REVISION OF THE *BREVIPALPUS PHOENICIS* 'COMPLEX' WITH DESCRIPTIONS OF NEW SPECIES FROM CHILE AND THAILAND (ACARINA, TENUIPALPIDAE)

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During a study of the Tetranychoidea of Chile, several new species of *Brevipalpus* were found, in addition to the previously recorded species of *B. chilensis* Baker and *B. obovatus* Donn. Three of these new species are described here and discussed in relation to the taxonomic problem posed by a related species, *B. phoenicis* (Geisjk). Another closely related species from Thailand is also described and discussed.

The genus *Brevipalpus* Donnadieu 1875, has customarily been separated into two groups according to the number of marginal hysterosomal setae. Those with five pairs have been further divided on the basis of the number of sensory rods (solenidia), on the distal part of tarsus II. Since the first modern comprehensive study of the family (PRITCHARD and BAKER, 1958) only one species, *B. phoenicis*, is known to possess a full combination of key characters, i. e. five pairs of marginal hysterosomal setae and two solenidia on tarsus II. Other morphological characters seem to be fairly stable and, although some variation in the pattern of the propodosomal reticulation have been recognized among specimens collected on different host plants (MANSON, 1967), they do not provide a firm basis for the separation of new species, as other accompanying characters are fairly similar. The four new species described in this paper share the key combination of five marginal hysterosomals and two solenidia on tarsus II, but otherwise both adults and immature stages differ considerably from *phoenicis*. During this revision abundant material of *phoenicis* including the holotype specimen was studied and it seemed desirable to redefine this species in the light of the data emerging from the present study.

B. phoenicis is known to occur in the Mediterranean basin, Africa (Egypt, Kenya, South Africa, Madagascar, Mauritius, Reunion Island), Near East (Lebanon, Syria Turkey), USSR, Asia (Burma, India, Malaysia, Taiwan, Thailand), America (Argentina, Brazil, Colombia, Cuba, Dominican Republic, Jamaica, Mexico, Trinidad, USA, Venezuela) and the Pacific Region (Fiji, Hawaii, New Caledonia, Samoa, Society Islands, Tahiti, Tonga). The original specimens described by *Geijskes* in 1939 were collected on a *Phoenix* palm in a greenhouse at The Hague, Netherlands. According to van de Vrie (personal communication, 1973) the species does not occur naturally in the Netherlands and collections are extremely rare under glass. The type locality is probably somewhere in the Mediterranean area. *B. phoenicis* is considered to be an economically damaging plant mite. Its association with many crops, its feeding damage and parti-

cularly the disorders transmitted to citrus trees make this mite an important species in its group. (KNORR, *et al*, 1968).

In PRITCHARD and BAKER (1958) three synonyms of *phoenicis* were recognized. Another species described as new, *B. deleoni*, was further accepted to be conspecific with *phoenicis* (De LEON, 1961). MANSON (1963) compared various specimens collected in the South East Asia area and noted that apart from the relative lack of consistency in the reticulation pattern of the female propodosoma, the nymphs also varied in size and shape of the dorsal setae. ATTIAH (1956) made a key to the nymphs of *Brevipalpus* spp. in Egypt ; that of *phoenicis* was characterized by having all propodosomal and marginal hysterosomal setae almost equal in length, although he recognized that sometimes " the humeral or first lateral hysterosomal are shorter than the others ". In the light of present knowledge, it is evident that a considerable confusion exists in characterization of the immature stages. It seems certain that Manson dealt with a mixture of nymphs and that Attiah's description of the nymph refers to a different species. Moreover, the only study on the biology of *B. phoenicis* has been conducted in Egypt (ZAHER *et al*, 1970) but judging from the description and drawings provided, it is concluded from present studies that the species reported by Zaher *et al* cannot be *B. phoenicis*.

MANSON (1967) suggested that the variation in the extent of propodosomal reticulation and relative length of dorsal setae seem to be associated with the host plant. Those collected on citrus show a relatively reduced reticulation pattern and the setae are rather broad, whilst those from *Hibiscus* present extensive reticulation and narrow body setae, However, specimens from other host plants exhibit intermediate characters. Manson's studies are not conclusive and such variation appears to be normal even within series collected from the same host plant.

