Inner surface of major palm with an oblique tuberculated ridge arising some distance proximal to base of pollex, reaching its greatest development close to carpal cavity, and dying out variably between the cavity and the dorsal margin, among an irregular scattering of tubercles. Carpal eminence well developed. A row of fine tubercles extends from proximal quarter of pollex, close to upper margin, and curves upward along distal part of manus, where the tubercles are larger, ending abruptly opposite middle of dactyl base. Distal to this, paralleling base of dactyl, a short row of fine, faint, rudimentary tubercles is sometimes distinguishable.

Major dactyl between once and a quarter and once and a half times as long as palm, smooth, moderately convex, curving downward beyond tip of pollex. Pollex slender, not triangular, with characteristic upper margin, there being an abrupt elevation or eminence about three-fifths or more of the way to the tip; basal and distal to this the margin is concave to varying degrees. Gape wide, except in the region of the eminence of the pollex. Several enlarged teeth in proximal half of dactyl, another opposite eminence of pollex. One or more surmounting and on the distal slope of this elevation are the only enlarged teeth on the pollex. In both chelae the remaining teeth are exceptionally fine and poorly developed. A row of small, close-set tubercles arising on outer side of distal end of manus continues out along proximal part of upper surface of pollex, close to prehensile margin.

Merus of ambulatories slightly enlarged in both sexes, that of third ambulatory in male extending less than a fifth of its length beyond antero-lateral margin when laid forward. A small amount of pile on carpus and manus of the three anterior ambulatories.

Abdominal appendage of male slender, curving, tapering little. Arm absent, represented only by a few bristles arising from a level shelf at beginning of distal seventh of appendage.

Measurements: Male holotype, length 4.8 mm., breadth 7.6 mm., base of manus to tip of pollex 11.8 mm.; three female paratypes (all ovigerous), length 2.9 to 4.3 mm.; nine male paratypes, length 2.7 to 4.5 mm.

Color: Displaying male observed through binoculars: carapace golden brown speckled and marbled variably with white. Merus and carpus of major cheliped, both external and internal surfaces, pinkish-brown; manus, externally and internally, bluish-white; chelae completely pure white, dazzling and polished. Buccal and pterygostomian regions golden brown speckled with white, like carapace. Anterior sides of meri of ambulatories pinkish-brown; rest of ambulatories and all of minor cheliped brown speckled and irregularly banded with white. Underparts bluish-white. Eyestalks bright green.

Display: Males were seen displaying throughout February at Balboa. The display in general is an interesting intermediate between that of *U. inaequalis* and of *U. saltitanta*, both in rapidity and in the development of the ground-rapping phase characteristic of all three. *U. batuenta* elevates the carapace high on all four pairs of legs with each display. Cheliped is extended from folded position, in front of mouth, outward and up, the chelae meanwhile opening moderately wide. At the peak it pauses momentarily and is then brought swiftly down, but not so fast as to jerk, to a folded position well in front of the normal place, the chelae closing. Then, in most displays, the manus and chelae are literally bounced back into place with three or four raps of the ground, being drawn closer to the mouth with each rap. Minor cheliped hangs motionless during display. The crab may move along a few steps while large cheliped is elevated. The entire display, including rapping, takes about a second; a pause of one or more seconds may intervene between displays.

Breeding: The three female paratypes, all ovigerous, were taken in February, at Ballenas Bay and Puntarenas, Costa Rica. At Balboa, during the same month, females were seen to be definitely interested in the displays of the males, although mating was not observed in this species. The eggs, which measured .25–.27 mm. in diameter after being preserved in alcohol, number about 500.

Growth: The young of this species are amazingly similar to the adults of *U. tenuipedis;* young males of *U. batuenta* may be distinguished at once, however, by the presence of an oblique ridge inside the major palm, even when the chelae are still so short as to resemble those of the other species; the greater width of the ambulatories in *U. batuenta* is the other major specific character readily discernible in the young.

Affinities: This species is allied most closely to *U. tenuipedis* and to *U. saltitanta.* It is distinguished from both by the characteristic profile of the major pollex; from *U. tenuipedis* by the broader ambulatories, and from *U. saltitanta* by the non-projecting orbital angle.

Range: Puntarenas, Costa Rica, to Balboa, Canal Zone.

Local Distribution: The 13 specimens in the collection were all taken in partly shaded mangrove mud, among new shoots.

Material: Male holotype, Cat. No. 4121, La Boca, Balboa, Canal Zone; two male and one ovigerous female paratypes, Cat. No. 381,136, Puntarenas, Costa Rica; four male and two ovigerous female paratypes, also an additional, detached major cheliped, Cat. No. 381,137, Ballenas Bay, Costa Rica; three male paratypes, Cat. No. 4122, La Boca, Balboa, Canal Zone.

The name *batuenta* is given to this species in reference to its habit of beating the ground during display.

Uca saltitanta sp. nov.

Text-figs. 4O, 5. Pl. II, Figs. 10, 11; Pl. III, Fig. 14; Pl. VI, Fig. 25.

(See also pp. 149, 153–156, 166, 169).

Diagnosis: Carapace strongly convex, practically semicylindrical in lateral view; front behind eyes between a fourth and a fifth maximum

width of carapace; orbits scarcely oblique; antero-lateral margin well developed, faintly sinuous, slanting outward, then turning sharply inward and backward, usually forming a distinct angle; orbital angle broadly acute, somewhat produced. Minor manus deep, especially in female; minor chelae strongly serrated throughout most of length, the serrated portions in contact; hairs plentiful in rows on all margins. Oblique tuberculated ridge inside palm of major cheliped present, extending to carpal cavity; pollex exceedingly broad, basally triangular, with prehensile edge straight or sinuous; two characteristic eminences on prehensile edge of the relatively slender dactyl. Merus of second maxillipeds without spoon-tipped hairs. Merus of ambulatories slightly enlarged. A large isolated tooth on outer edge of lower orbital margin in male. No arm on male abdominal appendage. Eyebrow narrow.

Description: A small species. Carapace with H-form depression distinct though fairly shallow. Regions scarcely delimited, although carapace is somewhat lumpy. Surface is naked except for a few microscopic hairs.

Carapace strongly convex, practically semicylindrical in lateral view; widest behind orbital angles. Antero-lateral margins slightly sinuous, slanting outward, about three-fourths as long as width of front behind eyes. They then turn inward and backward, usually at a sharp angle, continuing in the form of the usual concave ridge as far as level of middle of cardiac region, where they almost fuse with a similar ridge, extending from this point almost to edge of carapace above bases of last pair of ambulatories. Sides of carapace faintly concave, not converging, sometimes actually slanting outward. Front between posterior margins of eyestalks between one-fourth and one-fifth width of carapace, its margin invisible in dorsal view. Upper margin of orbit strongly sinuous, scarcely oblique. Eyebrow very narrow, less than a third width of adjacent portion of eyestalk, strongly inclined. Lower orbital margin little projecting, almost straight, with rudimentary crenulations and, at outer, excavated corner in males, two broad teeth, of which the outer is isolated; in females these are small or lacking. Suborbital region naked except for a row of hairs immediately behind orbital margin. Third to sixth abdominal segments more or less fused in male.

No hairs with distinctly formed spoon-shaped tips on merus of second maxillipeds, although there may be several with minute distal swellings. Woolly hairs relatively few in number. Ischium of third maxilliped with central groove represented only by a marginal depression.

Palm of minor cheliped deep, especially in female. Minor chelae slightly longer or shorter than palm, with strong serrations or teeth throughout all of length except a very short, variable basal area, and an unusually short, corneous area distally; the tips articulate perfectly, and are scarcely dilated. Gape slight, present only in basal half at most, usually in less. An oblique row of well developed hairs, thickening and lengthening distally, along inner surface of each chela; another row, of short, sparse hairs along external surface; and two more rows of fairly even, close-set moderate hairs along dorsal profile of dactyl and ventral profile of pollex, respectively.

Large cheliped of male with arm extremely finely rugose and tuberculate basally, smooth distally; most of wrist externally similarly sculptured. Short pile on inner side near dorsal profile of distal part of arm, all of carpus and proximal part of manus. Hand almost or quite as broad as long. Upper surface rounded, except for the sharp boundary of carpal cavity, and exceptionally short; lower margin marked by an elevated line of microscopic, close-set granules. Entire upper and outer surface covered with moderately large, low tubercles. Up to half a dozen short, dark hairs may be scattered over it.

Inner surface of major palm with an oblique tuberculated ridge arising near base of pollex close to ventral profile and extending to carpal cavity; the ridge is irregular, varying in width, from one to two tubercles, and in the size of the latter. Between carpal cavity and dorsal profile is only a scattering of fine tubercles. Carpal eminence scarcely developed. A row of tubercles, almost straight because of the width of the pollex base, extends on palm from lower part of base obliquely down and out along upper margin of pollex, close to prehensile edge; basal five or six tubercles large and close-set, beyond that they are tiny and die out in distal half of thumb as an elevated ridge. There is no additional ridge paralleling base of dactyl on inner distal end of palm.

Major dactyl slender, about twice as long as palm, with a few fine tubercles on dorsal, proximal profile, curving downward beyond and overlapping tip of pollex; the dactyl has a characteristic prehensile profile formed by the presence of two eminences, one at about a quarter of the way, the other at half the way to tip; the profile before, between and beyond the eminences is concave. Pollex exceedingly broad basally, triangular, tip abruptly tapering, curving upward; prehensile margin straight or slightly sinuous. Gape almost non-existent; the distal edges can be brought into actual contact, the long, curving dactyl tip passing to the inside of that of the pollex. Prehensile teeth numerous, small, poorly developed except for single enlarged teeth on summit of each eminence of the dactyl and, sometimes, on pollex at about two-thirds of distance to tip. On the outer surfaces of both pollex and dactyl a row of fine, close-set tubercles extends most of the length of the chela, close to and parallel with the prehensile margin. A more or less distinct elevated line passes along outer lower side of pollex; above this is a depressed area.

Merus of ambulatories moderately enlarged in both sexes, that of third ambulatory in male extending about a quarter of its length beyond antero-lateral margins when laid forward. A small amount of pile on carpus and manus of the three anterior ambulatories.

Abdominal appendage of male slender, curving, tapering. Arm absent, represented only by a tuft of bristles arising from a shelf slanting obliquely toward base of appendage, about six-sevenths of distance to tip.

Measurements: Male holotype, length 6 mm., breadth 8.8 mm., base of manus to tip of pollex, 12.2 mm.; 5 ovigerous female paratypes, lengths 3.8 to 5.3 mm.; 2 non-ovigerous female paratypes, lengths 3 and 3.3 mm.; 7 male paratypes, lengths 3.5 to 6.1 mm.; 116 other males, 42 ovigerous females and 28 non-ovigerous females of intermediate lengths.

Color: Displaying males observed through binoculars: usually pure white, though occasionally the carapace is grayish or yellowish, or has a few sparse markings of rich brown; it is probable that these individuals simply have not reached full display coloration, although when observed they were displaying vigorously. Females and young inconspicuous dark grayish or dark brownish, probably mottled. Eggs magenta.

Display: Throughout February at Balboa, these crabs were obviously at the height of the breeding season; and, in the broad open mudflats which were their habitat, they were certainly the dominant species of *Uca;* the summit of every tiny elevation in the mud was employed by a displaying male; in some places there were an average of four displaying males to the square foot.

During each display the body is raised high on all four ambulatories, which meanwhile carry it along three or four steps in either direction, or else the crab may stand in one place. Major cheliped is lifted from position folded in front of mouth, opened and stretched diagonally straight up and out, the chelae meanwhile opening wide; it is then brought down at once without pause practically in the same place from which it started, though it may fall a little more to the front. At the same time the body is lowered and the chelae closed. Then the manus and chelae are vibrated up and down against the ground three or four times with extreme rapidity. At end of each display is an infinitesimal pause, so that the accent is there, not when the cheliped is elevated. The display is then repeated, sometimes upward of a hundred times without rest. During each display the minor cheliped is half spread outward, then returned to folded position. There may be as many as two full displays to each second.

Males of this species when possible seem deliberately to mount a slight elevation to display, sometimes several inches from their holes. When a female is attracted the display is speeded up, and additions made, as the following field note shows: "On February 19 a female was obviously attracted directly to a male as soon as he came out of his hole six inches away and began to display. He became aware of her and speeded up his tempo. She circled him at a distance of several inches, then drew nearer. He seemed to be almost overcome with excitement, thrust his minor side down his hole, and made one last violent gesture with his major cheliped, his major ambulatories meanwhile stretched straight out, clear of the ground, absolutely rigid but quivering from their bases. The position was held perhaps a second, then he vanished down the hole. The female followed him at once, without the slightest hesitation." This procedure was typical when males attracted the attention of females; sometimes the latter emerged after a few seconds and wandered off, the males meanwhile emerging and resuming feeding and moderate display. More often neither crab emerged at all soon, in two observations not before the tide covered the holes, two hours later. As in other species, however, compared with the almost incessant display at this season of the thousands of males in the area, the number of females each day which followed the males down their holes, presumably to mate, is exceedingly slight.

