



# VETERINARY MEDICAL REVIEW

## DEADLY GARDEN

University of Missouri-Columbia  
College of Veterinary Medicine and  
Cooperative Extension Service

September/October 1981, N.S., Vol. 2, No. 5

In this issue. . . Cover story, p. 5; Endometritis in the mare, p. 6; Diagnosing organophosphate poisoning, p. 2; an elephant necropsy, p. 8; and more.

# Organophosphorus poisoning

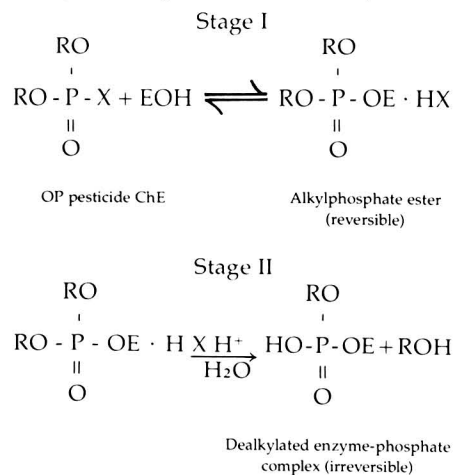
## The diagnostic value of blood cholinesterase inhibition

Fouad K. Mohammad, B.V.M.S.  
 Vincent V.E. St. Omer, D.V.M., Ph.D.  
 Veterinary Anatomy-Physiology

Organophosphorus (OP) pesticides are widely used in veterinary medicine as external insecticides and as anthelmintics in different animal species (Table I). They also are used as plant insecticides and for insect control in inanimate areas (Table I).<sup>1,2,3</sup> Extensive usage (therapeutically or accidentally) of different types of OP pesticides can lead to iatrogenic illness in the exposed animals.

### Inhibition of blood cholinesterases

Erythrocyte (EChE) and plasma (PChE) cholinesterases are inhibited by OP pesticides. The extent of enzymatic inhibition depends on the type and amount of the OP compound, the route of administration, duration and frequency of exposure of the animal to the OP pesticides.<sup>1,6,7,8</sup> The inhibition of the cholinesterase (ChE) enzyme by OP pesticides occurs in two stages (I and II) and results in the phosphorylation of the enzyme at the esteratic site, producing a more stable enzyme:



The enzymatic inhibition may be reversible or irreversible depending on the stage and level of exposure, and type of compound (chemical structure).<sup>1,7,8,9</sup> Irreversible inhibition of the cholinesterase (Stage II) is due to the covalent bonding between the enzyme and the phosphate group. This phenomenon is called "aging."<sup>7,9</sup> The "aged" phosphorylated enzyme is not reversible (dephosphorylated) by oximes such as pralidoxime (2-PAM), and the therapeutic effectiveness of 2-PAM in reversing the cholinesterase inhibition fol-

lowing OP poisoning is dependent upon its early administration (Stage I) following toxicosis.

The inhibition of blood cholinesterases activities in animals exposed to OP pesticides may or may not accompany the signs of OP poisoning.<sup>6,9,10</sup> Animals exposed to OP, especially during gradual but long-term exposure, have been known to tolerate low blood cholinesterase levels without adverse effects.<sup>6,8</sup> When various single oral doses (11-149 mg/kg) of dichlorvos were administered to dogs, EChE activities were depressed 60 percent to 90 percent of normal values, while PChE activities were depressed 37 percent to 85 percent of normal values<sup>11,12,13</sup> without signs of OP toxicity in some cases.<sup>11</sup> Following skin contact with dichlorvos-impregnated collars, some dogs<sup>14</sup> and cats<sup>15</sup> may exhibit depressed (up to 87 percent) blood cholinesterases activities. Similarly, significant depression of the cholinesterases activities in the blood was seen in cows treated orally with diazinon (1-11 mg/kg/day for two weeks).<sup>1</sup> Crotoxyphos sprays (0.5-2.0% emulsion) also depressed blood cholinesterases (69 percent to 100 percent) in calves.<sup>16</sup> No significant changes, however, were seen in the blood cholinesterases activities of calves sprayed with crotoxyphos (0.15-0.6 emulsion).<sup>17</sup> In sheep, oral administration of coumaphos (4 mg/kg/day for 6 days, or 8 and 15 mg/kg) significantly decreased EChE (55 percent to 85 percent) and PChE (90 percent to 95 percent) activities.<sup>18,19</sup> Similarly, spraying of sheep with Ciovap emulsion (0.25%) significantly reduced EChE activity (50 percent).<sup>20</sup>

### Drug interaction

Under field conditions, economy and convenience may dictate a combination of drugs to treat animal diseases. Drug potentiation or adverse reaction may result from the interaction.<sup>6,19,21,22</sup> Combination of more than one OP pesticide may produce increased toxicity in the animal.<sup>21</sup> Phenothiazine tranquilizers are well-known potentiators of OP pesticide toxicity in man<sup>23</sup> and several animal species such as rat<sup>22</sup> and sheep.<sup>19</sup>

