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BLOOD AND TISSUE IDENTIFICATION OF SELECTED BIRDS AND MAMMALS, PART II: Cross Reaction Patterns of Birds and Mammals, Using Deer, Bovine, Raccoon, Chicken and Mallard Duck Antiserum, part 4

David W. Oates

Nebraska Game and Parks Commission

Debra L. Weigel

Nebraska Game and Parks Commission

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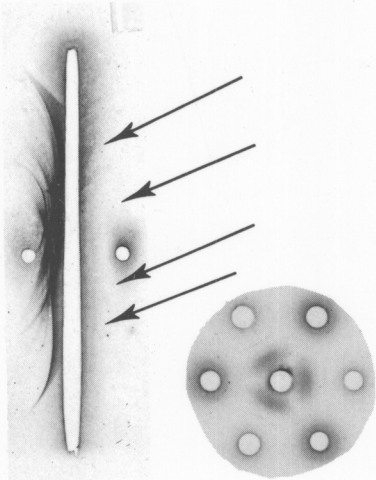
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Oates, David W. and Weigel, Debra L., "BLOOD AND TISSUE IDENTIFICATION OF SELECTED BIRDS AND MAMMALS, PART II: Cross Reaction Patterns of Birds and Mammals, Using Deer, Bovine, Raccoon, Chicken and Mallard Duck Antiserum, part 4" (1976). *Other Publications in Wildlife Management*. 11. <https://digitalcommons.unl.edu/icwdmother/11>

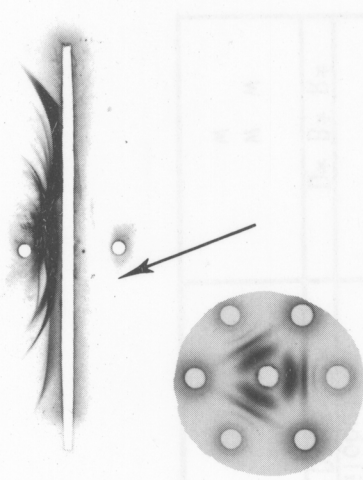
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	Pre-Albumin	Albumin	Alpha ₀ or Alpha ₁ Globulins	Alpha ₂ or Beta Globulins	Gamma Globulin
	D* B* R*	D* B* R*	D* B* R*	D* B* R*	D* B* R*
Horse					
Serum		w w	w w	w w	w
Dry Blood		w w	w w	w w	w
Meat		w			

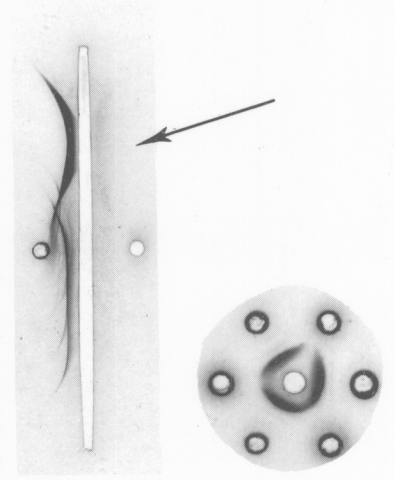
HORSE
Equus caballus
 SERUM



Versus Deer Antiserum

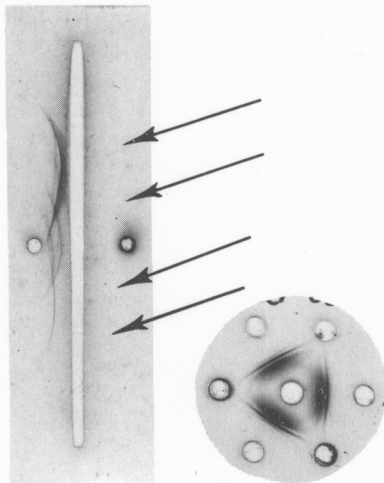


Versus Bovine Antiserum

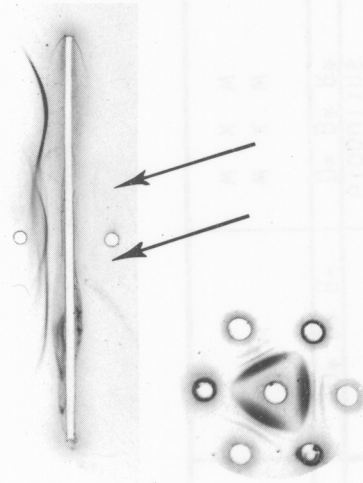


Versus Raccoon Antiserum

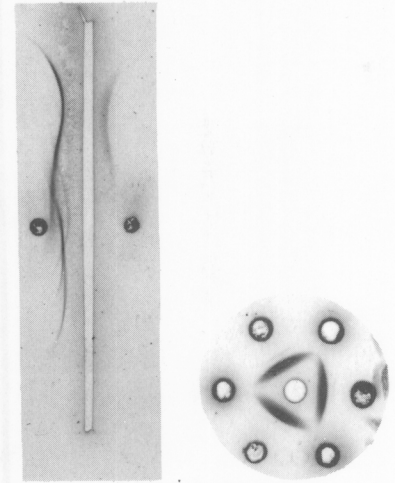
DRY BLOOD



Versus Deer Antiserum

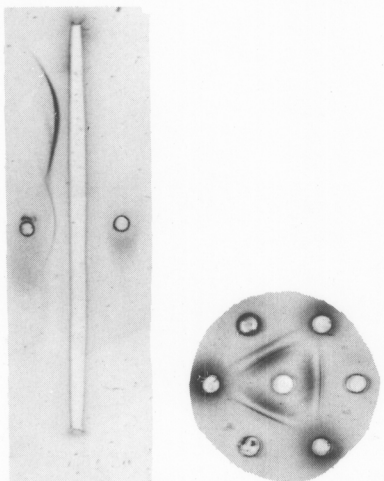


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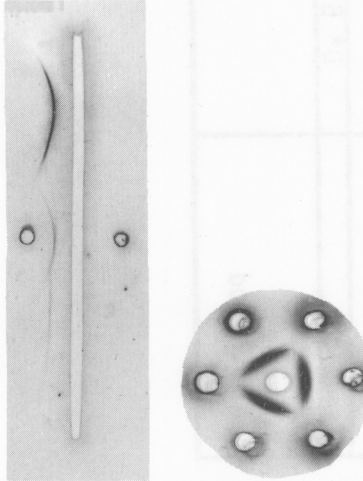


Versus Raccoon Antiserum

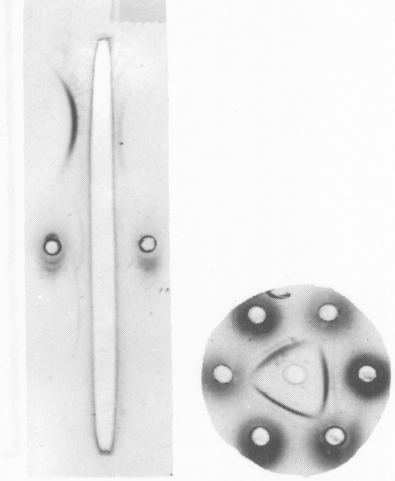
MEAT



Versus Deer Antiserum



Versus Bovine Antiserum

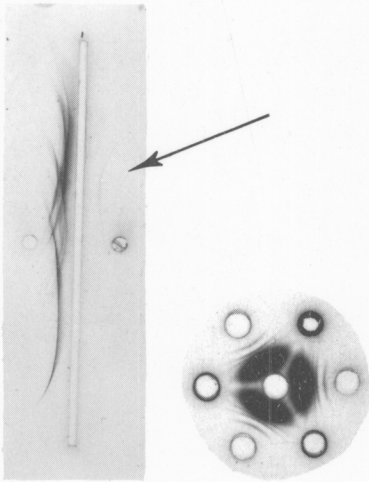


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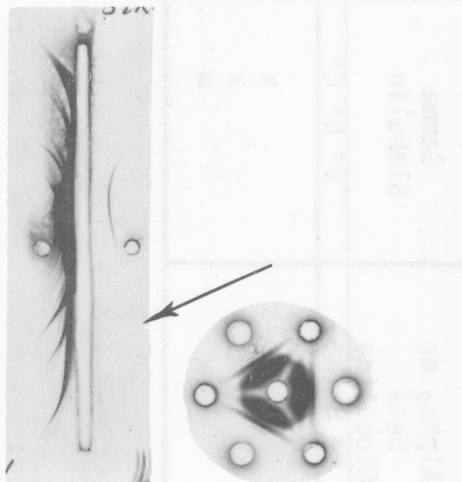
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	D* B* R*	D* B* R*	D* B* R*	D* B* R*	D* B* R*
Human Serum Dry Blood		W	W X W W X W	W W	W W W