The entire display, with its exceptional speed, continuity, and especially in the development of the phase in which the cheliped is vibrated against the ground, represents the highest development yet found of this type of display, in which rapping of the ground, after the gesture with the cheliped, is involved. It was found to a lesser degree in *U. batuenta* and *U. inaequalis.*

Breeding: More than three-fourths of the adult females taken, all in February, were ovigerous at La Boca, Balboa. Young crabs of both sexes were relatively rare. The eggs, which measure .24 mm. in diameter after being preserved in alcohol, number between 1,200 and 1,800.

Growth: The young of this species have most of the distinguishing characteristics of the adult well developed, except for the oblique ridge inside the major palm; the large cheliped in the smallest taken, however, is already unmistakably typical of the species.

Affinities: This species is related most closely to *U. batuenta,* although its major cheliped is distinctly different from that of any known species. The large, isolated tooth in the outer, lower corner of the orbit serves as a convenient mark of distinction from related forms when the large cheliped is missing. The females are easily distinguished from the similarly shaped females of *U. oerstedi* by the lack of pile on the carapace, and from those of *U. batuenta* by the much deeper manus of the chelipeds, the somewhat produced orbital angles and by the little projecting lower borders of the orbits, with the external corners deeply excavated.

Range: Puntarenas, Costa Rica, to Old Panama, Panama.

Local Distribution: The great majority of the 201 specimens in the collection were taken in open mud flats of the deepest, stickiest type. A few were taken among the unshaded outpost shoots of the mangroves. At La Boca (Balboa) and at Old Panama, thousands of them were seen displaying daily, out in the mud, as far as the eye could see.

Material: Male holotype, Cat. No. 4123, La Boca, Balboa, Canal Zone; 7 male and 7 female paratypes, Cat. No. 4124, La Boca, Balboa,

Canal Zone; 113 males and 69 females, Cat. No. 4125, La Boca, Balboa, Canal Zone; 3 males and 1 female, Cat. No. 381,138, Puntarenas, Costa Rica. Seen but not collected at Old Panama, R. de P.

This species is named *saltitanta* because, in displaying, it dances with such tireless energy.

Uca beebei sp. nov.

Text-figs. 4P, 5; Pl. IV, Fig. 16; Pl. V, Fig. 20; Pl. VI, Fig. 27.

(See also pp. 149–151, 153–157, 159, 166, 167, 169).

Reference: Uca stenodactylus, Rathbun, 1917, p. 417 (*part.*); pl. 152, fig. 3; pl. 153. Not *Gelasimus stenodactylus* Milne Edwards & Lucas, 1843.

Diagnosis: Close to *U. stenodactyla*, but differing in the following characters: grows to 8 mm., not 9; regions of carapace scarcely swollen, little delimited; sides of carapace much less steeply inclined; ambulatories less slender in both sexes (width of merus of third ambulatory on minor side of male about two-fifths of length, not a fourth to a third); tips of minor chelae not overlapping; projecting spoon-tipped hairs on merus of second maxilliped 100 to 140, not 160 to 250; shelf replacing arm of abdominal appendage slanting toward base of appendage, not horizontal or with rudimentary arm; deep purplish-brown color on lower inner surface of major cheliped usually persisting for at least several years in alcohol, never present on *stenodactyla*.

Description: Moderately small species. Carapace strongly convex, semi-cylindrical in lateral view, widest at orbital angles or behind; surface smooth, naked, regions scarcely delimited or separately swollen; H-form depression very slight.

Antero-lateral margins slightly sinuous, slanting slightly outward, about half as long as width of front behind eyes. They then turn inward and backward in the usual concave ridge as far as level of middle of cardiac region. Sides of carapace descending only moderately steeply, concave, usually slanting slightly outward. Front between posterior margins of eyestalks about one-fourth or less width of carapace, its lower margin invisible; marginal ridge obsolescent. Upper margin of orbit sinuous. Eyebrow broad, about as wide as adjacent portion of eyestalk, little inclined. Lower orbital margin moderately projecting, with crenulations throughout, strong except internally. Suborbital regions naked except for one, or sometimes one and a half, rows of hairs immediately behind orbital margin. Third to sixth abdominal segments in male incompletely fused.

Spoon-tipped hairs on merus of second maxilliped moderately numerous, arranged in about 11 to 13 rows on inner fifth or quarter of merus, throughout its distal half. Those which are nearest the longitudinal center of the merus are so short as to be difficult to count; excluding these, counting only those which project beyond the inner margin, a total of between 100 and 140 is reached, 100 having been found in a small, ovigerous female, 130–140 in a large, non-ovigerous female, and about the same number in large males. Ischium of third maxilliped with median groove represented by a marginal indentation.

Minor chelae about once and a sixth as long as palm, usually coarsely serrated or toothed in middle portion, though rarely (including in the holotype) the serrations are low and appear worn. Usually, however, the region has three or four large teeth in the middle of each chela, flanked by fine serrations, which articulate almost or completely, leaving a small gape only proximally and, sometimes, distally. The corneous tips, however, are slightly dilated and articulate well. Oblique row of hairs along inner margins sparse except for distal brushes. Additional interrupted rows of sparse hairs as follows: two on or near dorsal profile of dactyl, one on external side of pollex, near ventral profile, sometimes obsolescent.

Large cheliped of male with arm and wrist moderately rugose externally; short pile inside dorsal half of carpal cavity, and between bases of chelae. Hand about two-thirds or more as broad as long. Upper surface rounded, bent over proximally to bound carpal cavity sharply; lower margin marked by elevated line of microscopic, close-set granules. Entire upper and outer surface covered with moderately fine, close-set low tubercles, largest dorsally. Inner, lower, proximal part of major palm, near ventral profile, roughened with microscopic granules, not in special linear formation, which are opposable to a row of almost equally fine granules on carpus of first ambulatory on major side; traces of another row on distal end of merus of first ambulatory.

An oblique tuberculated ridge on inner side of manus of major cheliped extending in a curving line from close to ventral profile to carpal cavity, and continuing upward toward dorsal margin. Below cavity the tubercles are large, regular, close-set in a single line though sometimes flanked by a few small tubercles; above they tend to be in double lines, grow smaller, and the ridge dies out in a cluster of low tubercles which fills in the space between it and the dorsal profile. Carpal eminence scarcely developed. A row of strong, close-set tubercles arises opposite middle of dactyl base and continues down and out along pollex, close to prehensile edge, the tubercles dwindling in size and becoming a mere elevated line which continues to tip. There is no additional row of tubercles paralleling base of dactyl on inner distal end of palm.

Major dactyl slender, about once and a third times as long as palm, tuberculated proximally on dorsal surface, almost straight, curving only slightly downward to overlap pollex distally. Pollex about equally slender, straight or slightly sinuous. Gape moderately wide, with many small, low, tuberculous teeth, of which two are usually enlarged, one in proximal half of dactyl, the other half way to tip of pollex. A row of small tubercles close to and parallel with prehensile edge of outer side of dactyl, dying out on distal half. This is represented on the corresponding part of the pollex by about four irregular rows of slightly enlarged tubercles basally,

around proximal end of gape, which continue out on pollex as much reduced granules near prehensile margin and gradually die away distally.

Merus of ambulatories moderately enlarged in both sexes, that of third ambulatory on minor side in male extending about a quarter of its length beyond antero-lateral margins when laid forward. Ambulatories on major side more slender, as in *U. stenodactyla*. In males and females, width of third merus is about two-fifths of its length.

Abdominal appendage of male slender, strongly bowed, tapering; arm absent, represented only by a row of bristles arising from a shelf slanting obliquely toward base of appendage in its distal ninth.

Measurements: Male holotype, length 7.4 mm., breadth 10.4 mm., base of manus to tip of pollex, 19.2 mm.; 8 male paratypes, lengths 3.1 to 7.8 mm.; 4 ovigerous female paratypes, lengths 4.8–5.3 mm.; 4 non-ovigerous female paratypes, lengths 2.6–7.9 mm.; 6 young, questionably referred to this species, lengths 2 to 2.5 mm. The 98 other specimens in the collection are all of intermediate size.

Color: Displaying males, observed through binoculars: anterior part of carapace brilliant iridescent green, posterior part gray. Outer side of major manus above, bright ochre to rosy pink; fingers white outside and in, sometimes yellow basally; lower sides of merus, carpus and manus externally, and lower inner side of manus as well, dark, rich plum purple; this characteristic color alone will identify the species from a distance. Inner side of merus pearl gray; upper inner side of manus ochre to pink, changing to pearl gray farther down, above plum purple area. Minor cheliped whitish. Coxa and basal part of merus of major ambulatories bright plum both anteriorly (ventrally) and posteriorly (dorsally); corresponding parts on minor side greenish; rest of ambulatories gray, like posterior half of carapace. Color fades especially quickly when crab is captured.

Females: Mottled or spotted dark on grayish-brown.

Display and Mating: All four pairs of ambulatories are left on the ground during display, and there is no added elevation of the body, which is normally held fairly high, except in specimens living in the mud; these stretch upward a bit with each display. However, in all the carapace is usually tilted slightly up and back with the effort of lifting the cheliped. At the start of the display, with the cheliped flexed in front of mouth, held clear of the ground, the carpo-manus joint is lifted. The cheliped is then straightened diagonally upward and outward describing a slight forwardly directed arc. It is then brought down without pause to position in a straight line, with a definite jerk. The general effect is of an emphatic beckoning. The movement is fast, about two to the second, and is usually repeated about four times without a break in the rhythm. The minor cheliped at the same moment generally makes an incomplete outward and inward movement; when the crab is strongly excited through the attention of a female, this movement of the minor cheliped is complete and vigorous. Also, when displaying before an interested female, the male frequently turns his back, and revolves before her; since by this procedure the brilliant iridescent green of the anterior part of the carapace is shown, as well as the bright plum *posterior* (dorsal) parts of the ambulatory meri —parts which are not brightly colored in the other species where display was observed—it seems that this revolving is a definite part of display. Fingers are held slightly open, parallel, during each series of displays. The crab may stand close to his burrow and perform, or take a few steps in either direction.

As usual, when a female is interested, the whole display becomes swifter and more vigorous. The female must give some sort of signal when she is ready to follow the male, although I have never been able to see what this is, because suddenly, after seconds or minutes of display, the male without warning will vanish down his burrow, and in the perhaps half a dozen cases where I have seen courtship reach this stage, excluding the exceptions noted in the following paragraph, the female without hesitation followed after. The usual procedure thereafter is for one or both crabs to emerge briefly, then for both to disappear into the hole of the male and stay there, so far as I saw, until the succeeding tide.

Several times, however, I have watched the progress of a female wandering more than 10 feet from her own hole, and showing interest in the displays of a number of males, one after the other. One of these females, for instance, wandered across five feet of territory, crowded with both males and females, electrifying every male she came near into giving a vigorous display. In each case she paused and allowed matters to reach the point where the male, with a final excited flourish of his cheliped, vanished down his hole; then, instead of following him, she merely looked down into the hole, or literally stuck her eyes into it, then at once backed out and wandered on to the next male, who promptly paid her similar court. After she had crossed these five feet, she turned and came back toward the middle of the area by a slightly different route. Here she finally followed a male into his hole, after the usual preliminaries. He was not especially large or bright, though fully adult and with a well made shelter (see below). She stayed below about five minutes, then emerged momentarily, and descended again. After two minutes more they both came up, but descended again immediately, and this time they were both still down when I ceased observations, half an hour later, when the tide was almost covering the hole.

As in *U. stenodactyla*, actual pairing was observed at the surface. I was photographing another species at the time, and so missed the beginning of the mating, which was on the ground beside me, at the mouth of the female's

hole. As in other species, they were sternum to sternum, the female supporting most of the weight, the male slightly above her. His first two ambulatories grasped her body in front of her first ambulatories; his minor cheliped resting on her carapace behind her eyes; his major cheliped clearing her, held quietly. Both were stroking each other lightly with their ambulatories, but less actively than in *U. stenodactyla* at a similar stage. After about a minute they became perfectly quiet except for the quivering of their abdomens. After less then two minutes the female slipped down her hole, while the male moved three inches away toward his own and started feeding. It seems likely that, in this and other species, it is usual for mating to take place in the hole of the male, but that when he has come to the female, and interested her sufficiently near her hole, they mate outside, since he would not be able to descend the smaller opening.

