Setal relationships and their significance in *A. pallipes*[1]

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Summary. The setae of *A. pallipes* have a pattern of distribution. Many of the setae, although of a different type, are always found together. Such relationships can be linked with body functions.

The setae occurring in such profusion on the body and appendages of *A. pallipes* are distributed in definite patterns. Particular types of setae are present only on specific areas of the body, and certain types of setae are always found together. This consistent association of different setal types is much in evidence on the appendages and body of *A. pallipes*. Specialization of setae for particular functions is known amongst the Crustacea. Some setae have one function, others possessing a dual role[2], others always placed in proximity with other setal types of different function. Terms such as 'companion setae'[3] and 'accessory setae'[4] reflect the consistency of these associations.

3 days before hatching the hamate setae of the epipodite margins and branchial chamber wall are formed. Concurrently are developed the setobranchs which are very closely associated with the hamate setae in all stages of crayfish

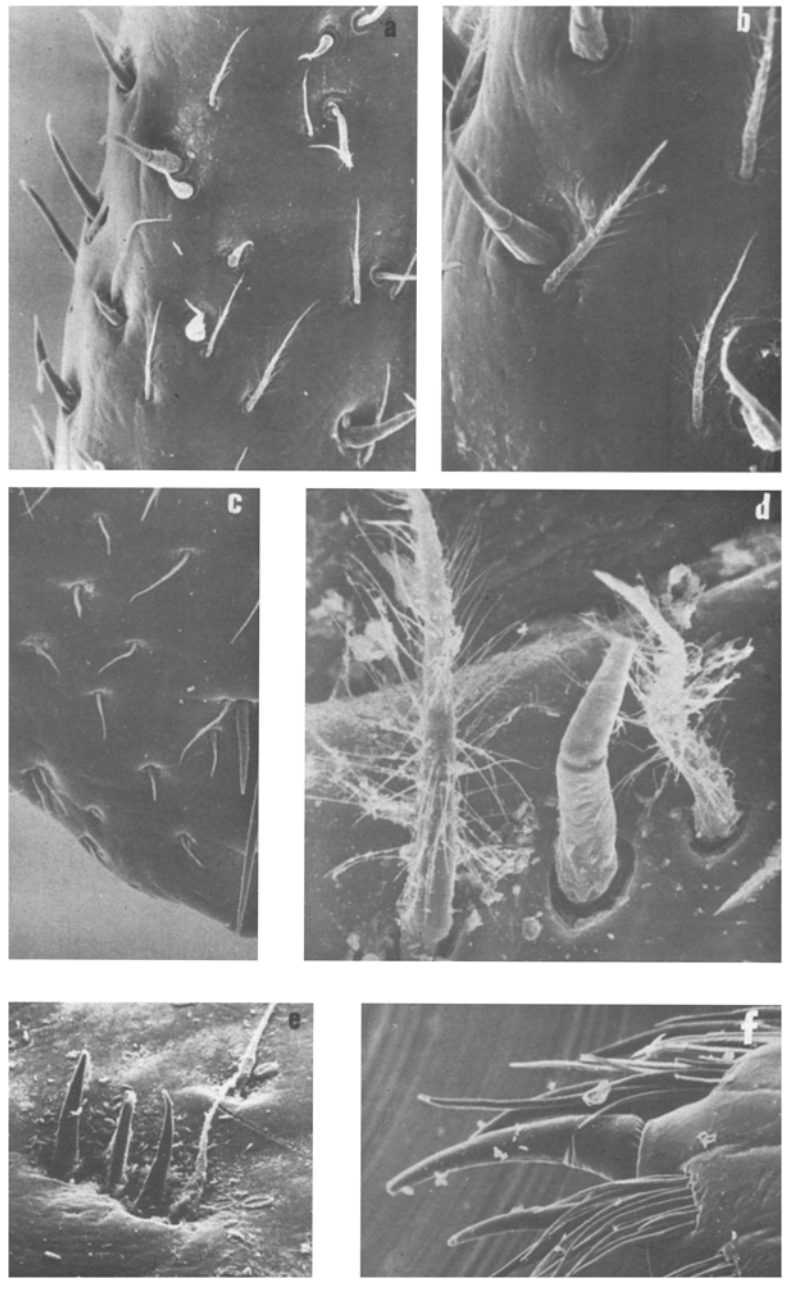

Fig. 1. *a* Shaft of setobranch from branchial chamber showing accumulation of 'material'. ×980. *b* Shaft of 'cleared' setobranch from branchial chamber. ×980. *c* Setobranchs growing out of the coxopod of pereiopod 2. ×137. *d* A single hooked or hamate seta from the epipodite margin of the 3 maxilliped. ×1.1 «. *e* Shafts of multidenticulate setae on the posterior edge of the scaphagnathite. ×980. *f* Shaft of a multidenticulate seta from the scaphagnathite. ×1 K.

