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# (Summary) of Variation in Pasture Ticks (Acarina, Ixodidae) and Its Significance for Systematics

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TRANSLATION 5 (T5)

DEPARTMENT OF MEDICAL ZOOLOGY  
UNITED STATES  
NAVAL MEDICAL RESEARCH UNIT NO. 3  
c/o AMERICAN EMBASSY  
CAIRO, EGYPT

TRANSLATION FROM RUSSIAN of pp. 191-197 (SUMMARY) OF PERVOMAISKY, G. S. (1954) Variation in pasture ticks (Acarina, Ixodidae) and its significance for systematics. Trud. vsesoyuz.ent. Obshch., 44:62-201.

SUMMARY

1) Pasture ticks (Ixodidae) have a great significance as specific vectors and stimulators of many infectious diseases of man and cattle.

Studying the composition of species, biology, and ecology of tick vectors becomes a necessary condition of basic scientific measures to control ticks and eliminate natural foci of diseases transmitted through ticks.

2) In determining composition of species of pasture ticks, one encounters difficulties owing to absence in literature of special investigations on variation in their systematic criteria. Significant variation in systematic criteria, especially of the tick genera Rhipicephalus and Hyalomma, is emphasized by many authors.

3) Variation of systematic criteria was studied by us in isolated, reared generations of the following species and subspecies of Ixodidae: Rhipicephalus bursa Can. & Fanz., R. sanguineus Latr., R. turanicus Pom., Hyalomma dromedarii Koch, H. asiaticum asiaticum Sch. & Sch., H. asiaticum caucasicum Pom., H. scupense Sch., H. anatolicum anatolicum Koch, H. anatolicum excavatum Koch, H. plumbeum plumbeum Panz.

4) Systematic characters of R. bursa Can. & Fanz. are rather constant in spite of considerable variation in their body size. Only in rather minute males and females (2.1 mm.) was noted weak pigmentation of the body, more sparse punctation of scutum, and rounding of posterior margin of adanal shields of males.

Length of female body slightly exceeds length of male body; large females are 4.5 mm.; males, 4.1 mm. Width of female scutum is greater

than its length; ratio between average width and length of scutum equivalent to 1.5:1.3.

5) In populations of R. sanguineus Latr., males and females were distributed in two morphological groups by punctuation of scutum, by width of appendix of peritreme, and by length of external spur of first coxa as compared with inner spur (female), and in presence or absence of a spur on adanal shields (males). Larger part of ticks were distinguished by characters typical for R. sanguineus Latr.; a smaller part resembled R. turanicus Pom. by one or several characters (as an example, by presence of a spur on adanal shields (and) by width of appendix of peritreme, and others). In populations of R. turanicus Pom., progeny of females collected in Armenia, similar grouping of ticks in two groups were observed with quantitative predominance of males and females with characters of maternal form. Some ticks from these populations corresponded to R. sanguineus Latr. by systematic criteria.

In populations of R. sanguineus Latr. males were larger than females; in populations of R. turanicus Pom. substantial distinctions in sizes were not noted between males and females. Larger male R. sanguineus Latr. reached 4.5 mm. in length, but large females - 3.8 mm. Large males and females R. turanicus Pom. had a length of 3.8 mm.

6) R. sanguineus Latr. and R. turanicus Pom. easily interbreed and produce fertile progeny. Considering similarity of specific criteria within the limits of separate populations of R. sanguineus Latr. and of R. turanicus Pom. and the interbreeding of these ticks, the question of systematic position of R. turanicus Pom. in the genus Rhipicephalus from detailed investigation of individuals of this species from Central Asia, remains to be elucidated.

7) In H. dromedarii Koch most large males reached 5.8 mm. length, but large females, 6.1 mm.

On large and average males width of middle festoon, and size and number of subanal shields more often varies.

On minute males (1.5 mm.) anal shields have great variation. As an example, adanal shields sometimes are rounded posteriorly and laterally, accessories are reduced to small appendages, and subanals do not develop at all.

