Rec. zool. Surv. India, 79 : 489-503, 1982

A NOTE ON GEOGRAPHIC VARIATION IN THE INDIAN BLACKBUCK (*ANTILOPE CERVICAPRA* LINNAEUS, 1758)

By

COLIN P. GROVES

Australian National University

(With 2 Text-figures and 2 Tables)

The Blackbuck is one of the species which is restricted to the Indian subcontinent. It is not the only Bovid to be so restricted : the Nilgai (*Boselaphus tragocamelus*) and Four-horned Antelope (*Tetracerus quadricornis*) are also confined to the subcontinent ; but the very fact that each of these three species occupies a genus by itself, and has never been found, even as a fossil, outside the Indian region; indicates that here we have the Bovid component of "India vera", the product of the Peninsular amphitheatre of faunal and floral differentiation (Mani, 1974, ch. XXIV).

As a fine study of the biology of the Blackbuck—including the general morphology, age and seasonal changes and sexual differences—has recently appeared (Mungall, 1976), these aspects need not be dealt with here.

The first author to study geographic variation of Blackbuck was Zukowsky (1927*a*, *b* ; 1928*a*, *b* ; 1929) ; prior to his study it had been assumed that variation within the species' range was non-existent or negligible, on the grounds one supposes that a plains-inhabitant within India would not have much restriction on its movement, hence not much opportunity to develop geographic forms in a situation of restricted gene-flow between populations.

The systematics of Zukowsky have been much criticised as those of an extreme "splitter". A historical background may be helpful here. Zukowsky was a pupil of Paul Matschie, who believed that a genus was represented by a different species in each river system encompassed by its range ; each of these species was a product of Special Creation—Matschie had no truck with evolutionary ideas. If he had before him samples from two different river systems, therefore, it was not a question of comparing them to see whether they differed taxonomically—but to see what the differences were, for difference there must be, in

his philosophy. It is interesting that in this theory can be seen the germs of a systematic theory based on populations: in this sense, Matschie was well ahead of his time, although he would have been the first to remonstrate against placing any such interpretation on his views.

Where two species met—as they were bound to, occasionally—they would, Matschie supposed, form hybrids. Concerned with the genetic advances of his day as little as with the advances in evolutionary theory, Matschie had his own ideas as to what these hybrids would look like: they would have the characters of one of the parent species on one side of the body, those of the other on the other side! The testing of this hypothesis came in 1910, with a paper by Zukowsky on some wild-shot buffaloes and hartebeest from Africa, which showed horn asymmetry; these specimens were, naturally enough, the long-sought "half-sided hybrids". The fact that in some cases the parent forms were undescribed was no deterrent: Zukowsky went right ahead and described *Bubalus caffer cunenensis* and *cubangensis* from a single specimen, the former being represented by the right horn, the latter by the left horn, of the same specimen. As he did give ranges of variation for the horn characters of his two new forms (and the other buffaloes and hartebeests described at the same time, two per specimen), one must suppose that specimens representing the parent forms were in fact to hand: but if so they have never been described, nor are they at present in any museum visited by me or by anyone known to me.

The ridicule heaped on Zubowsky for this paper is easy to imagine. In retrospect, it does seem most unfair for Matschie to have off-loaded the task of demonstrating his impossible theory onto his fresh young student: especially as it appears to have been Zukowsky's first publication. Yet, Zukowsky did hold to this theory for at least 20 years following, and as we shall see he thought he had an example of a half-sided hybrid in his Blackbuck collection.

Matschie went on to become more and more mystical, and eventually came to speak of species as inhabiting river valleys but quadrants of the earth's surface. At some point, Zukowsky seems to have parted company with him philosophically, although he seems always to have retained an enormous respect for his memory after his death in 1924, quoting him on every possible occasion. He himself however went on to fit fairly well—though always a little on the "splitter" side of the spectrum—into taxonomic thought of the 1930s to 1950s; by the time he died in 1965 he had even been known to mention the theory of evolution once or twice in his writings.

Matschie and Zukowsky were not, in general, known for describing new taxa from large samples ; it must be admitted, however, that they did tend to allot more specimens per taxon than some of their contemporaries—such taxonomists as Rothschild and Lydekker, and even Pocock, were distressingly fond of creating new species or subspecies on the basis of single specimens. But it is quite unexpected to read in his first paper on *Antilope* (1927*a*) that Zukowsky had examined "about 85" living specimens—and divided them into only three taxa ! It was unfortunately not stated how many individuals represented each taxon ; nor were any type specimens mentioned ; and there is no record that any of these specimens (imported by Carl Hagenbeck for his zoo at Stellingen, Hamburg) ended up in a museum.

