

THE VARIABILITY OF *RHIPICEPHALUS*
PULCHELLUS (GERSTÄCKER, 1873),

TOGETHER WITH ITS GEOGRAPHICAL DISTRIBUTION.

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(With 6 Text-figures.)

It has been pointed out by Warburton (1912) that the degree of variation within the species of the genus *Rhipicephalus* is very considerable, and in view of this fact it is important to investigate the range of a species and the value of the differential structural characters upon which species are based. The great majority of the *Rhipicephali* are inornate and this, in conjunction with the general lack of distinguishing structural features and the wide variation found within the species, renders determinations difficult. As *Rhipicephalus pulchellus*, however, possesses a characteristic and well-marked ornamentation, which is subject to but slight variation, any specimen, at least in the case of the males, may be determined without difficulty.

Hence this species is invaluable for such an inquiry, and as a casual observation of a number of specimens obtained from one host showed a great range in size, Prof. Nuttall suggested that I should examine critically a number of individuals collected under natural conditions. The material available for observation in Cambridge has been collected in Africa during a period of nine years. Of each consignment received, it has been customary to return a number of specimens after determination and to retain the largest and smallest individuals. Thus it is probable that the naturally-occurring extremes have now been received. The retention of the extremes applies more particularly to the males, in which the variation in size of the scutum is more noticeable than in the females. This artificial selection and the limitation of the number of

individuals (the species having a restricted distribution and being somewhat rare) have rendered the results of the investigation less instructive than they would otherwise have been.

We are only concerned with the variability of those structural characters which are usually employed in determining a species of this genus. It should be pointed out that there is a regular gradation of all the characters, described and figured for the largest and smallest specimens respectively (the characters of any individual being correlated with its size) unless the contrary is stated.

Size of Scutum.

The variation in the size of the scutum is the most striking feature. The measurements were made by means of verniers on a moveable-stage microscope, the ocular of which contained a pointer, a method which has been found very useful by Prof. Nuttall. A series of ticks, suitably orientated on a ridge of plasticine fixed to a glass slide, could be moved rapidly in the desired direction and measurements accurate to 0.1 mm. were easily obtainable. The limits of the ornamentation, which in both male and female practically covers the scutum, were used in place of the limits of the scutum itself, because in the majority of cases the exact margin of the scutum is vague. In the male the length was considered to be from the anterior emargination to the posterior border, the breadth across the posterior third, the scutum being broadest at that position; in the female, the length was measured as in the case of the male and the breadth immediately posterior to the eyes.

The results of the measurements of the scuta of 75 males and 53 females are given in the form of correlation diagrams (Figs. 1 and 5). The male scutum increases more rapidly in width than in length, giving a large specimen a somewhat truncated appearance, which contrasts with the oval form of a dwarf. A glance at the correlation diagram (Fig. 1) for the male individuals shows that the correlation between length and breadth, as would be expected, is very close, the correlation coefficient being as high as 0.93. It indicates the division, which is more clearly expressed in the frequency curve, of the individuals into two groups, and also enables the dimensions of the average sized scutum to be determined easily. For the male scutum, the extreme and average measurements are as follows :

	Length in mm.	Breadth in mm.
Largest specimen	4.4	3.4
Smallest specimen	2.4	1.6
Average specimen	3.2	2.3

Finally such a mode of expressing the results allows the aberrant variant to be picked out at once. Two individuals only are strikingly abnormal in size, one measuring 3.3×2.9 mm. and the other 4.6×2.8 mm.; in each case, size only is abnormal, the other characters being similar to those of individuals of similar breadth.