As the original description was very sketchy, (GEIJSKES, 1939) it was necessary to study the holotype material kept at Wageningen. The type slide contains fairly well preserved specimens — two deutonymphs and three adult females. As no holotype as such is indicated, the redescription provided below was made from the best specimen. Studies were also made on the type slide of *B. deleoni* (USNM type No. 2348).

Geijskes failed to describe and illustrate *phoenicis* correctly. He indicated *inter alia* that the species had six pairs of marginal hysterosomals and a single solenidion on tarsus II. His figure 7 said to represent *phoenicis* corresponds with *Tenuipalpus oudemansi* (= *Cenopalpus pulcher* (Can. & Franz)). However, figure 8 labelled as *T. cactorum* Ouds. (= *Brevipalpus russulus* Boisd.), corresponds with *B. phoenicis*. Our present knowledge of the latter species is based on PRITCHARD and BAKER (1952) who made an adequate description of the adult female. Regarding the deutonymph, this was later on described by PRITCHARD and BAKER (1958) as *B. deleoni*. The nymph was depicted showing the humeral seta setiform rather than oblong and denticulate, and the first propodosomals as denticulate, leaf-like setae.

The following redescription is based on the study of the holotype material.

Brevipalpus phoenicis (Geijskes)

Tenuipalpus phoenicis Geijskes, 1939, Meded. Land. b. Hoogesch. 42 (4) : 23-24, Fig. 8 (not *B. cactorum*).

Brevipalpus deleoni Pritchard & Baker, 1958, Univ. Calif. Publ. Ent. 14 (3) : 234-5. (For complete synonymy see the latter reference, p. 233).

Female — (figure 1) Body length 250 μ, including rostrum 290 μ. Propodosoma with mediodorsal area lacking reticulation ; instead there are a very few rounded areolae at a deeper focal

plane ; mediolateral area reticulated with large polygonal cells, 5-6 in a vertical row, more defined in the posterior part ; dorsolateral areas not reticulated. Propodosomal pores slightly suggested. Hysterosoma reticulated throughout the length of the mediolateral area only, with cells extending in columns of 3-4 vertically oriented rows. Mediodorsal area with transverse, discontinuous rugous lines which beyond the third pair of dorsal setae become posteriorly convergent. Hysterosomal pores present ; in addition two oval, lip-like pores, occur near the margin between the second and third lateral setae, and two others between the third and fourth setae. Dorsal setae oblong lanceolate, denticulate ; first and second lateral hysterosomal 6 μ, remaining setae 5 μ, the last two separated by two lengths of these setae. Distal segment of palpus with a sensory rod, 5 μ, almost as long as accompanying setae. Dorsal setae femur I strong, oblong, denticulate, 10 μ. Ventral posterior triangle to coxa II with small rounded areolae arranged in 5-6 rows ; internal plate coxae II with small rounded areolae arranged in 5-6 rows ; internal plate coxae III-IV with longitudinal striae (figure 2).

Deutonymph — (figure 3) Second and third propodosomal setae, humeral and last three hysterosomals, oblong, denticulate, the longest setae of dorsal series ; third propodosomal slightly longer than diameter both eyes and almost one third longer than preceding seta. First propodosomal, first and second marginal hysterosomal small, blunt, denticulate (" blattförmig " of Geijskes) ; central hysterosomals setiform. Internal seta genua I very strong, dorsalmost setae of genu and tibia I of comparable size.

Type slide — ex-*Phoenix* palm, indoors (glasshouse, The Hague, Netherlands 3 May 1917, Schoevers, colr (in Fauré's).

