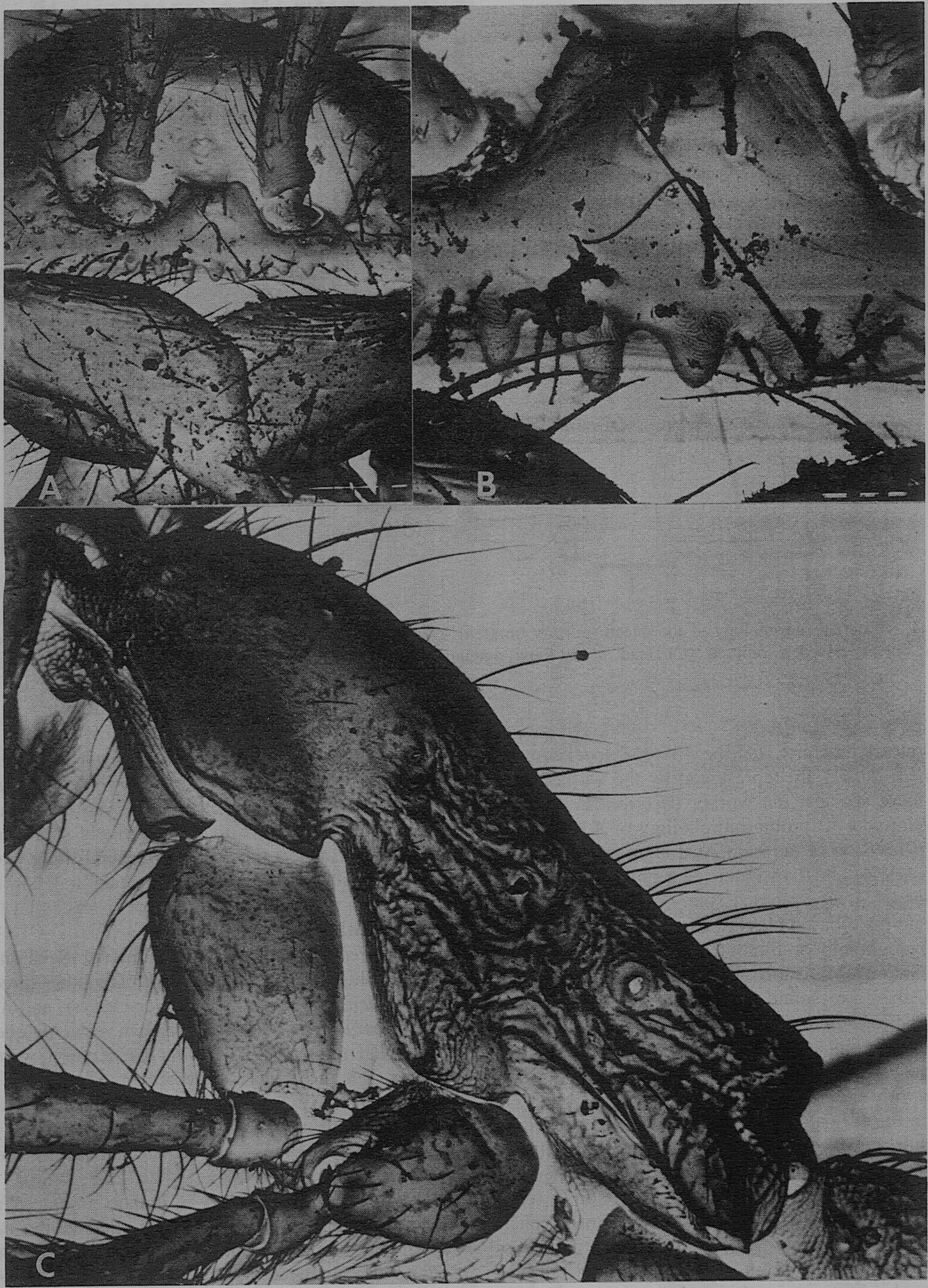

FIG. 3. External morphology of worker, scanning electron micrographs. (A) Head, oblique dorsal view. (B) Clypeal teeth, oblique dorsal view. (C) Alitrunk, lateral view.

Gaster as in Fig. 4 A and B; gaster length 5.18 mm. Gaster glossy without obvious punctures; pygidium armed with lateral spines (Fig. 4B).

The queen is deposited in the Museum of Comparative Zoology of Harvard University.