HUMAN
Homo sapiens

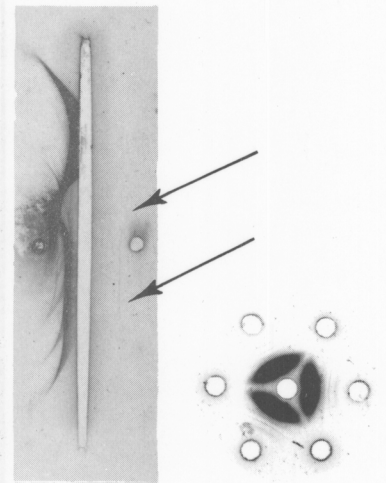
SERUM



Versus Deer Antiserum

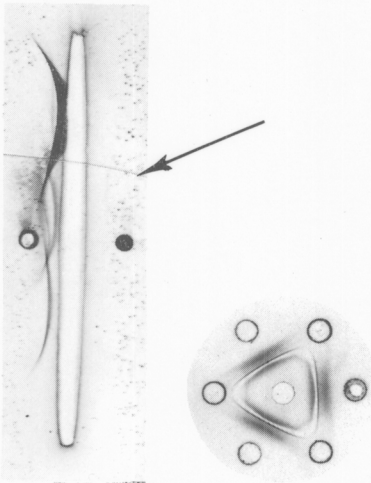


Versus Bovine Antiserum

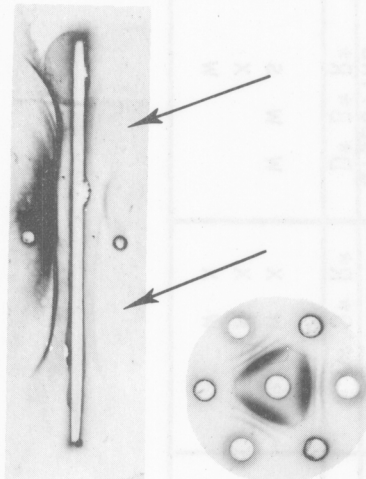


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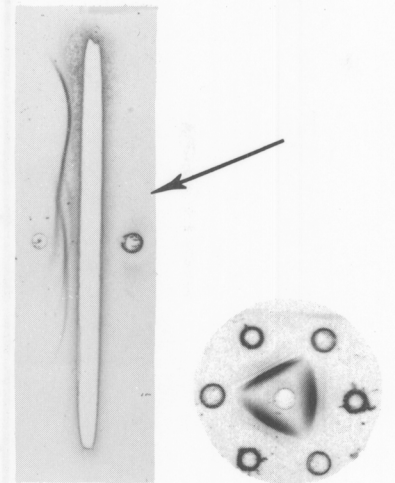
DRY BLOOD



Versus Deer Antiserum

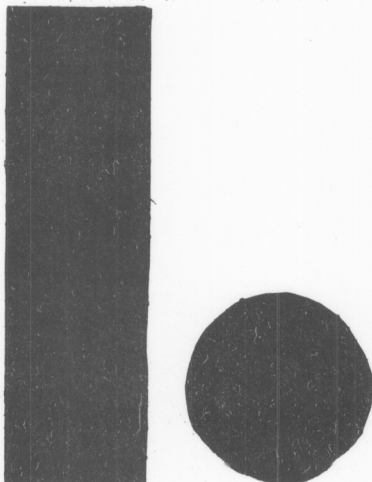


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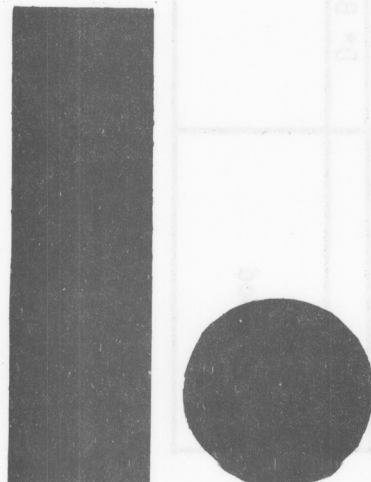


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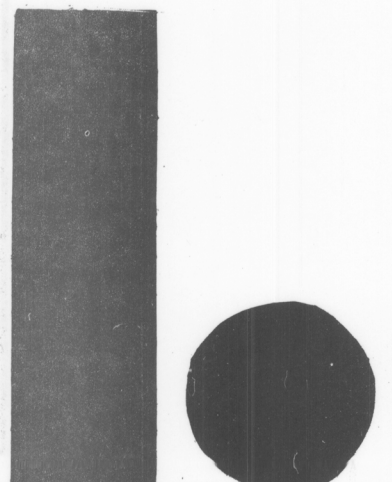
MEAT



Versus Deer Antiserum



Versus Bovine Antiserum

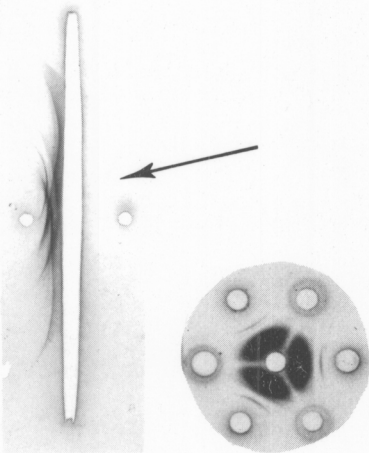


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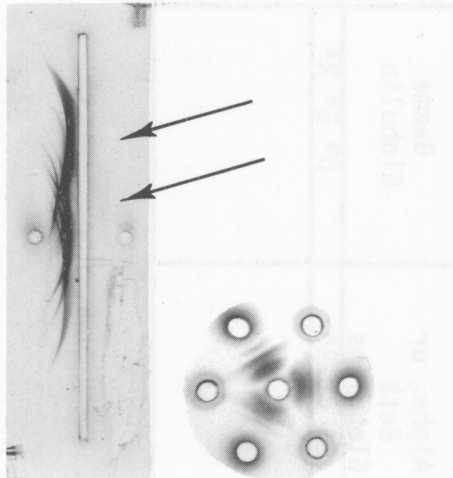
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	D* B* R*	D* B* R*	D* B* R*	D* B* R*	D* B* R*
Mink Serum		W X	W W S	S	X
Dry Blood		X X	X	WS	X
Meat		W X	W	X	W

MINK
Mustela vison

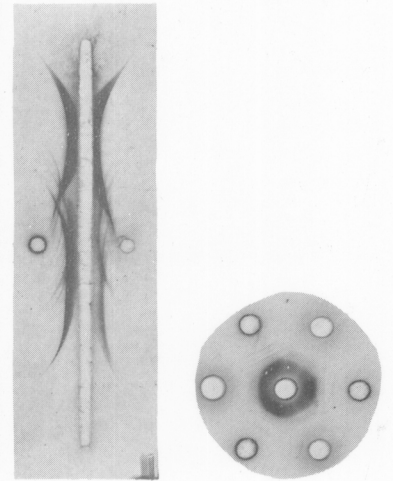
SERUM



Versus Deer Antiserum

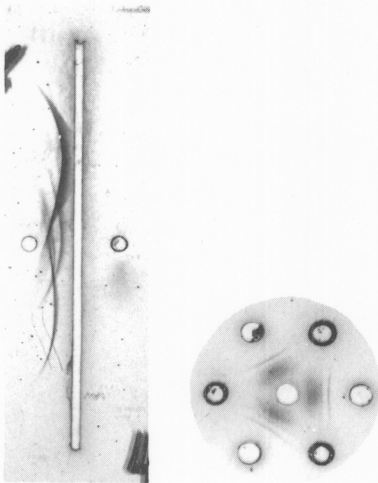


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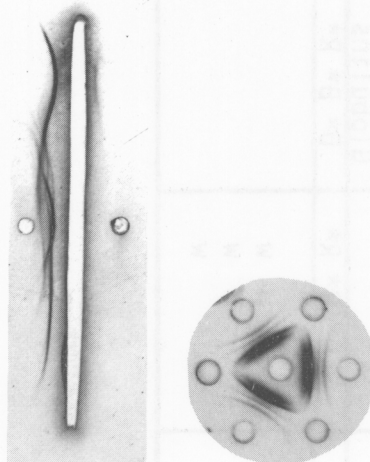


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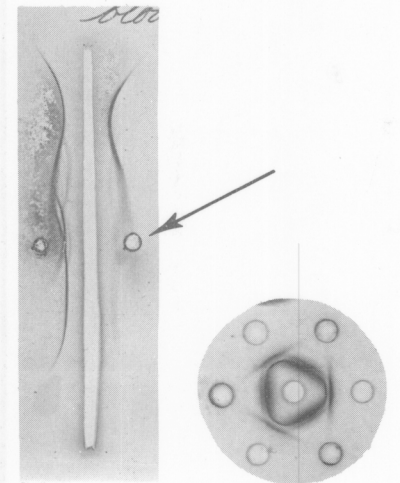
DRY BLOOD



Versus Deer Antiserum

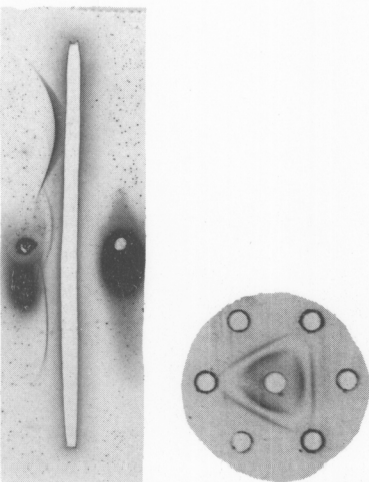


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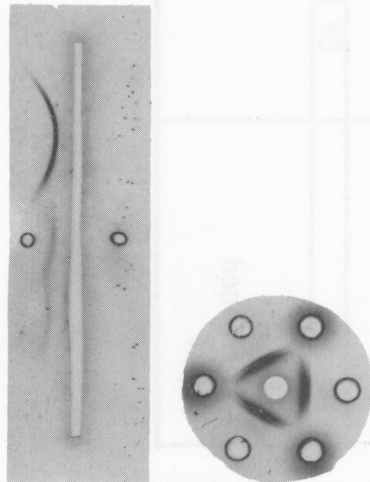