These differences in size may be due either to an intermingling of two or more species or varieties, which are difficult to separate, or to the variability of a single species. In the "male" frequency curve (Fig. 2, ♂) for which, unfortunately, less material was available than

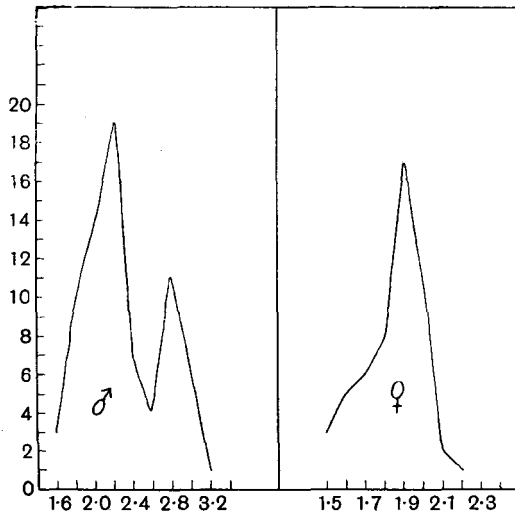


Fig. 2. Frequency curves, male and female.

was to be desired, it will be noticed that the individuals tend to group themselves about the means, and that such a division is absent in the "female" curve (Fig. 2, ♀). If the division in the former curve were due to the intermingling of two species or varieties, it would probably show also in the latter; as it does not show here, it may be assumed that only one species is present and the explanation of the division in the "male" curve is to be found in the artificial selection mentioned above. The occurrence of a tendency to dimorphism in the male would explain this result equally well, but is not a necessary assumption.

Pattern of male scutum.

The ornamentation consists typically of five dark-brown islands in a field of white-enamelled appearance, two being immediately behind the cervical grooves, two placed laterally, with inwardly projecting limbs and one in front of the festoons, containing the shallow dorsal furrows which determine its outline (Fig. 3); as such it is remarkably uniform throughout the whole series, what variation there is, never being sufficient to render doubtful the identification of a specimen.

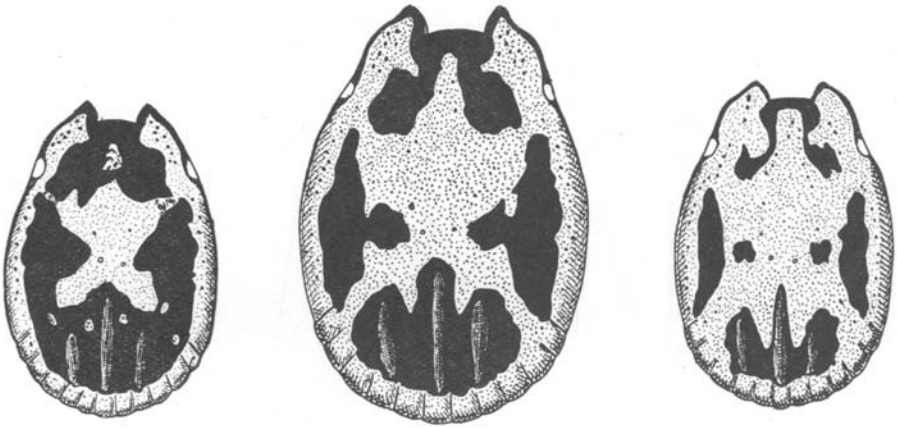


Fig. 3. *Rhipicephalus pulchellus*, males; ornamentation of normal form (central figure) and the two extreme forms, the three scuta being drawn to the same scale. N. C. del.

The departures from the normal take place in two directions. At one extreme, we find that :

1. the anterior islands tend to unite transversely;
2. the lateral islands become triangular, with the apex of the triangle inwards;
3. the posterior island forms an oval mass with its long axis transverse, and in a few cases (Fig. 3) actually unites with the lateral islands, forming a U-shaped marking, the anterior opening of which is partially closed by the anterior island.

At the other extreme :

1. the anterior islands tend to separate and are much smaller than in the normal scutum;
2. the lateral islands become free from their inwardly projecting limbs, which remain in the central field as two small circular patches, making a total of seven islands, instead of the normal number, five;

3. the posterior island tends to break up into three elongated patches, following the dorsal furrows.

It should be noted that the variation of the ornamentation is not dependent on the size of the scutum, the figured specimens all being drawn to the same scale.

Projection of Coxa I.

Normally the anterior projection of coxa I beyond the scutum is easily visible from the dorsal side and it bears a distinct ridge. In the larger well-developed forms this ridge tends to become much stronger and to a slight extent retrograde, whereas in the dwarf males, although the coxal projection is still fairly prominent, the ridge is much reduced and in the smallest individuals (Fig. 4) is hardly apparent at all.

Shape of Basis Capituli.