Taxonomic Discussion

Fifty-one of the type specimens representing the 64 nominal forms of African *Aenictus* have been examined by one of us (W.H.G.). *A. asantei* has been compared with all holotype and paratype workers among these 51

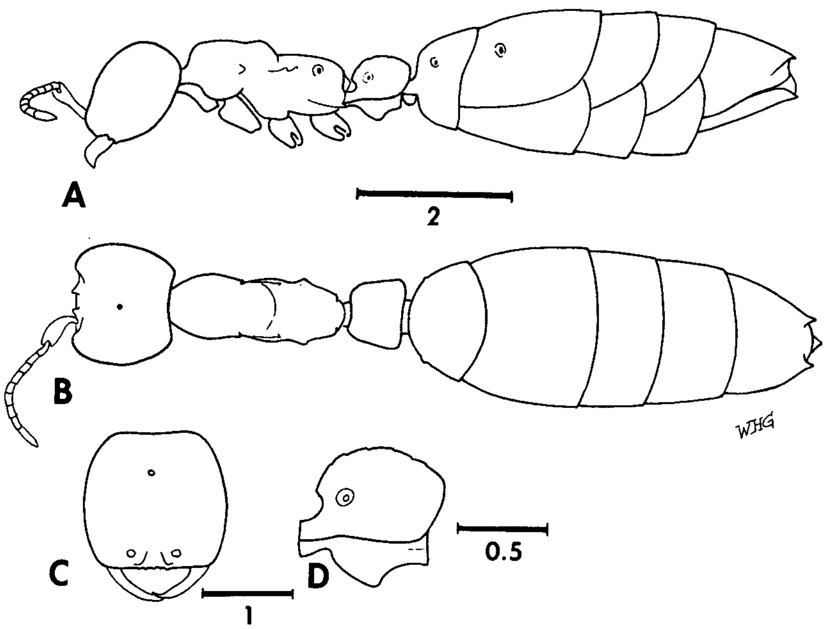

FIG. 4. External morphology of the queen (pilosity omitted). (A) General habitus, lateral view, legs omitted. (B) General habitus, dorsal view, legs omitted. (C) Head, dorsal view, antenna omitted. (D) Petiole (waist), lateral view. Scales in mm.

and is clearly distinct. Of the 13 type specimens not examined, only 3 are represented by the worker caste. In all these species, the worker descriptions depart in significant ways from the morphology of *A. asantei.*

In his revision of the Indo-Australian true army ants, Wilson (1964) chose to ignore that portion of the classification of *Aenictus* based solely on males because a "separate male-based classification would be of too little zoogeographic or biological interest to justify the nomenclatural confusion attendant on cultivating it." Indeed, there are sound reasons for avoiding the kind and magnitude of confusion evident in the taxonomic literature on army ants. Yet, because males are produced by colonies only periodically and because they probably remain with either their colony of origin or colony of adoption for only a short period of time, the probability of establishing worker-male associations is disappointingly low. We believe it decidedly judicious to maintain the male and queen classifications, since to do so serves at least to catalog existing forms, regardless of the phena representing the forms. We use the word "judicious" because it is now apparent that tropical habitats, especially lowland forests, are being destroyed or otherwise altered at an alarming rate and that this destruction will increase the extinction rate of tropical organisms. In the report of the National Research Council's (1980) Committee on Research Priorities in Tropical Biology, it was recommended that, because of the rapidity with which tropical vegetation is being destroyed, "high priority in the immediate future ought to be accorded to collecting and identifying species in relationship to other groups."

Obviously, any species based on fewer than the total number of phena may eventually by synonymized as appropriate associations between the various phena are discovered. We believe that in relatively small genera like *Aenictus,* where the chances of establishing worker-male associations are small, nomenclatural confusion will be minimized, in spite of the coexistence of a three-track classification system.

A. asantei represents only the fourth sub-Saharan species for which the queen is known. The other three are *A. congolensis* Santschi, *A. decolor* (Mayr), and *A. eugenii* Emery. Two additional African *Aenictus* queens, *A. abeillei* (André) and *A. vaucheri* Emery, were described, but these were collected in Algeria and Morocco and are known only from the queens (Wheeler 1930). The males have not been described for any of the sub-Saharan species for which the queens and associated workers are known.

The queen of *A. asantei* is unique among African queens in having a median ocellus and in the dorsal topography of the alitrunk. The queens of some Asian species also possess a median ocellus, e.g., *A. laeviceps* (Fr. Smith) (Wheeler 1930). In *A. asantei,* the mesonotum is elevated, representing a rather conspicuous departure from the other African queens in which the alitrunk is flattened dorsally, with little or no indication of its tergal elements. In turn, however, the African *Aenictus* queens are definitely distinct from the Asian forms, a fact not lost on Wheeler (1930), who noted that the queens of the Asian species *A. martini* (= *gracilis* Emery) and *A. laeviceps* "differ so widely from the three females previously known [all from Africa] that they would seem to belong to a distinct genus."