Although he had previously pre-empted his teacher, Matschie, in adopting the subspecies concept, in this case Zukowsky described his three blackbuck taxa as full species. They were as follows :

1. *Antilope cervicapra* Linnaeus ; type locality fixed as "Inland of Trivandrum", in the modern Kerala. Very small ; horns about 40-45 cm. long, little divergent, with only $2\frac{1}{2}$-3 (occasionally $3\frac{1}{2}$-4) spiral turns. Old males black-brown to black in the breeding season ; both sexes very short-haired. Limbs very faintly marked, almost white below knees. The southernmost species.

2. *Antilope hagenbecki* spec. nov. : type locality, hinterland of Calcutta. About a hand's breadth higher at withers ; horns wide-spiralled, over 10 cm. longer than in previous form, more divergent, with at most 3-4 spiral turns. Old males coloured as previous species ; but with more clearly maked leg pattern—a sharply marked brown stripe reaching almost to hoofs on outer side of legs. From the northeast part of "Vorderindien".

3. *Antilope rajputanae* spec. nov. ; type locality, Bahawalpur, Rajputana (now in Punjab, Pakistan). Large like the previous form ; horns 70 cm. long, even more divergent, with 6 clear, narrow turns. A clear grey sheen on back, flanks and outer side of legs ; pattern in between the first two on limbs, with only a whitish-yellow "shadow-stripe" below knee. Hair in both sexes much longer than in previous two species. The species from Rajputana and Punjab. Although the diagnosis is as above, Zukowsky also mentions, in the same paper, a specimen referred to this species with horns only 50 cm. long, with $4\frac{1}{2}$-5 spiral turns, and less divergent.

Apart from the uncertainty about the precise number of specimens seen, most of the diagnostic characters refer only to adult males : and presumeably the imports would have contained at least 50% of females.

Still, the division into three species is obviously much more securely based than many of the taxonomic apportionments of the day. Although he does not say so in so many words, his species *hagenbecki* and *rajputanae* are based on the Ganges and Indus rivers respectively ; only *cervicapra* has no strict river-valley allocation.

In the same paper, Zukowsky goes on to say that the range of *hagenbecki* does indeed go west along the Ganges system, as far as Agra according to records from the literature, and perhaps even to Gwalior, unless there is a special Central Indian form ; the male from Gwalior in Plate XLVII of Sclater and Thomas's *Book of Antelopes* has a grey sheen like *rajputanae*, and long horns, but the horn twists are very wide, and only 3-4 in number, while again the pattern on the legs is not so sharply marked.

In a second paper in the same year, Zukowsky (1927*b*) describes the leg patterns of his three species, stressing that *hagenbecki* is more different from the other two, in its clearly marked leg-stripe, than they are from each other.

The following year Zukowsky (1928*a*) mentioned seeing a further 28 specimens ; most of these were from the northeastern part of India and could be identified without difficulty as *hagenbecki*, but the other 6, from Agra, resembled the plate in Sclater and Thomas, and so a new species was required : duly described as *Antilope centralis*. Like *rajputanae* and *hagenbecki*, this is a big form with strong horns up to 70 cm. long, with a very long flat spiral of only 3 turns ; the axes of the horns stand at 20° to the nasofrontal plane, not in the same plane as in the other races. Like *rajputanae* it has a grey sheen ; the leg mark reaches the fetlock although not as strongly marked as in *hagenbecki*.

In fact, Zukowsky said, Agra is at the very eastern edge of the range of *centralis*, for one of the specimens from this locality is—yes, a half-sided hybrid : it has the right horn of *hagenbecki*, the left horn of *centralis* ! And to be sure, the photograph he gives of the animal shows a very odd-looking assymmetry.

A short description was also given in this paper of seasonal changes in colour in male blackbuck. A buck of *A. hagenbecki* in November and December 1927 was a shining black-brown colour ; in mid-May of the following year it began to lighten, and by the beginning of July had a yellow-brown coat with a gazelline lateral flank-stripe : only the head, neck and limbs remaining darker, just slightly lightened from their winter hue.

A second publication in 1928 described four males of *cervicapra* obtained by Hagenbeck from the southern part of India ; they substantiate his earlier description of this species as being small and short-haired, and deep brown to black in winter ; in summer they too became much lighter in tone.

A final publication by Zukowsky in 1929 describes skulls of two of his species : *A. rajputanae* was said to have broader frontals than *A. centralis*, a shorter molar row, smaller lacrimal, broad intermaxillae, and small supraorbital foramina. The significance of these differences is diminished by the size and quality of the samples studied : a single adult male *rajputanae*, and two young males of *centralis* : one of them castrated ! The greater skull breadth and shorter molar row of the former species are adequately explained by the age difference.

Ellerman and Morrison-Scott (1951), obviously impressed by the large samples ("over a hundred living specimens", as they go out of their way to point out), accept Zukowsky's classification with the qualification that his species are actually only subspecies. They make also one nomenclatorial change : Zukowsky's name *hagenbecki* is superseded by *Antilope rupicapra* Müller, 1776, which as they point out is not preoccupied by *Capra rupicapra* Linnaeus (the earliest name for the Chamois of Europe).

