Reports

Fossil Canis from the Tar Pits of La Brea, Peru

Abstract. New fossil material has been obtained from La Brea, Peru. Included in this material are remains of a large wolf-like canid which could not be referred to any living or fossil South American canine genus. Comparison with fossil canids from Rancho La Brea, Calif., shows that it closely resembles *Canis (Aenocyon) dirus* Leidy.

During January and February 1958, an expedition from the division of zoology and palaeontology of the Royal Ontario Museum, Toronto, excavated some tar pits at La Brea, which lies about 30 miles southeast of Talara, Peru. The deposit resembled that at Rancho La Brea, Calif. It was a matrix of sand consolidated by impregnation with asphalt. Within the matrix were found remains of invertebrates and vertebrates, pieces of wood, remains of various plants, and a few stones. The vertebrate fauna from the La Brea tar pits had a Pleistocene aspect. Remains of various animals were present; these are given here with tentative identification only (*1*): mastodon (*Haplomastodon* [*Aleamastodon*]); giant ground sloth (*Eremotherium, Glossotherium, Scelidotherium*); sabre-tooth cat (*Smilodon*); giant jaguar (*Felis atrox?*), horse (*Equus* [*Amerhippus*]); llama (*Palaeolama*); dire wolf (*Canis* [*Aenocyon*] *dirus*); field fox (*Dusicyon* [*Lycalopex*]) glyptodon (*Chlamytherium*); deer (*Odocoileus?*); rodent (two forms, one mouse-size and one rat-size); various unidentified aquatic and carnivorous birds; two unidentified forms of chelonian; and one unidentified crocodilian.

An examination of the material developed from the matrix during the first 6 months and referable to the Canidae shows that there were at least two canids present—namely, a large wolflike form and a small foxlike form. The latter is comparatively rare, but seems to resemble *Dusicyon* (*Lycalopex*) in its cranial characteristics. The wolflike creature is well represented, there being at present four brain cases, a badly damaged skull, many mandibles in different degrees of completeness, one femur, three tibiae, five humeri, and two atlases in good condition, together with more or less fragmentary specimens of most of the other postcranial bones. All this material is stored in the Royal Ontario Museum.

This wolflike creature was a massive animal with a marked sagittal crest projecting posteriorly from the lambdoid area, an expanded nuchal crest, flattened and uninflated frontals, well developed carnassials, and wide zygomatic arches. The rostrum is relatively long, as is the mandible. The teeth are well spaced, with little or no overlapping or contact between premolars; there are heavy and deeply implanted incisors and heavy molars. The coronoid process of the mandible is well developed, no doubt as a result of the action of the same enlarged muscles which produced the development of the sagittal and nuchal crests. Likewise, the postcranial skeleton is massive, being slightly smaller than that of a timber wolf, but relatively heavier. The Peruvian wolf was a heavier animal than any of the living canids of South America and had different proportions.

When the fossil specimens were compared with the figures and measurements for *Canis nehringi* Amegh. and *Canis gezi* Krag. (*2*), and for *Canis dirus* Leidy and *Canis milleri* Merriam (*3*), it was seen that the Peruvian form was closer to *C. dirus* than to any of the other three species. In Table 1 a comparison of selected measurements for all four species and for various specimens of the Peruvian form are given.

The figures in Table 1 for the Peruvian material fall, in all cases but one, nearer to those for *Canis dirus* than to any of the others; in the one exceptional case the figure is closest to that for *C. milleri*. It is, therefore, evident that the Peruvian wolf is not closely related to the two fossil dogs described by Kraglievich and Ameghino, and that it does not really resemble *C. milleri,* as the single dimension in which it is similar to *C. milleri* is insignificant when the other nine characters are taken into consideration.

The Peruvian wolf and *C. dirus* resemble one another in proportions, general curvature of the posteriorly projecting lamboid, width of the zygomotic

Table 1. Selected comparative measurements of *Canis gezi, C. nehringi, C. milleri, C. dirus,* and the fossil Peruvian canid from La Brea, Peru. Numbers in italics are specimen numbers and apply to all measurements listed below them.

