mm, while those of reproductive larvae and prepupae (Fig. 26) from another colony were 0.42–0.49 mm. Reproductive larvae are very robust when mature, the integument is greatly expanded, and structures such as the anteroventral body spinules tend to thrust almost straight out (Fig. 28). One 3rd instar from a colony producing only males was larger (1.28 mm) and had a wider head (0.27 mm) than 3rd instars of workers. Although male and female reproductive larvae lack any significant external morphological differences, there are internal gonopodal imaginal discs just anterior to the anus which differ in males and females, and which become visible through the cuticle after the larvae are fixed in Kahle's (Petralia and Vinson, unpubl. data).

Description of Hatching and Molting

The newly deposited egg is oval and remains unchanged in size for ca. a week (Fig. 29). The egg then assumes the shape of the fully formed embryo (Fig. 30). If the egg shell is experimentally removed, a fully formed larva is exposed (Fig. 5). When placed with adult workers, newly formed larvae remain at least partially covered with shell membranes for one to several days. Larvae can usually free the mouthparts from the shell by a series of body movements but appear unable to complete hatching without the aid of adult workers. The molting process of this species was previously described by O'Neal and Markin (1973) but is illustrated in more detail in Fig. 17. At the end of the molt, a strand of undetermined material usually connects the mouth to the exuviae (Fig. 9, 11, 14), which remains on larvae if they are isolated from adult workers. Expulsion of the meconium (Fig. 27) (formation of prepupa) and formation of pupa is possible without the aid of adult workers.

Evidence for Number of Instars

Four distinct instars were delineated according to morphology, as described above, and by observations of molting. No molting within any one of the 4 instars was observed. Many structures, especially hairs, varied much in size but this variation was in the same range for both the newly molted instar and the instar preparing to molt. There are no significant morphological differences within any one of the 4 instars. In 3rd and 4th instars, the head is slightly less wide in new molted larvae than in larvae ready to molt.

The hairs of newly molted 2nd, 3rd, or 4th instars are close together and the cuticle is wrinkled (Fig. 9, 14, 23). The head of these larvae is large relative to the body. Late in the instar the body is greatly expanded, the head relatively small (Fig. 2, 3, 4), the cuticle unwrinkled, and the hairs farther apart.

Brood Piles

Eggs and larvae cling to each other, and are stored in clumps in the colony (Fig. 29). Adult worker ants often groom brood, apparently over their entire surface. Eggs and 1st and 2nd instars usually had a bridge of material where they were in contact with each other (Fig. 29). This bridge was evident in live eggs (Fig. 31), but was most prominent in fixed eggs (Fig. 32). When 3rd and 4th instars were placed in contact with other larvae of similar age, the bifid hairs were seen to interlock, via the apical hooks, with each other (Fig. 33, 35, 36). A bridge of material may also be seen between two 3rd instars. Third and 4th instars fixed and stored in alcohol retained their ability to cling to each other.

Discussion

O'Neal and Markin (1975) described 4 larval instars for the imported fire ant. However, the figures and descriptions of larvae in their paper correspond only to our 3rd and 4th instars (Table 1). Their observed changes in mouthparts may be attributed to the use of light microscopy for discerning morphological details. Very minute details of mouthparts are difficult to resolve with the compound microscope and may be badly distorted in whole mounts for light microscopy. Scanning electron microscopy permits higher resolution, greater depth of field and examination of live larvae at higher magnifications. We could examine larval structures undistorted in their natural shape and position on the body.

O'Neal and Markin (1975) relied upon an application of Dyar's Rule when they determined the imported fire ant has 4 instars. However, this Rule may not apply to many insects (Schmidt et al. 1977). We found larval head-width increases vary considerably. As the larva grows, an increase of the body's volume just behind the head may cause the unsclerotized head itself to become wider. In addition, adult major-workers and reproductives have larger heads than minor workers, and their larvae too—even of the same instar—will differ.

Our studies of eclosion and the 3 larval molts support the morphological evidence for the 4 instars we describe. Female reproductive larvae probably differentiate from worker larvae before the 3rd instar, as 3rd-instar reproductives were larger than workers in the same instar.

Most morphological changes during the development of fire ant larvae are not radical; a basic pattern of body structures becomes more complex. This is evident in the development of the ventral rows of hairs and the position of head hairs, as well as the development of the labral hairs and sensilla, maxillary hairs, palps, and galea, labial hairs, palps, spinules, and the opening of the sericteries. We infer from this that there is a basic arrangement of epidermal cells laid down in the embryo and maintained throughout larval development. The most evident distinguishing characteristics for larval instars are the changes in chaetotaxy and mandible structure. Other important characteristics include changes in the size and position of labial spinules and the development of other spinules.

These morphological changes in larval development can be related to changes in function. Thus the development of sclerotized, well developed mandibles, and the specialization of hairs and spines on the anteroventral body region of the 4th instar, facilitate feeding on the solid chunks of food placed on the larvae by adult workers (O'Neal and Markin 1973, Petralia and Vinson 1978). The function of the posterior body spinules is not known.

Eggs and larvae have adaptations which facilitate the transport, handling, and storage of brood by adults. It appears that eggs stick together by means of an adhesive coating. First and 2nd instars are usually found mixed