There is a regular gradation in the size of the basis capituli, with practically no structural variation. The lateral angles are always rounded and distinctly anterior and the cornua strong and blunt. There are generally four small circular depressions arranged in the transverse median line, but the number varies from two to six. A number of hairs passing dorso-ventrally over the lateral angles, in a manner characteristic of *Rhipicephalus*, are present in all specimens.

Palps.

In the typical individual, articles II and III of the palps are notably concave dorsally; this concavity is very pronounced in the large specimens, but in the smallest forms it is absent, and its presence in the type is indicated only by a very indefinite ridge, the dorsal surface of the palp being flat or even slightly convex (Fig. 4).

Cervical Grooves.

These are deep oval pits, equally well defined in all specimens but one, which seems to be imperfectly formed in other respects.

Punctuation.

Towards the "dwarf" end of the series the few medium-sized punctations, situated chiefly on the white field, towards the scapulae, become very small, shallow and not readily discernible, those which indicate the obsolete lateral grooves being modified in a similar fashion.

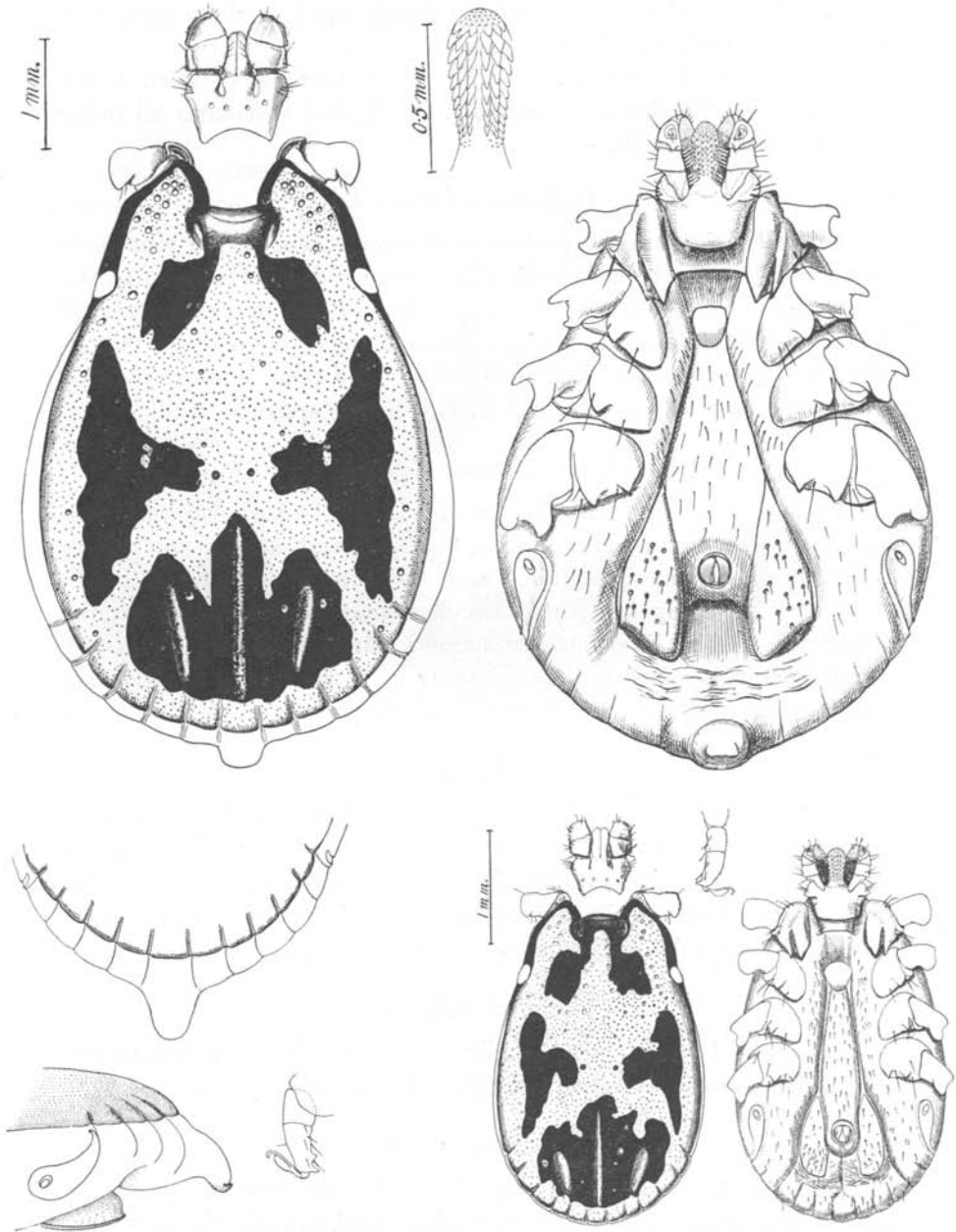


Fig. 4. *Rhipicephalus pulchellus*, extreme types of males, dorsal and ventral aspects; tarsi IV; hypostome of larger male; posterior end of another large well-fed individual, dorsal and lateral aspects, showing orientation of the caudal appendage and the anal plates. N. C. del.

The lateral grooves may be, however, sometimes represented by only three or four punctations, or by a linear series of many deep punctations.

Dorsal Furrows.

Independently of the size of the scutum, there is a considerable variation; in one of the smaller individuals the furrows are deep for the size of the tick and the two lateral furrows equal the median one in length, this extending beyond the anterior margin of the posterior island. In the majority of forms, however, the lateral furrows vary in length from a half to two-thirds that of the median furrow and from scarcely observable oval depressions to narrow elongated but still ill-defined furrows.

Hypostome.

The number of files and approximately the number of denticles on each file is constant throughout the series, but the denticles on the hypostome of the dwarf male are relatively small, not overlapping to the extent observed in the larger forms (Fig. 4), the files being more clearly separate from one another.