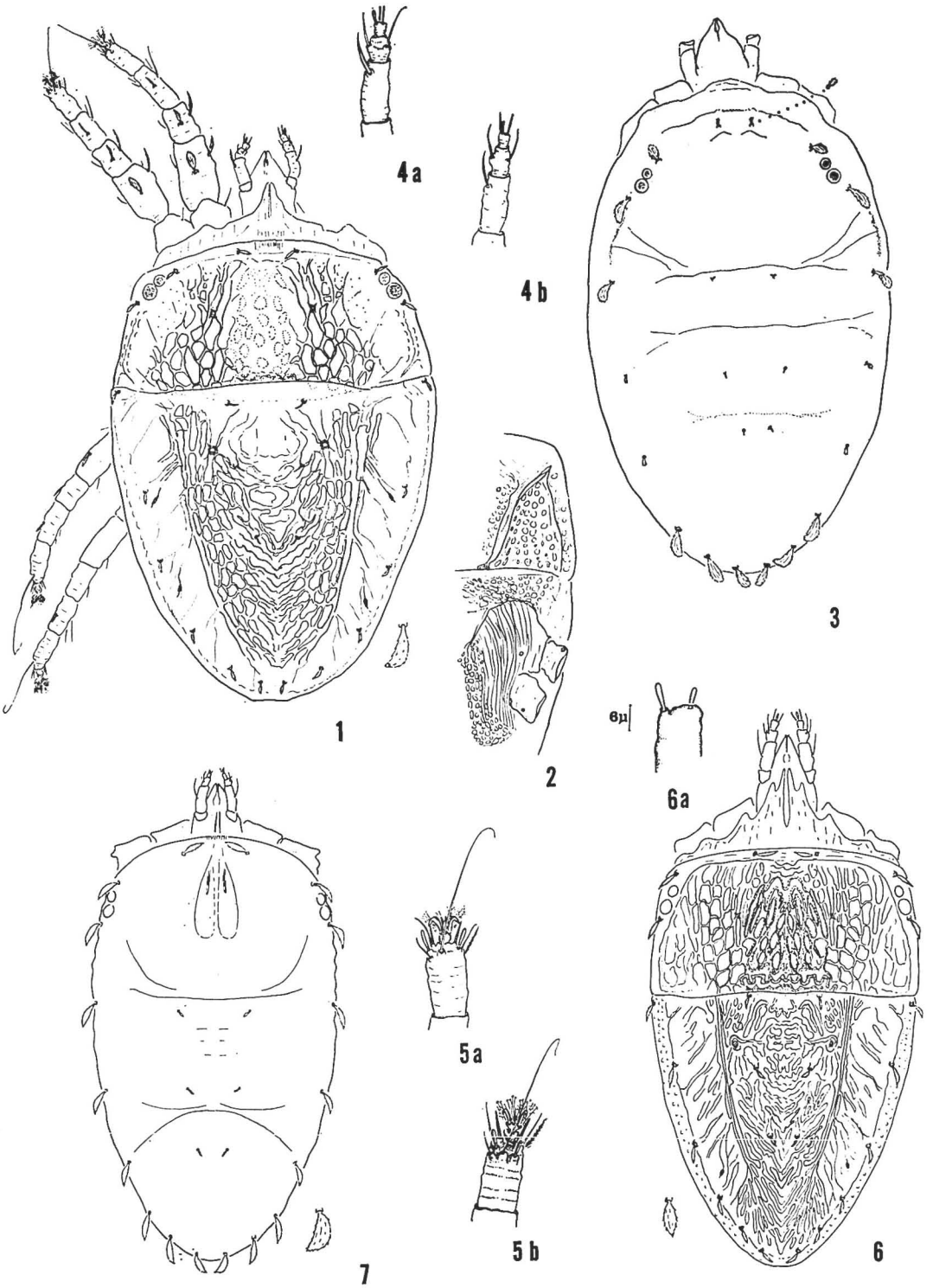
Male — not known to the writer.

Diagnosis : Diagnostic characters of the type material have been tabulated and compared with those of specimens from the following sources : citrus, Tucuman (Argentina), Cantanzaro (Italy), Chiang Mai, Satul and Trat (Thailand), Miranda and Aragua (Venezuela), Edgewater and Ruskin (Florida, USA) ; cotton, Sao Paulo (Brazil) ; *Tagetes patula* and pomegranate, Bangkhen (Thailand) ; *Buginvillaeae* sp., Bangkok (Thailand) ; *Petrea* sp. South Miami (Florida) ; quince, Egypt and *Elaeis guineensis*, Satul (Thailand).

The following sets of characters have subsequently been selected as stable and diagnostic for the species.

A. *Adult female*

1. Median propodosomal area without reticulation, which is replaced by faint and loose oval areolae ; reticulation of polygonal cells in the mediolateral area, more abundant towards the rear margin ; no more than 6 cells in anyone vertical row.
2. Hysterosomal reticulation restricted to 3-4 longitudinal rows of polygonal cells in the mediolateral area, dorsomedian part with discontinuous undulating lines which become convergent beyond the last pair of central setae ; hysterosomal pores present.
3. Dorsal marginal setae of comparable length, about 6 μ.
4. Sensory rods tarsus II, 5 μ each.
5. Triangle posterior to coxa II with small rounded areolae ; internal plate coxae III-IV provided with longitudinal striae.