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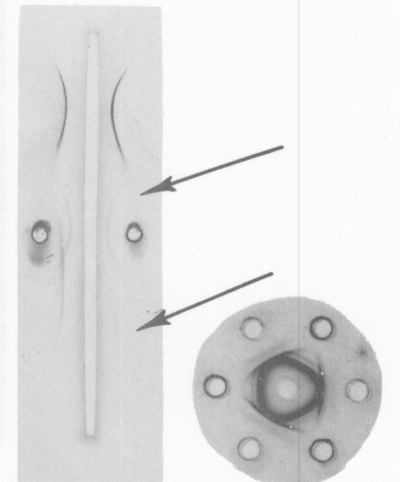
MEAT



Versus Deer Antiserum



Versus Bovine Antiserum

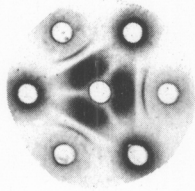
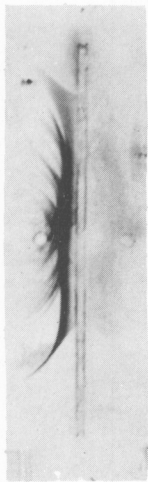


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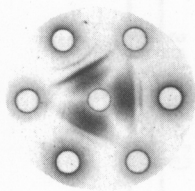
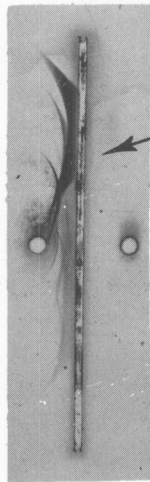
	Pre-Albumin	Albumin	Alpha ₀ or Alpha ₁ Globulins	Alpha ₂ or Beta Globulins	Gamma Globulin
	D* B* R*	D* B* R*	D* B* R*	D* B* R*	D* B* R*
Opossum Serum Dry Blood Meat		W W W W			

OPOSSUM
Didelphis marsupialis

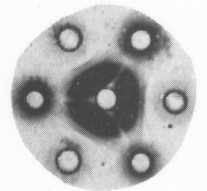
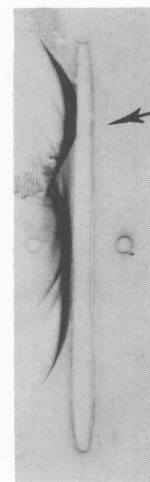
SERUM



Versus Deer Antiserum

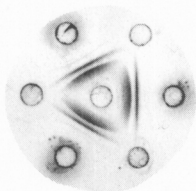
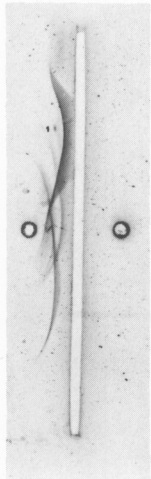


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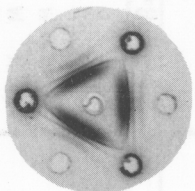
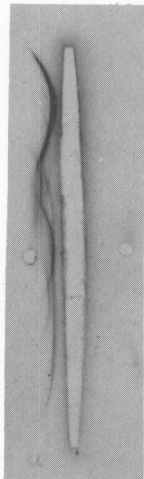


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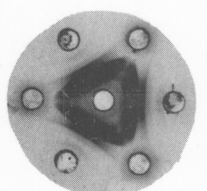
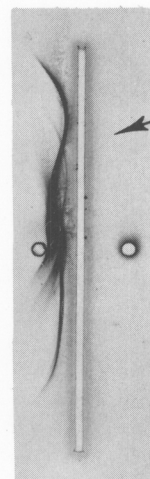
DRY BLOOD



Versus Deer Antiserum

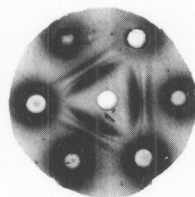


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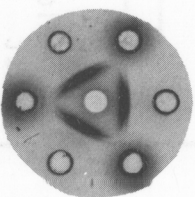
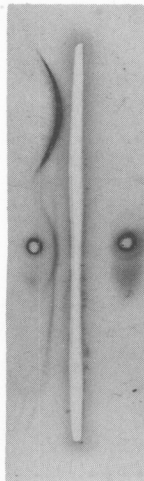


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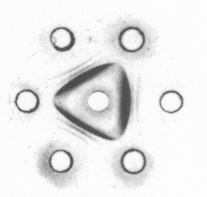
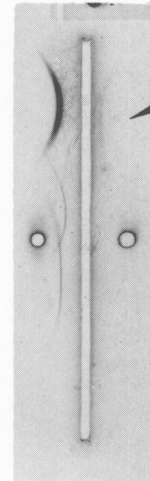
MEAT



Versus Deer Antiserum



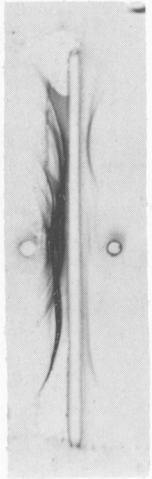
Versus Bovine Antiserum



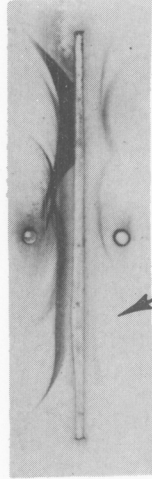
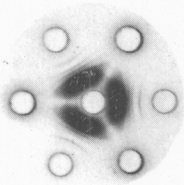
Versus Raccoon Antiserum

	Pre-Albumin	Albumin	Alpha ₀ or Alpha ₁ Globulins	Alpha ₂ or Beta Globulins	Gamma Globulin
	D* B* R*	D* B* R*	D* B* R*	D* B* R*	D* B* R*
Pig Serum Dry Blood Meat	x x	x x w x w x x w x	x x s w w x	s x s w	x w w x w w

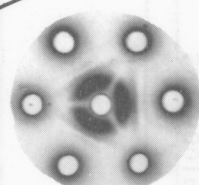
P I G
Sus scrofa
 SERUM



Versus Deer Antiserum

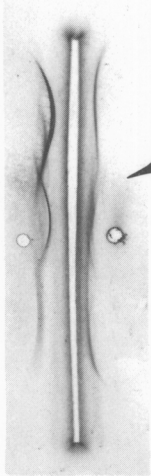


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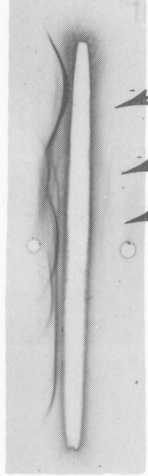
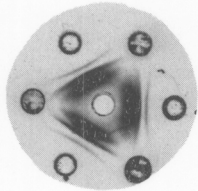


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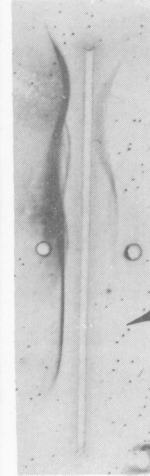
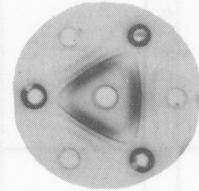
DRY BLOOD



Versus Deer Antiserum



Versus Bovine Antiserum

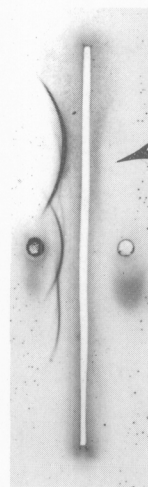
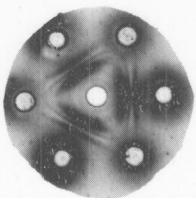


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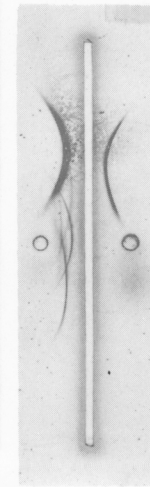
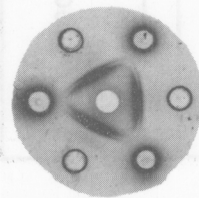
MEAT



Versus Deer Antiserum



Versus Bovine Antiserum

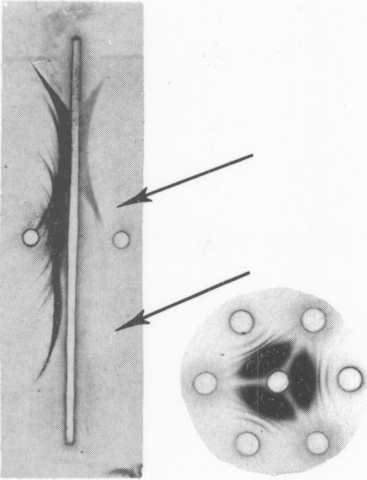


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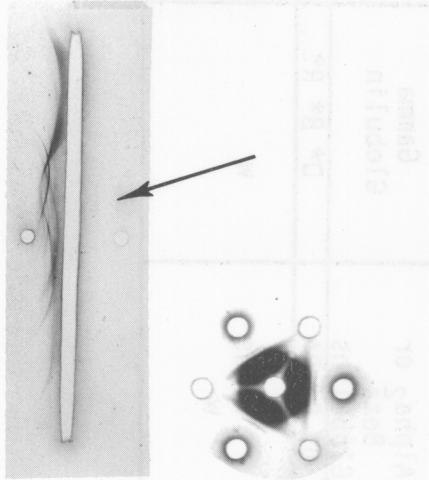
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	D* B* R*	D* B* R*	D* B* R*	D* B* R*	D* B* R*
Porcupine Serum		x w	w w		w
Dry Blood		w x	w		
Meat		x			