The following instance of precocious and somewhat irregular behavior was observed in a male which does not appear to be more than about two-thirds grown. He had erected a well built shelter (see below) 15 mm. high, above a hole 7.5 mm. wide, which proved later to go four inches straight down and then three inches obliquely, after a sharp turn. His color was poorly developed. He was feeding and displaying three inches from his hole when a large female passed (7.3 mm. long, while he measured 6.2 mm., with a definitely underdeveloped major cheliped). He stopped feeding instantly, raced to the mouth of his hole, apparently much excited, and displayed frantically for three minutes, facing her with the large cheliped turned partly toward her, so that some of his back showed during display, without revolving. She came closer. He descended his hole, and she followed at once. He remained down five minutes, then emerged momentarily and descended. After five minutes more he again emerged, and this time began displaying and feeding again. After a few minutes he again descended. This routine continued for 25 minutes, and since the tide was approaching, I dug them up. The resumption of display after the presumable winning of a mate may be interpreted either as a use of display in defiance to other males, or as simply the irregular behavior of immaturity. It was not observed in adults either of this species or of others: once a female had entered the hole of a male, he did not display any more at least during that particular low tide.

Shelter: Of the three species, *U. beebei*, *U. latimanus* and *U. terpsichores*, which were observed to build shelters above their holes, the present species, *U. beebei*, has the habit least well developed. This primitive development is indicated both in the variable and relatively small and poorly constructed forms of the shelters, and in the apparent erraticalness with which they are erected. Sometimes they are well formed hoods arching over the hole, more often they are scarcely more than oblique and slightly concave turrets—a sort of "leaning towers"—and sometimes they are only tapering heaps of sandy mud scarcely taller than the builder. Young males often start building, but do not finish. Even adults may take several hours to complete a shelter, working only sporadically, and often displaying for some time before starting operations. Furthermore, although they are built only by displaying males, not every displaying male builds a shelter; the ratio on most days at La Boca proved to be about one in ten. The exception to the latter proportion was when, on some days, a wave of shelter-building seemed to sweep a particular section of the colony. The males without shelters displayed as vigorously as those with perfect turrets; size and coloration of the crab are not involved; and I have seen females descend the holes of males with or without turrets, apparently without any preference at all. The male I saw actually pairing at the surface had no shelter. A given individual seems to build a shelter at least several days in succession, although I have not yet concluded satisfactory observations on this subject.

In general, a major wave of shelter building seemed to be prevalent in the colony on the right side of the beach at La Boca in the first two weeks in February, then, while it died down there, to rise to full swing in the colony on the left beach in the last two weeks of the same month. Furthermore, although this species was found at La Boca, and farther along the coast at Panama City and Old Panama both on the firm muddy sand and out in the true mud, at least within 15 feet of shore, turret building is chiefly confined to the individuals on the muddy sand. A few males, however, living in the mud erect poor ones; the semi-liquid consistency of this building medium of course militates against its use.

The method of building is the same as in other species, material being scraped by the major ambulatories at a distance from the mouth, carried back to the hole by the first two major ambulatories, and heaped up while the minor side of the crab rests in the mouth of the hole. (See p. 157).

Breeding: Many ovigerous females were seen at La Boca and Panama City in February. The collection contains five, four from La Boca, and one from Puntarenas, Costa Rica, also taken in February. The magenta eggs, measuring .24 mm. in diameter when preserved in alcohol, number about 1,500.

Young: The young are distinguishable from those of *U. stenodactyla* by their notably more swollen ambulatories. In both species specimens under about 3 mm., have very few—only about 25—spoon-tipped hairs on the merus of the second maxilliped. Possible confusion with members of the group of species containing *Uca oerstedi* and *Uca saltitanta* is eliminated variously by the lack of pile on the carapace (so characteristic of *U. oerstedi*), by the broad eyebrow, by the well developed crenulations on the lower orbital margin, and by the several enlarged teeth alone or among the serrations of the minor cheliped. These teeth, combined with the very slight gape, distinguish them at once from the

group containing *U. latimanus*, all of which have the minor chelae widely gaping. The moderately narrow front and beginnings of a broad carapace strongly arched, distinguish them easily from the young of more distantly related species.

Affinities: This species is very close anatomically to *U. stenodactyla;* the differences have already been listed under *Diagnosis*. In coloration and habits, however, it differs greatly, the colors being very different and less bright—iridescent green, plum, ochre and gray instead of blue, white, pink and red; these relatively dark colors, however, are equally striking in their own way. The beckoning portion of the display is fundamentally similar, although it is twice as fast, has a jerk, and differs in the characteristic preliminary raising of the carpo-manus joint; also, *U. beebei* revolves before a female, which *U. stenodactyla* does not. On the other hand, *U. beebei* never pursues females or races along with one encircled by the major cheliped, as does *U. stenodactyla*. Finally, displaying males of *U. beebei* sometimes build shelters, those of *U. stenodactyla* never, although adult females of the latter species sometimes by similar methods raise high walls around their holes. The colonies of the two species are often intermingled, one species being usually dominant, when *U. beebei* is found on muddy sand. *U. stenodactyla*, however, unlike *U. beebei*, is never found in pure mud.

Range: From Corinto, Nicaragua, to Old Panama, R. P.

Local Distribution: The 115 specimens were found principally on gravelly muddy sand, or muddy sand, but were common also on mud flats and, rarely, among mangrove shoots which were mostly unshaded. Six very young specimens of slightly questionable identity were found in the mud, among adults, close to a muddy sand beach.

Remarks: An examination of the specimens at the United States National Museum which were referred by Miss Rathbun (1917) to *U. stenodactylus* shows that Cat. Nos. 32321 and 32322, Boca del Rio Jesus Maria, and Puntarenas, Costa Rica, respectively, should be referred to *U. beebei*. It is one of these specimens that is illustrated in her monograph (pl. 152, fig. 3 and pl. 153).

Material: Male holotype: Cat. No. 4129, La Boca, Balboa, Canal Zone; 8 male and 8 female paratypes, Cat. No. 4130, same locality; 39 males and 25 females, Cat. No. 4131, same locality; 15 males and 3 females, Cat. No. 4133, Bellavista, Panama City, R. P.; 7 males and 3 females, Cat. No. 4134, Old Panama, R. P.; 1 male, Cat. No. 381,150, Bahia Honda, R. P.; 2 males, 3 females, Cat. No. 381,149, Puntarenas, Costa Rica; 2 males, Cat. No. 381,148, Corinto, Nicaragua; 6 young, Cat. No. 4132, La Boca, Balboa, Canal Zone, probably belong to this species.

This species is named in honor of Dr. William Beebe, Director of the Department of Tropical Research, New York Zoological Society, and of its Eastern Pacific Expeditions.

Uca stenodactyla (Milne Edwards & Lucas, 1843).

Text-figs. 4Q, 5. Pl. IV, Fig. 15; Pl. V, Fig. 21; Pl. VI, Fig. 28; Pl. IX, Figs. 41, 42.

(See also pp. 149–154, 156, 158–160, 166, 167, 169).

References: Gelasimus stenodactylus Milne Edwards & Lucas, 1843, p. 26; 1847, pl. 11, fig. 2.
Uca stenodactylus Rathbun, 1917, pp. 416–7, part.; not pl. 152, fig. 3 or pl. 153.

Range: Gulf of Fonseca, El Salvador, to Valparaiso, Chile. Reported from Brazil, probably erroneously, by Milne Edwards.

Local Distribution: Found on tidal flats and protected shores composed of sandy mud which is midway in consistency between the extreme softness and stickiness of clayey mud and the sand of true beaches. The colonies are large as a rule and occur near, but not among, mangroves.

Supplementary Specific Characters: Spoon-tipped hairs on merus of second maxilliped numerous, arranged in about 15 to 25 closely packed rows on inner quarter or third of merus, throughout its distal five-sixths. The spoon-tipped hairs arising nearest the longitudinal center of the merus are so short as to be difficult to count; excluding these—that is, counting only the spoon-tipped hairs which project beyond the inner margin—a rough total of about 160 to 250 is reached, the lower figures being typical of the smaller crabs. Woolly hairs sparse. Ischium of third maxilliped with median groove represented by a shallow, hairless depression extending about half length of ischium, parallel to inner groove; entire maxilliped bulging somewhat outward.

Minor chelae more than half again as long as palm, usually coarsely serrated or toothed in middle third. This portion includes several enlarged teeth on each edge; sometimes the dactyl serrations consist only of two to four good-sized teeth; rarely the serrations appear low and worn. In all cases, however, there is a gape only in the non-serrated basal portion and, sometimes, beyond the serrations distally, since the teeth and serrations almost or perfectly articulate. Distal part corneous but not dilated, tapering, the tips not articulating, that of dactyl falling inside that of pollex. Oblique row of hairs along inner margins sparse except for distal brushes. Additional rows of sparse hairs as follows: two on or near dorsal profile of dactyl, one on external side of pollex, near ventral profile.

Eyebrow broader than adjacent portion of eyestalk. Lower orbital margin crenulated throughout, though weakly internally. Suborbital region naked except for a short row of hairs immediately behind crenulated margins.

Merus of ambulatories scarcely dilated; even in female that of third ambulatory reaches a fifth to a quarter of its length beyond orbital angle when laid forward. Breadth of merus of third ambulatory on minor side of male about a fourth to a third of its length.

Abdominal appendage moderately slender, tapering distally. Arm absent, represented only by a few bristles arising from a horizontal shelf, or, rarely, produced as a rudimentary stump, at

the beginning of about the distal eighth or ninth of appendage.

Measurements: The 72 specimens taken include the following extremes of length: largest male, 9.1 mm.; largest females (ovigerous), 5.1 to 6 mm.; smallest specimen 1.6 mm.

Color: Displaying males observed through binoculars: carapace iridescent gray blue or violet blue anteriorly, white or blush pink posteriorly. Outside and inside of merus and carpus of major cheliped yellowish-white to white; outer lower part of manus and all of outer side of pollex bright lilac pink; upper part of manus and dactyl white or pinkish-white; inside of manus pale salmon pink; inside of both chelae flame orange in brightest, in palest pale salmon. Minor cheliped with merus and carpus yellowish, manus and chelae pink or salmon. Eyestalks lemon yellow. Buccal and pterygostomian regions greenish or yellowish-white to pure white. Ambulatories anteriorly (ventrally) flame scarlet, the merus brightest; posterior (dorsally) pale rosy, the last two legs dullest. As courting males brighten in the sunlight from dull browns and buffs resembling female coloration, after emergence from their holes, the first change is the appearance of the flame color. This shade spreads from the inside of the chelae to the inside of the manus, then around to the outer lower part of the manus in the form of lilac pink; the carapace gains last its full brilliant, iridescent, violet blue anteriorly, and white or blush pink posteriorly.

Females and young, grayish-brown, mottled or spotted; the ambulatories banded gray and brown; manus and dactyls of chelipeds white to violet; eyestalks yellow in largest.

Display and Mating: Body held consistently high during a series of displays without special stretching. Large cheliped starts from folded position, held well clear of ground, opens slowly outward and only very slightly upward, so that at end of gesture it is only a little way above eye level; then, without a break in the rhythm, it is folded inward and drawn down into place. The small cheliped meanwhile makes a small, corresponding, outward gesture. Chelae of both sides are held slightly open. A few rapid running steps are usually taken during each display, which itself is slow and measured, with no downward jerk, and lasts slightly more than one second. Every few minutes a wave of excitement sweeps over half a dozen or so adjacent males—a wave which is not to be confused with the fear "alert" signal, in which the claw is at once folded and a swift return made to the hole. In the excitement under consideration, a female is always the stimulus: either one has appeared at her hole close by, or has stopped feeding and looked around, or has progressed from a distance into the neighborhood of the interested males. She is not necessarily large (I do not say "not necessarily adult," since very small females have been observed carrying eggs); I have never seen the response evoked by an ovigerous female. At this time the excited, adjacent males raise their large chelipeds much higher than usual, holding them, when much excited, almost perpendicularly above their heads, and race several inches to one side and back again, either holding the cheliped motionless, or, sometimes, waving it slightly, and with the fingers spread wider than usual. Sometimes the cheliped is stretched straight out to the side instead. When the female pays no attention, passes by, or resumes feeding, the male returns to the original, less excited, beckoning type of display, which is often accompanied by feeding.

Often several males, galvanized in the above fashion, chase a female some distance, while she doubles and dodges skillfully. Sometimes one will manage to encircle her with his large cheliped, holding her loosely, without touching her, and race along with her, apparently trying to direct her toward his hole, while she endeavors to duck out from under and escape, although she never seems actually frightened and the male never seems to make a serious effort to hold her. On all of the numerous occasions I have watched this performance, it has always ended with the female's escaping and racing down her own hole. Sometimes brief duels result between males who have been chasing the same female. The whole performance seems to be at the least an expression of excess energy, rather than any serious attempt at mating, and may even be interpreted as an approach to sheer sexual play or sport.

Actual mating, on the surface, was observed twice; on about three or four other occasions a female was induced by the male to follow him, after violent display at an increased tempo, down his hole; she stayed for varying lengths of time, from ten minutes to indefinitely, the tide covering the hole in the latter cases before either crab emerged.