Internal Morphology of the Worker

Alimentary canal and accessory structures. The pharyngeal area of the alimentary canal follows the cibarium, and is essentially parallel to the dorsal surface of the head. The pharynx has a thin chitinous lining, the intima, thicker ventro-anteriorly, forming a platelike structure. The pharynx is laterally compressed (Fig. 5A) and becomes more circular as it approaches the brain. For the most part, the intima is invested with fine, hairlike spines (Fig. 5A) and has an underlying layer of epithelium consisting of flattened, squamous cells. The muscles of the pharynx include the transverse muscles (constrictors), which connect the lateral margins to each other ventrally. These muscles become more complete ring muscles posteriorly. Also included are two bundles of precerebral fronto-pharyngeal muscles and two bundles of anterior tentorio-pharyngeal muscles. Before passing through the brain, the pharynx bends posteriorly, and the transformation into esophagus begins. The pharynx decreases in diameter, the walls become thinner, and the circular musculature is complete.

The esophagus extends from the pharynx to the crop in the first gastral segment. The wall of the esophagus is uniform in appearance throughout its length. This distensible tube is made up of the intima and the underlying epithelial layer. There is evidence of irregular longitudinal ridges or folds but internal spines are not present. Circular musculature is abundant anteriorly but becomes sparse after the esophagus passes through the brain, where the esophageal wall is thinner and almost membranous. Approximately four to six longitudinal muscle fibers are associated with the esophagus as it passes between the supra- and subesophageal ganglia (Fig. 5B), but this type of muscle is not apparent beyond this point.

In the first gastral segment, the esophagus dilates to form the expansible crop, which completely occupies the major portion of this segment. Histologically, the crop is similar to the esophagus; the epithelial layer is quite thin, although the intima is slightly thicker.

In the crop the intima is thrown into a series of irregular folds and sharp ridges throughout the entire organ. Longitudinal muscle is absent from the crop wall, and circular muscle fibers occur only sparingly.

The posterior constricted portion of the crop, the proventriculus, is invested with an inner layer of longitudinal muscles covered with a single layer of circular muscle. Internally, the epithelial tissue and the intima are irregularly and deeply folded. The proventriculus closely resembles that of *Eciton hamatum* (F.) (Eisner 1957).

The ventriculus, with the crop, occupies the anterior gaster; it is elliptical, with the anterior portion rotund but narrowing caudally to a tubelike structure at the point where the Malpighian tubules insert. The walls are thick, composed of a thin basement membrane, a layer of regenerative cells with centrally located nuclei, and irregular layers of spindle-shaped digestive cells with discoid nuclei (Fig. 5C). The inner layer of digestive cells often form large reservoirs. The muscular coat of the ventriculus consists of sparsely arranged circular muscle fibers.

Posteriorly, the ventriculus tapers and forms the narrow, thinner-walled intestine. At this junction the Malpighian tubules radiate and extend into the posterior perivisceral sinus. It was not possible to determine the exact number of tubules, but there may be two or three. They are composed of a single layer of large, cuboidal cells with distinct nuclei; the lumen is smooth walled, narrow, and constructed at any single transect of 7 to 10 cells (Fig. 5C).

The multicelled wall of the ventriculus gradually diminishes in width as it becomes a convoluted intestine posteriorly, where the epithelium is formed of one layer of cuboidal cells with nuclei located in the basal portion of the cells. Internally, the epithelium is covered by a thin intima; both layers are arranged in longitudinal folds. Conspicuous circular muscle fibers surround the intestine, and occasional longitudinal muscles fibers are present.

Caudally, the intestine expands to form the bulb-shaped rectum. The walls become extremely thin; the epithelium is so reduced that only scattered nuclei are evident, and the intima varies in thickness and is arranged in irregular folds. As the rectum narrows to form the anal opening, in the dorsal part of the last gastral segment, the epithelium becomes distinct and forms a well-defined layer of cuboidal cells. Circular and longitudinal muscle is sparse, except postero-laterally where the rectum is closely flanked by large bundles of longitudinal muscle.

There are two rectal papillae protruding into the lumen of the rectum (Fig. 5D). Within each papilla, there is a layer of intima and a layer of spherical cells with distinct discoid nuclei, whereas externally there is a layer of columnar cells with long distinct nuclei. The intima is thicker and transparent around the wide margin of the papillae. Each papilla is invested with a layer of circular muscle.

Glands: Six paired glands and two unpaired glands were detected. The paired glands are the mandibular, maxillary, and pharyngeal in the head, the labial and metapleural in the alitrunk, and the poison filaments in the gaster. The pygidial and Dufour's glands are unpaired glands in the gaster.

The mandibular glands, one lateral to each of the antennal sockets, are composed of large globate cells with distinct discoid nuclei. Presumably each cell empties its products into a common duct that terminates at the base of its corresponding mandible.

The maxillary glands, located on each side of the pharynx, near the infrabuccal chamber, are made up of spherical cells with clear nuclei. Each cell narrows to form a small duct which unites with the ducts of other cells to produce a prominent duct opening into the corresponding lateral wall of the infrabuccal pocket.