PORCUPINE
Erethizon dorsatum

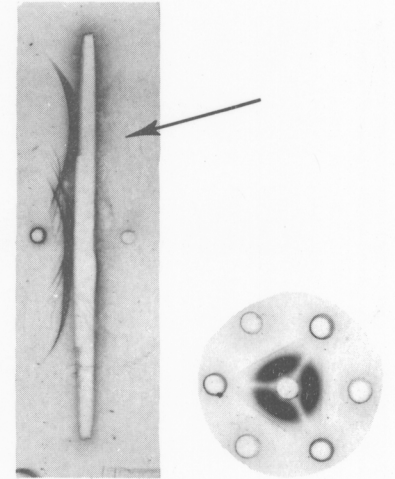
SERUM



Versus Deer Antiserum

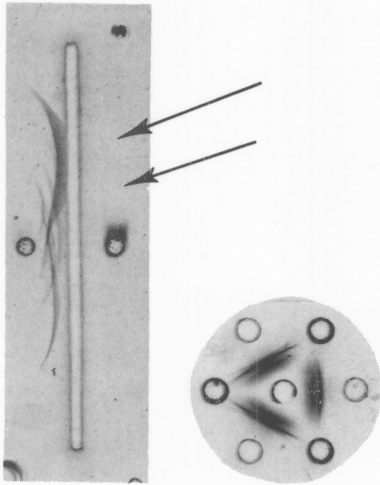


Versus Bovine Antiserum

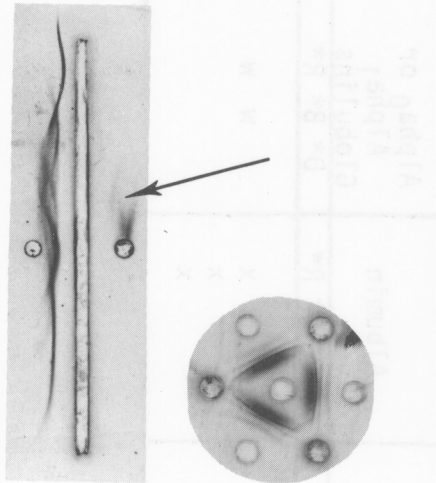


Versus Raccoon Antiserum

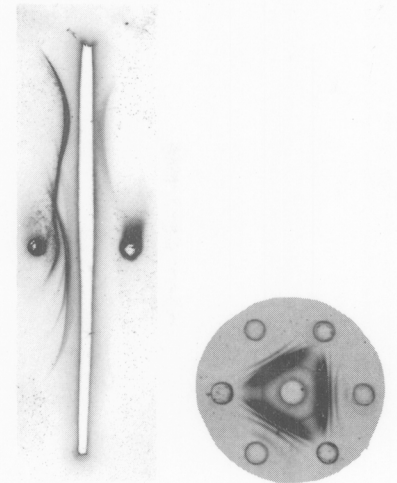
DRY BLOOD



Versus Deer Antiserum

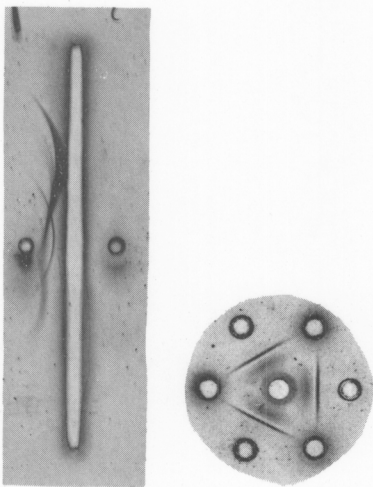


Versus Bovine Antiserum

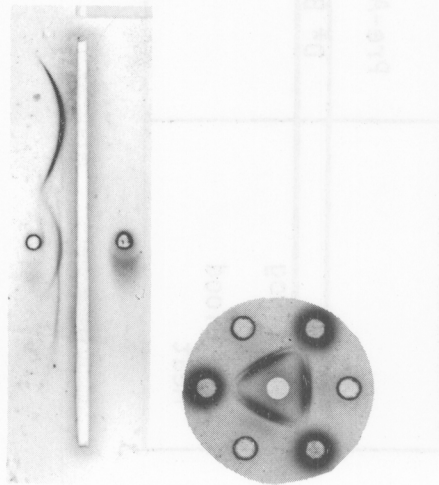


Versus Raccoon Antiserum

MEAT



Versus Deer Antiserum



Versus Bovine Antiserum

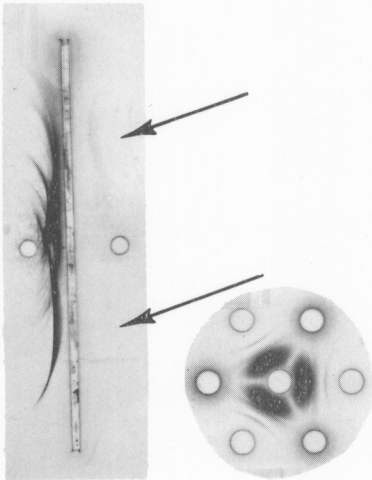


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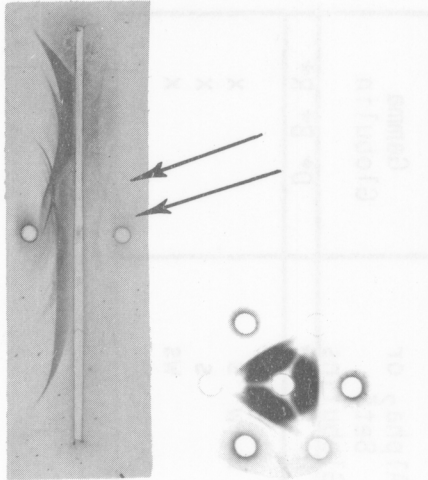
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	D* B* R*	D* B* R*	D* B* R*	D* B* R*	D* B* R*
Prairie Dog Serum		W W X	W W	W WS	W
Dry Blood		X		W	
Meat		X			