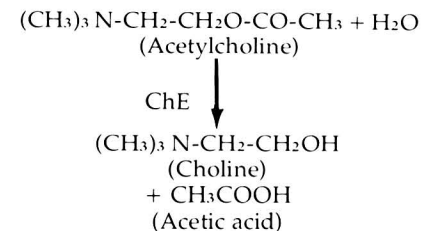
The role of stressors is very important in iatrogenic diseases and in evaluation of drug interaction. Factors such as species, age, sex, disease, and nutritional state of the animal may modify or enhance OP poisoning.<sup>6,7,19,22,24,25</sup> Gopal *et al.*<sup>19</sup> found that sheep maintained on a low dietary protein were more susceptible to couma-

phos toxicity, and to the potentiation effect of triflupromazine (a phenothiazine tranquilizer) combination, than those on a normal protein diet. In contrast, combination of phenothiazine anthelmintic with OP pesticides did not potentiate OP toxicity in cattle<sup>26</sup> and sheep.<sup>20,27</sup>

### Determination of cholinesterase activity

Measurement of EChE or PChE activity is the most important and sensitive diagnostic index for detecting the exposure of an animal to OP pesticides.<sup>1,28,29,30,31</sup> This is especially very valuable in confirming the diagnosis of OP poisoning. Measurement of erythrocyte cholinesterase activity rather than plasma cholinesterase appears to be the best guide in detecting the exposure of an animal to OP pesticides.<sup>1,8,19,20</sup> This is especially true in ruminants because of the associated low plasma cholinesterase activity (Table II). In general cats, dogs, horses and food animals have much lower PChE activity than man (Table II).

Several assay techniques are available to measure EChE and PChE activities.<sup>30,31,39,40</sup> Modifications of the electrometric method originally described by Michel<sup>32,33,35,36,37,38</sup> are used most commonly in veterinary medicine. Michel's method is based principally on the enzymatic hydrolysis of the choline ester substrate (acetylcholine) by the ChE of the blood sample.<sup>38</sup> The result of this enzymatic reaction is the production of acetic acid which decreases the pH of the reaction medium:



The change in the pH produced over a definite period of time at a specific temperature represents the enzyme activity (e.g., ΔpH/hr at 25°C). The pH is usually measured with a glass electrode using a pH meter. The electrometric method of Michel and the various modifications are simple, accurate, and very useful assay techniques for routine diagnosis of OP poisoning. The recent modifications of Michel's electrometric method described by Silvestri<sup>33</sup> to measure erythrocyte and plasma cholinesterase activities in domestic animals are sensitive, rapid, and valu-

TABLE I

LD<sub>50</sub> and no toxic effect levels of some commonly used organophosphorus pesticides in different animal species\*

Common Name	Species	Route	LD <sub>50</sub> mg/kg	No Effect Level mg/kg/day	Common Name	Species	Route	LD <sub>50</sub> mg/kg	No Effect Level mg/kg/day
Azinphos-methyl	rat	oral	11-25	rat - 0.125	Fenclorophos	rat	oral	906-2630	rat - 0.5
	chicken	oral	277	dog - 0.125		rat	dermal	2000	dog - 1.0
	sheep	oral	6-10			dog	oral	500	
Bromophos	rat	oral	1600-8000	rat - 0.65	rabbit	oral	640		
	chicken	oral	9700	dog - 1.5	Fenitrothion	rat	oral	250-940	rat - 0.25
	rabbit	dermal	720			chicken	oral	280	dog - 0.125
	dog	oral	625			cat	oral	142	
Chlorfenvinphos	rat	oral	10-39	rat - 0.05	Formothion	rat	oral	218-540	rat - 1.0
	dog	oral	12000	dog - 0.05		chicken	i.v.	20	dog - 1.0
	dog	i.v.	50.5			cat	oral	310	
	chicken	oral	29		Malathion	rat	oral	390-1150	rat - 5.0
	rabbit	dermal	400			chicken	oral	850	man - 0.2
	sheep	abomasal	71.3			calf	oral	80	
calves	abomasal	20		cow		oral	560		
Coroxon	rat	oral	9.8-12		Methidathion	rat	oral	20-81	rat - 0.2
	chicken	oral	2.2			chicken	oral	80	dog - 0.1
Coumaphos	rat	oral	16-230			rabbit	dermal	375	monkey - 0.25
	chicken	oral	14		dog	oral	200		
	rabbit	oral	80		Mevinphos	rat	oral	1.4-4	rat - 0.02
Crotoxyphos	rat	oral	21-125			chicken	oral	7.52	dog - 0.025
	chicken	oral	111-147			rabbit	dermal	4.7	
	cat	oral	802		Naled	rat	oral	250-430	
Demeton	rat	oral	35-85	rat - 0.1		rat	dermal	800	
	cat	oral	5-10	dog - 0.05	Parathion	rat	oral	2-30	rat - 0.05
	cat	dermal	10-20			rabbit	dermal	40	pig - 1.0
	dog	oral	50			duck	oral	2.34	
dog	oral	50		dog		oral	3-5		
Diazinon	rat	oral	76-300	rat - 0.1	Phosalone	rat	oral	120-207	rat - 1.25
	rabbit	dermal	455-900	dog - 0.02		guinea pig	oral	150	dog - 0.625
				man - 0.02		TEPP (pyrophosphoric acid, tetraethyl ester)	rat	oral	0.5-2
Dichlorvos	rat	oral	56-80	rat - 0.25	rabbit		dermal	5	
	dog	oral	1090	dog - 0.37	Thiometon	rat	oral	100-125	rat - 0.25
	chicken	oral	15	man - 0.033		rat	dermal	1000	dog - 0.35
	rabbit	dermal	107			cat	oral	36	
Dimethoate	rat	oral	180-336	rat - 0.05-0.4	Trichlorfon	rat	oral	316-650	rat - 2.5
	chicken	oral	37	cat - 0.5		chicken	oral	75-110	dog - 1.25
				dog		dermal	5000		
				dog		oral	420		
				man - 0.04		horse	oral	100	
EPN [phosphonothioic acid, phenyl-O-ethyl-O-(p-nitrophenyl) ester]	rat	oral	8-26						
	dog	oral	20						
	rabbit	dermal	30						
	duck	oral	3						