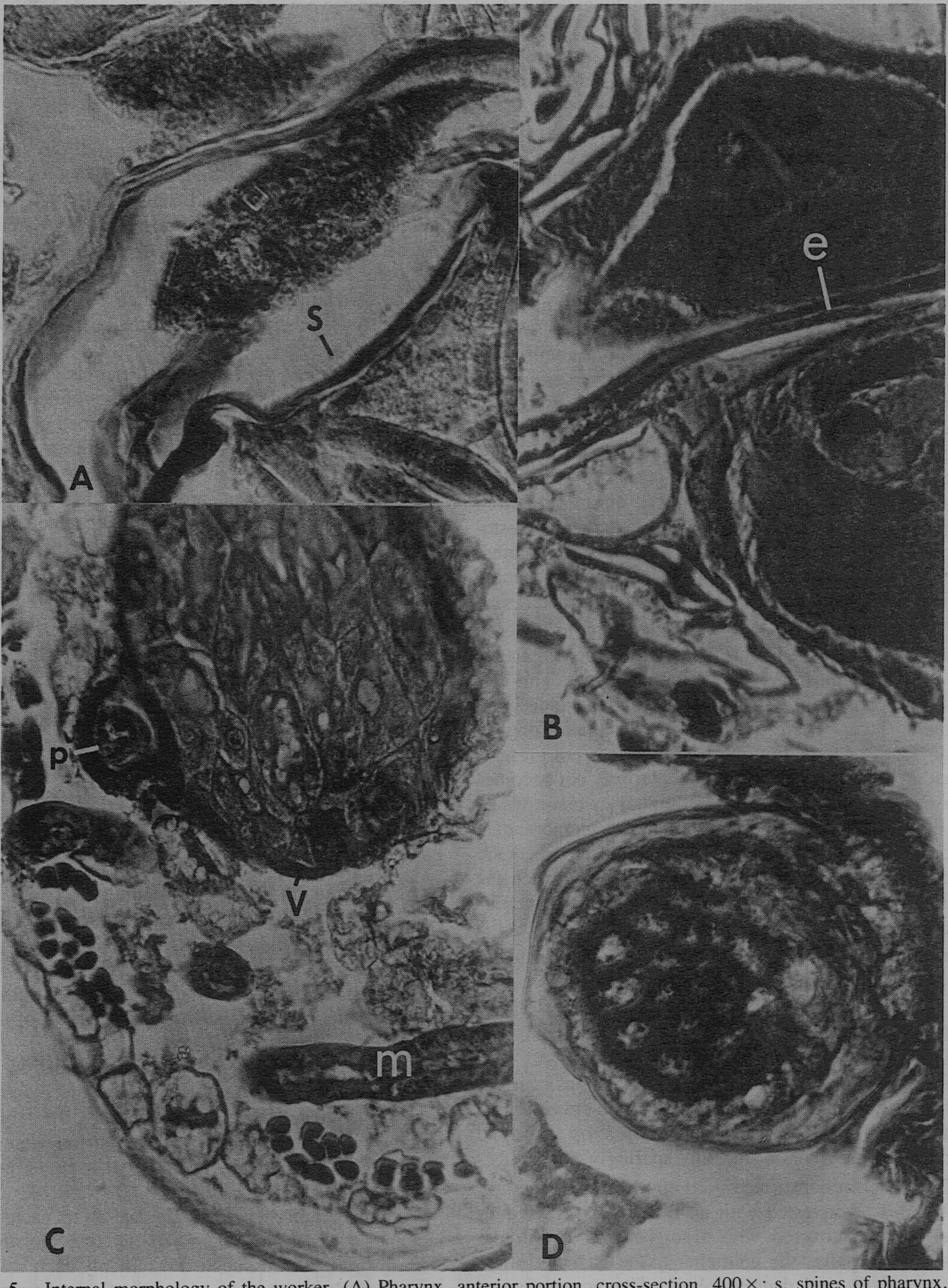

FIG. 5. Internal morphology of the worker. (A) Pharynx, anterior portion, cross-section, 400×; s, spines of pharynx. (B) Brain and esophagus, longitudinal section, 400×; e, esophagus. (C) Gaster, cross-section, 200×; m, Malpighian tubule; p, proventriculus; v, ventriculus. (D) Rectal papilla, longitudinal section, 400×.

The pharyngeal glands are composed of numerous tubules extending from the dorsal, posterior section of the pharynx. These tubes lie lateral to the brain and parallel to the pharynx. The tubes unite to form a pair of ducts that open separately on each posterior, dorsolateral area of the pharynx.