Thus far the literature. But the theory and practice of taxonomy has in the meantime changed, and the question that immediately occurs to an enquirer in 1977 is whether these four subspecies are real, or whether they are merely the ends of cross-cutting clines. That such a question is appropriate has been recognised by Corbet (1970), who perhaps represents the modern consensus viewpoint when he says,

> The only solution, to make subspecific names meaningful, seems to be to reject all names based on average differences or that have been shown to represent points on a cline ; to treat as "provisional subspecies" groups that can be discretely diagnosed on the basis of presently available data but cannot yet be confidently considered to represent discrete groups in nature ; and as "definitive subspecies" groups whose presence as discrete entities in nature has been shown by adequate sampling.

So, with the problem in mind—do the "subspecies", assuming the differences between them are them are real, represent discrete entities in nature ?—we turn to the data. I have studied specimens in the following collections : British Museum (Natural History) ; Rijksmuseum voor Natuurlijk Historie (Leiden) ; Powell-Cotton Museum (Birchington, Kent, England) ; Zoologisches Museum A. Humboldt (Berlin) ; the

Indian Museum and the Zoological Survey of India (Calcutta) ; Bombay Natural History Scoiety ; Delhi Natural History Museum ; Indian Forestry College (Dehra Dun) ; Van Ingen and Van Ingen, Taxidermists (Mysore) ; The Palace, Wankaner ; The Palace, Kolhapur ; The Palace, Vadodara ; Gass Forest Museum (Coimbatore). From collation of measurements on these specimens we arrive at the results listed in Table 1. (Breadth measurements, also taken on each specimen where available, followed the length measurements exactly, for adult male skulls.)

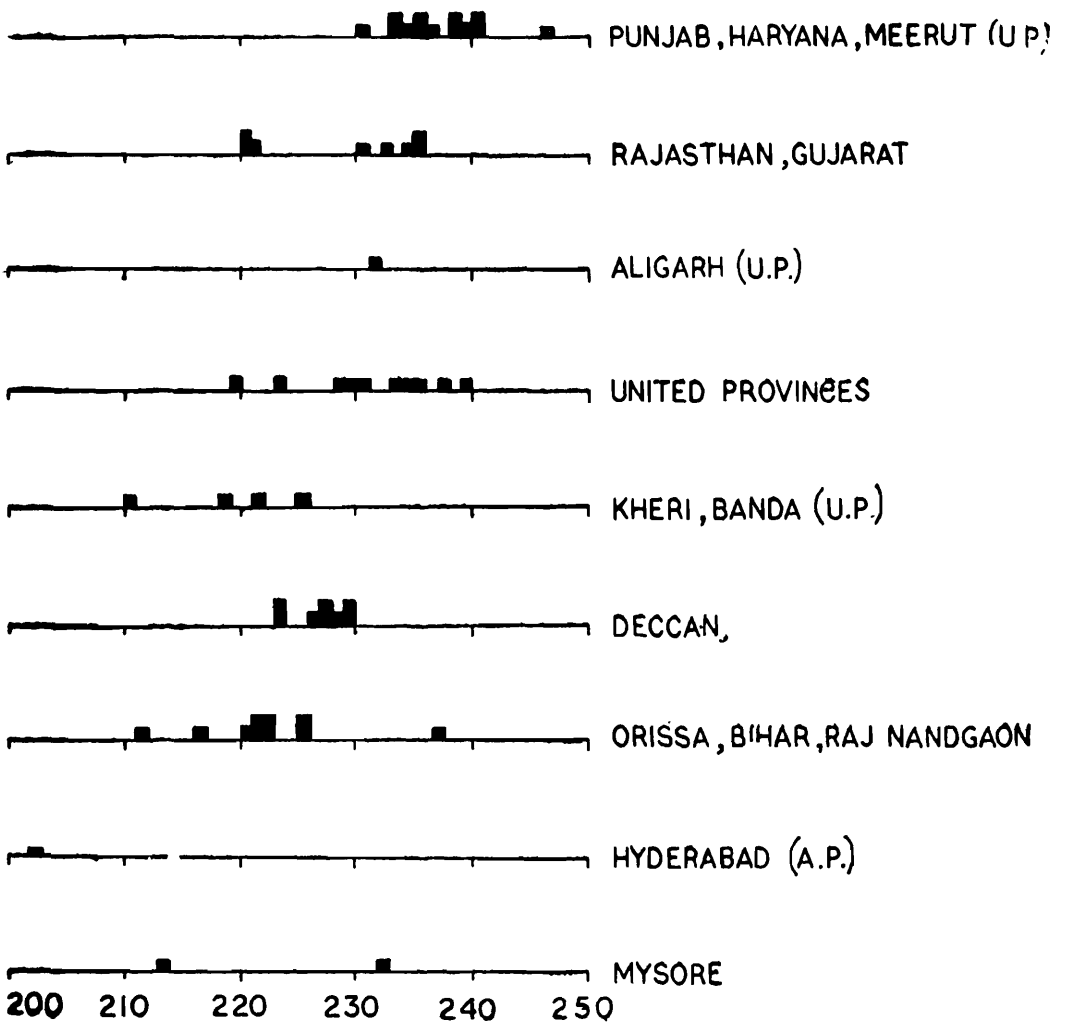
We see in Table 1 that skull length falls into two groups : those from the northwestern part of the range (Saurashtra, Baroda, Faridkot/Karnal/Amritsar/Hissar/Meerut, Bikaner, Gurgaon/Gwalior/Agra/Aligarh, and various groupings not specified beyond State ("Punjab") or even vague area ("N. W. India") being larger than those