Anal Plates, etc.

Here the extreme differences in form will be best appreciated from the figured specimens (Fig. 4), although it may be pointed out that the plate in the larger forms develops an outer angle posteriorly; that in the dwarfs the degree of chitination, and hence the visibility, of the plates is but slightly more than that of the general body surface; and finally that the punctation of the plates of the dwarf forms is rather more pronounced than that on the scuta.

There are no accessory plates in this species.

There remain to be considered a few minor points. The legs of the dwarfs have not the pronounced "beady" appearance of those of the typical specimen, but the relative proportions of the false articles of the fourth tarsus are almost constant.

The "foveae" and the minute dark punctations which cover the whole scutum appear to be similarly developed in all specimens. The hairiness of the general body surface is relatively constant, although not obviously so, owing to the fact that the hairs of the larger forms are frequently broken off, leaving stumps visible only under considerable magnification and conveying to the hasty observer the impression of a

glabrous surface. The spiracle shows no important modification, but the general chitinisation is less strong in the dwarfs, except for the coxal armature and the auriculae of the basis capituli, and for this reason such organs as the spiracles and the anal plates are not raised above the general surface.

Female Scutum.

The variation in the structural features of the females of *Rhipicephalus pulchellus* is practically negligible, the dwarf specimens being smaller replicas of the larger forms. The ornamentation of the scutum, the cervical and lateral grooves, the punctation, the shape of the basis, the spiracle, and lastly the hairs and depressions of the dorsum, in fact almost all the characters by which a species determination is made, are

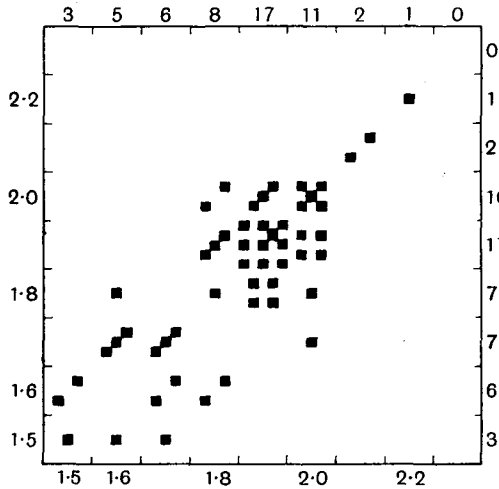


Fig. 5. Correlation diagram, female.

remarkably constant, except of course in size. The following table gives the extreme and average dimensions of the female scutum :

	Length in mm.	Breadth in mm.
Largest specimen	2.2	2.2
Smallest specimen	1.5	1.5
Average specimen	1.9	1.9

In the majority of cases, however, the scutum is either slightly longer than broad or *vice versa*, as is shown by the spreading on each side of the diagonal in the correlation diagram (Fig. 5). Here also the correlation coefficient is high, being 0.95.