The first surface mating seen was on February 14, at La Boca, and was particularly interesting because of the actions of the female. The latter, along with others close by, were for the first time observed to be building high thick walls of pellets around their holes. High tide came at noon; the sky was about two-thirds clear. Starting about an hour and a half before low tide a number of the largest females swiftly began to build walls. In each case the muddy sand was scraped from a distance, usually about two inches, beyond the mouth of the hole, as with the male shelter builders (*U. beebei*, *U. latimanus* and *U. terpsichores*), not brought up from below as with the females and young of *U. latimanus*, which stop up the mouth of the burrow with a small dome, presumably against the heat of the sun. The highest of the *stenodactyla* walls was about two-thirds of an inch; some were lower but thicker, being an inch and a half across the outer circumference. By dead low tide all of the females concerned had entered and sealed themselves in with the tossing of a few pellets across the top. No ovigerous females were seen building walls, and no small ones. The males seemed to be paying especial attention to the builders during operations.

The copulation mentioned above occurred as follows: An adult male, large and moderately brightly colored, displayed before a female who watched attentively from near her just-completed wall. They then both walked slowly over to it. When they reached it, she climbed halfway to its top, clinging to it, while the male remained at the bottom, reached up with his minor middle ambulatories, and stroked her adjacent ambulatories gently. Then they both climbed to the broad top of the wall, and he spent almost a minute stroking her legs and carapace, very gently, with both major and minor ambulatories and with his minor cheliped; occasionally she stroked him in return. She made no effort whatever to descend into her hole. Finally they both very deliberately straddled the wall, which gave them excellent support, sternum to sternum, the posterior part of the carapaces not quite touching the wall. The male clasped the female about the body, between her first and second ambulatories, with his first and second, supporting himself on the sides of the wall with his last two pairs. He was slightly higher than she; the major cheliped was not used at all, but rested folded just above her eyes, not touching her. The minor cheliped rested lightly on her carapace, behind her right eye. Her abdomen was (I think) underneath, and his apparently bent back, although since her back was toward me, it was difficult to make sure. At first he continued to stroke her legs a little every few seconds, very lightly, with the two pairs of legs which held her. Then they both remained absolutely motionless for about two and one half minutes. Then, although they had not been alarmed or disturbed, she swiftly but gently disengaged herself and slipped down her hole. The male made no effort to follow but descended to the ground, swinging his abdomen down and back into place three or four times as he did so; he then began feeding normally at once. The female never reappeared, except to close her hole with a plug within the next three-quarters of an hour. It was then just about dead low tide, the time of greatest activity in the colony. The male definitely stood guard at first, shooing off two other males who came from time to time to the top of her wall and peered down. Several times the guarding male mounted the wall, straddling the hole, and threatened off aggressors by lunging at them with his large cheliped, in motions quite different from the display "beckonings." He never made any effort, to descend the female's hole.

A second mating was observed on February 28. In this case the male had been courting the female for at least an hour, catching her attention with display, approaching her hole, and getting as far as stroking her. She had not built a wall, and each time he approached her slipped down her hole after having allowed several strokings. Finally mating occurred, at the mouth of her hole, the position being much as in the pairing previously described, and I secured several photographs (Plate IX). This time the abdomen of the female was clearly outside that of the male. Since I was busy with the camera, I did not count seconds to time the copulation, but it seemed to last two or three minutes, as in the other case. As before, the female ended it by going down her hole, which she eventually plugged up.

As in other species, I believe that the more usual method of mating is for the male to induce the female to follow him down his hole (see p. 157). I have no idea of the significance of the walls erected by large females, which, after the first observations of them, were on some days absent from the colony and on other days fairly numerous; weather conditions did not seem to be involved.

A strange episode was the deliberate destruction of the wall of an exceptionally large female by an immature male. He had just started to stroke her legs with his, after an incomplete, brief, very elementary display, to which she appeared to pay no attention. She was on the side of the wall, he at the base. At this point she climbed to the top and disappeared down her hole He did not try to follow, but at once began systematically tearing the wall down, using chiefly the ambulatories of the minor side, and did not stop until it was well levelled and trampled flat, the operation lasting about five minutes. Then he moved off to his own hole and began feeding unconcernedly. After a few minutes she emerged and began feeding too. She showed no evidence of any emotion, or even realization that the wall was gone, and did not rebuild before the tide covered her hole.

Breeding: Ovigerous females were fairly common in the colony at La Boca in February. Three were captured at Corinto, Nicaragua, in January. The eggs, which measure between .25 and .27 mm. in diameter after having been preserved in alcohol, number from about 1,000 to 1,500. There were many very young specimens at Corinto in January, but not at La Boca in February.

Growth: Although the major chelipeds are as usual short and specifically uncharacteristic in the young, and the carapace relatively flat and narrow, the broad eyebrows, moderately narrow front, minor cheliped strongly toothed in the central area, and second maxillipeds with abundant spoon-tipped hairs, make them difficult to confuse with the young of any species except, possibly, those of *U. beebei*, of which very young specimens have not been identified with certainty. Comparable specimens of the two species measuring 2.7 mm. in length are readily distinguishable by the more slender ambulatories in *U. stenodactyla*. Specimens of the latter under 2 mm. long have only about 25 spoon-tipped hairs, but these are strongly developed. Young between 1.6 and 3 mm. long ran freely in and out of the burrows of largers crabs, both of their own species and of *U. stylifera*, at Corinto. In young males the major cheliped is the first part of the crab to show adult coloration, turning gradually pinkish, with the tips of the claws taking on color last; the carapace changes next from the

mottled phase, becoming blue and white; and the ambulatories are the last to be transformed, changing from the banded coloration to buff and scarlet.

Burrows: The burrow of a large male extends from two to six inches straight underground, then turns with a short crook at the end, or else it may continue diagonally from the turn to a total of about nine inches underground. A smooth, clean area is usually left for several inches or more around the hole, the size of this display ground depending on the extent of crowding in the colony

Remarks: The specimen illustrated by Rathbun (1917, pls. 152, 153) should be referred to *U. beebei* (see p. 195).

Material: A total of 72 specimens was taken from Corinto, Nicaragua; Port Parker and Golfito, Costa Rica; La Boca, Balboa, Canal Zone; and Panama City, Panama. Cat. Nos. 381,145, 381,146, 381,147, 4127, 4128.

Uca helleri Rathbun, 1902.

Text-figs. 4R, 5.

(See also pp. 149, 161, 166, 167, 169).

Reference: Uca helleri Rathbun, 1902, p. 277, pl. 12, figs. 3 and 4; 1917, p. 415, pl. 151. Boone, 1927, p. 278, fig. 98.

Range: Galápagos Islands.

Supplementary Characters: Spoon-tipped hairs on merus of second maxilliped moderately numerous, arranged in about 12 to 15 or more rows on inner fifth or quarter of merus, throughout its distal half. The spoon-tipped hairs arising nearest the longitudinal center of the merus are so short as to be difficult to count; excluding these—that is, counting only the spoon-tipped hairs which project beyond the inner margin—a rough total of about 130, in a female 7.7 mm. long, is reached. Woolly hairs moderately sparse. Ischium of third maxilliped with median groove represented by a shallow, hairless, distal depression.

Minor chelae almost once and a half times as long as manus, widely gaping to the abruptly tapering, corneous, articulating tips. Prehensile edges armed only with rudimentary, fine serrations, sometimes almost lacking. An oblique row of rather long hairs along inner side, sometimes interrupted distally, but resumed as the usual long brushes distally. Traces of two or three additional rows, represented only by a few stubby hair bases, near profiles of both dactyl and pollex.

Eyebrow about as broad as adjacent portion of eyestalk. Lower orbital margin well crenulated throughout. Suborbital region naked except for a row of hairs immediately behind crenulated margins.

The abdominal appendage of a young male (3.7 mm. long) is moderately slender with a slim, rudimentary arm arising at about the distal fifth.

Material: The four specimens at present in the collections of the Department of Tropical Research were taken at Tower Island, Galápagos, by the *Arcturus* Oceanographic Expedition in 1925. They consist of two males, 3.2 and 3.7 mm., and two females, 4.2 and 8 mm. in length. They have already been recorded by Boone (1927, p. 278). The male illustrated by her (p. 279, fig. 98) has been mislaid.

Uca crenulata (Lockington, 1877).

Text-figs. 4S, 5.

(See also pp. 149, 151, 166, 169).

References: Gelasimus crenulatus Lockington, 1877, p. 149.

Uca crenulata, Rathbun, 1917, p. 409, pl. 146.

Range: Previously known from San Diego, California, to Mazatlan, Mexico. The present collection extends the range south about 4 degrees to Tenacatita Bay, Mexico.

Local Distribution: Found on the muddy shore of a lagoon.

Supplementary Specific Characters: Spoon-tipped hairs on merus of second maxilliped numerous, arranged in about 12 to 15 rows on inner fifth or quarter of merus, throughout its distal half, and numbering roughly 175 to 200 in large specimens (borrowed from the American Museum of Natural History), and about 125 in the smaller males (about 6 mm. long) in the present collection. Woolly hairs sparse. Ischium of third maxilliped with median groove represented by a shallow, hairless, distal depression.

Minor chelae about once and three-fifths times as long as manus, widely gaping to the abruptly tapering, corneous, articulating tips. Prehensile edges armed with weak serrations. An oblique row of hairs along each inner surface, ending in a short brush distally; another row of longer hairs along inside of each prehensile edge. Traces of two or three rows of stubby, microscopic hairs near dorsal profile of dactyl and ventral profile of pollex, respectively.

Eyebrow almost as broad as adjacent portion of eyestalk, scarcely inclined. Lower orbital margin crenulated throughout. Suborbital region naked except for a row of hairs immediately behind crenulated margins.

Abdominal appendage slender, with well developed, slender arm arising about seven-eighths of the way to the tip.

Measurements: The three specimens taken consist of two males measuring 5.9 and 6.24 mm. in length, and one immature female, 5 mm. long.

Material: All were taken at Tenacatita Bay, Mexico. Cat. No. 381,151.

Uca limicola sp. nov.

Text-figs. 4T, 5; Pl. IV, Fig. 17; Pl. V, Fig. 22; Pl. VI, Fig. 29.

(See also pp. 149, 166, 169).

Diagnosis: Carapace semi-cylindrical in lateral view; front behind eyes slightly more than a quarter maximum width of carapace; orbits scarcely oblique; antero-lateral margin slightly

concave, followed by a sharp angular turn inward and backward; orbital angle acute, moderately produced. Minor chelae gaping moderately widely throughout length to articulating tips, feebly serrated. Oblique ridge inside palm of major cheliped present, strong in upper half; pollex tapering distally to a rounded tip, not obliquely truncate; several slightly enlarged teeth in each chela. Eyebrow slightly more than half width of adjacent portion of eyestalk, continued outward almost as far as orbital angle. Merus of second maxillipeds with about 100 to 135 spoon-tipped hairs. Abdominal appendage of male slender with well developed arm.

Description: A small species. Carapace with regions practically indistinguishable, including H-form depression; surface covered with widely spaced microscopic hairs.

Carapace strongly convex, semi-cylindrical in lateral view, widest at orbital angles. Anterolateral margins concave, slanting slightly inward, about half as long as width of front behind eyes. They then turn inward and backward at a sharp angle, continuing in the form of the usual concave ridge as far as middle of cardiac region. Sides of carapace concave, scarcely converging. Front between posterior margins of eyestalks slightly more than one-fourth width of carapace; the distal part of its marginal ridge obsolescent. Marginal line of front distinct. Upper margin of orbit sinuous, scarcely oblique. Eyebrow slightly more than half width of adjacent portion of eyestalk, moderately inclined, continuing outward almost to orbital angle. Lower orbital margin little projecting, crenulated throughout, the most internal crenulations, though small, being perfectly formed. Suborbital region naked except for a row of hairs immediately behind orbital margin. Third to sixth abdominal segments in male very incompletely fused.

Spoon-tipped hairs on merus of second maxilliped moderately numerous, arranged in about 10 rows on inner fifth or quarter of merus throughout its distal three-fifths, and numbering roughly about 100 to 135. Ischium of third maxilliped with median groove represented only by a marginal indentation.

Minor chelae about once and a sixth as long as palm, gaping moderately widely throughout length as far as the articulating, corneous tips; the latter are scarcely dilated and taper distally. Prehensile edges feebly serrated. Oblique row of hairs along inner margins of dactyl and pollex well developed, ending in long, thick brushes. Another pair of rows, on outside, close to their prehensile margins, also elongated distally, although not so much as inner hairs. Traces of four other rows, two near dorsal profile of dactyl and two near ventral profile of pollex respectively.

Large cheliped of male with arm and wrist granulated and finely rugose externally. Hand about two-thirds as broad as long. Upper surface of palm rounded, bent over proximally to bound carpal cavity sharply; lower margin marked by an elevated line of microscopic, close-set granules. Entire upper and outer surface covered with moderately fine, close-set low tubercles, largest dorsally. Inner, lower, proximal part of palm, near ventral profile, roughened very slightly by a few microscopic granules; carpus of first ambulatory on major side similarly roughened with a very few minute granules.