PRAIRIE DOG
Cynomys ludovicianus

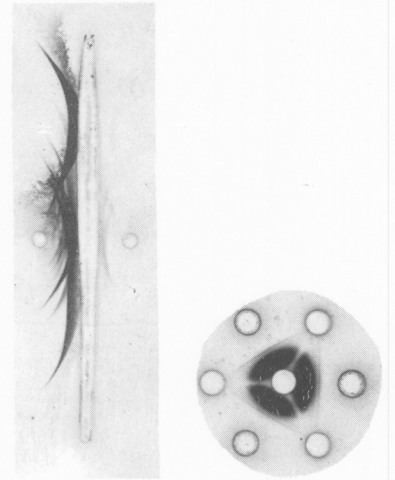
SERUM



Versus Deer Antiserum

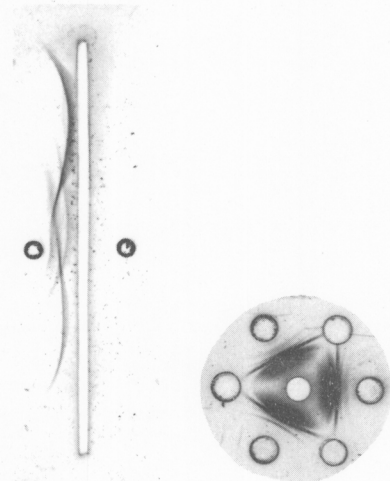


Versus Bovine Antiserum

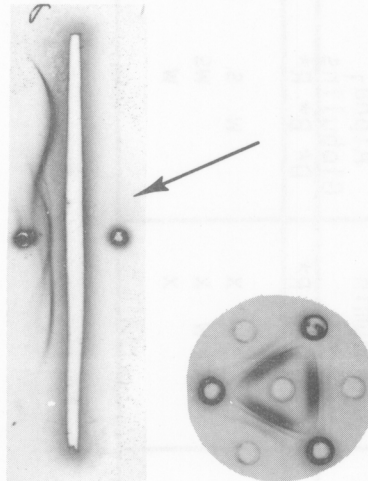


Versus Raccoon Antiserum

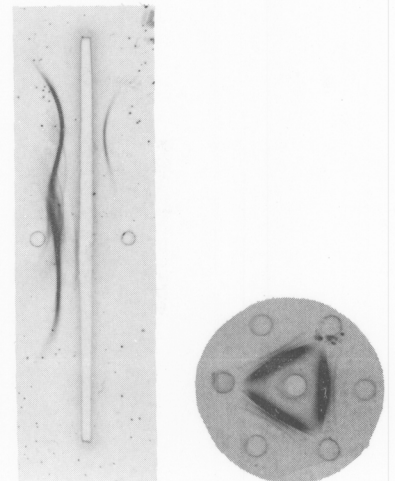
DRY BLOOD



Versus Deer Antiserum

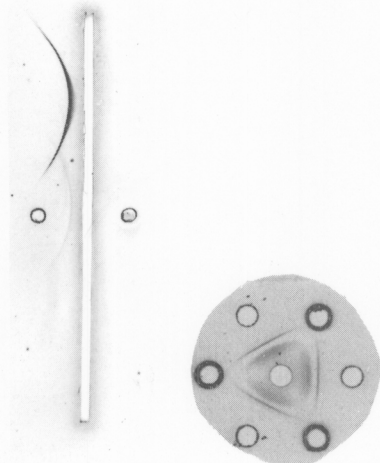


Versus Bovine Antiserum

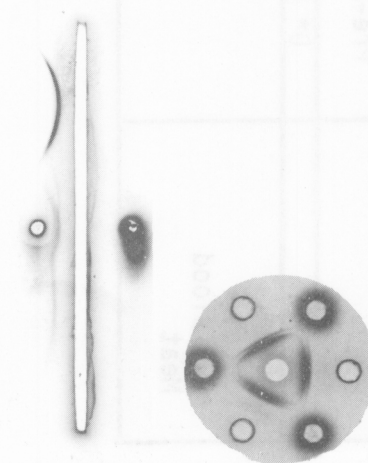


Versus Raccoon Antiserum

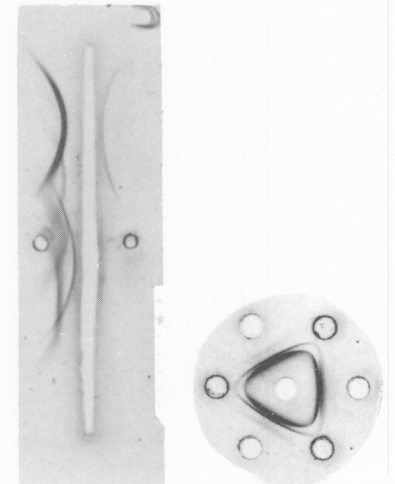
MEAT



Versus Deer Antiserum



Versus Bovine Antiserum

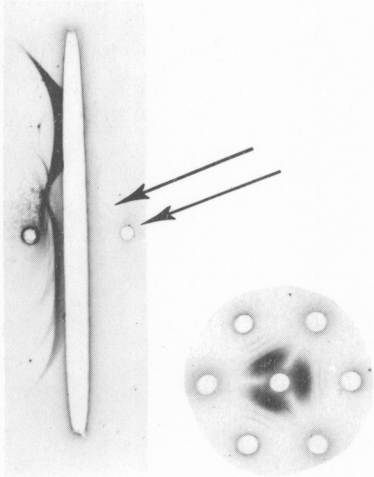


Versus Raccoon Antiserum

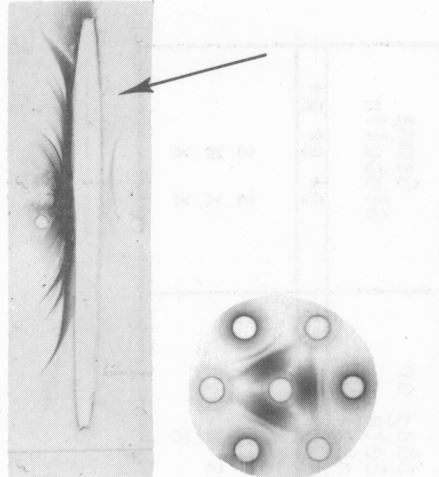
	Pre-Albumin	Albumin	Alpha ₀ or Alpha ₁ Globulins	Alpha ₂ or Beta Globulins	Gamma Globulin
	D* B* R*	D* B* R*	D* B* R*	D* B* R*	D* B* R*
Raccoon Serum		W X	W S	W W S	X
Dry Blood		W X	WS	S	X
Meat		X	W	WS	X

RACCOON
Procyon lotor

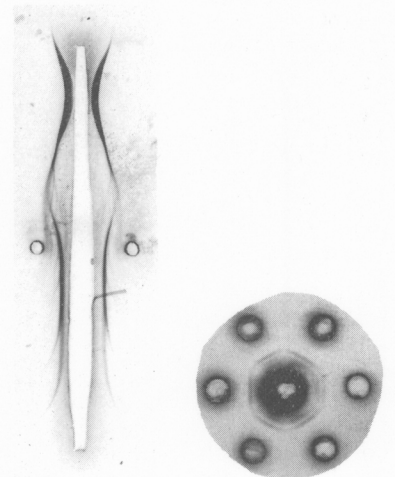
SERUM



Versus Deer Antiserum

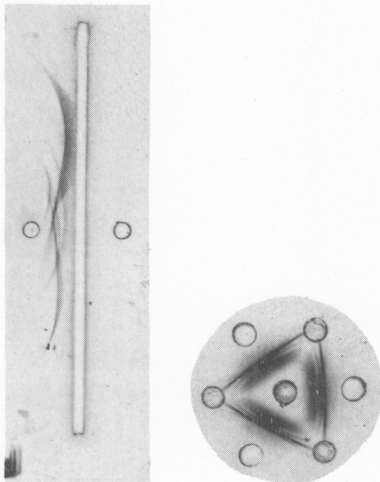


Versus Bovine Antiserum

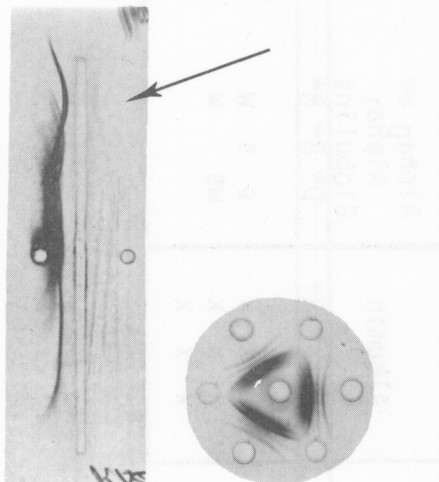


Versus Raccoon Antiserum

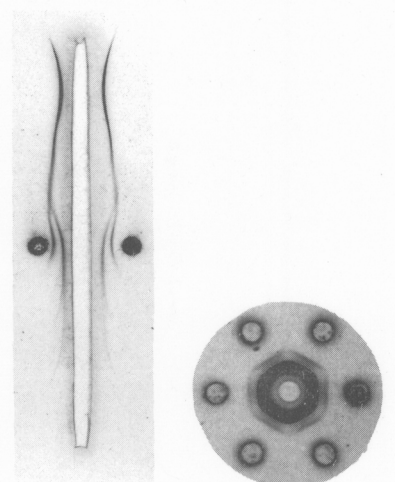
DRY BLOOD



Versus Deer Antiserum

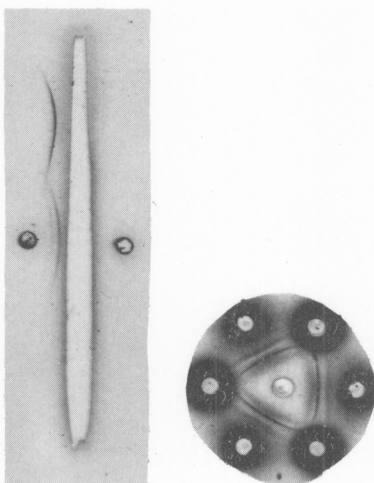


Versus Bovine Antiserum

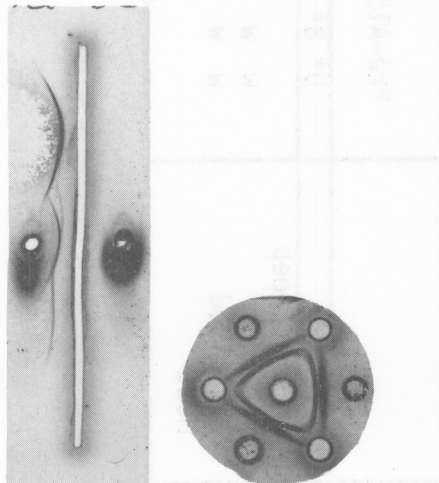


Versus Raccoon Antiserum

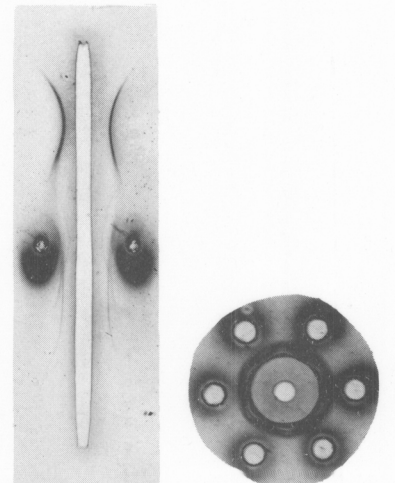
MEAT



Versus Deer Antiserum



Versus Bovine Antiserum

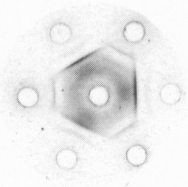
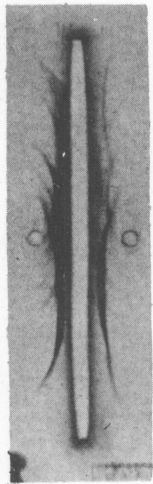


Versus Raccoon Antiserum

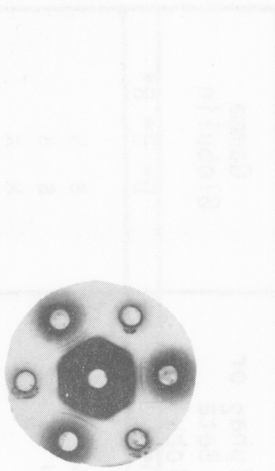
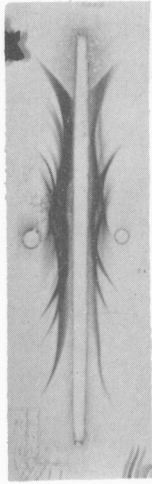
	Pre-Albumin	Albumin	Alpha ₀ or Alpha ₁ Globulins	Alpha ₂ or Beta Globulins	Gamma Globulin
	D* B* R*	D* B* R*	D* B* R*	D* B* R*	D* B* R*
Big Horn Sheep					
Serum	w w	x x x	s s w	s s	s s
Dry Blood	w w	x x x	ws w	ws w	x w
Meat		x x x		x x	x x