The labial glands are paired and are located dorsolaterally in the immediate anterior portion of the pro-

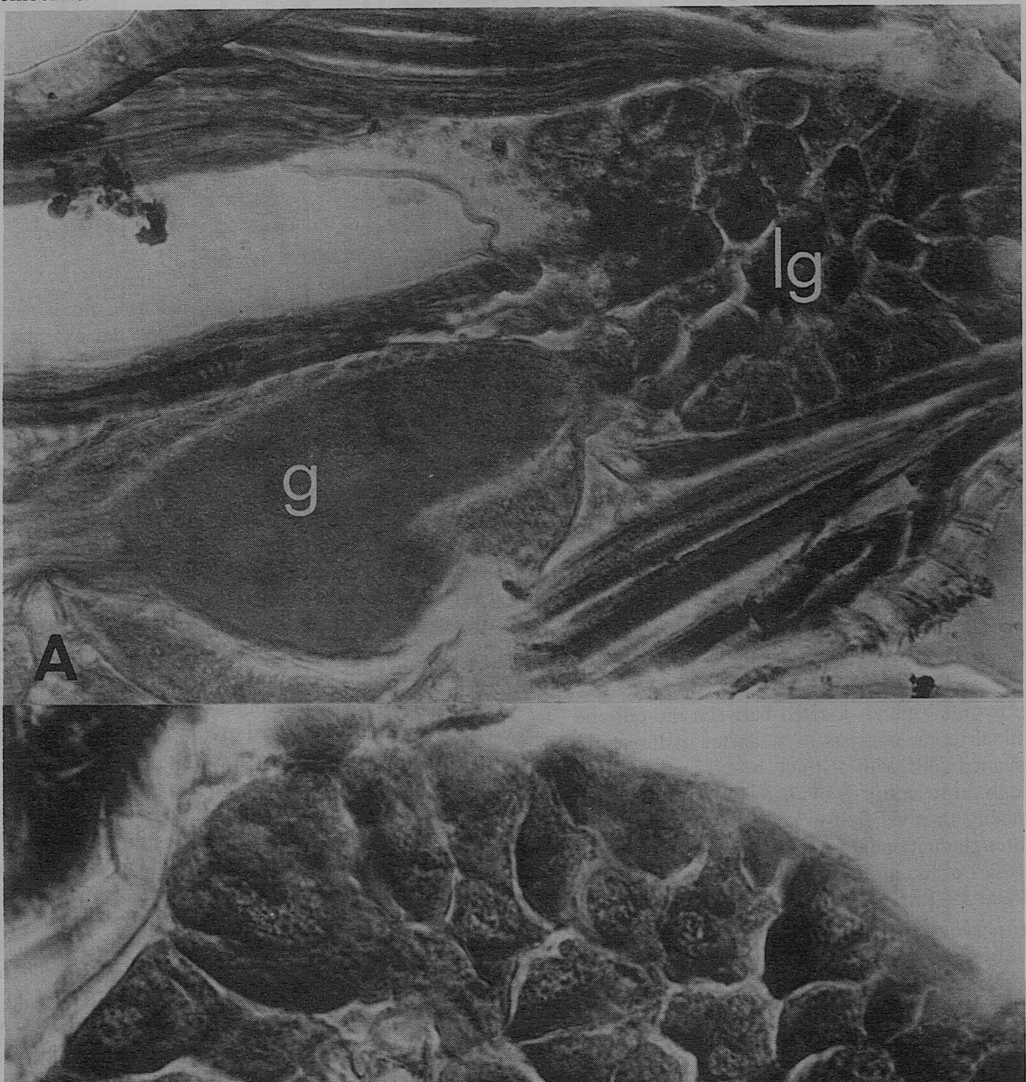

FIG. 6. Internal morphology of the worker. (A) Anterior alitrunk, longitudinal section, 400×; g, ganglion; lg, labial gland. (B) Metapleural gland, longitudinal section, 400×; r, reservoir.

thorax. Each gland consists of a large group of spherical cells (Fig. 6A) with ducts that unite to form ductlike reservoirs anterior and dorsad to each gland. A pair of lateral tubes, encased in muscle, lead anteriorly to the neck region, where they unite below the esophagus. This common duct passes ventrad of the brain and terminates in the labium. The labial duct orifice marks the boundary between the hypopharyngeal and premental regions of the labium (Gotwald 1969).

The paired metapleural glands, located posterolaterally in the alitrunk, are represented externally by the bullae, which cover the orifices of the collecting chambers. Internally, each gland is composed of a cluster of cells posterior to the third thoracic ganglion (Fig. 6B). Each gland extends medially to flank the posterior section of the ganglion. Each cell tapers toward the collecting chamber emptying into it through a minute intracellular duct.

The poison gland consists of paired filaments which unite to form a convoluted duct opening into a reservoir, the poison sac. The large poison sac is located between the ventriculus and the rectum. The sac is elliptical, although the structure may assume this shape from the pressure applied by the rectum (Gotwald 1971). The poison sac duct enters the sting bulb dorsal to the duct from Dufour's gland. The pair of poison gland filaments arise from the poison gland dorsally and anteriorly from the poison sac and are distributed at random in the gaster.

The Dufour's gland opens into the poison duct near the base of the sting and ventrad to the duct of the poison gland. Located ventro-lateral to the poison sac, this gland is elongate, although irregular in shape. The walls are composed of simple cuboidal cells, which vary in height, causing the surface of the lumen to appear irregular. The gland is invested with a single layer of circular muscle.