An oblique tuberculated ridge on inner side of manus of major cheliped, strong throughout, the tubercles in a single line, continuing distinctly to upper margin. Carpal eminence moderately developed. A row of similarly strong tubercles arises close to dorsal margin at base of dactyl, continues obliquely downward, and dies out along pollex in a gradually obliterated line close to and paralleling prehensile margin. Across base of dactyl, distal to this first row, are several rudimentary tubercles.

Major dactyl slender, about once and a quarter times as long as manus, with only a few fine granules dorsally at extreme base, arched downward distally beyond tip. Gape wide throughout with very small, low, tubercular teeth, of which one in the proximal half of the dactyl and several more in distal half of pollex are enlarged. In addition there may be several slightly enlarged on the dactyl. On external side are two rows of microscopic granules close to and paralleling prehensile edges of dactyl and pollex, respectively.

Merus of ambulatories scarcely enlarged.

Abdominal appendage of male slender, with an obliquely truncate tip, and a well developed, slender, tapering arm arising about six-sevenths of way to tip.

Measurements: Male holotype, length 5.8 mm., breadth 9.2 mm., base of manus to tip of pollex 15.8 mm.; 11 male paratypes, length 3.6 to 6.6 mm.; 8 female paratypes (non-ovigerous), length 3.9 to 6.4 mm.

Affinities: U. limicola is most closely related to *crenulata* and *deichmanni*. The principal distinctions are indicated in the key. In the specialization trends shown in Group 5, directed toward increased arching of carapace and reduction of serrations and increase in gape of the minor chelae, the proposed new species is a perfect intermediate between *crenulata* and *deichmanni*.

Range: Known only from Golfito, Gulf of Dulce, Costa Rica.

Local Distribution: Found along the muddy bank of a slightly brackish stream.

Material: The 20 specimens consist of the male holotype, Cat. No. 381,152, and 11 male and 8 female paratypes, Cat. No. 381,153, all from Golfito, Costa Rica.

The name *limicola* is given to this species in reference to its occurrence in mud.

Uca deichmanni Rathbun, 1935.

Text-figs. 4U, 5; Pl. IV, Fig. 18; Pl. V, Fig. 23; Pl. VI, Fig. 30.

(See also pp. 149, 150, 153, 156, 166, 167, 169).

Reference: Uca deichmanni Rathbun, 1935, p. 52.

Range: Previously known only from the holo-

type, taken at Panama. The present collection was made between Port Parker, Costa Rica, and Old Panama, R. P.

Local Distribution: Found on very moist, gravelly, muddy sand, or on pure sand, often at the borderland between beach and mud flat, and often in the same type of terrain close to large, scattered stones. Burrows only about three inches deep.

Supplementary Specific Characters: The present material has been compared with the holotype at the U. S. National Museum and found to agree perfectly. In the light of these additional specimens, Miss Rathbun's preliminary description may be amplified as follows:

Diagnosis: Carapace semi-cylindrical in lateral view; front behind eyes about a quarter maximum width of carapace; orbits moderately oblique; antero-lateral margin concave, followed by a moderately sharp turn inward and backward; orbital angle acute, slightly produced. Minor chelae gaping widely throughout length to tapering, poorly articulating tips; edges feebly serrated. Oblique ridge inside palm of major cheliped present, weak in upper half; pollex obliquely truncate; only one enlarged tooth on chelae, located at beginning of middle third of dactyl. Eyebrow almost as wide as adjacent portion of eyestalk, dying out, except for an elevated line, less than three-fourths of way out to orbital angle. Merus of second maxillipeds with about 150 to 200 spoon-tipped hairs which are long enough to project beyond inner margin, and additional shorter ones. Abdominal appendage of male slender with well developed arm arising at distal eleventh.

Description: A small species. Carapace strongly convex, semi-cylindrical in lateral view, widest at orbital angles, regions fairly well indicated, due to their individual convexities; surface naked.

Antero-lateral margins concave, slanting slightly inward, less than half as long as width of front behind eyes. They then turn inward and backward at a broad, not strongly marked angle, in the form of the usual concave ridge as far as middle of cardiac region. Sides of carapace sinuous, slanting slightly either outward or in. Front between posterior margins of eyestalks about one-fourth width of carapace. Eyebrow slightly more than half as wide as eyestalk; margin of front distinct but weak. Lower margin of orbit strongly projecting, strongly crenulated throughout, the most internal crenulations, though small, being perfectly formed. Suborbital region completely naked. Third to sixth abdominal segments in male showing faint signs of partial fusion.

Spoon-tipped hairs on merus of second maxilliped numerous, arranged in about 14 to 20 rows on inner quarter or third of merus throughout its distal three-fifths and numbering roughly about 150 to 200, counting only those spoon-tipped hairs which are long enough to project beyond inner edge of merus. Ischium of third maxilliped with median groove represented by a very shallow, hairless depression on distal third.

Minor chelae about once and a half as long as palm, gaping widely throughout length to the slender, tapering, poorly articulating tips. Prehensile edges with feeble serrations barely distinguishable. Oblique row of hairs along inner margin of dactyl and pollex moderately well developed, ending in long, thick brushes. Another pair of rows, on outside, close to their prehensile margins, also elongated distally, although not so much as inner hairs. Traces of five other rows, three on upper, outer side of dactyl and two on outer side of pollex, near ventral profile, respectively.

Large cheliped of male with arm and wrist externally finely granulate on rugosities. Hand slightly more than two-thirds as broad as long. Upper surface of palm rounded, bent over proximally, to bound carpal cavity sharply; lower margin faintly cristate. Entire upper and outer surface covered with fine, close-set granules, larger dorsally; erosions mentioned in type description inconspicuous. Inner, lower, proximal part of major palm, near ventral profile, roughened very slightly by a few microscopic granules; carpus of first ambulatory on major side with no more than several minute granules for roughening.

An oblique, tuberculated ridge on inner side of manus of major cheliped, greatly elevated, strong and composed of a single row of tubercles as far as carpal cavity; beyond this it continues to dorsal profile as an irregularly double row of small, low tubercles, not at all elevated. Carpal eminence strongly developed. A row of distinct, moderate-sized tubercles arises close to dorsal margin at base of dactyl, continues downward and dies out along pollex in a gradually obliterated line close to and paralleling prehensile margin. Across base of dactyl, distal to this first row, is a line of four or five small but distinct tubercles.

Major dactyl slender, about once and a half times as long as manus, with only a few fine granules dorsally at extreme base, arched downward distally beyond tip of pollex, which is also slender, with the tip obliquely truncate. Gape wide throughout with numerous small, low, similar teeth except for one, much enlarged, about one-third of way to tip of dactyl. A row of small tubercles proximally close to prehensile edge of dactyl both internally and externally. A corresponding one on external side of pollex.

Ambulatories slender, the merus scarcely enlarged.

Abdominal appendage of male slender with a convexly truncate tip, and a well developed, slender arm arising at the beginning of about the distal eleventh.

Measurements: The 64 specimens taken include the following extremes of length: largest male, 6.4 mm.; largest female, 6.4 mm.; ovigerous female, 5 mm.; smallest male 3 mm.; smallest female, 3.1 mm.

Color: Displaying males observed through binoculars: carapace and dorsal (posterior) sides of ambulatories, brownish or dark gray. Outer

side of merus and carpus of major cheliped dark brown; outer side of manus and chelae dazzling pure white; inner side of merus and carpus magenta; inner side of manus and chelae violet rose, or, sometimes, ochre. Buccal and pterygostomian regions violet blue; subhepatic region bottle green. Ventral (anterior) side of merus of first three ambulatories yellowish.

Eggs magenta.

Display: During each display body is elevated as high as possible on all four pairs of legs. At beginning cheliped is flexed at right angles, parallel to front, covering front completely. Chelae are held slightly open, parallel to each other. With a swift movement cheliped is opened and raised with an upward and outward swing. At point of highest possible stretch it is held for an instant, exactly as in a Fascist salute, then lowered swiftly in the same plane in which it was raised. The display is repeated without pause; hence, unlike other species, the accent is at the peak of the elevation of the cheliped, not at the flexed position. During display, the minor cheliped remains flexed, or hangs motionless. A few steps in either direction may be taken during display, which is made at the rate of about two to the second. Twelve or fifteen displays may be made without pause.

Breeding: Ovigerous females were seen at Balboa, and in nearby regions in Panama, throughout February. Only one was captured. The eggs, which measure .24 mm. in diameter after having been preserved in alcohol, number about 2,000.

Affinities: This species is most closely related to *U. limicola*. The distinctions are indicated in the key.

Material: The 64 specimens in the collection were taken at Port Parker, Piedra Blanca, Uvita Bay, and Golfito, Costa Rica; at Bahia Honda, Panama City, and Old Panama, Panama; and at La Boca, Balboa, Canal Zone. Cat. Nos. 381,154, 381,155, 381,156, 381,157, 381,158, 4141, 4142, 4143.

Uca latimanus (Rathbun, 1893).

Text-figs. 2, 3, 4V, 5. Pl. VI, Fig. 33, Pl. VII, Fig. 36; Pl. VIII, Figs. 38, 39, 40.

(See also pp. 149, 150, 153–159, 161, 165–167, 169).

References: Gelasimus latimanus Rathbun, 1893, p. 245.

Uca latimanus, Rathbun, 1917, p. 422, pl. 157.

Range: La Paz, Lower California, to Tumaco, Colombia.

Local Distribution: Sandy-mud and muddy banks of fresh- and brackish-water streams and lagoons.

Supplementary Specific Characters: Spoon-tipped hairs on merus of second maxilliped exceptionally numerous, covering all except outer third of dorsal surface, found even on proximal part of inner margin, though flanked externally by the usual long and short slender-tipped hairs. The spoon-tipped hairs are arranged in about 45 or more rows in fairly regular quincunxial formation. Counting only those which arise near the margin and are long enough to project beyond it, a total of about 400 or more can be counted on a mature specimen. Woolly hairs moderate in number. Ischium of third maxilliped broad, smooth, strongly convex and practically naked, with median groove absent and even inner groove, though distinct, not deep.

Minor chelae about once and a half times as long as palm, gaping widely throughout length to the slender, tapering, corneous tips, which articulate poorly. Prehensile edges without a trace of teeth or serrations. Oblique rows of hairs along inner margin of dactyl and pollex poorly developed, except for distal brushes of long hairs. Other rows, all irregular and represented chiefly by several isolated, fairly long hairs, are found on both surfaces of both chelae.

Eyebrow about as broad as adjacent portions of eyestalk. Marginal line of front well developed. Lower orbital margin crenulated throughout, the internal crenulations small but distinct. Suborbital region naked except for one to three short rows of hairs, immediately behind crenulated margins.

Ambulatories short, in addition to the well known breadth of all segments. That of merus of third ambulatory on minor side of male is fully two-fifths of its length.

Abdominal appendage moderately slender, tapering little distally. Arm well developed, arising at about distal tenth of appendage.

Entire lower proximal inner surface of manus roughened by close-set granules, opposable to a conspicuous corneous ridge on anterior (ventral) surface of carpus of first ambulatory.

Measurements: The 59 specimens taken include the following extremes of length: largest male, 9.5 mm.; largest female, 8.6 mm.; smallest male, 4.5 mm.; smallest female, 3.1 mm.

Color: Displaying males observed through binoculars: carapace white, usually marked sparingly with slate or brown, but quite often pure, dazzling white. Major cheliped, except chelae, externally bright tawny, or tawny orange, sometimes with a salmon tinge. Inside of merus similar to outside. Chelae white both outside and in. Inside of manus and carpus less bright than outside. Minor cheliped bluish-white. Buccal, pterygostomian and subhepatic regions and all underparts bluish-white to pure white. Anterior (ventral) sides merus of first three pairs of ambulatories bright plum red, rest of anterior sides of ambulatories slate blue; posterior (upper) side of ambulatories white with slate or brown markings stronger and more numerous than those on carapace. The above coloration is acquired very gradually, in the sun, during and after completion of the shelter, the building of which follows feeding in the daily routine. At the earliest the coloration is acquired about two hours after high tide, and then only by crabs living high on the beach; usually it appears much later, about an hour before low tide. In this species display coloration is lost especially

quickly when the crab is held in the hand or bottled, so that in a few minutes it is quite indistinguishable in color from females and non-displaying males.

Non-displaying males: Carapace and all legs olive brown speckled with gold; in addition a set of larger gold spots is invariably arranged as follows: three in a triangle on mesogastric region, one pair on hepatic, one pair on branchial, one unpaired spot on cardiac region. Manus light ochraceous brown. When crab is caught the latter darkens quickly. Chelae bluish-white. Minor cheliped slate gray. Undersides of legs dark slate gray. Sternum and abdomen bluish-white.

Coloration of females and young is exactly similar, except, of course, for the lack of a bright manus in the major cheliped.