BIG HORN SHEEP
Ovis canadensis

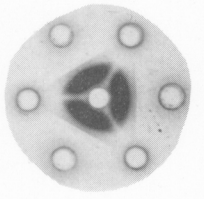
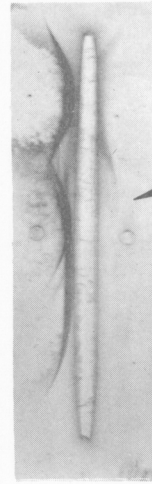
SERUM



Versus Deer Antiserum

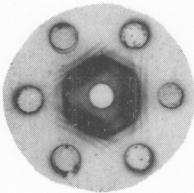
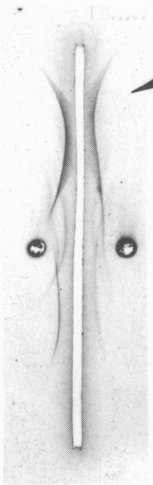


Versus Bovine Antiserum

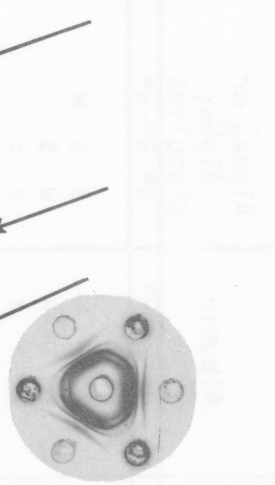
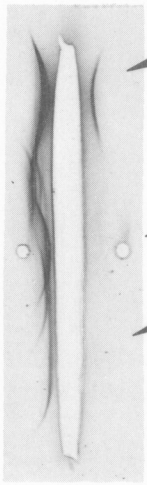


Versus Raccoon Antiserum

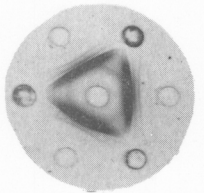
DRY BLOOD



Versus Deer Antiserum

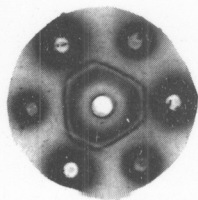
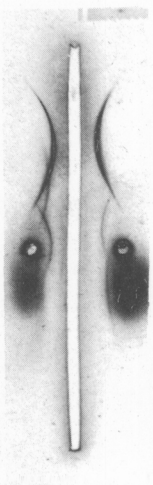


Versus Bovine Antiserum

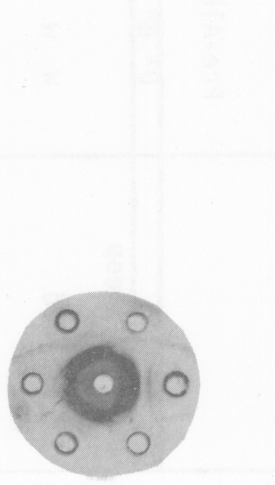
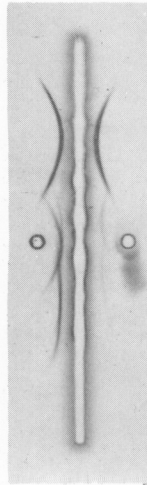


Versus Raccoon Antiserum

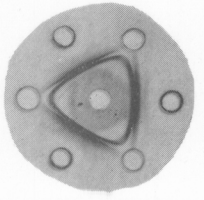
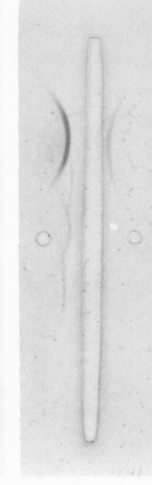
MEAT



Versus Deer Antiserum



Versus Bovine Antiserum



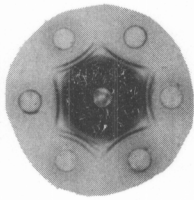
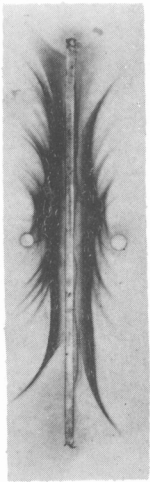
Versus Raccoon Antiserum

	Pre-Albumin	Albumin	Alpha ₀ or Alpha ₁ Globulins	Alpha ₂ or Beta Globulins	Gamma Globulin
	D* B* R*	D* B* R*	D* B* R*	D* B* R*	D* B* R*
Domestic Sheep					
Serum		X X W	S S W	S S W	S S
Dry Blood	W W	X X X	W S	W S	S S
Meat		X X X	X X		X X

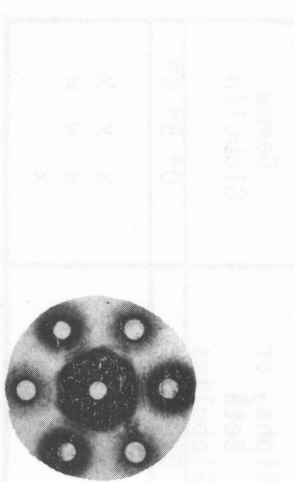
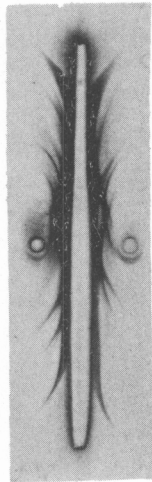
S H E E P (DOMESTIC)

Ovis aries

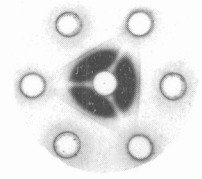
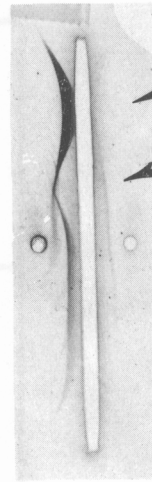
SERUM



Versus Deer Antiserum

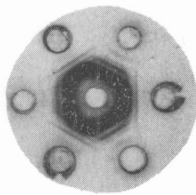
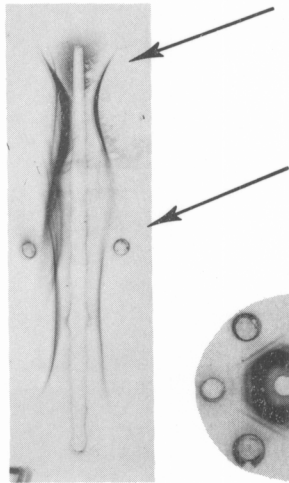


Versus Bovine Antiserum

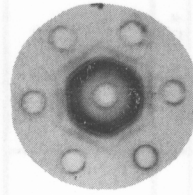


Versus Raccoon Antiserum

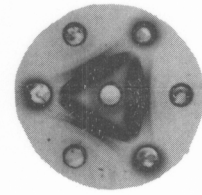
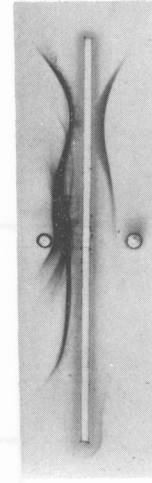
DRY BLOOD



Versus Deer Antiserum

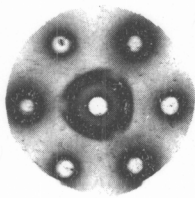
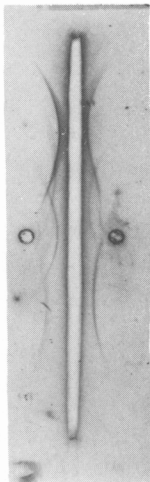


Versus Bovine Antiserum

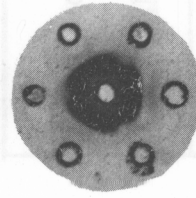
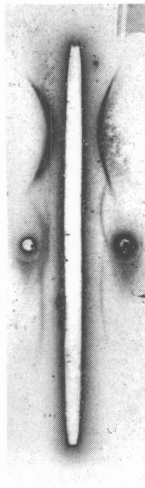


Versus Raccoon Antiserum

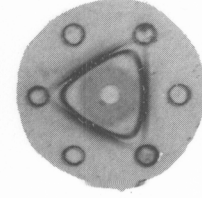
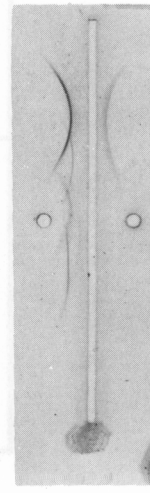
MEAT



Versus Deer Antiserum



Versus Bovine Antiserum

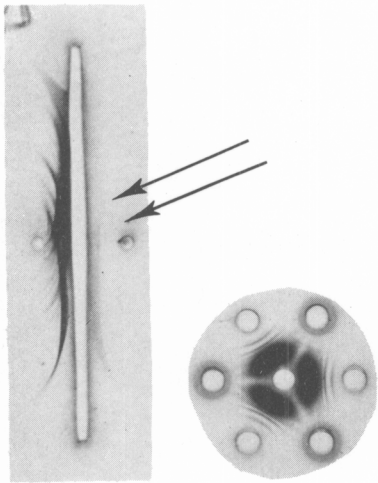


Versus Raccoon Antiserum

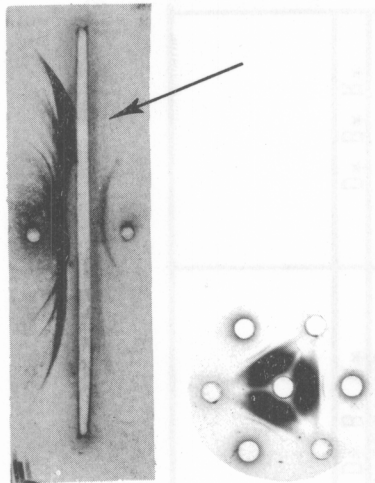
	Pre-Albumin	Albumin	Alpha ₀ or Alpha ₁ Globulins	Alpha ₂ or Beta Globulins	Gamma Globulin
	D* B* R*	D* B* R*	D* B* R*	D* B* R*	D* B* R*
Striped Skunk Serum		W X	W W S	W X S	X X X
Dry Blood		X X	X X	S	W W W
Meat		W X	W	X	X