FIGS. 1-4a. — *B. phoenicis*, holotype ;
female (1) ; coxal triangle and plate coxae III-IV (2) ; deutonymph (3) ; palpus (4a).
FIGS. 4b-5b. — *B. deleoni*, holotype ; palpus (4b) ; tarsus II (5b).
FIG. 5a. — *B. phoenicis*, Venezuela, tarsus II.
FIGS. 6-7. — *B. phoenicoides*, holotype ;
female (6) ; solenidia tarsus II (6a) ; deutonymph (7) (scale applies to nearest figure only).

B. *Deutonymph*

First propodosomal, first and second marginal hysterosomal, the shortest setae of marginal series ; remaining marginal setae oblong lanceolate with denticulate margin. Third propodosomal setae longer than second pair.

Discussion

Some variability in the described pattern of reticulation and relative length of some of the dorsal setae has been observed in the study of a large series (n = 45) from the same host plant. Apparently a very uniform population may also yield nymphs in which one of the humeral setae or sometimes the first and second marginal hysterosomal of the same side vary in size and even in shape. These variations have been discussed by Manson (1967) and Knorr (1968). The present author's view with regard to minor variations is to accept them as normal variations among populations. Specimens of *phoenicis* may show some degree of variability in the dorsal reticulation pattern and strength of setae. Figure 4 illustrates the minor variations occurring in the relative lengths of palpal setae in *B. phoenicis* from Venezuela (4a) and *B. deleoni* (= *phoenicis*) (4b).

Similarly, small variations are found in the tarsal accompanying setae and plumose mesal seta on tarsus II. Figure 5a shows the tarsal structure in holotype *B. phoenicis*, and 5b that of holotype *B. deleoni* (= *phoenicis*).

A study of variation in setal length among several hundred nymphs suggests that much of the variability claimed by several authors may be due to (i) the collection of mixed populations, *B. phoenicis* and *B. californicus*, or *B. phoenicoides* n. sp., (ii) age of the specimen (in relation to the time of molting process), (iii) asymmetry in size which occurs within setal pairs, and (iv) only to a minor extent, to actual variability in parental or imparental populations.

Key to the species of *Brevipalpus* having 5 pairs of hysterosomals and two sensory rods on tarsus II

1. Dorsomedian propodosomal area of female lacking reticulation of polygonal cells 3
   Dorsomedian propodosomal area reticulate, uniformly, covered with polygonal cells 3
2. Dorsomedian propodosomal area with loose oval areolae ; propodosomal setae about 7 μ long ; marginal hysterosomal setae of uniform comparable length about 6 μ each ; mediolateral hysterosomal area with polygonal cells ; deutonymph with last 3 pairs of marginal hysterosomal setae at least twice as long as first two pairs ..... *phoenicis* (Geisjk.)
   Dorsomedian propodosomal area with a series of elongated alveoli ; propodosomal setae 12-14 μ length ; marginal hysterosomal setae gradually diminishing in length varying from 12 to 9 μ ; mediolateral hysterosomal area lacking polygonal cells ; marginal hysterosomal setae of deutonymph of comparable size (Thailand) ..... *phoenicoides* n. sp.
3. First propodosomal setae of adult and deutonymph the longest of dorsal series ; third marginal hystersomal setae female reach base fourth pair of setae ; all marginal setae female except ultimate pair, longer than diameter both pair of eyes (Chile) ..... *cortesi* n. sp.
   Propodosomal setae of uniform size ; marginal hysterosomal setae much shorter than distance between bases 4
4. Propodosomal setae longer than hysterosomals ; propodosomal reticulation having large cells, larger than diameter posterior eyes ; all hysterosomal setae subequal ; propodosomal pores missing ; female and nymph palpfemur seta smooth (Chile) ..... *tarus* n. sp.

All marginal setae of comparable length ; propodosomal reticulation of female smaller than diameter posterior eyes ; marginal hysterosomals five times longer than dorsocentrals ; propodosomal pores present ; female and nymph palpfemur seta strongly denticulate (Chile)..... *araucanus* n. sp.