Display: Body held moderately high, position unchanged during display. Cheliped starts slowly from position held flexed in front of mouth, sweeps down and outward, almost touching ground, and then on upward at the same slow rate. When it reaches topmost point, without a pause it is brought straight downward and inward swiftly, with a jerk. Entire display is fairly slow, at the rate of about one to a second. Before an interested female the display is considerably quickened, with a higher upward reach, and the small cheliped is vibrated up and down in front of the mouth, three or four times to each gesture of the major cheliped, the crab meanwhile facing the female constantly. Chelae of both chelipeds are held half open. Except for moving to face the female, steps are not usually taken during display.

Shelters: For an account of shelter-building, and its connection with color change and display, see pp. 155–157.

Breeding: Several ovigerous females were seen at La Boca, but none was taken.

Material: A total of 59 specimens was taken from Tenacatita Bay, Mexico; Corinto and San Juan del Sur, Nicaragua; Port Parker and Golfito, Costa Rica; La Boca, Balboa, Canal Zone; and Panama City, R. P.

Uca terpsichores sp. nov.

Text-figs. 4W, 5; Pl. IV, Fig. 19; Pl. V, Fig. 24; Pl. VI, Fig. 31; Pl. VII, Fig. 37.

(See also pp. 149, 150, 153–157, 160, 165, 166, 170).

Diagnosis: Carapace semi-cylindrical in lateral view, front behind eyes slightly more than a fifth maximum width of carapace; orbits scarcely oblique; antero-lateral margins concave, then curving gradually inward and backward; orbital angle very acute, produced. Minor chelae gaping widely throughout length, very slender, tapering, tips articulating poorly, serrations absent. Oblique ridge inside palm of major cheliped present, reaching dorsal profile far out almost at base of dactyl. Strong stridulating ridges, on lower inner proximal part of major manus, and on merus and carpus of first ambulatory of major side, respectively. Eyebrow about as wide as adjacent portion of eyestalk. Merus of second maxillipeds with hundreds of spoon-tipped hairs, covering inner three-fifths or more of dorsal surface. Abdominal appendage of male slender with rudimentary arm arising at distal. Manus of first major ambulatory with a longitudinal row of thick-set bristly hairs near ventral profile.

Description: Carapace strongly convex, semi-cylindrical in lateral view, widest at orbital angles, regions poorly indicated, naked except for a very sparse scattering of microscopic hairs.

Antero-lateral margins concave, two-thirds width of front behind eyes. They then curve inward and backward very gradually in the form of the usual concave ridge as far as middle of cardiac region. Sides of carapace with a strong median indentation. Front behind posterior margins of eyestalks slightly more than a fifth maximum width of carapace, the distal part of its marginal ridge obsolete. Orbital angle very acute, produced. Upper margin of orbit sinuous, scarcely oblique. Eyebrow about as wide as adjacent portion of eyestalk, moderately inclined, traceable outward almost to orbital angle. Lower orbital margin projecting strongly, even beyond level of front, with strong crenulations only externally, those on inner half being almost or completely obsolete. Suborbital region completely naked. Pterygostomian region tumid. Third to sixth abdominal segments in male almost completely fused.

Spoon-tipped hairs on merus of second maxilliped abundant, arranged in about 25 to 30 rows, covering inner three-fifths or more of dorsal surface, and numbering roughly about 125 to 200, counting only those spoon-tipped hairs which are long enough to project beyond inner edge of merus. Ischium of third maxilliped strongly convex, practically naked, its median groove absent and inner groove obsolescent.

Minor chelae very slender, almost twice as long as palm, gaping widely throughout to the corneous, tapering, poorly articulating tips. Prehensile edges without serrations, but with a few long hairs in median portion. Oblique row of hairs along inner sides of dactyl and pollex represented by a few long isolated hairs and well developed terminal brushes. Traces of other rows outside, and along dorsal and ventral profiles; short external terminal brushes.

Large cheliped of male with arm and wrist externally finely granulate on rugosities. Hand about four-fifths as broad as long. Upper surface of palm rounded, bent over proximally to bound carpal cavity sharply; lower margin moderately cristate. Entire upper and outer surface covered with fine granules, larger dorsally. On inner lower proximal side of palm is a well developed stridulating ridge, composed of short elevated lines, roughly parallel to each other and to the longitudinal axis of the cheliped; carpus of first ambulatory on major side with a row of tubercles opposable to the stridulating ridge; tubercles continuing in an oblique row on distal end of ambulatory merus.

An oblique tuberculated ridge on inner side of manus of major cheliped, starting from lower margin near base of pollex, continuing to carpal cavity, and then curving upward and forward to reach the bent over dorsal margin almost at the base of the dactyl. Although composed of a single row of tubercles throughout most of its length, in its terminal portion it merges with a cluster of tubercles. Carpal eminence moderately developed. A short curving row of tubercles arises close to dorsal margin at base of dactyl, and continues, after an interruption, for a short distance out along pollex close to prehensile margin. Across base of dactyl, distal to this first row, is a row of small, rudimentary tubercles.

Major dactyl slender, about once and a half times as long as manus, finely granulate basally and along dorsal profile, curving gradually downward beyond tip of pollex. The latter is also slender, the tip tapering and curving slightly upward. Gape wide throughout with numerous small teeth, of which one near base of dactyl and about four scattered along pollex are enlarged. Those on distal two-fifths of dactyl are remarkably fine and even, and are serrations rather than teeth. Traces of rows of tubercles near prehensile edges of both dactyl and pollex, both externally and internally.

Ambulatories slender, the merus scarcely enlarged. Manus of first ambulatory on major side short and thick, with a row of thickset bristly hairs near ventral profile.

Abdominal appendage of male slender, the short arm arising about four-fifths of distance to tip.

Measurements: Male holotype, length 6.3 mm., breadth 10.4 mm., base of manus to tip of pollex 16 mm.; 2 female paratypes, length 6.4 mm., breadth 11 mm.; 1 female paratype, length 6.2 mm., breadth 10.5 mm.; 1 male paratype, length 6 mm.; 7 males 3.7 to 5.8 mm.; 5 females, 3.7 to 5.7 mm.

Color: Displaying males observed through binoculars: sometimes completely pure white, except for lower outer part of manus, base of pollex and inner side of merus, which are bright shell pink to violet pink. More often there are markings of yellow ochre on carapace, in addition to, or instead of, yellow ochre on the upper part of the merus of the major cheliped, outside and in. The anterior side of the ambulatory meri are apparently always white.

Females plain grayish, not spotted.

Display: Body held high off ground, legs stretched, during an entire series of displays. Cheliped starts from position extended straight forward in front of crab, touching or nearly touching ground. It is then elevated, diagonally upward, with a slight outward curve, then dropped with a jerk into its original place stretched in front of crab. A pause follows, so that the accent is here. The small cheliped makes a feeble corresponding gesture. A few steps may be taken during display in either direction. Movement is swift, about two displays taking place to the second. When at the mouth of the shelter, before an interested female, the cheliped may be extended stiffly straight out at side, either held motionless or vibrated up and down with extreme rapidity; meanwhile, at random one ambulatory or another, and sometimes the minor cheliped as well, are raised and extended laterally, then returned to place and another leg at once extended; sometimes a leg on each side—seldom members of the same pair—are in the air at a given instant. The crab does not move at all from its chosen display spot, and the effect is that of a complicated dance step similar to a clog.

Shelter: In this species the shelters erected by displaying males are similar to those of *U. latimanus*, but form more perfect hoods, and are far superior to those of *U. beebei*. The shelters are the largest of all three species, measuring up to 30 mm. high, 20 mm. wide (more than twice diameter of the hole), up to 5 mm. thick, and always forming a complete hood overhanging the entire mouth. Relative to the size of this diminutive crab, which is at most about 6.5 mm. long, the size of the shelters is even more remarkable. In general, about one-third of the displaying males of this relatively rare species built shelters every day at La Boca during February, although at the end of that month and in the first two days in March—when observations ended—the proportion was larger; hence it is likely that this species had not yet attained the full breeding season. No ovigerous females were seen. The method of digging is in general the same as in the other two species (see p. 157).

Burrow: Six to eight inches deep; almost straight, with a slight turning at the end.

Growth: In the smallest males in the collection, 3.7 mm. long, the stridulating ridge is already well developed.

Affinities: O. terpsichores is closely related to *musica*, a northern form, which almost certainly has developed directly from it. The two species are, however, perfectly distinct. In *terpsichores* the carapace—especially the branchial, buccal and pterygostomian regions—are much less swollen than in *musica;* the gape between the chelae of both major and minor chelipeds is less; the arm of the abdominal appendage in the male is scarcely more than rudimentary, instead of well developed; the front is somewhat deeper and the sides of the front less divergent, so that it appears distinctly narrower, although there is little actual difference; the distinct parallel lines (not counting those which merge with the margin) forming the stridulating ridge on the major manus are fewer in number (between 8 and 12) instead of between 14 and 16; finally, adult male *terpischores* measure at most 6.5 mm. in length, instead of 8 mm. as in *musica*, the crab as a whole being about two-thirds as large. These differences are also true of immature specimens of both species.

Females are easily distinguished from those of *latimanus* by the obsolescence of the anterior marginal line of the front; by the more swollen carapace with the antero-lateral margins longer,

more concave, and slanting more sharply outward; by the eyebrows, which are much less inclined; and by the strongly projecting lower orbital margins. They may be told at once from those of *deichmanni, limicola* and *crenulata* by the breadth of the eyebrow. A useful characteristic is the meeting of the dorsal end of the oblique ridge inside the major palm with the ridge at the base of dactyl, distinguishing males of both *musica* and *terpsichores* from all other species in Group 5.

Range: From Corinto, Nicaragua, to Old Panama, R. P.

Local Distribution: Found on protected shores of muddy sand near the mouths of streams.

Material: The 17 specimens taken consist of the male holotype, Cat. No. 4144, from La Boca, Balboa, Canal Zone; 1 male and 3 female paratypes, Cat. No. 4145, from the same locality; 1 female, Cat. No. 381,159, from Corinto, Nicaragua; 1 male and 3 females, Cat. No. 381,160, from Port Parker, Costa Rica; 4 males and 1 female, Cat. No. 381,161, from Golfito, C. R.; and 2 males, Cat. No. 4146, from Old Panama, R. P.

This species is named for the Muse who presided over dancing.

Uca panamensis (Stimpson, 1859).

Text-figs. 4X, 5.

(See also pp. 149, 151, 159, 161, 165, 167, 168).

References: Gelasimus panamensis Stimpson, 1859, p. 63.

Uca panamensis, Rathbun, 1917, p. 412, pl. 149.

Uca galapagensis, Boone, 1927, lower part of fig. 97.

? *Uca mordax*, Boone, 1929, p. 582, fig. 17b, c. (See *Discussion*, p. 177 of present paper.)

Range: Gulf of Fonseca, El Salvador, to Peru.

Local Distribution: This species, even without allowing for its restricted habitat, is one of the most abundant crabs of the tropical eastern Pacific coast. It is almost always present wherever stones are mingled with sand at the end of a beach, or, rarely, just beyond the beach in shallow tidepools under stones.

Supplementary Specific Characters: Spoon-tipped hairs on merus of second maxilliped moderately numerous, usually between about 65 and 80; all are located on distal half of merus on its inner margin, with a few non-spooned hairs projecting beyond them; and are arranged in about 9 to 11 rows. Woolly hairs moderately numerous. Ischium of third maxilliped with median groove absent, inner groove shallow; entire maxilliped noticeably flattened, with few hairs.

Manus of minor cheliped rounded, almost as broad as long, and two-thirds as thick; chelae only slightly longer than palm, broad and thick, gaping moderately to the corneous tips which articulate well. Prehensile edges without serrations. Entire upper distal end of dactyl and lower of pollex covered with a thick brush of long hairs, which continues backward on both chelae, inside and out, as the usual oblique rows of relatively scanty hairs.

Eyebrow slightly more than half as broad as adjacent portion of eyestalk. Lower orbital margin with sharp crenulations throughout. Suborbital region naked except for scanty hairs immediately behind crenulated margin.

Abdominal appendage thick and blunt, with a well developed arm, arising at the beginning of about its distal seventh and lying close against it.

Measurements: The 113 specimens taken include the following extremes of length: largest male, 13.5 mm.; largest female 14.5 mm.; ovigerous females 7.1 to 10 mm.; smallest male 3.4 mm.; smallest female 3.8 mm.

Color in Life: There is a great deal of variation in color in this species which is definitely associated with the color of the sand and stones in the environment. Crabs living on light sand among pale stones are usually grayish-white or yellowish-buff; crabs surrounded by dark gray volcanic sand and dark stones are brownish, olive yellow, dark green, or dark gray, and are often speckled, marbled, or spotted with brown, buff, maroon, dark green or gray. However, even in the same area there is individual variation: one specimen may be entirely creamy white, while another from under the same stone may be light gray with maroon markings. No reliable sexual differences have been discovered, although the major cheliped of the male in dark-colored crabs is usually lighter than the rest of the body. The only two males seen displaying (see below) were side by side on adjacent rocks, one being white, the other pale gray. The sternum and abdomen in all specimens are generally plain grayish-white. The young vary less than the adults, the usual color being lighter or darker grayish-brown mottled with dark gray.