\*See references 1-5

able assay procedures. From experience in our laboratory, however, we recommend the modifications of Silvestri.<sup>33</sup>

#### References/additional reading

- Derache, P.R. 1977. Organophosphorus Pesticides. Pergamon Press Inc., Elmsford, NY. pp. 13-18, 43-148.
- Berg, G.L. (ed.) 1981. Farm Chemicals Handbook. Meister Publishing Co., Willoughby, OH.
- Thomson, W.T. 1979-1980. Agricultural Chemicals, Book 1 - Insecticides. Thomson Publications, Fresno, CA.
- Christensen, H.E. and Luginbyhl, T.T. (eds.) 1975. Registry of Toxic Effects of Chemical Substances. U.S. Dept. of Health, Education, and Welfare, National Institute for Occupational Safety and Health, Rockville, MD.
- Murphy, S.D. 1980. Pesticides. In: Casarett and Doull's Toxicology, Doull, J., Klaassen, C.D. and Amdur, M.O. (eds.), Macmillan Publishing Co., Inc., NY. pp. 357-408
- Khan, M.A. 1973. Toxicity of systemic insecticides. Vet. Rec. 92:411-419.
- Natoff, I.L. 1971. Organophosphorus pesticides: pharmacology. Prog. Med. Chem. 8:1-37.
- Solly, S.R.B. 1971. Veterinary aspects of insecticides: organophosphates. N.Z. Vet. J. 19:233-240.
- Wills, J.H. 1972. The measurement and significance of changes in the cholinesterase activities of erythrocytes and plasma in men and animals. CRC Crit. Rev. Toxicol. 1:153-202.
- Roberson, E.L. 1977. Antinematodal Drugs. In: Veterinary Pharmacology and Therapeutics, Jones, L.M., Booth, N. and McDonald, L.E. (eds.), Iowa State Univ. Press, Ames, IA. pp. 994-1051.
- Ward, F.P. and Glicksberg, C.L. 1971. Effects of dichlorvos on blood cholinesterase activity in dogs. JAVMA 158:457-461.
- Snow, D.H. and Watson, A.D.J. 1973. The acute toxicity of dichlorvos in the dog: 1. Clinical observations and clinical pathology. Aust. Vet. J. 49:113-119.
- Hazelwood, J.C., Stefan, G.E. and Bowen, J.M. 1979. Motor unit irritability in beagles before and after exposure to cholinesterase inhibitors. Amer. J. Vet. Res. 40:852-856.
- Walker, A.I.T. and Stevensen, D.E. 1968. Studies on the safety of plastic dog collars containing dichlorvos. Vet. Rec. 83: 538-541.
- Bell, T.G., Farrell, R.K., Padgett, G.A. and Leendersten, L.W. 1975. Ataxia, depression and dermatitis associated with the use of dichlorvos-impregnated collars in the laboratory cat. JAVMA 167:579-586.
- Weidenbach, C.P. and Younger, R.L. 1962. The toxicity of dimethyl 2-(alphamethylbenzylloxycarbonyl)-1-methyl vinyl phosphate (Shell compound 4294) to livestock. J. Econ. Entom. 55:793.
- Matthysse, J.G. and Lisk, D. 1968. Residues of diazinon, coumaphos, cioldrin, methoxychlor, and rotenone in cow milk from treatments similar to those used for ectoparasite and fly control on dairy cattle with notes on safety of diazinon and cioldrin to calves. J. Econ. Entom. 61:1394-1398.
- Silvestri, R.G., Himes, J.A. and Edds, G.T. 1975. Repeated oral administration of coumaphos in sheep: effects on erythrocyte acetylcholinesterase and other constituents. Amer. J. Vet. Res. 36:283-287.
- Gopal, T., Oehme, F.W. and St. Omer, V.