Brevipalpus phoenicoides, new species
(Figs. 6, 7)

Female — (figure 6) Body length, including rostrum, 300 μ. Median and propodosomal area lacking reticulation, instead with distinctly elongated alveoli. Mediolateral area with 3 to 4 rows of irregular, large, polygonal cells, about 8 cells per row. Propodosomal pores present. Hysterosomal reticulation without defined polygonal cells. Median area with contorted elongated elements converging in the median posterior section ; mediolateral area without reticulation, this replaced by oblique, interrupted lines. Hysterosomal pores set behind strong arcs. Propodosomal setae 14 μ, (range 12-14) marginal hysterosomal setae gradually diminishing in length, 12.0, 11.0, 10.5, 10.0 and 9.0 μ respectively. Lateral sensory rod tarsus II 6.0 μ, mesal 4.5 μ (fig. 6a).

Male — Propodosomal pattern as in female ; large hysterosomal pores ; opistosomal reticulation made up of longitudinal elements.

Deutonymph — (figure 7) Marginal setae of comparable size, 12.5 μ length. Dorsocentral setae oval, foliate.

Holotype — Female, on *Citrus reticulata*, Fang, Thailand ; 6 March 1974 (L. C. Knorr). Deposited in UCH. (University of Chile, Acarological Collection, Santiago).

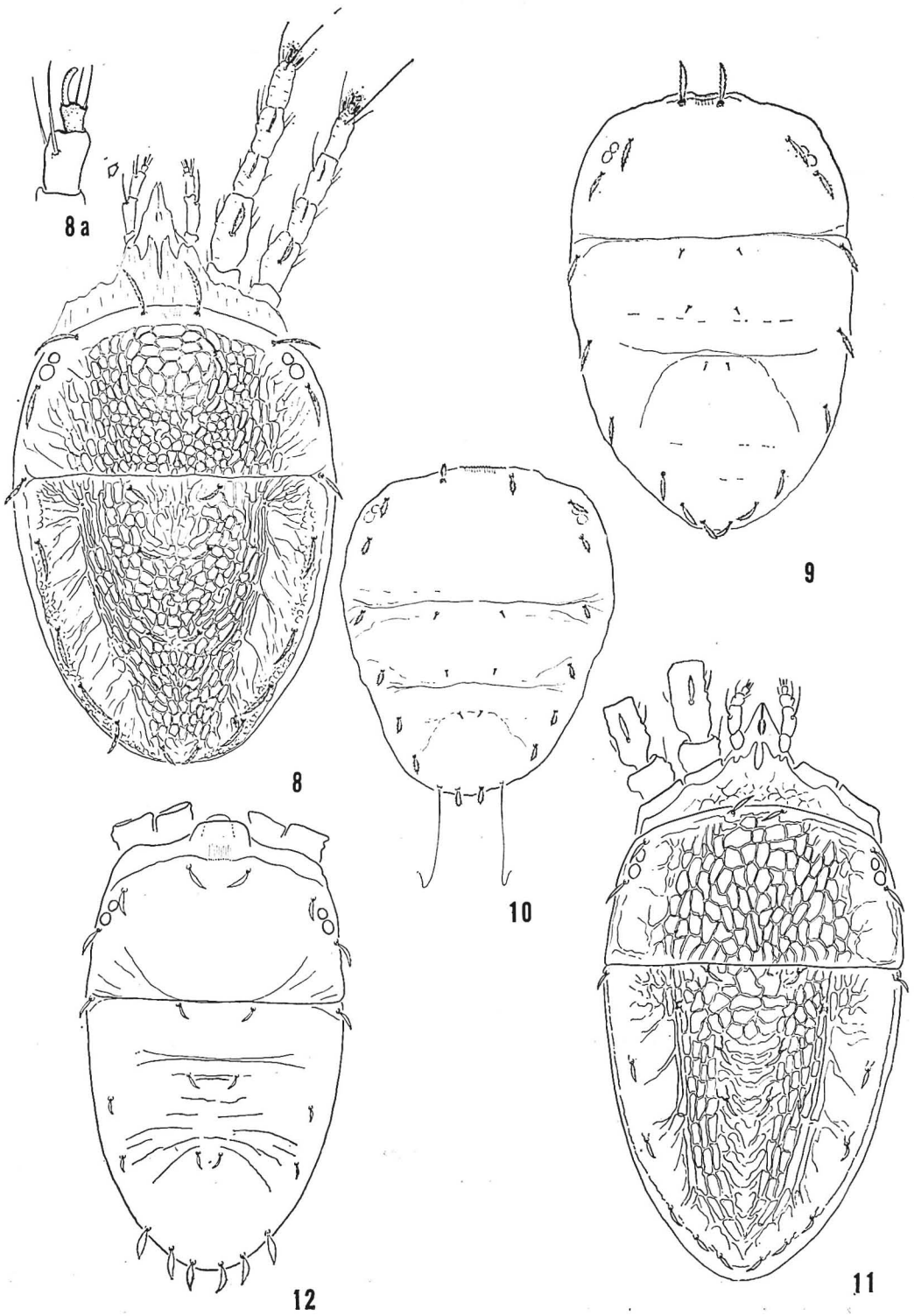
Paratypes — Two females, one male, nymphs, same data as holotype ; 15 females, 4 immatures ex-*Pandanus* sp., Bangkapi, Bangkok, 1 January 1974 ; 10 females, 3 immatures ex-*Syzygium jambos* (L) Alst., Bangkhem, Thailand, 18 February 1974 and 21 June 1974 ; 2 females ex-*Citrus aurantifolia*, Satul, S. Thailand, 1 July 1974 (associated with *B. phoenicis*). All paratype material collected by Dr. L. C. Knorr. Distributed to UCH, USNM, and Plant Protection Department, Thailand.