Display: The display of only two individuals was seen, and this was brief and appeared half-hearted. On February 2, on the shore beyond Bellavista, Panama City, two large males mounted to the tops of stones about two feet apart, within a few moments of each other, and began to display. Major cheliped was extended diagonally upward from flexed position in front of both, then lowered without pausing. During each gesture the body was elevated on all the ambulatories, then lowered. Small cheliped held motionless. The display lasted one second, with a wait of between two and six seconds between displays. The entire performance appeared slow and casual. No steps were taken, nor revolutions made. The two males were not facing, and did not pay to the least attention to each other. Each made perhaps ten displays, then, one after the other, they descended and began feeding. No females were in sight before, during or after display. It is probable that the full display of mid-breeding season will prove to involve more activity and be more complicated.

Breeding: Only three of the 45 females taken were ovigerous. All were taken in March, at Uvita Bay, Costa Rica, and on Gorgona Island, Colombia. The eggs, which measure .27 mm. in

diameter after having been preserved in alcohol, number about 4,000.

Food: The young, and to a lesser extent, the adults, sift organic detritus from the sand at low tide in typical *Uca* fashion. The staple food of all fair-sized specimens, however, is the minute algae found in the form of a fur-like growth on stones at low tide. These are plucked, by the minor cheliped in males and by both alternately in the females, just as they are by *Grapsus* and *Pachygrapsus*. Stomach examinations confirm visual observations: in more than a dozen examined from various localities, the contents consisted entirely of rock algae, except for a few sand grains. The latter could be accounted for entirely by the fact that at every high tide sand is stirred up and washed over the stones, and a certain amount sticks to the algae. Of all the adults seen feeding, not more than one-tenth were seen seeking food in the sand. The strong brushes surrounding the tips of the minor chelae, and the remarkable sturdiness of the latter, are doubtless adaptations to this method of feeding.

Burrows and Behavior: In this species, burrows are rudimentary, the crabs relying rather on overhanging stones for shelter and safety. However, all the young dig very short, straight burrows, up to an inch in length, in the sand close to the edge of a stone. The adults, too, often dig burrows, up to four inches long, against the edges of large stones; the tunnels go obliquely under the rocks and are adapted to the contour of the stony ground; the excavated sand is simply brought up in large lumps and dropped a few inches from the hole, at random. It seems almost certain that they dig a new burrow, if any, with every tide. Where adequate sand for digging is lacking, no burrow is attempted, the crab finding shelter during high water underneath a stone; the flatness of the carapace and underparts must be of aid in this mode of life. The crabs have far less sense of "home" than any of the other species of *Uca* observed, and the range of individuals seems to be little restricted. When startled but not pursued, crabs of all ages, but especially the young, teeter back and forth for a few seconds and then remain absolutely motionless for minutes afterward, apparently relying on their coloration for protection. When actually pursued, even when fairly close to their burrows, the crabs prefer to run rapidly, dodging around stones with agility and, eventually, vanishing underneath a large one. Their behavior in general shows them to be among the most adaptable of the genus.

Material: A total of 113 specimens was taken from the following localities: Gulf of Fonseca, near Potosi River, and Corinto, Nicaragua; Port Parker, Culebra Bay, Piedra Blanca Bay, Ballenas Bay, Uvita Bay and Golfito, Costa Rica; Honda Bay and Panama City, R. P.; Gorgona Island, Colombia, Cat. Nos. 37,701, 37,735, 3861, 3892, 38,119, 38,166, 38,197, 38,345, 38,456, 38,517, 38,706, 38,855, 4149, 38,878.

Specimens were, in addition, observed and examined, but not preserved, at the following localities: Parida Island and Cedro Island, Gulf of Nicoya, Costa Rica; and Panama City, Panama.

The specimen illustrated by Boone, 1927, in the lower half of fig. 97, and designated as *U. galapagensis* should be referred instead to *U. panamensis*. It is from Cocos Island and measures 11.5 mm. in length.

Bibliography.

Abramowitz, R. K., & Abramowitz, A. A.

1940. Moulting, growth, and survival after eyestalk removal in *Uca pugilator*. *Biol. Bull.* 78 (2): 179–188.

Alcock, A.

1892. On the habits of *Gelasimus annulipes*. *Ann. Mag. Nat. Hist.* (6), p. 415.

1902. A Naturalist in Indian Seas, or Four Years with the Royal Indian Marine Survey Ship "Investigator." London. pp. xxiv & 328.

Bate, S. C.

1866. Vancouver Island Crabs. *Naturalist in Vancouver Island and British Columbia, by J. Keast Lord.* London. Vol. II. Chap. xiii, pp. 262–284.

Beebe, W.

1926. The *Arcturus* Oceanographic Expedition. *Zoologica*, Vol. VIII, No. 1, pp. 1–32.

1928. Beneath Tropic Seas. G. P. Putnam's Sons. N. Y. pp. 64–65.

1938. Eastern Pacific Expeditions of the New York Zoological Society, XIV. Introduction, itinerary, list of stations, nets and dredges of the Eastern Pacific *Zaca* Expedition, 1937–1938. *Zoologica*, Vol. XXIII, No. 14.

Boone, L.

1927. The littoral crustacean fauna of the Galápagos Islands. *Zoologica*. Part I. Brachyura. pp. 127–288.

1929. A collection of Brachyuran Crustacea from the Bay of Panama and the fresh waters of the Canal Zone. *Bull. Amer. Mus. Nat. Hist.* 58 (11): 561–583.

Bouvier, E. L.

1895. Sur une collection de Crustaces decapodes recuillis en Basse-Californie par M. Diguet. *Bull. Mus. Hist. Nat. Paris.* Tome 1, pp. 70–72.

Brown, F. A., Jr.

1940. The crustacean sinus gland and chromatophore activation. *Physiol. Zool.* 13 (3): 343–355.

Chidester, F. E.

1911. The mating habits of four species of the Brachyura. *Biol. Bull.* Woods Hole, Mass. p. 235–248.

Crane, J.

1940. Eastern Pacific Expeditions of the New York Zoological Society. XVIII. On the post-embryonic development of brachyuran crabs of the genus *Ocypode*. *Zoologica*, Vol. XXV, pp. 65–82.

DARWIN, D.
1871. Descent of Man. First Edition, pp. 331–336.
1876. Descent of Man. Second Edition, p. 672.

DEMBOWSKI, J.
1925. On the "Speech" of the Fiddler Crab, *Uca pugilator*. *Travaux inst. Nencki.* Vol. III, No. 48.
1926. Notes on the behavior of the Fiddler Crab. *Biol. Bull. Woods Hole Mass.*, Vol. L, pp. 179–201.

GLASSELL, S. A.
1934. Some corrections needed in recent carcinological literature. *Trans. San Diego Soc. Nat. Hist.*, Vol. VII, pp. 453–454.

HEDIGER, H.
1933. Beobachtungen an der marokkanischen Winkerkrabbe, *Uca tangeri*. (Eydoux). *Verh. schweiz. naturf. Ges.* 114, pp. 388–389.
1934. Notes sur la biologie d'un crabe de l'embouchure de l'oued Bou Regreg *Uca tangeri* (Eydoux). *Bull. Soc. Sci. Nat. Maroc.*, Vol. XIII, pp. 254–259.

HOLMES, S. J.
1900. Synopsis of California stalk-eyed Crustacea. *Occ. Pap. Calif. Acad. Sci.* Vol. VII, pp. 1–262, 4 pls.
1904. On some new or imperfectly known species of West American Crustacea. *Proc. Calif. Acad. Sci.*, Zool. 111, pp. 307–328., pls. xxxv–xxxvii.

JOHNSON, M. E., & SNOOK, H. J.
1927. Seashore animals of the Pacific coast. Macmillan, N. Y.

KINGSLEY, J. S.
1880. Revision of the *Gelasimi*. *Proc. Phil. Acad. Sci.*, pp. 135–152, pls. ix and x.

KLEINHOLZ, L., & BOURQUIN.
1941. Effects of eye-stalk removal on decapod crustaceans. *Proc. Nat. Acad. Sci.* 27: 145–149.

LOCKINGTON, W. N.
1877. Remarks on the Crustacea of the west coast of North America with a catalogue of the species in the Museum of the California Academy of Sci. *Proc. Calif. Acad. Sci.*, Vol. VII, pp. 94–108 & 145–156.

MACCAGNO, T.
1928. Crostacei decapodi. Le specie del genere *Uca* conservate nel Regio Mus. Zool. Torino. *Boll. Mus. Zool. ed Antat. Comp. R. Univ. Torino*, Vol. XLI, Ser. III, No. 11, pp. 1–52.

MATTHEWS, L. H.
1930. Notes on the fiddler-crab, *Uca leptodactyla*, Rathbun. *Ann. Mag. Nat. Hist.*, Ser. 10, pp. 659–663.

MONOD, T.
1923. Sur la biologie de l'*Uca tangeri* Eydoux. *Rev. Gen. Sci.* 34e annee, no. 5, pp. 133.

MILNE EDWARDS, H.
1849? Les Crustacés. In "Le Règne Animal d'aprés son Organisation," by Georges Cuvier. Disciples' Edition, Paris, Vols. 17 (text), 18 (atlas), 1836–1849.
1852. Observations sur les affinities zoologiques et la classification naturelle des crustacés. *Ann. des Sciences Naturelles Zoologie*, 3rd Ser., Vol. 18, pp. 128–164.

MILNE EDWARDS, H. & LUCAS, H.
1843. Crustacés, in *D'Orbigny's Voyage dans l'Amer. Meridionale.* Vol. 6, Pt. 1.

MULLER, F.
1869. Facts and arguments for Darwin. London.
1881. Farben wechsel bei krabben und garnelen. *Kosmos*, Vol. VIII, p. 472.

NOBILI, G.
1897. Decapodi e stomatopodi raccolti dal Dr. Enrico Festa nel Darien, a Curacao, La Guayra, Porto Cabello, Colon, Panama, ecc. *Boll. Mus. Anat. Comp. Torino*, Vol. XII, No. 280, pp. 1–8.
1901.1 Decapodi raccolti dal Dr. Filippo Silvestri nell America meridionale. *Boll. Mus. Zool. Anat. Comp. Torino*, Vol. XVI, No. 402, pp. 1–16.
1901.2 Viaggio del Dr. Enrico Festa nella Republica dell' Ecuador e regione vicine. Decapodi e Stomatopodi. *Boll. Mus. Zool Anat. Comp.* Torino, Vol. XVI, No. 415, pp. 1–58.

ORTMANN, A. E.
1897. Carcinologische Studien. *Zool. Jahrb. Syst.* X. pp. 258–372.

PEARSE, A. S.
1912. The habits of fiddler-crabs. *Philippine Jour. Sci.*, Vol. VII, D, 1912, pp. 113–132.
1914.1 On the habits of *Uca pugnax* (Smith) and *U. pugilator* (Bosc). *Trans. Wisconsin Acad. Sci.*, Vol. XVII, Pt. II, pp. 791–802.
1914.2 Habits of fiddler crabs. *Ann. Report Smith. Inst.* 1913 (1914), pp. 415–427.

RATHBUN, M. J.
1898. The Brachyura collected by the U. S. Fish Comm. str. *Albatross*, on the voyage from Norfolk, Va. to San Francisco, 1887–1888. *Proc. U. S. Nat. Mus. Vol. XXI, No. 1162. pp. 567–616.*
1902. Papers from the Hopkins Stanford Galapagos Expedition, 1898–1899. Vol. VIII. Brachyura and Macrura. *Proc. Washington Ac.* IV. pp. 275–292.
1914. New genera and species of American brachyrhynchous crabs. *Proc. U. S. Nat. Mus.*, Vol. XLI, pp. 117–129.
1917. The Grapsoid Crabs of America. *Spec. Bull. U. S. Nat. Mus.*, No. 97, pp. xxii & xxxx 1–461.
1935. Preliminary descriptions of six new species of crabs from the Pacific coast of America. *Proc. Biol. Soc. Washington* 48: 49–52.

SMITH, S. F.
1870. Notes on American Crustacea. No. 1. Ocypodoidea. *Tr. Conn. Ac.* II. pp. 113–176.

STIMPSON, W.
1862. Notes on North American Crustacea. No. 1. *Ann. Lyc. Nat. Hist. N. Y.* 1859 (1862). Vol. 7. pp. 49–93.

1862.2 11. Notes on North American Crustacea in the Museum of the Smithsonian Institution. No. 2. *Ann. Lyc. Nat. Hist. N. Y.* 1860 (1862); Vol. 7. pp. 176–246.

STONOR, C. R.

1940. Courtship and display among birds. Country Life, Limited. London.

SYMONS, C. T.

1920. Notes on certain shore crabs. *Spolia Zeylan. Colombo* 11. pp. 306–313.

VERRILL, A. E.