Continued on Page 4

# OP poisoning

From Page 3

1976. Influence of dietary protein on the effect of coumaphos and triflupromazine in sheep. *Amer. J. Vet. Res.* 37:1143-1151.
20. Mohammad, F.K. and St. Omer, V. 1981. Unpublished data (M.S. thesis in preparation).
21. DuBois, K.P. 1961. Potentiation of the toxicity of organophosphorus compounds. *Adv. Pest Cont. Res.* 4:117-151.
22. Gaines, T.B. 1962. Poisoning by organic phosphorus pesticides potentiated by phenothiazine derivatives. *Science* 138:1260-1261.
23. Arterberry, J.D., Bonifaci, R.W., Nash, E.W. and Quinby, G.E. 1962. Potentiation of phosphorus insecticides by phenothiazine derivatives. *J.A.M.A.* 18:110-113.
24. Durham, W.F. 1967. The interaction of pesticides with other factors. *Resd. Rev.* 19:21-103.
25. Radeleff, R.D. 1970. *Veterinary Toxicology*. Lea and Febiger, Philadelphia, PA pp. 215-255.
26. Schlinke, J.C. and Palmer, J.S. 1973. Combined effects of phenothiazine and organophosphorus insecticides in cattle. *JAVMA* 163:756-758.
27. Malone, J.C. 1962. Toxicity of croxon/ phenothiazine and coumaphos/phenothiazine. *Res. Vet. Sci.* 3:18-33.
28. Holmstedt, B. 1971. Distribution and determination of cholinesterases in mammals. *Bull. WHO.* 44:99-107.
29. Purshottam, T. and Kaveeshwar, U. 1979. Effect of diet on dichlorovinyl dimethyl phosphate toxicity in rats. *Aviat. Space Environ. Med.* 50:581-584 *Pest. Abstr.* 1979, 12:633.
30. MacQueen, J. and Plaut, D. 1973. A review of clinical applications and methods for cholinesterase. *Amer. J. Med. Tech.* 39:279-287.
31. Aldrich, F.D. 1969. Cholinesterase assays: their usefulness in diagnosis of anticholinesterase intoxications. *Clin. Toxicol.* 2:445-448.
32. Kruckenberg, S.M. and Vestweber, J.G.E. 1973. Whole blood cholinesterase activity of laboratory and domestic animals: contribution of erythrocyte and serum enzymes. *Vet. Med. Small Anim. Clin.* 68:54-55.
33. Silvestri, G.R. 1977. New techniques to

SPECIES	ESTERASE	VALUE	REFERENCE
SHEEP	EChE	0.39 ΔpH/hr	32
	PChE	0.06 ΔpH/hr	32
	EChE	0.76 ΔpH/30 min	33
	W.B. ChE	0.20 ΔpH/hr	34
GOAT	EChE	0.68 ΔpH/30 min	20
	PChE	0.16 ΔpH/30 min	20
	EChE	0.35 ΔpH/hr	32
	PChE	0.16 ΔpH/hr	32
CATTLE	W.B. ChE	0.14 ΔpH/hr	35
	EChE	0.69 ΔpH/45 min	33
	EChE	0.47 ΔpH/hr	36
HORSE	EChE	0.65 ΔpH/hr	32
	PChE	0.03 ΔpH/hr	32
	EChE	0.65 ΔpH/15 min	33
	EChE	0.18 ΔpH/hr	32
PIG	PChE	0.62 ΔpH/hr	32
	EChE	0.78 ΔpH/45 min	33
	PChE	0.66 ΔpH/20 min	33
	W.B.ChE	0.39 ΔpH/hr	35
DOG	EChE	0.71 ΔpH/25 min	33
	PChE	0.46 ΔpH/hr	33
	W.B.ChE	0.32 ΔpH/hr	34
CAT	EChE	0.13 ΔpH/hr	32
	PChE	0.16 ΔpH/hr	32
	EChE	0.63 ΔpH/45 min	33
	PChE	0.67 ΔpH/30 min	33
MAN	EChE	0.10 ΔpH/hr	32
	PChE	0.56 ΔpH/hr	32
	EChE	0.13 ΔpH/3 hr	37
MAN	EChE	0.75 ΔpH/hr	38
	PChE	0.70 ΔpH/hr	38

\*Consult the original references for procedural details of the modifications of Michel's electrometric method.