Dimensions (mm)	C. gezi	C. neh-ringi	C.mil-leri	C. dirus Large	C. dirus Medium	Peruvian fossil material deposited at the Royal Ontario Museum, Toronto		
	*5120**	*500**	*11257†*	*10856‡*	*10834‡*	*2053§*		
Condylobasal length	243	236	223	282	267	271.3		
Width of rostrum above roots of C¹	54	52	50.2	67.3	58.5	57.2		
Bizygomatic width			151		175¶	164.5	160¶	
Width across postorbital processes	71¶	75	64	93.6	77.0	80.6		
						2001§	*2009§*	*2047§*
Length of mandible		165	178	230	210.5	188.3	187.8	194.9
Height of mandible at coronoid		70.5	82.5	91.3	87.0	82.2		83.4
Depth of mandible below hypoconid of M_1	32	29	29.8	39.7	37.0		36.2	39.7
	6297#					*2044§*		
Length of femur	227			260.0**	241.8††	256.8		
						2017§	*2045§*	*2046§*
Length of tibia	227	219		237**	231.6††	247.3	250.5	238.5
						2040§	*2041§*	*2042§*
Length of humerus				240**	217.9††	249.3	242.7	233.7
						2057§	*2058§*	
Width across wings of atlas	97.5			120.5**		110.4	112¶	

* Specimens in the Museo Nacional, Argentina. † Specimen in the University of California collections in vertebrate palaeontology (*3*). ‡ Specimens of *C. dirus* from Rancho La Brea, after Merriam (*3*). § Peruvian fossil specimens in the Royal Ontario Museum, Toronto. ¶ Approximate measurements. # Measurements of *Canis* sp. in the Museo Nacional, Argentina, after Kraglievich (*2*). ** Measurements of various *C. dirus* limb bones after Merriam (*3*). †† Means of various measurements of limb bones of *C. dirus* after Stock and Lance (*4*).

arches, and massiveness of the dentition. In no character was there a wide divergence between these two animals. On the other hand, the Peruvian fossil differs from the illustrations of *C. gezi* and *C. nehringi* in the shape of the dorsal profile of the skull. In *C. gezi* and *C. nehringi* the frontals are inflated, as in many domestic breeds of dog. None of the La Brea specimens from Peru show this inflation. The rostrum is shorter and lighter in both *C. gezi* and *C. nehringi* than in *C. dirus* and is so constructed the P^4 seems to be set below and behind P^3 to give the suggestion of a "step down" from P^3 to P^4. This condition is not clearly marked in *C. dirus*.

Comparison of the postcranial skeleton of *C. dirus* and that of the Peruvian fossil canid shows a striking similarity both in shape and dimensions, while the postcranial material of both *C. gezi* and *C. nehringi* is so scarce that little comparison is possible.

The conclusion resulting from this first investigation is that a large wolf-like creature existed in the Pleistocene of Peru and that this creature belongs within the genus *Canis* and is closely related to *C. dirus* of the Californian Pleistocene tar pits. Until further material has been developed from the matrix it is too early to state definitely whether it is identical with *C. dirus* or not, and it is proposed for the present to refrain from giving the Peruvian wolf a separate name, since its synonymity with *C. dirus* is a distinct possibility.

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References and Notes

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Effect of Anxiety on the Akerfeldt Test

Abstract. Acute anxiety episodes do not significantly alter the lag time of the Akerfeldt test, serum ceruloplasmin level, or serum ascorbic acid level in man.