The pygidial gland, located between the 6th and 7th abdominal terga, consists of a cluster of large, irregularly shaped cells with distinct, round nuclei (Fig. 7A). Although no reservoir is evident, the intracellular ducts presumably (not verified in section) secrete their products through duct openings associated with filament-like protrusions of the intersegmental membrane (Hölldobler and Engel 1978).

The nervous system. The brain consists of a fused mass of nervous tissue, the supraesophageal and the subesophageal ganglia. It is perforated by the esophagus and its associated longitudinal muscle fibers (Fig. 7B). The paired ganglia of the brain can be recognized as three distinct areas, although the tritocerebrum is retained as a pair of small bodies concealed under the olfactory or antennal lobes, innervating the labrum and the walls of the pharynx (Wheeler 1910). The deutrocerebrum is characterized by the pair of antennal lobes. The corpora pedunculata can be easily distinguished in the protocerebrum (Fig. 7C), the largest pair of ganglia. The corpora pedunculata, or "mushroom bodies," are paired structures, lying on either side of the midline of the protocerebrum and occupying the bulk of the brain segment. Each corpus pedunculatum consists of a lateral and a medial calyx, which are fused. Immediately beyond this fusion two lobes are formed; the alpha lobe and the beta lobe (Vowles 1955).

The ventral nerve cord consists of eight ganglia, joined by paired interganglionic connectives, which enter the alitrunk from the subesophageal ganglion. Histologically, the connectives are composed of nerve fibers, whereas the ventral ganglia consist of a core of fibers surrounded by conspicuously nucleated neuron cell bodies. The first of the three ganglia of the alitrunk is partially encased by portions of the prosternum, whereas the other two are located in the posterior half of the alitrunk (Fig. 7D). The petiole and postpetiole each contain a small ganglion. Three closely connected ganglia are located in the anterior portion of the gaster. The last ganglion terminates ventrad of the ventriculus and is no doubt a composite of several fused ganglia.

Morphological Discussion

The internal morphology of the *Aenictus* worker has been largely ignored, as has indeed the external morphology. The mouthparts of *Aenictus* workers were examined by Gotwald (1969), who identified two distinct types of labrum in the genus (emarginate along the distal margin with and without a slitlike median cleft) and three kinds of mandible. Reid (1941) examined the worker alitrunk in army ants and concluded the alitrunk of *Aenictus* most closely resembles that of *Eciton*. Hermann (1969) included *Aenictus* in his investigation of the army ant sting apparatus. The only internal morphological study ever devoted exclusively to any *Aenictus* was that of the digestive system of the male of *A. gracilis* (Shyamalanath and Forbes 1980). Thus, although the present study makes no claim to be more than moderately detailed, it represents the first attempt to include a general histological and morphological review of the internal features of the *Aenictus* worker.

The alimentary canal, with the notable exceptions of the proventriculus and the numbers of Malpighian tubules, is rather uniformly developed throughout the family Formicidae. The pharynx and esophagus of *A. asantei* are not unlike those described for the army ants *Eciton hamatum* (F.) and *E. burchelli* (Westwood) (Whelden 1963), *Cheliomyrmex morosus* (F. Smith) (Gotwald and Kupiec 1975), and *Dorylus (Anomma) molesta* (Gerstaecker) and *D. (A.) nigricans* Illiger (Gotwald and Schaefer 1982). These similarities even include the hairlike spines that are produced by the intima of the esophagus and project into its lumen.

The proventriculus of *A. asantei* closely resembles the degenerative type of *E. hamatum* (Eisner 1957) and *C. morosus* (Gotwald and Kupiec 1975). Eisner (1957) reports that damming of this type of proventriculus is dependent upon continuous muscular contraction, and thus crop storage and trophallaxis may be weakly developed in the army ants. However, foraging *Dorylus (Anomma)* workers do return to the nest with crops filled with liquid probably of prey origin, indicating that the regurgitative exchange of food may be more important to army ants than previously assumed (Gotwald 1974). Santschi's (1933) observation that workers of *A. eugenii* Emery tend homopterans of the genus *Pseudococcus* suggests that these workers gather honeydew. Only one other observation of army ants gathering honeydew exists in the literature (Arnold 1915). Both observations support the view that crop storage is significant to army ants.