development (figure 1, a, b, c and d). These setobranchs are very long and grow out from the coxopodites of the pereiopods (figure 1, c). Observations of crayfish with part of the carapace removed show the setobranchs intertwined with the gill filaments and their accompanying epipodites bearing the hamate setae. These coiling setobranchs link with the hooked hamate setae serving to bind, and thus support the feathery gill filaments. A 2nd function of the coiling setobranchs is to prevent excessive deposition of mud and detritus within the branchial cavity (figure 1, a and b). Other setae found in the branchial cavity are the long multidenticulate setae trailing backwards from the posterior edge of the scaphagnathite into the gill chamber (figure 1, e and f). Here then are 3 types of setae closely related to the respiratory stream.

Tooth setae first appear on the pereiopods of the 2nd-stage hatchlings. At the end of 1 year's growth the tooth setae lining the chelar claws are replaced by blunt cuticular spines. Closely associated with these spines are groups of short acuminate setae with accompanying pappose types. This association of acuminate and pappose setae occurs all over the body surface and appendages of *A. pallipes,* especially on the caraface and pereiopods (figure 2, a–f).

These particular pappose setae are characterized by relatively short thick setules (figure 2, b) well set apart along the shaft of the seta. All these pappose setae are set at an acute angle from the surface of the integument with their tips directed anteriorly on the body surface, and distally on the appendages (figure 2, a). Often there are groups of from 3 to 4 acuminate setae with 1 of the pappose type (figure 2, e). Within these numbers there is not a set formula for the content of a group (figure 2, a–f).

Although there is an obvious association between the pappose and acuminate setae they do occur singly (figure