Large female H. dromedarii Koch, by species criteria, correspond to the description of typical specimens. But minute females are distinguished by smoothness of cervical grooves, narrow appendix of peritreme, and absence of white bands on leg segments.

8) H. asiaticum asiaticum Sch. & Sch. and H. asiaticum caucasicum Pom. represent two geographical variants. They are distinguished by locality of distribution and by criteria of external morphology; they easily interbreed and produce fertile progeny. Sizes of the body of H. asiaticum asiaticum Sch. & Sch. vary: length from 2.5 to 7.0 mm.; width from 1.2 to 4.0 mm. In males, constant criteria are superficial punctations of scutum, minute, superficial interstitials combined with large, very sparse, punctations; wide, white middle festoon (parma), strongly concave basis capituli, and very narrow appendix of peritreme.

In every population of H. asiaticum asiaticum Sch. & Sch. one encounters a certain number of individuals grading from mentioned criteria towards H. asiaticum caucasicum Pom. Sizes of body of H. asiaticum caucasicum Pom. vary: length from 2.5 to 6.00 mm.; width from 1.2 to 4.0 mm. Average length of H. asiaticum caucasicum Pom. is less than average H. asiaticum asiaticum Sch. & Sch. by 0.5 mm. Punctations of scutum of male H. asiaticum caucasicum Pom. are the same as on male H. asiaticum asiaticum Sch. & Sch. In small males of both varieties length of body reaches 4.5 mm., not infrequently punctation of scutum is of the same type - minute, sparse, superficial. Up to 65% of males from populations of H. asiaticum caucasicum Pom. have the middle festoon narrower than the rest, about 10% wider than the rest, and 25% equal to rest of festoons. Such criteria as punctations of caudal surface, wide appendix of peritreme, and large pads on tarsi vary rather little in male H. asiaticum caucasicum Pom.

Female H. asiaticum caucasicum Pom. differ from female H. asiaticum asiaticum Sch. & Sch. not only by smaller size bodies, but chiefly by large pads on tarsi and absence of wide, white bands on joints of legs.

By width of dorsal appendix of peritreme, females of H. asiaticum caucasicum Pom. are divided into two groups. Some females have appendix of peritreme similar to females of H. asiaticum asiaticum Sch. & Sch.; in others (this is) wider.

9) H. scupense Sch., length of body varies from 2.5 to 5.5 mm. and width from 1.2 to 3.5 mm. Length of female body exceeds length of male body average by 0.5 to 0.6 mm.

In males, constant criteria are weak punctations of scutum, parma, posteromedian groove reaching to parma. Greatly variable is width of appendix of peritreme and size of subanal shields. In populations of H. scupense Sch. from 58 to 65% of males have wide appendix of peritreme and large subanal shields. In the other males the appendix of the peritreme was narrow, the subanal shields were minute; by standard criteria they are suggestive of male H. detritum Sch.

In female H. scupense Sch., as in male, the scutum is covered by small, sparse superficial punctations and by large, very sparse punctations; apart from that, approximately half of females had transverse or longitudinal wrinkling of scutum.

Cervical grooves, appendix of peritreme, and pigmentation of legs of females vary little.

10) H. anatolicum Koch differs by polymorphism of external criteria which can be investigated not only in places of its mass reproduction, but also by laboratory breeding.

From small females, belonging usually to subspecies H. anatolicum anatolicum Koch, after feeding on fresh rabbits, progeny of larger sizes resulted. Part of ticks from such progeny, if their origin were not known, would have been identified as H. anatolicum excavatum Koch. In turn, by similar feeding of large females of the subspecies H. anatolicum excavatum Koch, one can produce F<sub>1</sub> males and females that are smaller than the parental forms.

In one of the experiments, average length of body of large female progeny of first generation equalled 5.2 mm., 2nd. 5.0 mm., 3rd. 4.6 mm., but males, correspondingly, 4.6 mm., 4.3 mm. and 4.0 mm.

From small females, collected in Tadjkistan from domestic animals, was obtained progeny among which individual females reached 5.2 mm. in length, but males 4.3 mm.