TABLE 1. Skull and Horn Measurements of Geographical groups of Blackbuck (Males)

	Horn Length			Tip-to-tip			Skull length		
	Mean	S. d.	n	Mean	S. d.	n	Mean	S. d.	n
"N. W. India"	505.0	39.05	3	311.7	25.66	3	238.5	—	2
"Kashmir"	420.0	—	1	305.0	—	1	—	—	—
"Himalayas"	521.7	7.64	3	313.3	11.55	3	—	—	—
"Punjab"	550.4	58.40	5	469.8	87.92	5	237.5	—	2
"Rajputana"	545.0	18.03	3	315.0	118.22	3	235.0	—	2
Amritsar	631.0	—	1	327.0	—	1	227.0	—	1
Saurashtra	548.0	37.73	13	397.8	56.89	13	227.0	6.56	3
Faridkot/Meerut	639.1	36.48	10	441.9	95.94	9	236.3	5.04	8
Baroda	508.3	10.41	3	372.0	16.29	3	220.0	—	1
Bikaner	605.0	—	2	442.5	—	2	231.0	—	2
Gurgaon	545.0	—	1	249.0	—	1	238.0	—	1
Gwalior/Agra	526.0	59.23	3	371.7	34.03	3	231.0	—	1
"United Provs."	455.0	29.31	12	338.8	52.36	12	231.8	6.21	12
Kheri/Banda	498.6	61.31	6	379.8	47.07	6	218.5	6.35	4
"Central Provs."	540.0	—	2	482.5	—	2	—	—	—
Bhopal	540.0	—	1	380 0	—	1	—	—	—
Rajnandgaon, M. P.	452.0	—	1	262.0	—	1	222.0	—	1
Deccan	519.4	34.69	8	364.2	55.54	6	226.5	2.39	8
Dharwar	467.0	—	1	222.0	—	1	—	—	—
Hyderabad	530.0	—	—	—	—	—	202.0	—	1
Mysore	414.0	15.68	4	366.8	82.50	4	222.5	—	2
Bangalore	430.0	—	2	345.0	—	2	—	—	—
Puri	455.0	37.53	7	311.4	64.53	7	219.4	4.58	7
Bihar/Bengal	383.0	16.61	4	302.0	37.72	4	225.0	—	1

from southern ("Central Provinces", Bhopal, Deccan (Khandesh and Haturna (?=Eturna, Andhra Pradesh near the Maharashtra border), Hyderabad, Mysore) and eastern (Rajnadgaon, Kheri/Banda, Puri,

Ranchi, and Palamau/Bokaro/Champonan) parts ; skulls labelled only "United Provinces" (*i.e.*, Uttar Pradesh) stretch across both these groups. From Text-fig. 1, it can be seen that this distinction is fairly clear-cut : most skulls more than 230 mm. belong in the northwestern group, most of those less than 230, in the southern and eastern group. Moreover, these two groups approach each other closely in Uttar Pradesh : the skull from Aligarh is 231 mm. long, within the range of the Faridkot/ Meerut sample, while the largest skull from Kheri or Banda is 225 mm. It would therefore be most enlightening to know whether the "United Provinces" skulls—of which all but one (of the complete, measureable



Text-fig. 1. Skull length in different geographical groupings of Blackbuck.

ones) are in series, in the British Museum—are from a single locality, presumeably somewhere between Aligarh and Banda or Kheri, or from a number of widely scattered localities. As can be seen from Text-fig. 1, they range in length from 219 to 239 mm., not quite covering the combined ranges of the whole of the other samples.

The single skull from Hyderabad deserves further comment. It falls right outside the range for the southern series as a whole, and so

is "small" as Zukowsky said *cervicapra* should be ; but does it represent a discrete, small form, or the tail end of a normal curve ? There is no evidence either way as yet ; but specimens from Mysore, further south, are larger, so the second possibility seems more likely.

Horn length varies rather differently : there is a general tendency for southern and eastern samples to have smaller horns than northern and western, but there are many exceptions ; and the standard deviations are—as one would expect—extremely large. The largest horns are those of the Faridkot/Meerut sample ; the smallest, from Bihar and Bengal. No marked asymmetry was noted, not even in the potentially intermediate "United Provinces" series ; the only noticeable asymmetry, and that not very marked, was in a British Museum specimen (no. 98.6.3.1) from Kathiawar, in which the right horn is 530 mm, long, the left horn only 490.