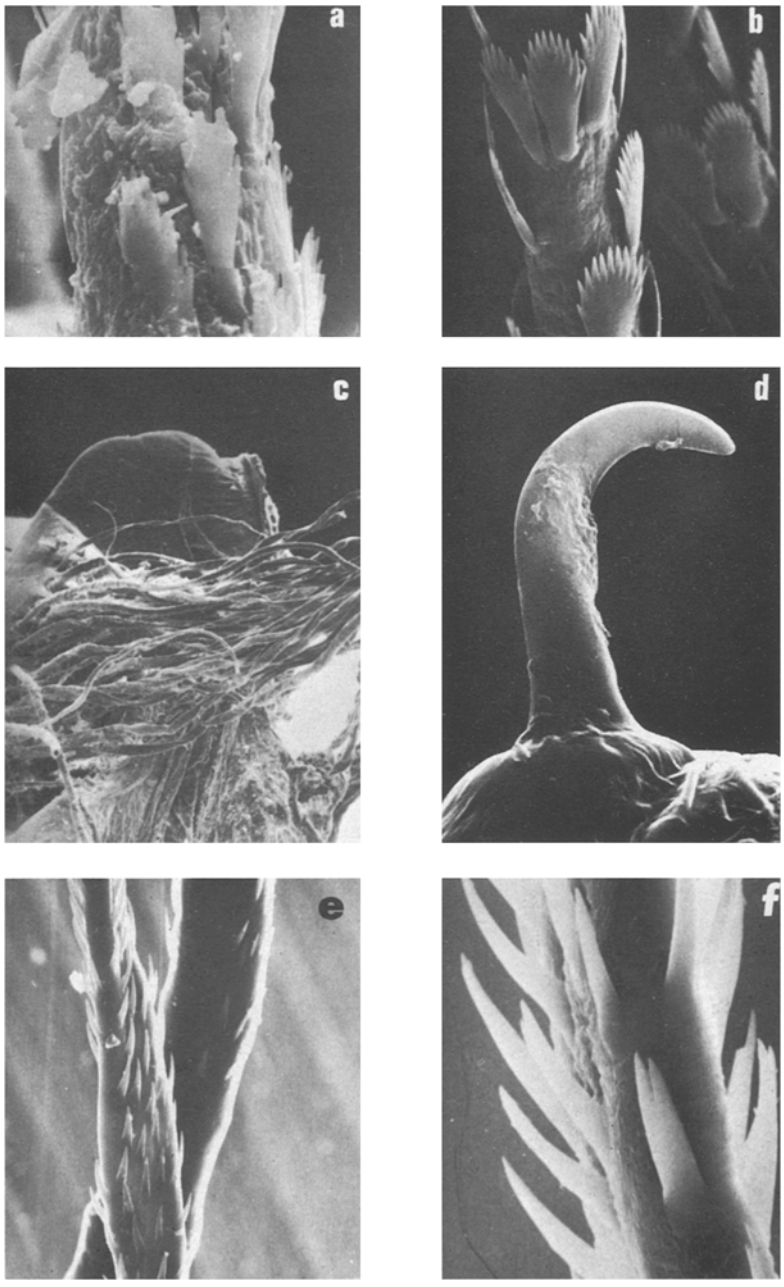

Fig. 2. *a* Surface of the propodite of pereiopod 2 of *A. pallipes* showing acuminate setae and associated pappose types. × 140. *b* The protopodite of pereiopod 2 showing the acuminate and pappose types, note the tips all pointing the same way. × 270. *c* Setae, both acuminate and pappose on the pleuron surface. × 107. *d* Both acuminate and pappose setae on the basipod of pereiopod 5. × 570. *e* 3 acuminate and 1 pappose setae on the carapace surface. × 240. *f* Distal edge of dactyl of 2nd maxilliped showing association of cuspidate and rod setae. × 125.

2, c), particularly on the 4th and 5th podomeres of the pereiopods. The same types of pappose setae are often found in association with cuticular spines as on the dorsal surface of the uropods. Here a row of cuticular spines possesses a frings of pappose setae just proximal to them, and also groups of setae set between adjacent spines. A similar condition is seen on the chelae and carapace of older animals where setae tend to be replaced by cuticular spines.

Cuspidate setae are strongly developed on the distal edge of the dactyl of the 2nd maxillipeds where they are associated with bundles of rod-like setae (figure 2, e). These 2 setal types are associated at the tips of the 3rd and 4th pairs of walking legs. Both types are innervated and it now requires electrophysiological studies to ascertain their precise functions.

On the margins of the uropods and telson the plumose setae are subtended dorsally by a fringe of alternating long and short slim acuminate setae. This association is also seen on the pleopod margins. Both these setal types play a part in the expansion of the 'tail-fan' surface during the escape movements of the crayfish. Both are innervated, whether these setae act as mechanoreceptors or chemoreceptors remains unanswered.

1 Acknowledgments to the Central Research Fund of the University of London who provided the financial assistance for this research work.