The spindle-shaped columnar digestive cells of the ventriculus wall are similar to those of the *A. gracilis* male (Shyamalanath and Forbes 1980). This type of cell is also present in *C. morosus* (Gotwald and Kupiec 1975)

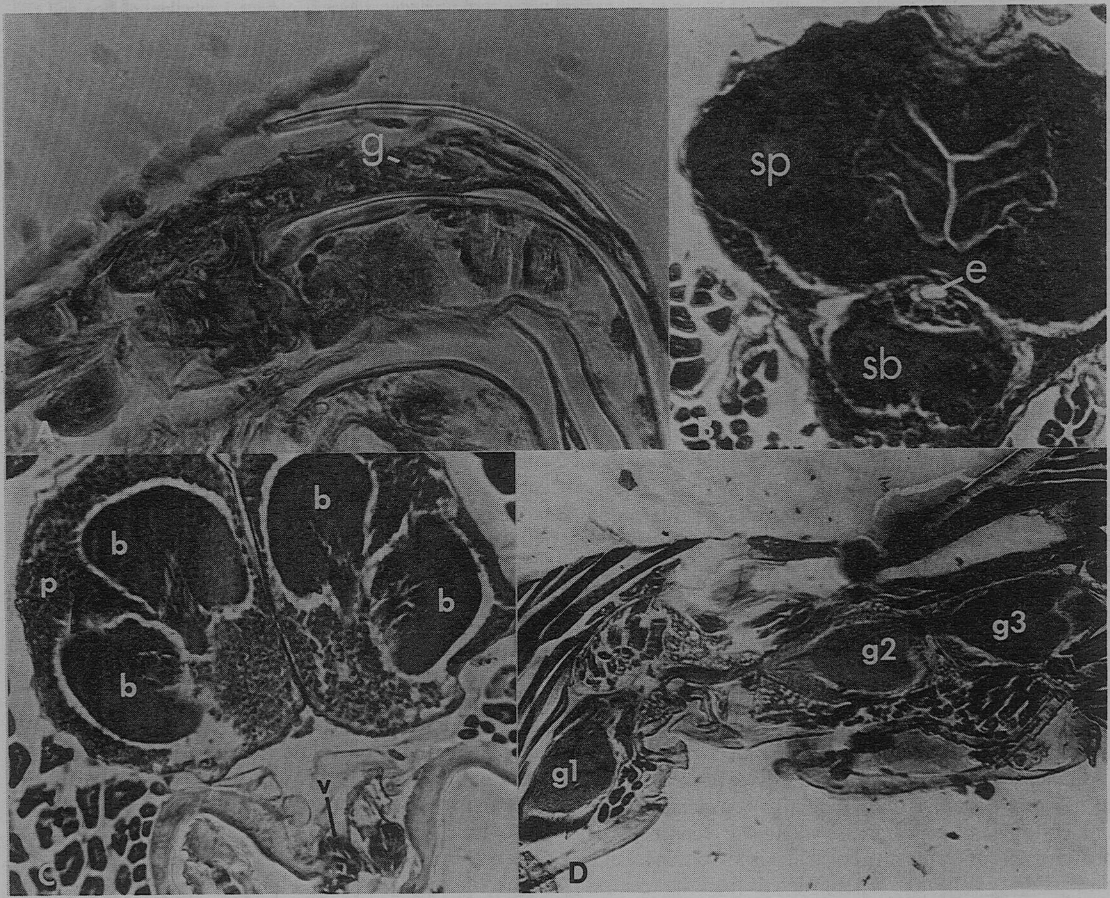

FIG. 7. Internal morphology of the worker. (A) Gaster, longitudinal section, 400×; g, pygidial gland. (B) Brain, middle portion, cross-section, 200×; e, esophagus; sb, subesophageal ganglion; sp, supraesophageal ganglion. (C) Brain, posterior portion, B cross-section, 200×; p, protocerebrum; b, corpora pedunculata ("mushroom bodies"); v, ventral nerve cord. (D) Alitrunk, longitudinal section, 200×; g1, g2, g3, first, second, and third thoracic ganglia.

and *E. hamatum* and *E. burchelli*, as well as in other ant subfamilies (Forbes 1938, Walker and Clower 1961). Likewise, regenerative cells of the ventricular wall have been described in the *A. gracilis* male and the *C. morosus* worker. Although these cells have not been described in *Eciton*, it is likely that they exist in all army ants. The Malpighian tubules of *A. asantei* are histologically the same as those of the *A. gracilis* male (Shyamalanath and Forbes 1980) and the workers of *C. morosus* (Gotwald and Kupiec 1975) and *E. hamatum* and *E. burchelli* (Whelden 1963). Although tubule numbers may be of taxonomic significance in monomorphic species, they are only of limited value in polymorphic species where numbers are positively correlated with body size (Gotwald and Schaefer 1982). A survey of Malpighian tubule numbers in *Aenictus* workers would probably be of taxonomic value.

Gotwald and Kupiec (1975) suggested that the number of rectal papillae may be a useful taxonomic character. There are two papillae in *A. asantei* and three in the male of *A. gracilis* (Shymalanath and Forbes 1980). Numbers recorded in other army ant workers are: two in *C. morosus* (Gotwald 1971), two in *Dorylus (Alaopone) orientalis* Westwood (Mukerjee 1933), and usually three (rarely six) in *E. hamatum* and *E. burchelli* (Whelden 1963). In the queens of *E. hamatum* and *E. burchelli*, Whelden (1963) frequently found six rectal papillae, infrequently three.