Diagnosis — This species is very closely related to *B. phoenicis*. As they may coexist on the same host plant they are likely to be confused. However, apart from the distinctive setal pattern of the deutonymph, adults can be separated by the setal length (about twice longer in *phoenicoides*) and the pattern of propodosomal dorsomedian structures.

The value of the setal pattern among nymphs may be questioned as a means of characterising *B. phoenicis*, as there is some variation. However, the nymphs of *B. phoenicoides* were all found to be very uniform in this respect, and if compared side by side with *phoenicis* the smaller first propodosomal and first and second hysterosomal setae in the latter species are clear diagnostic features.

Brevipalpus cortesi, new species
(Figs. 8-10)

Female — Body length 235 μ, including rostrum 310 μ. Propodosoma extensively reticulated with large polygonal cells in the dorsomedian area, individual cells not clearly arranged



FIGS. 8-10. — *B. cortesi*, holotype, female (8) ; deutonymph (9) ; larva (10).
FIGS. 11-12. — *B. tarus*, holotype, female (11) ; deutonymph (12).

in defined rows. Hysterosomal reticulation with larger cells in the median area, these cells becoming elongated in the mediolateral area. Lateral areas without reticulation. First propodosomal setae the longest of dorsal series, 25 μ, as long as distance between their bases; second and third propodosomal longer than diameter both eyes, 22 μ. First and third lateral hysterosomal setae reaches base fourth pair. Hysterosomal pores very atenuate. Tip of palpus reaches half portion of genu I. Distal end of palpus with a strong sensillum, longer than bearing segment (fig. 8a). Sensory rods tarsus II, 7 μ each.

Deutonymph — (fig. 9) First propodosomal seta the longest of dorsal series. Setae strongly lanceolate, with denticulate margins. This pattern of setal length is also observed in the protonymph.

Larva — (figure 10) As illustrated.

Male — Not known.

Holotype — Female, on leaves of *Escallonia* sp., Quebrada Dupliza, road to Mamiña, Cordillera de Tarapacá (Chile) at 2 100 m., 28 September 1967 (R. H. González). Deposited in UCH.

Paratypes — Eight females and six immatures, same data. Distributed in UCH and USNM (United States, National Museum, Washington).

Diagnosis — This is a very distinct species in the group having 5 lateral hysterosomals and 2 sensory rods on tarsus II. The comparatively longer first propodosomal seta, the strong palptarsus sensillum and the dorsal reticulation pattern are characteristic.

This species is dedicated to Prof. Raul CORTÉS, University of Chile, Santiago.