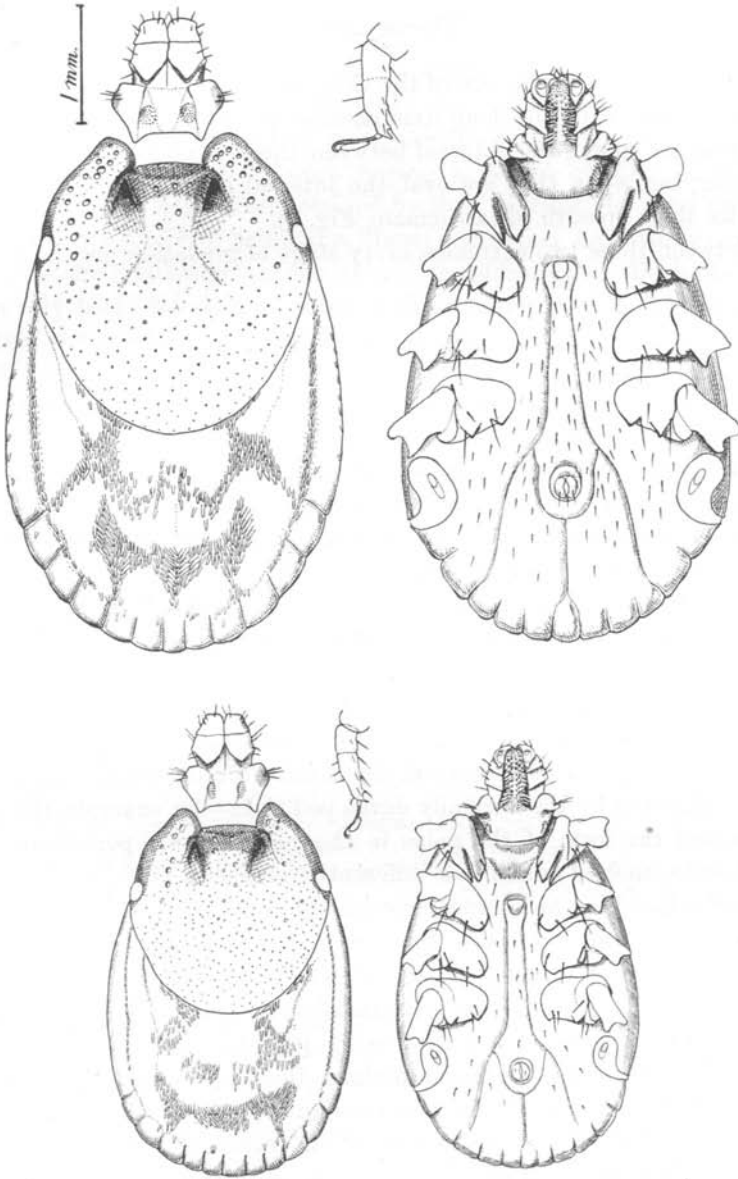


Fig. 6. *Rhipicephalus pulchellus*, extreme types of females, dorsal and ventral aspects; tarsi IV. N. C. del.

Porose Areas.

Independently of the size of the tick, the porose areas may be either round, or oval, with the long axis parallel to the median line. When the areas are round, the interval between them is about equal to their diameter, but when they are oval, the interval is equal, approximately, to twice their breadth (dwarf female, Fig. 6).

Between these two extremes, every stage of gradation may be found.

Lateral Grooves.

The lateral grooves are generally obsolete, but occasionally may be just visible anteriorly.

The question as to what comprises a species is very difficult to answer. It is a problem which all systematists love to attack, but the solution is necessarily influenced by personal bias, species being artificial separations tolerated only on account of their utility.

We have seen that the variability of this species both in size and form is very considerable and it is not possible to do more than indicate the range found within the species.