The glands of *A. asantei* present no significant departures in histology or morphology from those described in other army ants (see Gotwald and Schaefer 1982). The pygidial gland of *A. asantei* is the first to be identified in the genus. Because the tergal gland probably opens through the intersegmental membrane connecting abdominal terga 6 and 7, it opens directly above the tip of the gaster. Hölldobler and Engel (1978) have noted that these glands in the New World army ants *Eciton* and *Neivamyrmex* possess distinct reservoirs that also open above the anus at the abdominal tip, because the 7th tergum in these ants is small. A pygidial gland is also present in *Dorylus (Anomma)*, although in morphology it is quite different from the gland in the

Table 1. Numbers of ganglia and ganglionic masses in the ventral nerve cord (excluding the subesophageal ganglion) of New and Old World army ants

Species	Alitrunk	Petiole	Postpetiole	Gaster	Total
Cheliomyrmex morosus (F. Smith)	3	1	Uninodal	2	6
Eciton burchelli (Westwood)	3	1	1	1	6
Eciton hamatum (F.)	3	1	1	1	6
Dorylus (Anomma) molesta (Gerstaecker)	3	1	Uninodal	4	8
Aenictus asantei Campione, Novak, and Gotwald	3	1	1	3	8

New World army ants (Hölldobler and Engel 1978). Even though the pygidial gland of *A. asantei* does not possess a reservoir, its opening at the gaster tip makes it resemble more closely the gland in New World army ants than it does the gland in *Dorylus (Anomma)*. Preliminary tests with *Eciton* workers suggest that the pygidial gland is involved in chemical trail communication (Hölldobler and Engel 1978). A post-pygidial gland has been identified in *Eciton* and *Neivamyrmex* (Hölldobler and Engel 1978), but was not detected in our histological preparations of *A. asantei*.

Histologically, the nervous system of *A. asantei* is similar to that of *C. morosus* (Gotwald and Kupiec 1975), *E. hamatum* and *E. burchelli* (Whelden 1963), and *D. (Anomma) molesta* and *D. (A.) nigricans* (Gotwald and Schaefer 1982). *Aenictus* and *Anomma* do not have a conspicuous optic nerve, whereas *Eciton* does. Because the nervous system is evolutionarily conservative, the numbers of ganglionic masses along the ventral nerve cord may be of value to the analysis of phylogenetic relationships. Wheeler (1910) noted that the central nervous system of the adult worker included 11 ganglionic masses, counting the supra- and subesophageal ganglia. It is now clear that fewer ganglionic masses may be present. Three such masses are always found in the alitrunk; there is also one in the petiole, and one in the postpetiole, if this segment is present in the waist (i.e., if the waist is binodal). The number of ganglia in the gaster depends on the extent to which ganglionic fusion has occurred. Table 1 compares the numbers of ventral ganglia in army ant workers for which the numbers are known.

Although ovaries are apparently common in army ant workers (Gotwald and Schaefer 1982), they were not identified in the histological preparations of *A. asantei* examined.

Biology of the Species

Behavioral observations on *A. asantei* were published previously (Gotwald 1976). The species (species A in Gotwald [1976]) was observed on four occasions (colonies GC-027, GC-035, GC-037, GC-047) in coastal scrub and grassland at Legon, Ghana, and once (colony GC-049) crossing a path between plots of cocoa, *Theobroma cacao* L., in the moist, semideciduous forest region at Jukwa, Ghana. All five colonies were collected in heavily cultivated habitats. The four colonies found at Legon, the type-locality, were in columns moving near or in plots planted with cassava, *Manihot esculenta* Crantz, in the University of Ghana farm system.

A. asantei is probably a column raider (a column raid consists of a system of branching columns that usually terminate in small groups of advancing workers engaged in foraging activities), although on two occasions (colonies GC-035 and GC-037) the workers were traveling in a series of anastomosing columns that merged to form a single base column, reminiscent of the swarm raiding patterns of the driver ants of the army ant genus *Dorylus*. In these two cases, the workers were traveling unidirectionally toward the base column, presumably toward the colony nest. The base columns varied from one to four workers, in width, and some workers in each carried prey. Each trunk column entered a hole in the soil. The column of colony GC-037 was lined on both sides with clustered workers for the last 10 cm before the column made its subterranean descent. Colonies GC-027 and GC-049 were each observed as columns consisting of a single file of workers. The prey collected from colony GC-037 consisted of immature forms of the ant *Pheidole* sp. and included 24 worker pupae and 3 larvae. Although colony GC-047 was emigrating, several workers carried prey, all adults of *Pheidole*. The prey items included one queen, two workers, three worker heads, and one alitrunk.

The emigrating column of colony GC-047 was discovered at 0950 h. A detailed description of the emigration can be found in Gotwald (1976).

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