EChE = erythrocyte cholinesterase; PChE = plasma cholinesterase

W.B.ChE = whole blood cholinesterase

- measure blood cholinesterase activity in domesticated animals. *Am. J. Vet. Res.* 38:659-662.
34. Crookshank, H.R. and Palmer, J.S. 1978. Comparison of two procedures for determination of cholinesterase in livestock. *Clin. Toxicol.* 13:557-566.
35. Palmer, J.S., Jackson, J.B., Younger, R.L., Hunt, L.M., Daz, J.W. and Wunderlich, B.W. 1963. Normal cholinesterase activity of the whole blood of the horse and Angora goat. *Vet. Med.* 58:885-886.
36. Radeleff, R.D. and Woodward, G.T. 1956. Cholinesterase activity of normal blood of cattle and sheep. *Vet. Med.* 51:512-514.
37. Callahan, J.F. and Kruckenberg, S.M. 1967.

- Erythrocyte cholinesterase activity of domestic and laboratory animals: normal levels for nine species. *Amer. J. Vet. Res.* 28:1509-1512.
38. Michel, H.O. 1949. An electrometric method for the determination of red blood cell and plasma cholinesterase activity. *J. Lab. Clin. Med.* 34:1564-1568.
39. Augustinsson, K.B. 1971. Determination of activity of cholinesterases. In: *Analysis of Biogenic Amines and Their Related Enzymes*. Glick, D. (ed.). Interscience Press, NY, pp. 217-273.
40. Silk, L., King, J. and Whittaker, M. 1979. Assay of cholinesterase in clinical chemistry. *Ann. Clin. Biochem.* 16:57-75.



## Minority students look at veterinary careers

Three St. Louis-area high school students sampled veterinary medicine as a possible career this summer while visiting the College. Wylda D. Carey, Panzita Brown and Thomas D. Granberry spent several days in each facet of the Veterinary Teaching Hospital as part of the College's minority student program. Funded through the Rockefeller Foundation and Howard University, the program is designed to acquaint students with viable career options in health sciences. Here, the trio watches Dr. Cecil Moore conduct an eye examination. This is the third year the College has operated its minority student program.

Don Connor photo



*Poison hemlock, bitterweed, Russian knapweed, smartweed and pokeweed are some of the toxic weeds that adorn the College's poisonous plant garden. White snakeroot is planted under the tree outside the garden plot.*

Don Connor photos

## DEADLY GARDEN

*From a weed patch comes the seeds of knowledge of plant toxicology.*

Gary Osweiler and Merl Raisbeck are not your typical gardeners.

While most backyard farmers were cursing the bumper weed crop of last summer, these two veterinarians were nurturing a pampered patch of 30 poisonous plants near the College's Veterinary Medical Diagnostic Laboratory.

"These are plants that are important to Missouri," Dr. Osweiler says. "One of the biggest problems veterinary students have is identifying poisonous plants. So, we're making the plants easily available for them to study."

The garden is a self-learning center for students, veterinarians and clients. Together with six slide-tape lessons and a set of pressed plant specimens, it fleshes out the single three-hour toxicology course offered to veterinary students.

An inventory of weeds growing in the garden reads like a list of horticultural horrors: poison hemlock, water hemlock, jimsonweed, black nightshade, buffalo burr, horsenettle, bracken fern, dogbane, larkspur, milkweed, pigweed, star-of-Bethlehem, white snakeroot, pokeweed, lambsquarter, buckeye, chokecherry, buttercup, St. John's wort, beefsteak plant, smartweed, bitterweed, castor bean, may-apple, Russian knapweed, Johnson grass,

Sudan grass, fescue, alfalfa and iris.

The collection of weeds, grasses and ornamental plants poses serious health hazards to large and small animals. Some are lethal. All should be familiar sights to veterinarians.

Dr. Osweiler, a professor of veterinary pathology, and Dr. Raisbeck, a resident in toxicology, designed the garden with four uses in mind.

As a teaching tool, it introduces veterinary students to plant toxicology. For graduate students, it provides the opportunity to study poisonous plants in detail, and in one place. The garden also has been used in continuing education courses, particularly those on large animal diagnostics.

For livestock owners, the garden may prove to be an invaluable aid in diagnosis and herd management.

"The farmer who comes to the Diagnostic Laboratory with an animal problem knows he has some weeds," Dr. Osweiler says. "But he may not know what they are. He can come out here and take a look to identify those he doesn't know."

The College's poisonous plant curriculum soon will be enhanced by slide-tape lessons on each season's plants and those toxic to small animals. The lessons, now

being edited, were prepared by Dr. Arthur Case, emeritus professor of medicine and surgery, and Penny Kelso, a fourth-year veterinary student. Dr. Case also has collected pressed specimens of toxic plants, for use out-of-season. The slide-tape lessons and pressed plants should be available in the College's Veterinary Medical Library by the winter semester.

"Dr. Case has been a big help," says Dr. Osweiler. "Most of the plants in the garden were either found by him, or he told us where to find them."