The tip-to-tip distance is a measure of horn divergence ; obviously it must be taken in conjunction with horn length (tip-to-tip distance will be as great in a specimen with very long, not very divergent horns as in one with short, widely divergent ones!), but even when this is done we have a picture like that of horn length : a general tendency, not very marked, for northwestern animals to have more divergent horns, but standard deviations so large as to render any search for an absolute distinction hopeless.

In Table 2 are listed the numbers of spiral twists per horn, in each of the samples. A weak correlation appears between this measure and horn length ; specimens from the Faridkot/Meerut series have very long horns, with many turns (up to the maximum observed, $5\frac{1}{2}$), while easternmost samples have rather short horns, with few turns (maximum $3\frac{1}{2}$; more usually only 3 or even the minimum observed, $2\frac{1}{2}$).

As far as traditional subspecific differentiation goes (the Coefficient of Difference—the difference between the means divided by the sum of the standard deviations), the Faridkot/Meerut sample differs in skull length from the Banda/Kheri sample at C. D. = 1.56 ; from Puri at C. D. = 1.76 ; and from Deccan at 1.32. All of these figures are above the level (C. D. = 1.27) of conventional subspecific difference, at 90% joint non-overlap or 75% vs. 100%. Compared to the general "United Provinces" sample, no other reaches this level.

For horn length, Faridkot/Meerut is above this level of difference compared to Banda/Kheri, Puri, Deccan, Bihar ; and Gwalior/Agra ; Bihar is above it compared to Deccan, Banda/Kheri ahd Gwalior/Agra ; no other pairwise comparisons reach the level. This means that among

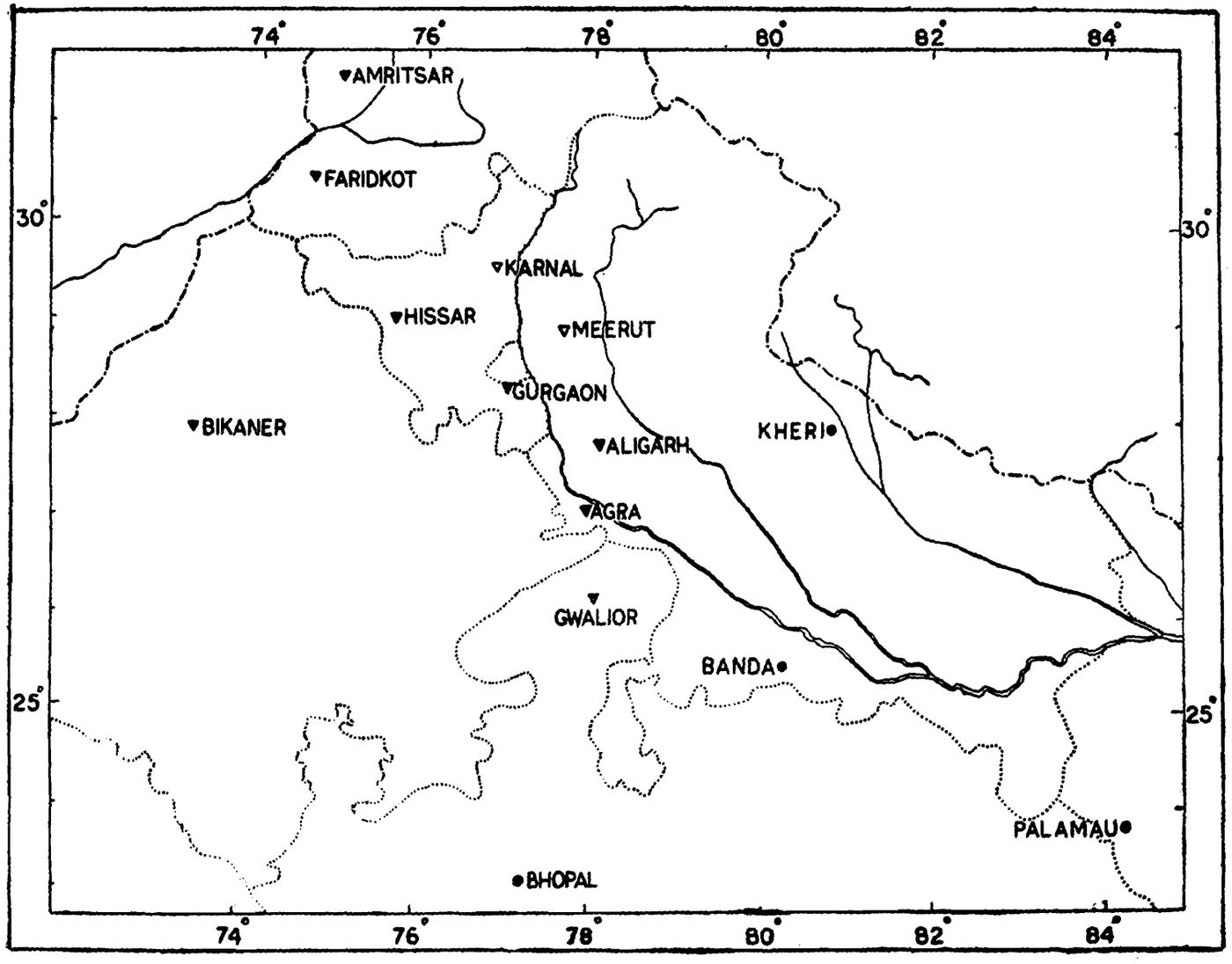
the samples of the Northwestern group, Faridkot/Meerut stand out, and Bihar/Bengal stand out among the southern and eastern samples—rather than these two groups differing from one another as a whole.