These experiments prove that H. anatolicum Koch represents a very variable species whose morphological characteristics depend upon the living conditions of individuals. The middle festoon of male H. anatolicum Koch is distinguished by the variety of its structure, but in general in 2/3 of the males investigated it is equal to the rest of festoons or is slightly wider than the rest. In the other males, the middle festoon is narrower than in the rest. The posteromedian groove, as a rule, does not reach middle festoon.

In male H. anatolicum Koch two different kinds of scutal punctations are characteristic: (1) minute dense, concentrated in scapular area, and (2) on posterior third of scutum and on its margin minute, dense in conjunction with large, sparse scattered punctations.

On majority of males appendix of peritreme was wide, in small number of males it was narrow.

Female H. anatolicum Koch have length of scutum exceeding its width by an average of 0.1 to 0.2 mm. The entire scutum is covered by minute, sparse punctations, on the surface of which stand out large sparse punctations, concentrated chiefly on margins.

In large females not infrequently minute punctations are dense, though large punctations are arranged in rows on central scutum. These females resemble female H. plumbeum plumbeum Pom. by scutal punctation.

More than 80% of investigated female H. anatolicum Koch had wide appendix of peritreme with a depression on posterior margin.

11) Study of variation of H. plumbeum plumbeum Panz. showed that length of body of these ticks varies from 3.2 to 6.3 mm., width from 1.8 to 3.6 mm. As in all Hyalomma species described above, size of body of females is more variable than that of males.

In male H. plumbeum plumbeum Panz. three types of scutal punctations were observed; these were predominantly minute punctations, dense, and evenly distributed, in conjunction with large, rare punctations; the second type of punctation, minute dense, is also very characteristic of males. On a small number, chiefly, in minute males, minute punctations are supplemented by large sparse punctations. Narrow middle festoon, wide appendix of peritreme, and presence of inner projection of adanal shields are constant characters of male H. plumbeum plumbeum Panz.

In female H. plumbeum plumbeum Panz., apart from the three types of scutal punctation as described for males, there also occurs minute sparse punctations; this is a peculiarity of smaller females.

The other female characters adopted for species diagnosis are relatively constant.

12) The cause of variation in ixodid ticks, apart from nutrition and influence of environment, can be assumed to be their development from unfertilized eggs and hybridization. Experiments showed that in Rhipicephalus and Hyalomma parthenogenic development occurs in some eggs laid by unfertilized females.

As a rule, larvae developed from such eggs possessed low viability and were not always able even to feed. Many larvae of this origin were distinguished by deformities of mouthparts and legs. From unfertilized eggs H. anatolicum and H. dromedarii Koch larvae resulted which later developed into females outwardly not distinguishable from normal females of the same species. Parthenogenic females, on being mated with males of the same species, produced fertile progeny represented by individuals of both sexes.

13) In copulating males and females of distantly related Hyalomma species the following was observed:

a) pairing males of one species does not show influence on the nutrition of females of the other species with which interbreeding occurred; example, male H. dromedarii Koch interbreed with female H. anatolicum Koch, but the latter behave as unfertile; they remain attached to the skin of their host more than a month and lay a small quantity of sterile eggs.

b) Males of one species copulate with females of another species, and these females behave as fertilized; example, female H. plumbeum plumbeum Panz., after copulation with male H. anatolicum Koch, lay the usual number of eggs, but as a rule these eggs do not produce larvae.

c) Males of one species fertilize females of another species, which later, after feeding on blood, lay eggs that produce progeny. Such as, female H. anatolicum Koch fertilized by male H. plumbeum plumbeum Panz., lays eggs from which 20 to 100% of larvae hatch. Therefore, not every interbreeding of Hyalomma ticks of different species leads to fertilization of females, as larvae develop from the eggs laid by them only from certain combinations of copulated species.

14) Interspecific interbreeding of male H. plumbeum plumbeum Panz. with female H. anatolicum Koch occurs easily (16 hybrid generations were obtained). Hybrid males and females basically inherited morphological criteria of maternal form, but between hybrids of first generation were ticks combining paternal and maternal forms. Hybrids of above variants remained sterile.