Brevipalpus tarus, new species
(Figs. 11, 12)

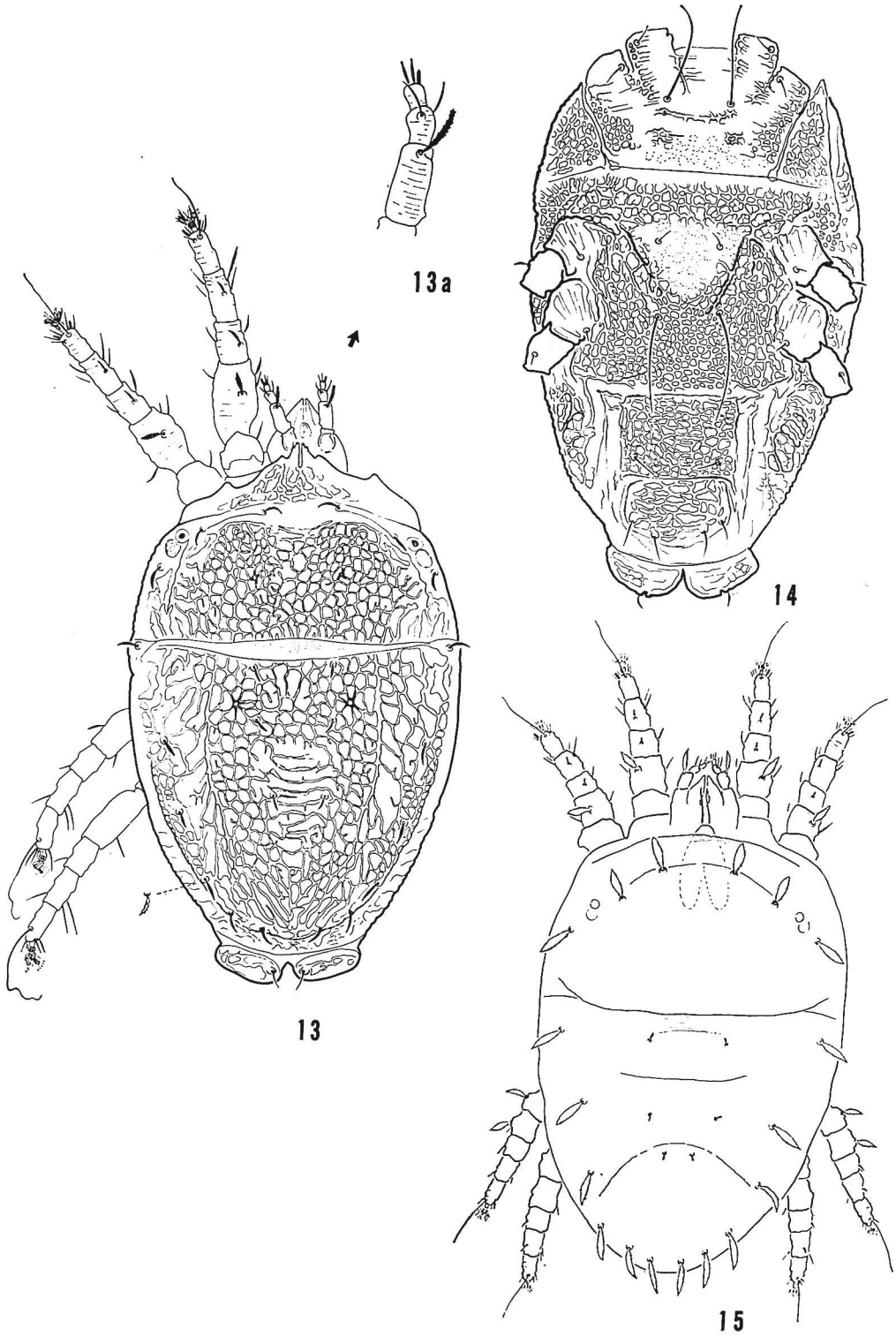
Female — (figure 11) A large species, body including rostrum 365 μ. Propodosomal reticulation in dorsomedian and mediolateral areas with large polygonal cells, about 8 cells in any median vertical row, about 16 cells in widest transverse row. Median and mediolateral hysterosomal areas uniformly reticulate except behind last pair of dorsocentral setae, the pattern becoming V-shaped. Hysterosomal pores slight. Propodosomal setae 16 μ; marginal and dorsocentral hysterosomals subequal, 12 μ. Distance between bases of marginal hysterosomal, setae 48, 40, 23 and 20 μ respectively. Ventral aspect similar to *phoenicis*.