TABLE 2. Number of Horn Spirals of Geographical Groups of Blackbuck

	2½	3	3½	4	4½	5	5½
"N. W. India"		3					
"Kashmir"		1					
"Himalayas"		1	2				
"Punjab"		1	2	1	1		
"Rajputana"		1	2				
Amritsar				2			
Saurashtra			3	6	3	1	
Baroda				3			
Faridkot/Meerut			2	3	1	1	3
Bikaner				1		2	
Gurgaon				1			
Gwalior/Agra	1	2	1				
"United Provs."		3	5	3	1		
Kolhapur		1	1	2		2	
Kheri/Banda	1		2	2		1	
"Central Provs."				2			
Bhopal					1		
Rajnandgaon				1			
Deccan		1	3	3		1	
Hyderabad					1		
Mysore		2	2				
Bangalore		1	1				
Puri	2	5	1				
Bihar/Bengal	1	4					

The amount of skin material available for this study was rather limited : 12 complete skins, and 30 head-skins (one albino aside). All the skulls belonged to males ; only 3 skins were female, all the rest males. However, a large number of living animals were observed : in Guindy and Kanha National Parks, Sunderpura and Sikandra Reserves, and Ahmedabad and Hyderabad zoos (these latter of known origin).

The full skins consisted of 1 from Saurashtra, 1 from Sind, 1 from Ghazipur (U. P.), 1 from Khandesh, 4 from Bengal, 1 from Mysore, and 2 from Dharwar, together with the type of *A. centralis*, from Gwalior. The Bengal skins all show the dark colour of the body extending right down the limbs, becoming nearly black on the pasterns ; the adult male is dark black-brown, the young male and the two females are paler brown, with a gazelle-like pattern of longitudinal light and dark zones on the flanks. These four are in the Leiden Museum,



Text-fig. 2. Map of northern segment of distribution of Blackbuck in India, to show close approach of *A. c. rajputanae* (triangles) and *A. c. cervicapra* (dots) in Uttar Pradesh.

The young male from Mysore (British Museum) is a medium brown, and this colour too extends all the way down the legs—much more marked than Zukowsky said should be the case in *A. cervicapra* from southern India. Wild specimens in Guindy (Madras) and Kanha (M. P.) are exactly of this description, as are those in Hyderabad zoo from Andhra Pradesh. The two from Dharwar (in Calcutta), a male and a female, are both red-brown—the male darker than the female, but not in its black breeding coat—with a dark line down the limbs ; and the type of *A. centralis* is, exactly as described by Zukowsky and figured in Sclater and Thomas, washed with a grey sheen, and having the dark line rather poorly marked down the limbs. Living bucks in Sikandra reserve, at Akbar's tomb, near Agra, vary somewhat with either weak leg-stripe or none at all ; while those in Sunderpura, near Baroda, have a marked grey sheen and—from a distance, at least—pure white shanks.

The head-skins show no particular differences in colour ; the head is in any case darker than the body in this species—except in the full sable livery—and does not appear ever to have much of a grey tone to it. One noticeable difference does stand out between one series and another however : in all the Northwestern specimens the eye-ring is very broad, both above and below the eye, whereas in southern and eastern specimens it is broad only below it, but rather narrow above, in approximately 3 : 5 ratio. The type of *centralis* shows the broad type as do skins from Khandesh, Saurashtra and Sind, the other full skins show the superior narrow type. Northwestern head-skins are from Faridkot, Kathiawar, Hissar, Kashmir, "Punjab", "Jarpin" (not traced), and "United Provinces" ; southern and eastern ones are from Kolhapur, Bhopal, Banda and "Central Provinces". It is interesting to note that of the five "United Provinces" head-skins, the only two which are associated with skulls have a skull-length of above 230 mm. This difference can be seen in photos of wild blackbuck, or zoo specimens of known origin.

It remains firstly to compare these findings with Zukowsky's, and then to see whether the differences found between the regional forms are subspecific or not. Finally, diagnoses and synonymies will be given.