1873. Report upon the invertebrate animals of Vineyard Sound and the adjacent waters . . . *Rep't. on condition Sea Fish. South Coast New England in 1871–1872. U. S. Comm. Fish & Fisheries*, Washington, 1873.

VERWEY, J.

1930. Einiges über die biologie ost-indischer mangrovekrabben. *Treubia.* Vol. XII, 2. pp. 169–261.

EXPLANATION OF THE PLATES.

PLATE I.

Fig. 1. *Uca pygmaea.* Male paratype (381,111), dorsal view. Carapace length 5 mm.
Fig. 2. *U. zacae.* Male paratype (381,113), dorsal view. Carapace length 5.5 mm.
Fig. 3. *U. argillicola.* Male holotype (381,134), dorsal view. Carapace length 7.8 mm.

PLATE II.

Fig. 4. *U. pygmaea.* Major chela of paratype (381,111), inner view. Carapace length 5 mm. × 5.1.
Fig. 5. *U. zacae.* Major chela of paratype (381,113), inner view. Carapace length 6.6 mm. × 3.4.
Fig. 6. *U. argillicola.* Major chela of holotype (381,134), inner view. Carapace length 7.8 mm. × 4.3.
Fig. 7. *U. tenuipedis.* Major chela of paratype (381,144), inner view. Carapace length 5 mm. × 5.3.
Fig. 8. *U. inaequalis.* Major chela, outer view (381,141). Carapace length 6.2 mm. × 6.2.
Fig. 9. Same, inner view. × 6.1.
Fig. 10. *U. saltitanta.* Major chela of paratype (4124), outer view. Carapace length 6 mm. × 4.8.
Fig. 11. Same, inner view. × 4.6.

PLATE III.

Fig. 12. *U. inaequalis.* Male (381,142), dorsal view. Carapace length 6 mm.
Fig. 13. *U. tenuipedis.* Male paratype (381,144), dorsal view. Carapace length 4.5 mm.
Fig. 14. *U. saltitanta.* Male paratype (4124), dorsal view. Carapace length 6 mm.

PLATE IV.

Fig. 15. *U. stenodactyla.* Male (381,147), dorsal view. Carapace length 8 mm.
Fig. 16. *U. beebei.* Male (4133), dorsal view. Carapace length 6 mm.
Fig. 17. *U. limicola.* Male paratype (381,153), dorsal view. Carapace length 6.5 mm.
Fig. 18. *U. deichmanni.* Male (381,157), dorsal view. Carapace length 6 mm.
Fig. 19. *U. terpsichores.* Male paratype (4145), dorsal view. Carapace length 6 mm.

PLATE V.

Fig. 20. *U. beebei.* Major chela, inner view (4133). Carapace length 6.5 mm. × 4.6.
Fig. 21. *U. stenodactyla.* Major chela, inner view (381,147). Carapace length 8 mm. × 3.3.
Fig. 22. *U. limicola.* Major chela of paratype (381,153), inner view. Carapace length 5.5 mm. × 6.
Fig. 23. *U. deichmanni.* Major chela, inner view (381,157). Carapace length 6 mm. × 5.
Fig. 24. *U. terpsichores.* Major chela of paratype (381,161), inner view. Carapace length 5.8 mm. × 4.1.

PLATE VI.

Abdominal appendages of adult males in *Uca*. Each photograph represents the distal ¼ to ½ of the right appendage, outer lateral view.

Fig. 25. *U. saltitanta.* × 15.6.
Fig. 26. *U. batuenta.* × 15.6.
Fig. 27. *U. beebei.* × 15.6.
Fig. 28. *U. stenodactyla.* × 15.6.
Fig. 29. *U. limicola.* × 25.4.
Fig. 30. *U. deichmanni.* × 25.4.
Fig. 31. *U. terpsichores.* × 29.
Fig. 32. *U. musica.* × 29.
Fig. 33. *U. latimanus.* × 29.

PLATE VII.

Fig. 34. *U. umbratila.* Major chela of immature paratype (4118), inner view. Carapace length 12 mm. × 1.3.
Fig. 35. *U. brevifrons.* Third maxilliped of adult male, outer view. × 6.5.
Fig. 36. *U. latimanus.* Third maxilliped of adult male, outer view. × 10.4.
Fig. 37. *U. terpsichores.* Adult male, in partial display coloration, beside shelter. When color change is complete, the carapace is pure white. × *ca.* 1⅝.

PLATE VIII.

Fig. 38. *U. latimanus.* Adult male, in dark phase, feeding shortly after high tide. The small cheliped is depositing on the ground a pellet of muddy sand which it has snipped off the posterior part of the buccal frame, after the mouthparts have removed organic matter. Each pellet is formed of half a dozen or more pinches of sand scooped up in rapid succession by the hollowed tips of the same chelae. Similar pellets surround the crab. × 1½.
Fig. 39. Same, building shelter.
Fig. 40. Same, in white phase, displaying beside shelter.

PLATE IX.

Fig. 41. *U. stenodactyla.* Two adult males, in display coloration, displaying before an adult female (lower right). The third male (with cheliped folded, facing away from female) is *U. beebei.*
Fig. 42. *U. stenodactyla,* mating. This photograph was taken about ten minutes after Fig. 41, and shows the nearest male in that picture copulating with the same female, at the mouth of her hole.

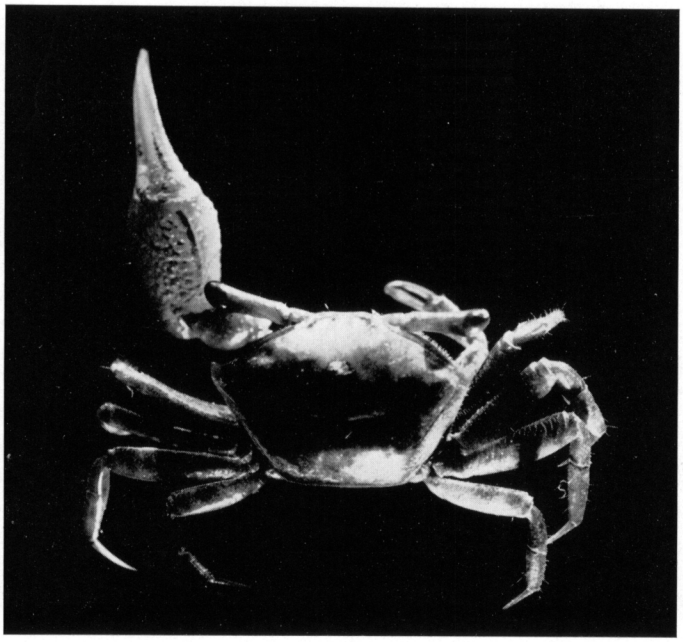

FIG. 1.

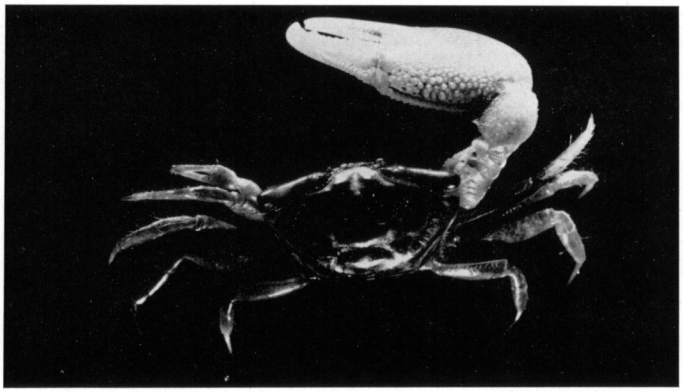

FIG. 2.

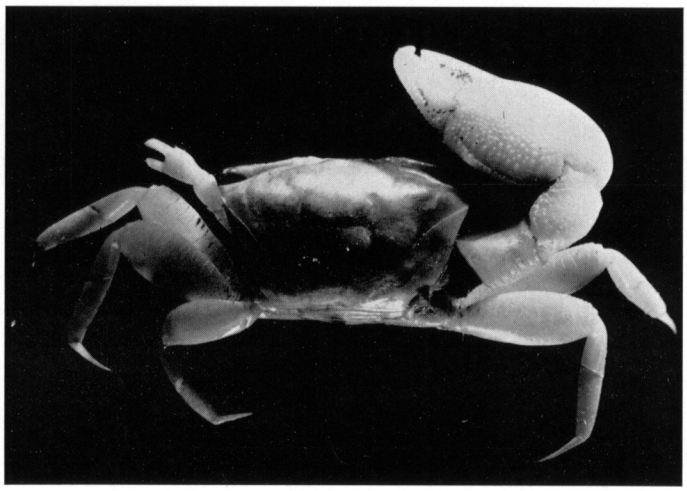

FIG. 3.

CRABS OF THE GENUS UCA FROM THE WEST COAST OF CENTRAL AMERICA.

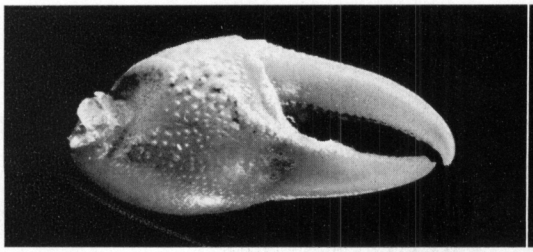

FIG. 4.

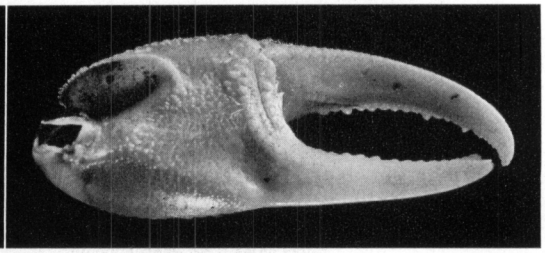

FIG. 5.

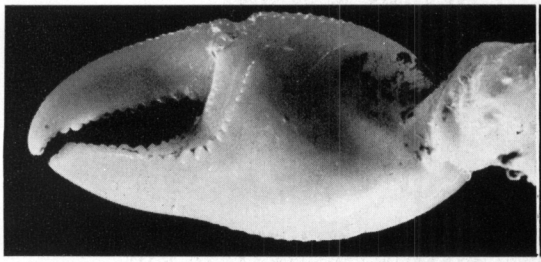

FIG. 6.

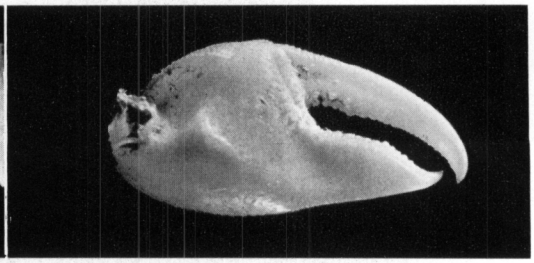

FIG. 7.

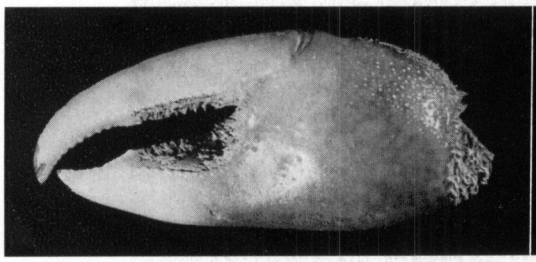

FIG. 8.

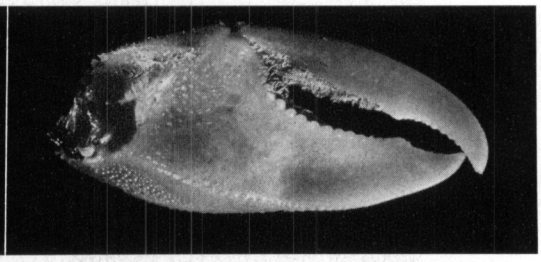

FIG. 9.

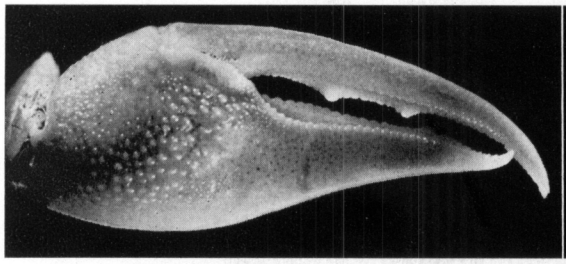

FIG. 10.

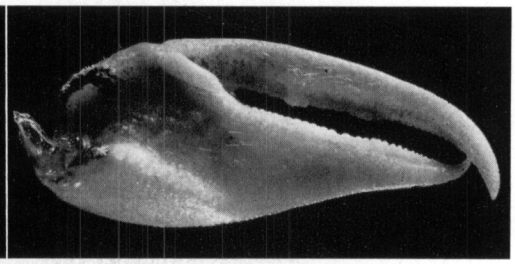

FIG. 11.

CRABS OF THE GENUS UCA FROM THE WEST COAST OF CENTRAL AMERICA.