STRIPED SKUNK
Mephitis mephitis

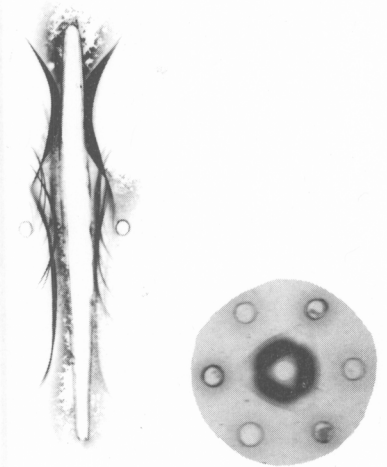
SERUM



Versus Deer Antiserum

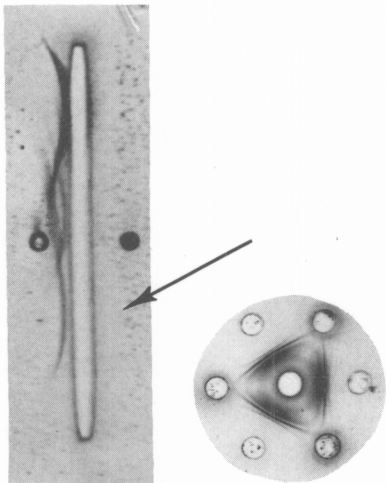


Versus Bovine Antiserum

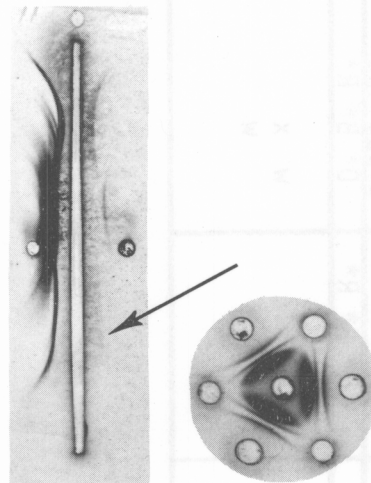


Versus Raccoon Antiserum

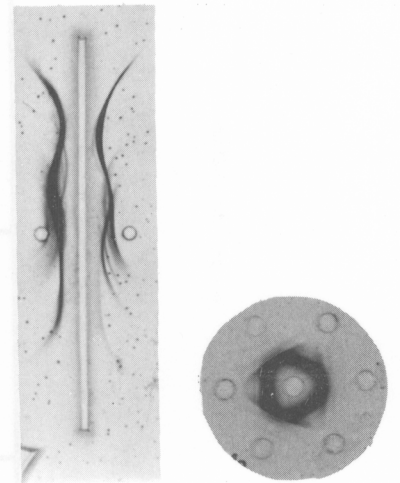
DRY BLOOD



Versus Deer Antiserum

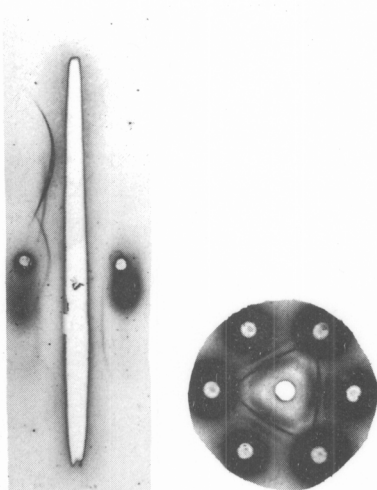


Versus Bovine Antiserum

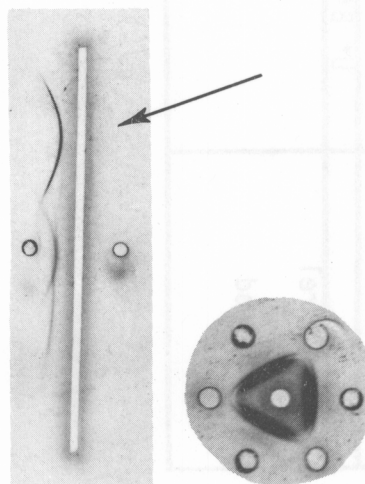


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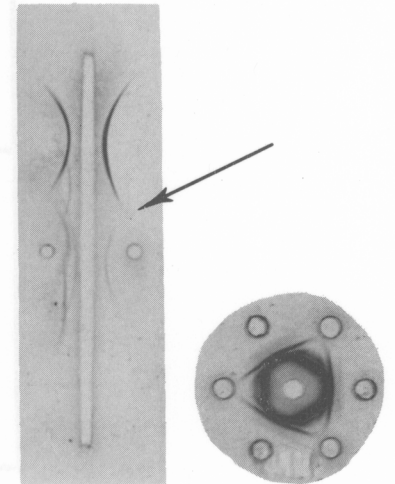
MEAT



Versus Deer Antiserum



Versus Bovine Antiserum



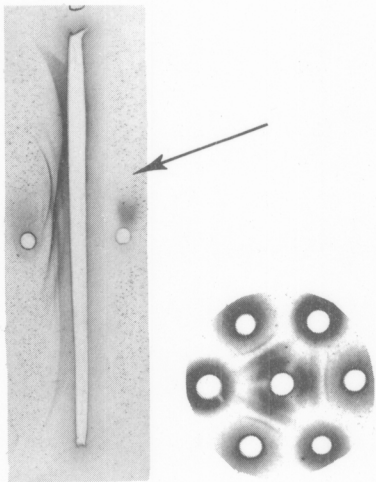
Versus Raccoon Antiserum

	Pre-Albumin	Albumin	Alpha ₀ or Alpha ₁ Globulins	Alpha ₂ or Beta Globulins	Gamma Globulin
	D* B* R*	D* B* R*	D* B* R*	D* B* R*	D* B* R*
Fox Squirrel Serum Dry Blood Meat			W X W	W	