Deutonymph — (figure 12) First and second marginal hysterosomals the shortest of dorsal series (including dorsocentrals). Propodosomals 12 μ, first and second hysterosomals 6.5 μ, remaining marginals 16 μ. Dorsocentrals 8.0, 7.0 and 5.0 respectively.

Male — Not known.

Holotype — Female, on unknown ornamental plant. Pica oasis, Tarapacá (Chile), 27 September 1967, (R. H. GONZALEZ). Deposited in Acarological Collection, UCH.

Paratype — Twenty females and immatures same data as above. Deposited UCH and USNM.



FIGS. 13-15. — *B. araucanus*, holotype, female (13) ; ventral aspect female (14) ; deutonymph (15).

Diagnosis — This sizeable species differs from others in the group by the following combination of characters, viz. : reticulation of pattern of propodosoma with large, uniform cells, propodosomal setae longer than hysterosomals ; dorsocentrals and marginal hysterosomals subequal in length. The deutonymph resembles that of *phoenicis* with respect to the first and second hysterosomals, shorter than the other marginals. Differs in the much longer dorsocentrals and first propodosomal.

This species is only known from the dry Tarapacá desert in northern Chile. Named after the Atacamenian voice " tara " meaning " tree of the north ".

Brevipalpus araucanus, new species
(Figs. 13, 14, 15)

Female — (figure 13) Body length 240, including rostrum 290 μ. Propodosoma evenly reticulate, about 23 polygonal cells in widest tranverse hows. Median and mediolateral hysterosomal area with polygonal cells, except between the second and third dorsocentral setae. Propodosomal and hysterosomal pores present. Marginal hysterosomal setae 11 μ, dorsocentrals 8 μ. Distance between bases marginal hysterosomals 46, 37, 25 and 23 respectively. Distance bases last pair 32 μ. Sensory rods tarsus II, 6.5 μ each. Palpfemur with a strong, blunt, broadly denticulate seta, 12 μ (fig. 13a). Ventral aspect uniformly reticulate, with loose rounded areolae in ventral plate and area anterior to this plate ; area between first ventral setae not reticulate (fig. 14).

Deutonymph — (figure 15) Marginal setae broadly lanceolate, denticulate margin, 19 μ. First dorsocentral seta 4,5 μ. Remaining 3 μ. Palpfemur seta broadly lanceolate, 15 μ. Dorsal seta genua I-II, peg-like, less than 2 μ ; dorsal seta tibiae I-II, 4 μ.

Male — Not known.

Holotype — Female on leaves of *Lapageria rosea* (Liliaceae), " Copihue ", the Chilean National flower, in the transitional relict forest at Rari, near Panimávida, Linares, Chile, 1 150 m., 18 December 1967 (R. H. González). Deposited at UCH.

Paratypes — Eighteen females, 6 nymphs same date. Distributed UCH, USNM.

Diagnosis — The deutonymph is characterized by the broadly lanceolate palpfemur seta and by the minute dorsal setae on genua and tibiae I and II. The strong, blunt seta on palpfemur and the pattern of dorsal and ventral reticulation are characteristic for the female.

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ABSTRACT

Brevipalpus phoenicis has been the only known species in the genus having the following combination of characters, viz : five pairs of marginal hysterosomal setae and two sensory rods (solenidia) on the distal part of tarsus II. In the course of the study on the tetranychoid mites of Chile, three new species pertaining to the *phoenicis* group were found on wild host plants. These species include *B. cortesi*, *B. tarus* and *B. araucanus*. A fourth species, *B. phoenicoides*, very closely related to *phoenicis*, collected in Thailand on *Citrus*, *Pandanus* and other wild plants is also described as new. The holotype specimen of *B. phoenicis* is redescribed. The importance of chaetotaxy on immature stages is stressed.

RÉSUMÉ

Dans le cadre d'un prochain travail sur les Tetranychoidea du Chili, nous décrivons trois espèces nouvelles du genre *Brevipalpus* provenant du Chili qui appartiennent au groupe de *B. phoenicis*, avec cinq pairs de soies hysterosomals et deux solénidions au tarse II. Une quatrième nouvelle espèce, *B. phoenicoides*, très proche du *phoenicis*, fut récoltée en Thailande. L'espèce type de *B. phoenicis* est décrite à nouveau. L'importance de la chaetotaxie des nymphes est soulignée.

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