Ostfeld, Abood, and Marcus have recently reported that the concentration of ceruloplasmin in the serum of "disturbed" patients is significantly greater than the levels found in more "tranquil" patients (*1*). The primary behavioral characteristic of the disturbed patients which differentiated them from the less

disturbed group was their greater degree of anxiety. We have attempted to verify this claim by experimentally raising the anxiety level under hypnosis of a group of normal volunteers and measuring their ceruloplasmin level (along with several related biochemical variables) before, during, and after the experimental anxiety state. A detailed description of the experimental subjects and the mode of their selection, the experimental design employed, the method of producing the experimental anxiety state during the hypnotic trance, and of the anxiety state achieved, has been reported elsewhere (*2*).

Blood samples were drawn from each subject on four occasions: (i) before hypnosis, (ii) during hypnosis, (iii) during the hypnotically induced anxiety state, and (iv) after hypnosis. Serum obtained from these samples was analyzed immediately for the delay in oxidation of N,N-dimethyl-*p*-phenylenediamine (lag time of Akerfeldt test) (*3*), the slope of the oxidation curve, and the concentration of ascorbic acid in the serum. The lag time and slope were measured as follows: 1.5 ml of 0.1 percent N,N-dimethyl-*p*-phenylenediamine dihydrochloride was added to 1.5 ml of serum, and the optical density at 552 mμ was determined in a Beckman DU spectrophotometer at 10-second intervals until oxidation of the substrate was complete. Serum and water (1.5 ml each)

were employed as the blank. The lag time was taken as the time in seconds before oxidation of the substrate commenced and was obtained graphically from the intersection of the two rate curves of the over-all reaction. As the index of ceruloplasmin concentration, the average slope of the substrate oxidation curve was chosen (change in optical density per second). Serum ascorbic acid was determined by the method of Mindlin and Butler (*4*). Aprison and Grosz (*5*) have shown that the lag time is proportional to the ascorbic acid content of the serum.

The results of our experiment are given in Table 1. An analysis of variance for each variable by sex and occasion is given in Table 2. The female subjects exhibited a longer lag time, a greater slope, and a larger ascorbic acid level on each experimental occasion, but this tendency was significant only for the level of ascorbic acid. Although the lag time for females is almost double that for males, the enormous variability of individual response prevents this difference from attaining the conventional 5 percent confidence level. The female subjects also manifest higher ceruloplasmin levels on every testing occasion, but here again statistical significance is not achieved. The greater ascorbic acid level of the female subjects is most likely due to the much greater ascorbic acid intake by these subjects. The elevated ascorbic

Table 1. Lag times and slopes of Akerfeldt tests and serum ascorbic acid levels of 12 normal subjects on four different occasions. (Means ± standard deviations for six male and six female subjects.)

Occasion	Assay					
	Lag time (sec)		Slope (ΔO.D./sec)		Ascorbic acid (mg/100 ml)	
	M	F	M	F	M	F
Pre-hypnosis	167 ± 162	318 ± 118	8.2 ± 3.1	11.2 ± 3.5	1.39 ± 0.97	2.70 ± 0.70
Hypnosis	163 ± 161	317 ± 153	7.9 ± 2.9	11.6 ± 3.2	1.24 ± 0.88	2.53 ± 0.67
Hypnosis + anxiety	163 ± 156	285 ± 79	8.7 ± 2.3	11.5 ± 3.4	1.28 ± 0.76	2.67 ± 0.66
Post-hypnosis	167 ± 162	302 ± 129	10.4 ± 7.4	12.6 ± 4.1	1.29 ± 0.72	2.60 ± 0.48

Table 2. Analysis of variance among the lag times, slopes, and ascorbic acid levels by sexes and occasions.

Variation	df	Lag time		Slope		Ascorbic acid	
		MSq.	F	MSq.	F	MSq.	F
Between sexes	1	236,602	2.97	100.34	2.98	21.081	10.44*
Between subjects in sexes	10	79,722		33.63		2.020	
Between occasions	3	796	1.19	8.83	0.82	0.054	0.86
Between occasions × sexes	3	743	1.11	1.23	0.12	0.005	0.08
Between occasions × subjects in sexes	30	668		10.71		0.062	
Total	47						

* Significant at better than the 5 percent level.