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Comparison of inhibitory effects of royal jelly acid and myrmicacin on germination of *Camellia sinensis* pollens

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Summary. Royal jelly acid (10-hydroxy-2-decenoic acid) secreted by honeybees and ant-origin myrmicacin (3-hydroxydecanoic acid) inhibited germination of *Camellia sinensis* pollens, and the latter was stronger in the inhibition. Their inhibiting activities were stronger at lower pH, and their inhibitions were reversible.

Royal jelly acid was isolated from royal jelly[1] produced by honeybees *(Apis mellifera)* and identified as 10-hydroxy-2-decenoic acid[2], and the acid was proved to be an essential constituent for antibacterial activity of royal jelly by Blum and co-workers[3].

Myrmicacin (l-3-hydroxydecanoic acid), found in the secretions of South American leaf-cutting ants *(Atta sexdens)* by Schildknecht and Koob[4], is assumed to prevent germination of collected seeds and spores in the ants' nest during storage. With respect to biological activity of myrmicacin, Iwanami and Iwadare[5,6] have reported its inhibiting effect on germination of pollens of several higher plants, and Iwanami[7] has described its peculiar ability to stop mitotic division of generative nuclei of pollens even after metaphase.

Since both the compounds were normal fatty acids with 10 carbon atoms, their structural analogy led us to study further and compare effects of the compounds on pollen germination.

The pollens of *Camellia sinensis* used in this study were collected from the freshly opened flowers. Sugar-agar plates (sucrose 10% and agar 1%) were employed for culture of the pollens. Royal jelly acid (m.p. 63–63.5 °C) was purchased from Nihon Shoji Co. dl-Myrmicacin (m.p. 58–58.5 °C) was prepared according to Meyers' synthesis[8]. Capric acid (m.p. 31 °C), the chemically parent compound of both acids, was supplied by Tokyo Kasei Co. and used as one of the controls.

It has been reported[5,6,9,10] that the activities of royal jelly acid and myrmicacin are stronger at lower pH. Thus pH dependency of activities of the acids was first examined. There pH was adjusted by titration with diluted sodium hydroxide solution. The top chart of figure 2 shows germination of pollens treated with various concentration of the agents at pH 4, 5 and 6. Germination, expressed in percentage, was measured 1.5 h after sowing. The chart reveals strong inhibiting activity of royal jelly acid on pollen germination, similar to that of myrmicacin, and that the latter is stronger than the former over all the measured range of pH. The result that royal jelly acid loses most of the activity at pH 6 is in good agreement with Townsent and colleagues' reports[10,11] that strong antitumor activity of royal jelly acid at low pH is lost at a pH higher than 6.

As the conditions, under which royal jelly acid and myrmicacin exerted the inhibitory activities, were revealed through the above experiments, then release from the inhibition was investigated. The *Camellia* pollens were cultured on the separate culture media containing royal jelly acid (100 ppm) or myrmicacin (50 ppm) or capric acid (50 ppm) at pH 4.5. After 1, 2, 3 and 4 h ungerminated pollens were transfered to the agent-free cultures and growth of the pollens was observed.

As seen in the last chart of figure 2, the pollens treated with the insect-origin inhibitors restored germination after transfer to the inhibitor-free medium, whereas treatment of pollens with capric acid resulted in complete loss of germinative ability. Although growing ability was retained during culture on the natural inhibitors, the longer treatment caused the less restoration of growth after release from the

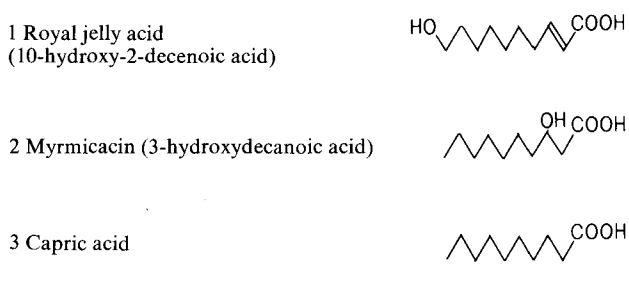

Fig. 1. The agents used in the experiments and their chemical structures.