There are plans to enlarge the garden.

"Right now, we have mostly wild toxic plants," Dr. Osweiler says. "We'd like to add common grasses and forages, and some of the poisonous ornamental plants that small-animal practitioners have to deal with." He would like to end up with 50 to 75 plants.

Eventually, a directory will be set up to augment the labels on each plant, detailing specifics on each plant and the damage it can cause.

"Students—and veterinarians—should know the plants that animals eat," Dr. Osweiler says. "This is a convenient way to get across some very useful knowledge."

# Endometritis in the mare

Although difficult to diagnose, infections have been linked to infertility.

*Terry L. Blanchard, D.V.M.  
Veterinary Medicine and Surgery*

Bacterial infection of the reproductive tract is a cause of infertility in the mare. Various organisms have been cultured from the reproductive tract of the mare, but the association between infertility and organisms cultured from there is unclear. Recovery of organisms does not necessarily indicate disease. For example, bacteria can be recovered from the reproductive tract of more than 80 percent of mares during the first 30 days postpartum. Normal mares also rapidly eliminate pathogenic organisms following experimental inoculation of the uterus. Barren mares, however, take longer to eliminate an experimental infection.

If infertility is suspected, a complete physical examination should be performed to check for signs of infection and eliminate other causes of barrenness. Abnormalities or changes may signify the presence of bacteria. Poor conformation of the vulva increases the likelihood of infection. In the uterus, a metritis often leads to palpable changes while an endometritis does not. Speculum examination may reveal the presence of a discharge, indicating a possible infection. Sometimes, however, a vaginal or a cervical discharge may be present without involvement of the uterus. It is also possible for the uterus to

be infected with no discharge present in the cervix or vagina.

Postmortem studies have shown that the vulva, vestibule, vagina, and cervix are richer sources of organisms than the uterus. That is, fewer organisms are likely to be recovered if the culture sample is taken from deep within the reproductive tract. But infection in the uterus (endometritis) is more likely to result in infertility than infection elsewhere, such as cervicitis or vaginitis.

Take care when retrieving cultures for infertility tests. Contamination of the swab before, during, and after passage through the reproductive tract results in erroneous results. Swabs encased in canulas with an occlusion (gelatin capsule, plastic cap, etc.) on the end will limit the contaminants recovered if the swab is not exposed until it is placed in the uterus, but even this method is not foolproof. Errors also occur if transport of the swab to the laboratory is sloppy. Swabs left in nutrient broth for more than a few hours will encourage an overgrowth of contaminants. Dried-out swabs give no-growth cultures. Packaging the swab transport in a cool, dark place helps prevent contamination.

Endometrial biopsy is a useful tool for evaluating uterine infection, especially when used in conjunction with physical examination and uterine swab culture. When organisms are recovered from the uterus and inflammatory changes are present in the biopsy, an endometritis probably is present. When organisms are recovered from the uterus and no histologic evidence of inflammation is present in the biopsy, the swab may have been

contaminated. Some mares may have considerable histologic evidence of inflammation even though no organisms are recovered from the uterus. Such mares may have eliminated the infection from the uterus, although the histologic inflammation has not subsided yet. It is also possible that organisms are causing the inflammation, but the culture technique is not capable of recovering them.

The severity of histologic inflammation present in the endometrial biopsy can be used to estimate the type and duration of therapy needed. For example, inflammation occurring deep within the endometrium is more difficult to treat successfully and requires a longer duration of therapy than does a more superficial inflammation. Biopsies taken two to four weeks following treatment can be used to determine success or failure of therapy.

In summary, a thorough physical examination of the reproductive tract always should be performed on mares with a history of infertility. Scrupulous attention should be paid to culture techniques used to recover organisms from the uterus. An endometrial biopsy is a valuable aid in diagnosis of endometritis and in determining proper therapy.

Equine endometrial biopsy specimens should be placed in a container of Bouin's or formalin solution and sent as soon as possible to a laboratory. Specimens can be sent to Dr. Terry Blanchard, Theriogenology Section of the Veterinary Teaching Hospital, or to the Veterinary Medical Diagnostic Laboratory, College of Veterinary Medicine, University of Missouri, Columbia, Mo. 65211.

## Dr. Selby dies

Dr. Lloyd Arthur Selby died August 19 in Columbia, Mo., after a long bout with cancer. He was 45 years old.

A University of Missouri professor, Dr. Selby taught microbiology in the College of Veterinary Medicine and family and community medicine in the School of Medicine. A nationally known epidemiologist, he was considered one of the foremost experts on birth defects of animals and children from environmental factors.

A native of Denver, Colo., Dr. Selby came to the College in 1967 from Tulane University where he held a National



Institutes of Health fellowship. He received his B.S. and D.V.M. degrees from Colorado State University in 1959 and 1961. In 1964, he received a Master of Public Health degree from Tulane University School of Medicine. He earned his Doctor of Public Health degree from Tulane in 1967. He served as an assistant veterinary officer in the U.S. Public Health Service from 1961-63.