The value of the various structural features, on which the species of *Rhipicephalus* are based, remains to be considered. In both sexes, we find in the dwarf forms, structural characters differing considerably from those exhibited by the normally developed ticks—for example, the anal plates and the form of the palps in the male, and the porose areas in the female, each of which is a differential character. If *Rhipicephalus pulchellus* had been an inornate species, the dwarf forms would certainly have been considered, even by recent authors, as distinct species. Therefore as in all other biological sections great care must be exercised in future with regard to species formation, at least within the genera of the *Brevirostrata*, due regard being paid to the probability of an apparently new form (differing perhaps from a known species in one or two characters only) being but a variant of a known species. From this point of view an investigation of the range of the variability, at any rate of pathogenic species, would be of considerable value.

Geographical Distribution.

Since 1904, many specimens of *Rhipicephalus pulchellus* have been received at this laboratory, through the courtesy of the Imperial Bureau of Entomology and of many private collectors. It is however a comparatively rare tick, since during a period of nine years only 44 consignments have been received by Prof. Nuttall, the total number of individuals received, being at a liberal estimation, between seven and eight hundred, although on one or two occasions, when the hosts have been very badly infested, as many as three hundred ticks have reached us from the one host.

With three exceptions, *R. pulchellus* has been obtained only from British East Africa and Uganda, in which provinces it is widely spread¹.

In April 1912, D. S. G. Parham collected this species from bullocks in various localities in Zanzibar; Dönitz also received specimens, which were sent to him by Rob. Koch, from cattle in this island; in Nov. 1909, a number of these ticks from a dog were sent by R. E. Drake-Brockman from British Somaliland, and R. I. Pocock (1900) described the species as new under the name *R. marmoreus* from one male collected in May 1895 at Bularli, West Somaliland (no host mentioned)².

The tick has probably been spread over the adjacent provinces, from its home in British East Africa, by cattle and dogs, these animals being the usual hosts in Somaliland, Zanzibar, etc.

Hosts.

R. pulchellus is commonly known as the "Zebra Tick" but it is not peculiar to this host, occurring more frequently on other animals. It has also been collected from desert country in B. E. Africa and swept from grass at various localities along the Uganda Railway, B. E. A.

¹ Localities mentioned by Neumann (1911) and Dönitz (1905), other than those indicated above, are as follows:

Neumann—Zanguebar, Abyssinia, German East Africa.

Dönitz—Pangani, Aruscha, Moschi.

² In 1911, through the kindness of Prof. Newstead, we received a number of ticks sent by Capt. R. Markham Carter from Kasauli, Punjab, India, the hosts being cattle and *R. pulchellus* was alleged to be amongst these. In view of the restricted distribution of the species it is very possible that the Indian locality is wrongly given, and until confirmed no reliance may be placed upon it.

The following authentic list gives some indication of the variety of its hosts¹:

Ungulata	<i>Equidae</i>	Various species of <i>Equus</i> , including	Horse, Ass, Zebra.
	<i>Rhinocerotidae</i>	<i>Rhinoceros</i> sp.	Rhinoceros.
	<i>Suidae</i>	<i>Phacochoerus aethiopicus</i>	Wart-hog.
	<i>Bovidae</i>	<i>Connochaetes albojubatus</i>	Wildebeeste.
		<i>Bubalis caama</i>	Hartebeeste.
		<i>Cobus ellipsiprymnus</i>	Waterbuck.
		<i>Strepsiceros imberbis</i>	Lesser Kudu.
		<i>Oreas canna</i>	Eland.
		<i>Oryx capensis</i>	Fringe-eared Oryx
		<i>Aepyceros melampus</i>	Impala.
		<i>Bos taurus</i>	Cattle.
Carnivora	<i>Felidae</i>	<i>Felis leo</i>	Lion.
	<i>Hyaenidae</i>	<i>Hyaena striata</i>	Striped Hyaena.
	<i>Canidae</i>	<i>Canis</i> sp.	Domesticated and
			wild dogs.

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¹ Dönitz (1907) cites as a host the bird *Francolinus infuscus* (Phasianidae) and Neumann (1911) similarly, the Gnu (*Connochaetes gnu*); but the latter animal inhabits South Africa only, of which locality no mention is made.