Zukowsky said that *rajputanae* and *centralis* both have an overall grey sheen, which the others do not (in sable-coated males !). As far as the data go in the present study, this difference is probably valid. The degree of expression of the leg-stripe should be : good in *hagenbecki*, fair in *centralis*, poor in *rajputanae*, little or absent in *cervicapra*. The

material seen in the present study supports Zukowsky for *centralis*, *rajputanae* and *hagenbecki*, but fails to support him in the *cervicapra* case. Either, therefore, there is individual variability in southern India, or else Zukowsky's specimens came actually from a restricted locality not represented in the present study. It is a pity that the distinctively small Hyderabad skull lacks as associated skin ; but as specimens in Hyderabad zoo stated to be from Andhra Pradesh and showing other characters of the southern/eastern type (eye-ring, short horns, etc.), had leg-stripes, this is unlikely to be the source of Zukowsky's *cervicapra*.

Again, according to Zukowsky *cervicapra* should be smaller than all the rest, which are of equal size. Leaving aside the Hyderabad skull, which may or may not be from whatever region the Hagenbeck specimens derived from, we have seen that there is in fact a very clear-cut size difference of which Zukowsky was unaware : between his *rajputanae* and *centralis*, on the one hand, and *hagenbecki* (and *cervicapra?*) on the other.

According to Zukowsky the horns are very long in *centralis* and *rajputanae*, shorter in *hagenbecki*, very short in *cervicapra*. In the present study a restricted sample, probably referable to *rajputanae* (the Faridkot/ Meerut sample), has very long horns, and the outstandingly short-horned sample is that from Bihar and Bengal, presumeably topotypical *hagenbecki*.

The horns diverge most, according to Zukowsky, in *centralis* and *rajputanae*, less in *hagenbecki*, least in *cervicapra*. Again, the picture is rather one of some samples standing out, rather than whole regions.

Finally in Zukowsky's study *rajputanae* has the most spiral turns to the horns, *hagenbecki* next, *cervicapra* and *centralis* fewest. Again we note some samples standing out within their general regions, although it is true that it is among "*rajputanae*" that the most twists can occur ($5\frac{1}{2}$, rather than 6 as Zukowsky described), but it is *hagenbecki* which commonly has the fewest (only $2\frac{1}{2}$).

How to explain these discrepancies ? The probable answer is that the Hagenbeck imports will have been from relatively restricted areas : Zukowsky speaks of the Rajputana/Punjab border, the hinterland of Calcutta, the very south (Trivandrum and Cape Comorin), Gwalior, and Agra. The first of these regions is precisely the Faridkot district, whence come the longest-horned members of the Northwestern type ; while no specimens are known to have come from the hinterland of Calcutta (merely, "Bengal") or as far south as Trivandrum.

We have found, then, that Zukowsky's descriptions are in part applicable to wide-ranging populations of blackbuck ; in part not. As far as present evidence goes, a Northwestern and a Southern and Eastern form can be distinguished : the former is larger, with a longer coat of hair, a grey sheen in the breeding male, little or no dark leg-stripe, and a broader eye-ring—this last being a character not noticed by Zukowsky. The latter is smaller, short-haired, with no grey sheen, a more clearly marked leg-stripe, and an eye-ring that is narrowed above the eye. Whether a third form can be distinguished in the south, very small in size and with almost completely white limb shanks, there is as yet no evidence to say : but a skin from Mysore and the living animals in Guindy, Madras, indicated that if such a southern form did exist it would have to be very restricted in distribution, and the very small skull from Hyderabad (well to the north of Mysore) suggests that any such form would be characterised by non-concordance of its two distinguishing features.

The fact that so few females are in collections does not allow us to say with any confidence that the size difference holds overall. One can note only that little or no difference in shoulder height is apparent in living specimens of the two sexes. The limb-extension and eye-ring characters do work in females as well as males, however, although all females (as well as males in non-breeding coats) have at least some indication of a dark shankstripe ; and the hair-length difference seems to work as well.

Now : are these two regional types subspecies, or not ? Inspection of Table 1 and Text-fig. 1 shows that the Northwestern sample that approaches the Southern and Eastern group geographically, the sample from Gwalior, Aligarh and Agra, is as large-sized as any northwesterner ; while the sample from the other group which approaches the northwesterners geographically, that from Banda and Kheri, is as small as any. There is therefore a sharp break between these two samples. The eye-ring character follows this exactly ; one cannot vouch for the leg-stripe, although the type of *centralis* does, perhaps, have a rather less obliterated one than the *rajputanae* illustrated by Zukowsky or those seen by me ; but on the contrary, the type of *centralis* has a clear grey sheen, which no southern or eastern specimen does. Accordingly, the two really do seem to be "discrete entities in nature", with just a suggestion—in the character of the leg-stripe in the *centralis* type and that and the eye-ring in Khandesh—of gene-flow between them in some characters.

The two subspecies may now be defined as follows :

1. **Antilope cervicapra rajputanae** Zukowsky, 1927. Northwestern Blackbuck

Synonym : *A. centralis* Zukowsky, 1928.