Dr. Selby received numerous honors and awards during his career. This summer, he received an honorary diploma from the American Veterinary Epidemiology Society for his outstanding contributions to veterinary public health. He was named to American Men of Science in 1969, Who's Who in the Midwest in 1970, Men of Achievement in 1973, Who's Who in the United States in 1975, Notable Americans of

1976-77, and Distinguished Leaders in Health Care in 1978. He has been honored by the American Board of Veterinary Public Health and is listed in the Dictionary of International Bibliography. In 1979, he received the Teacher of the Year Award from the American Association of Food Hygiene Veterinarians.

He is survived by his wife, Jan, whom he married in 1963, and five children, Mary, Kathleen, Elizabeth, Teresa and Joseph.

A scholarship fund has been established in Dr. Selby's name at the College. Checks made out to the University of Missouri and designated for the Lloyd Selby Memorial Scholarship Fund may be sent to Assistant Dean Kenneth Niemeyer at the College of Veterinary Medicine, Columbia, Mo. 65211.

# Faculty update

## Dr. Arthur Case

Dr. Arthur A. Case, emeritus professor of veterinary medicine and surgery, retired August 31 after 34 years at the College.

Dr. Case was instrumental in creating the College's Teaching Hospital, where he taught almost every aspect of clinical work. Last year, University President James Olson presented him with the College's Distinguished Service Award.

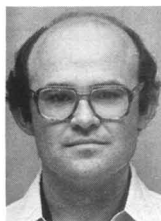


Retirement will be busy for Dr. Case, who will maintain an office at the College. He still plans to lecture in the College's herd health block, continue some of his extension work and help Associate Dean Emeritus Leslie Murphy with a new history of the College. As he sees it, his retirement will be "a gradual winding down of the past 35 years."

## Dr. David Hardin

Dr. David K. Hardin of Hartville, Mo., has begun a residency in theriogenology at the College. He replaces Dr. Jennifer Balke, who now is in a graduate program in theriogenology.

Dr. Hardin, 29, is a University alumnus; he earned his B.S. degree in agriculture here in 1973 and his D.V.M. in 1977. He has had a private practice in Hartville since 1977. He also has worked with veterinarians in Fayette and Ava.



## Dr. Alex Walker

Dr. Alex M. Walker of Auckland, New Zealand, is the College's newest resident in small animal surgery. He replaces Dr. Amelia Toomey, who finished her residency in August.

Dr. Walker holds a B.V. Sc. degree from Massey University in New Zealand. After his graduation in 1978, he worked as an associate in a practice for one year, before opening his own practice in Auckland.



## Dr. Tod Luethans

Dr. Tod N. Luethans joined the Department of Veterinary Pathology this summer as a research associate.

Dr. Luethans, 36, received his D.V.M.

degree from the College in May. He also holds an A.M. and Ph.D. in French from Harvard University and an A.B. in French from Washington University in St. Louis. He is a former assistant professor of French at Purdue and Indiana universities and a former teaching fellow at Harvard.

As a student in Columbia, Dr. Luethans won the Cecil Elder Award for Veterinary Pathology in 1979 and the Loren D. Kintner Veterinary Diagnostic Laboratory Award in 1981. He is a member of Phi Zeta.

## Dr. John Amann

Dr. John Amann has joined the College's Department of Veterinary Anatomy-Physiology as an assistant professor. He replaces Dr. Roger Brown, who retired in April.

Dr. Amann, 35, hails from Pine City, N.Y., where he had worked in a large-animal practice since 1978. He received his D.V.M. degree in 1976 from New York State College of Veterinary Medicine at Cornell University. He also holds M.A. and Ph.D. degrees in anthropology from Cornell and a B.A. in anthropology from Fordham University.

Dr. Amann also has worked in a mixed-animal practice in Holley, N.Y., was a member of the large-animal clinic crew at Cornell, and was a laboratory assistant in physiology at Cornell. He spent a year as a post-doctoral research fellow in neuroanatomy at Walter Reed Army Institute of Research in Washington, D.C., and has taught in Cornell's anthropology department.



## Dr. Catherine LaBerge

Dr. Catherine A. LaBerge began a rotating internship in the College's small animal clinic this summer.

Dr. LaBerge, 27, comes to Columbia from St. Paul, Minn. She received her D.V.M. degree from the University of Minnesota last June, and her B.S. in biology from the College of St. Benedict/St. John's University in 1976. She has worked as a veterinary assistant for veterinarians in Minneapolis and St. Cloud, Minn., and in hypertension research at the University of Minnesota School of Medicine. Dr. LaBerge also served as a research assistant in leptospira research at St. John's University.

She is a member of Phi Zeta and Delta Epsilon honor societies, and is listed in the



1975-76 edition of Who's Who In American Colleges and Universities.