15) On mating male R. sanguineus Latr., with female R. bursa Can. & Fanz., females feed normally and lay eggs, part of these eggs develop into larvae. In generation from these interbreedings only females with criteria of maternal form developed.

16) In hybrid populations including normal gynandromorphs also appeared in some quantity.

In the progeny of gynandromorphs from interbreeding male H. plumbeum plumbeum Panz. with female H. anatolicum Koch, the male part of the body sometimes bears indications of paternal species, but the female part has criteria of the maternal species.

In the F<sub>1</sub> generation from interbreeding of male R. sanguineus Latr., with female R. bursa Can. & Fanz., among some normal females a number of gynandromorphs also appeared. Masculine and feminine parts of these gynandromorphs had criteria of maternal form. Analysis of criteria of external morphology of 150 experimentally hatched gynandromorphs permitted to specify the classification of types of ixodid gynandromorphism. From mosaic gynandromorphs H. anatolicum Koch, after feeding and copulating with males of same species, normal male and female progeny was obtained.

From half and half gynandromorph-hybrid R. bursa Can. & Fanz., R. sanguineus Latr., interbred with male R. bursa Can. & Fanz., was obtained F<sub>1</sub> males and females, identical by their species criteria with R. bursa Can. & Fanz.

Interspecific breeding of ixodid ticks by definite selection of parental forms permitted the possibility of obtaining some number of gynandromorphs; this new and special problem demands different and special investigations.

17) Hybrid gynandromorphs of ixodid ticks are comparable with interspecific mosaic botanical hybrids with contrasting distribution of criteria of two inoculated components. As in the first, the second also possess mixed inheritance and represents the product of distantly related hybridization.

18) For classification of pasture ticks the study of deformities has also significance especially of those which change the whole form of the body and disposition and structure of external organs.

Origin of most deformities on pasture ticks is bound with abnormalities of their nutrition and larval and nymphal molting. Some types of deformity of ticks result from violation of normal course of embryological development.

When a dense number of larvae and nymphs feed on the skin of their host, inflated ticks press one upon another. Apart from this, they also influence the quality of the host skin. As a result steady deformities appear on the body of fed larvae and nymphs that do not disappear even during the period of molting of nymphs into adult ticks. Loss of legs by nymphs during molting can lead to compensatory widening of the body towards missing extremities. Such changes of body form remain in adult ticks.

Larvae and nymphs of pasture ticks possess high regenerating ability, which must be considered as progressive step in favor of preserving tick species. Mouthparts and legs lost by nymphs are regenerated in the process of developing into adult ticks. Regeneration of the palpi, hypostome, chelicerae, and legs is not always complete.

Sometimes new formations appear on the body of ticks, teeth-like projections on basis capituli, fingerlike protuberances on dorsal surface; comblike outgrowths on genital aperture, and others. To elucidate origin of these demands special investigations.

19) In Hyalomma ticks 5 specimens were discovered with redoubled posterior part of body.

On 3 males (2 H. anatolicum Koch and one hybrid) widened posterior part of body had double set of festoons, 2 anal apertures, and a double number of ventral shields. Two females (H. dromedarii Koch and H. anatolicum Koch) had widening of posterior part of body and each of them had 2 anal apertures.

A number of "double deformities" hybrid male (H. anatolicum Koch X H. plumbeum Panz.) and female H. dromedarii Koch, had a supplementary peritreme on the middle of the posterior margin of the body.

20) Study in variation of body size and criteria of external morphology of ticks, progeny of Rhipicephalus and Hyalomma, in separate populations, gave realistic notion of the character of variation, which permits the introduction of corresponding corrections in the classification of already investigated species.

Materials for the study of parthenogenetic development of hybridization, conditional appearance of gynandromorphs, and deformity of F<sub>1</sub> generations of Rhipicephalus and Hyalomma, appear in considerable part new, completing the notion about biology of ixodidae.