Localities : Faridkot, Gurgaon, Hissar, Meerut, Ghazipur, Aligarh, Agra, Gwalior, Kular (not traced, but in Rajasthan), Bikaner, Saurashtra (Bhal, Bhavnagar, Rajthali, Wankaner), Baroda, Jarpin State (not traced), Mehna (Punjab), Amritsar ; "Punjab", "Rajputana", "Kashmir", "Himalayas", "N. W. India".

Diagnosis : Adult male skull length usually above 230 mm. ; grey sheen in breeding season in adult male ; long rough hair ; leg-stripe poorly marked or absent on shanks ; eye-ring broad all round eye.

Comments : the longest, most divergent, and most closely spiralled horns occur in this race, but the character is not an absolute one.

The photos of Texas blackbuck in Mungall (1976) show animals very decidedly of this race, which agrees with the likelihood (p. 21) that they were originally imported from the present-day Pakistan.

2. **Antilope cervicapra cervicapra** Linnaeus, 1758. Southern and Eastern Blackbuck.

Probable synonyms : *A. rupicapra* Muller, 1776 ; *A. bilineata* Grey, 1830 ; *A. hagenbecki* Zukowsky, 1927.

Localities : Kheri, Banda, Dharwar, East Khandesh (including Bhadwad, Ghodasgaun), Haturna (?=Eturna), Hyderabad, Bangalore, Mysore, Madras, Rajnandgaon, Kanha, Puri, Jeypur (Orissa), Palamau, Ranchi, Bokaro, Champonan (not traced, but in Bihar, probably Champaran), Bhopal ; "Central Provinces", "Bengal".

Diagnosis : Adult male skull length less than 230 mm. ; no grey sheen ; short, fine hair ; leg-stripe well-marked all down legs, at least in specimens examined ; eye-ring distinctly narrowed above eye.

Comments : the shortest, least divergent, and most open-spiralled horns occur in this race, but there are wide overlaps.

Summary

Geographic variation in *Antilope cervicapra* is described. It is of a type which can be termed subspecific even under stringent criteria. Many of the characters described by Zukowsky as of taxonomic significance fail, because of the restricted geographical nature of his samples ; but others are valid, and some of the differences between the Northwestern and Southern and Eastern races (*A. c. rajputanae* and *A. c. cervicapra*) were not noticed by Zukowsky.

ACKNOWLEDGEMENTS

Many thanks are due to the following curators of collections and others : Dr. G. D. Corbet and Mr. J. E. Hill ; Mr. L. Barton ; Dr. C. Smeenk ; Dr. R. Angermann; Dr. B. Biswas, Mr. T. P. Bhattacharyya, and Dr. P. K. Das ; Dr. J. C. Daniel ; Messrs. J. & D. Van Ingen ; H. H. Maharana Saheb and M. K. Digvijaysinhji of Wankaner ; Mr. C. K. Gaekwad ; the staff of H. H. Maharajah of Kolhapur ; Mr. S. Shanmugamathan ; Dr. Mammen Koshi. All the curators, and their assistants, were most hospitable at all times, offering welcome diversions at key points in the day, in the form of cups of tea and intellectual conversation. Mr. Harry Miller, Dr. Kamal Naidu, Mr. Charles Wesley, Mr. Reuben David and Mr. Ajitsingh Gaekwad took as much pleasure in showing me living blackbuck as I received in seeing them.

REFERENCES

CORBET, G. B. 1970. Patterns of subspecific variation. *Symp. zool. Soc. Lond.*, **26** : 105-116.

ELLERMAN, J. R. AND MORRISON-SCOTT, T. C. S. 1951. *Checklist of Palaearctic and Indian Mammals*. BM(NH) Trustees.

MANI, M. S. 1974. Biogeographical evolution in India. In M. S. Mani, ed., *Ecology and Biogeography in India* : *Monogr. Biol.* **23** : 698-724.

MUNGALL, E. CARY. 1976. The Indian Blackbuck Antelope : a Texas view. *Kleberg Studies in Natural Resources*, Texas A & M University.

ZUKOWSKY, L. 1927*a*. Bemerkungen über die rassenweise Verschiedenheit der Hirschziegenantilope. *Carl Hagenbeck's illustrierte Tier- und Menschenwelt*, **2** : 124-7.

ZUKOWSKY, L. 1927*b*. Nachtrag zu den Bemerkungen über die rassenweise Verschiedenheit der Hirschziegenantilope. *Ibid.* **2** : 147.

ZUKOWSKY, L. 1928*a*. Weitere Mitteilungen über die Systematik der Hirschziegenantilope. *Ibid.* **3** : 60-2.

ZUKOWSKY, L. 1928*b*. Notiz über Hirschziegenantilopen. *Ibid.* **3** : 122.

ZUKOWSKY, L. 1929. Bemerkungen über den Schädelbau von *Antilope centralis* und *Antilope rajputanae*. *Ibid.*, **3** : 182-3.