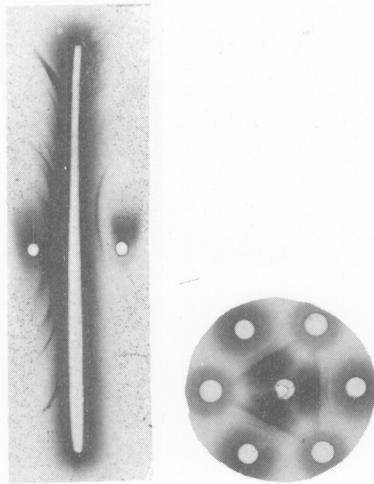
FOX SQUIRREL

Sciurus niger

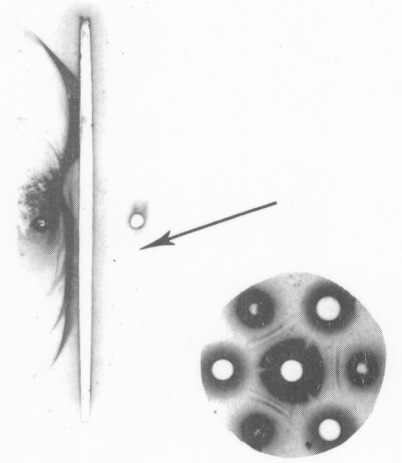
SERUM



Versus Deer Antiserum

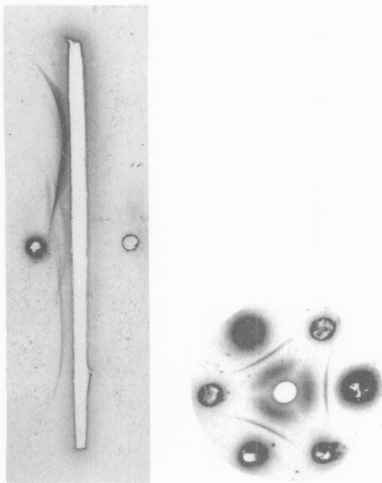


Versus Bovine Antiserum

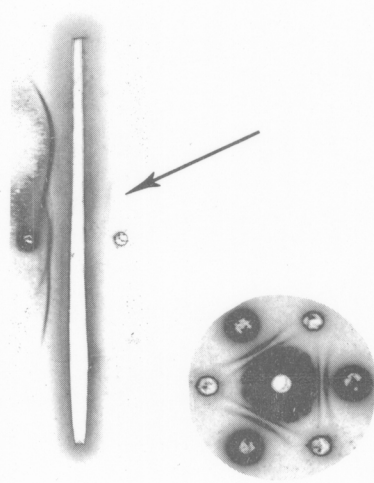


Versus Raccoon Antiserum

DRY BLOOD



Versus Deer Antiserum

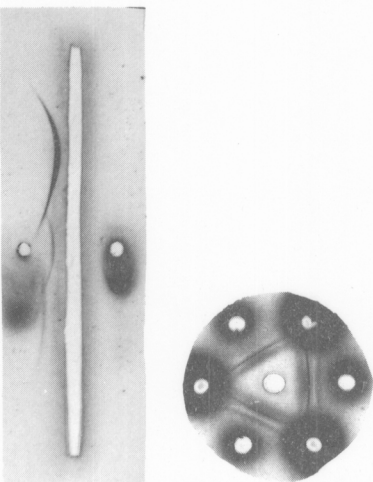


Versus Bovine Antiserum

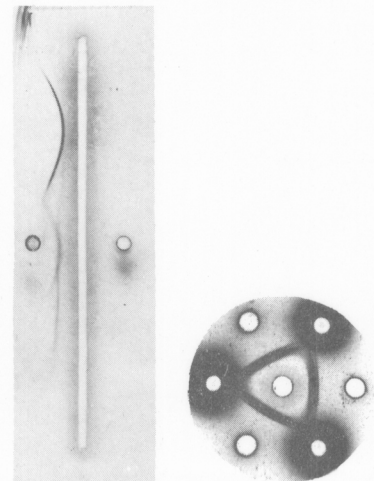


Versus Raccoon Antiserum

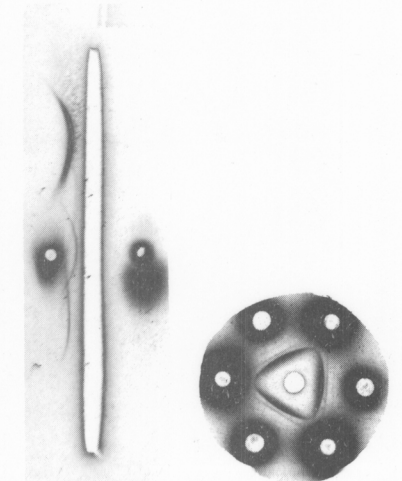
MEAT



Versus Deer Antiserum



Versus Bovine Antiserum



Versus Raccoon Antiserum

DISCUSSION

Oates et al. (1974) covered the historical development of immuno diffusion and immunoelectrophoresis techniques and the application of several techniques for law enforcement purposes.

The precipitin reaction discovered by Kraus in 1897 was a forerunner to the techniques used in this study. At the time, precipitin reaction was considered very specific. This specificity was mistakenly verified by Tchistovitch (1899) in his comparison of horse and ass serum verses horse antiserum. In theory, he shouldn't even have been able to distinguish between the two with his techniques, as pointed out by Boyden (1942).

Bordet (1899) found that antisera was not necessarily specific when fowl-antisera reacted with pigeon serum. Myers (1900) found that sheep antiserum reacted with cow serum, but not as strongly as with sheep serum. Nuttall (1901) determined that human antiserum reacted only with the bloods of other primates. These initial studies led to the use of this technique for both law enforcement (Gay, 1908; Clarke, 1914; and Borhn and Korschgen, 1950) and taxonomic purposes. Boyden (1942) gave a good early taxonomic review of the technique, covering its use in systematic serology.

Findings on the 26 mammals tested in the current study are presented in Table 2 and consolidated in Table 4, which designates a protein component with an "x" if it was found in any of the representative samples (serum, dry blood, or meat). Deer, bovine and raccoon antisera were tested to determine both the type and degree of cross reaction with various species. Mammalian antisera did not cross-react with any avian species tested, nor did they cross-react with snapping turtle, catfish or carp serum.

A simple scanning of Table 4 would indicate that at least a minor cross-reaction was observed for each species examined in this study. The notable exceptions are jack rabbit and cottontail. The absence of reactions in these instances may be due to the host, since domestic rabbit was used to prepare the antiserum. The only other cases where there were apparently no cross reactions occurred when deer antiserum reacted with opossum and domestic cat. If an arc should have been observed, an albumin would be expected for opossum and an α_2 or beta globulin for domestic cat. Several other observations from Table 4 are also worthy to note:

1. Observations using deer antiserum
 - a. Only α_0 or α_1 globulin arcs were observed for badger, beaver, human, mink, and fox squirrel;
 - b. Only α_2 or beta globulin arcs were observed for bobcat and raccoon;
 - c. Pre-albumins were observed only with these ungulates--deer, elk, pig, big horn sheep, and domestic sheep. Albumin, α_0 or α_1 globulines, α_2 or beta globulins, and gamma globulin arcs were also observed for these species;
 - d. Only in the ungulates were albumin, α_0 or α_1 , α_2 or beta globulin, and gamma globulin all observed.

Table 4. Synopsis of mammalian observations.

	Anti-Deer					Anti-Bovine					Anti-Raccoon				
	Pre-Albumin	Albumin	Alpha ₀ or Alpha ₁ Globulins	Alpha ₂ or Beta Globulins	Gamma Globulin	Pre-Albumin	Albumin	Alpha ₀ or Alpha ₁ Globulins	Alpha ₂ or Beta Globulins	Gamma Globulin	Pre-Albumin	Albumin	Alpha ₀ or Alpha ₁ Globulins	Alpha ₂ or Beta Globulins	Gamma Globulin
Antelope		x	x	x	x		x	x	x	x		x	x		
Badger			x				x	x	x			x	x	x	x
Beaver			x					x				x			
Bobcat				x			x	x	x			x	x	x	x
Buffalo		x	x	x	x		x	x	x	x		x	x		
Cat (Domestic)								x	x			x	x		x
Cow		x	x	x	x		x	x	x	x		x	x		
Coyote		x		x	x		x					x	x	x	x
Deer	x	x	x	x	x	x	x	x	x	x		x	x		
Dog		x		x	x			x				x	x	x	x
Elk	x	x	x	x	x	x	x	x	x	x		x	x	x	x
Red Fox		x		x	x		x	x	x	x		x	x	x	x
Horse		x	x	x	x			x	x			x			
Human			x				x	x	x				x		x
Mink			x				x	x				x	x	x	x
Opossum							x					x			
Pig	x	x	x	x	x	x	x	x	x			x	x		x
Porcupine		x	x		x			x				x			
Prairie Dog		x			x		x	x	x			x	x	x	
Rabbit															
Cottontail															
Jack Rabbit															
Raccoon				x			x	x	x			x	x	x	x
Big Horn Sheep	x	x	x	x	x	x	x	x	x	x		x	x		
Domestic Sheep	x	x	x	x	x	x	x	x	x	x		x	x	x	
Striped Skunk			x	x	x		x	x				x	x	x	x
Fox Squirrel			x					x						x	

2. Observations using bovine antiserum

- a. Only α_0 or α_1 globulin arcs were observed for beaver, coyote, dog, porcupine, and fox squirrel;
- b. Only an albumin arc was observed for opossum;
- c. With the exception of opossum, an α_0 or α_1 globulin was observed in all species examined;
- d. With the exception of red fox, a gamma globulin arc was observed only in ungulates;
- e. Pre-albumins were only observed with the same five ungulates that gave a pre-albumin with deer antiserum (deer, elk, pig, big horn sheep, and domestic sheep). Albumin, α_0 or α_1 globulins, α_2 or beta globulins and gamma globulin arcs were also observed, as they were with deer antiserum;
- f. Only in the ungulates were albumin, α_0 or α_1 globulin, α_2 or beta globulin, and gamma globulin all observed.

3. Observations using raccoon antiserum

- a. Only an albumin arc was observed for beaver, horse, and opossum;
- b. Only a beta globulin was observed for fox squirrel;
- c. Only an albumin arc was observed for beaver, horse, and opossum;
- d. An α_0 or α_1 globulin was observed for all species except beaver, horse, opossum, porcupine, and fox squirrel;
- e. No pre-albumins were observed with any species;
- f. With the exception of a gamma globulin arc for pig and an α_2 or beta globulin arc for domestic sheep, ungulates did not give an α_2 , beta, or gamma globulin arc;
- g. Albumin, α_0 or α_1 globulin, α_2 or beta globulin, and gamma globulin were observed in badger, bobcat, coyote, dog, red fox, mink, raccoon and striped skunk.

As could be expected, species within the order Carnivora showed the greatest similarity to raccoon. Mammals within the order Artiodactyla showed the greatest similarity to deer and cow. Using raccoon antiserum, raccoon can be differentiated

from the other species examined. Using deer antiserum, deer could be differentiated from all the species examined except elk. Using bovine antiserum, cow could be differentiated from all the species examined except buffalo.

Boyden (1926 and 1942) and Wolfe (1939a and 1939b) used the precipitin test to determine animal relationships. Some of their antisera were found to cross-react with many of the species tested. Red and gray squirrel antiserum reacted strongly with several species of squirrel but slight reactions were observed against antigen serum proteins of Artiodactyla and Primata (Wolfe 1939a). When using human antisera cross-reactions were observed with antigen serum proteins of Artiodactyla and Carnivora (Wolfe 1939a). Boyden (1942), using pig, sheep, and beef antiserum, found each antiserum to react the strongest to its homologous antigen, but each also reacted to a lesser degree with pig, beef, sheep, goat, horse, dog, human, and rat sera.

We, too, commonly observed some cross-reaction with most of the mammalian species examined, using antiserum to deer, cow, and raccoon. For the most part, the selected species could be differentiated from deer, cow, and raccoon. Exceptions were distinguishing deer from elk and cow from buffalo. These mammals could possibly have been differentiated by using absorption or dilution techniques. However, methods, such as passive hemagglutination, use of starch gel or acrylamide gel electrophoresis, or iso-electric focusing, may prove to be better techniques.