## Dr. Kay Schwink

Dr. Kay Linda Schwink has begun a rotating internship in small animal medicine with the Department of Veterinary Medicine and Surgery.

Dr. Schwink, 24, received her D.V.M. from Iowa State University in 1980. She comes to the College from a private practice in Marshalltown, Iowa.



## Dr. Etta Wertz

Dr. Etta M. Wertz has begun a rotating internship in the small animal clinic of the College's Department of Veterinary Medicine and Surgery.

Dr. Wertz, 27, is a May graduate of the Colorado State University College of Veterinary Medicine. She also holds a B.S. in animal science from Colorado State. She has worked as a teaching assistant at Colorado State, a veterinary trainee for the U.S. Animal and Plant Health Inspection Service in Jefferson City as part of the brucellosis eradication program and animal welfare act, and as a veterinary technician at an Aurora, Colo., practice.



## Dr. Lisa Williamson

Dr. Lisa H. Williamson of Sandston, Va., recently began an internship in equine medicine in the College's Department of Veterinary Medicine and Surgery.

Dr. Williamson, 24, is a 1981 graduate of the University of Georgia College of Veterinary Medicine. She also holds a B.S. degree in biology from the University of Georgia. She has worked in a Lawrenceville, Ga., animal clinic, at a saddlebred farm in Lawrenceville and as part of an *E. coli* research project in Athens, Ga. She also has served an externship at the University of Pennsylvania's New Bolton Center.

Dr. Williamson is a member of Alpha Lambda Delta and Phi Kappa Phi honor societies, the American Veterinary Medical Association and the American Association of Equine Practitioners. She received the University of Georgia's 1981 Clinical Proficiency Award in Equine Medicine.



## Datebook

**November 4-5.** Continuing Education course for animal control officers, at the College and Columbia's Campus Inn. For further information on all CE courses this year, contact the Office of Continuing Education, W-234 Veterinary Medicine Building, or call (314) 882-7854.

**November 11.** Continuing Education course on caged bird medicine and management, at the College.

**November 12.** Visiting lecturer: Dr. Mitchell Bush on zoological medicine and surgery, "Aspects of Anesthesia, Preventative Medicine, Orthopedics and Laparoscopy," 8 p.m. at the College.

**November 12-14.** Continuing Education course on endoscopy, at the College.

**November 18-19.** Continuing Education course on parasitology, at the College.

**November 22.** Continuing Education course on care of the renal patient, at the College.

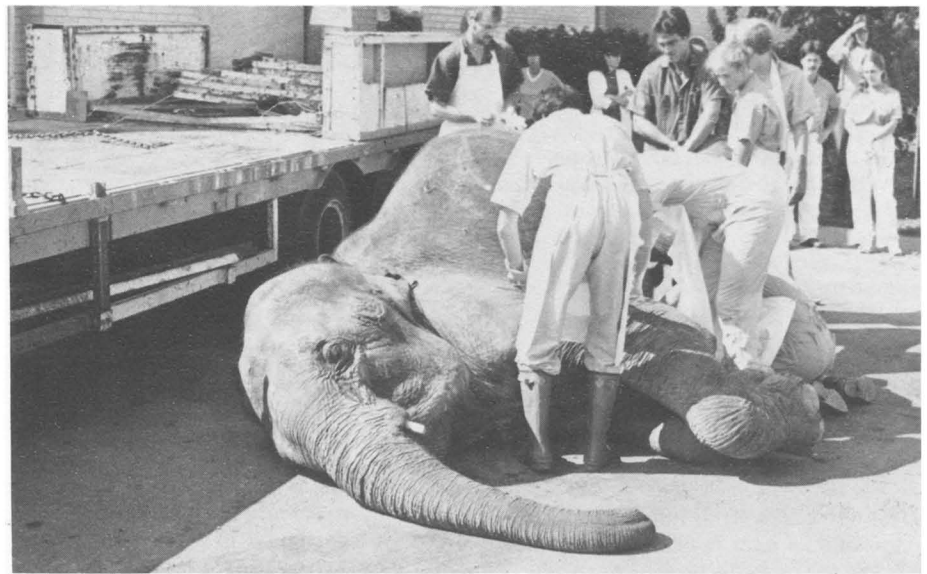
**November 22.** Continuing Education course on equine reproduction, at the College. Note that this course's date has been changed from the one in the CE calendar.

**November 28-December 2.** The 27th annual meeting of the American Association of Equine Practitioners, New Orleans Hilton, New Orleans, La.

**December 10.** Continuing Education course on interpretation of laboratory data, at the College.

### ACVIM (Cardiology) chooses associate dean for president

Interim Associate Dean Allen Hahn, has been elected president of the American College of Veterinary Internal Medicine (Cardiology). The group chose new officers at its meeting during the American Veterinary Medical Association convention in July.



Don Connor photo

### Elephantine task

When Tasha, an Indian elephant, dropped dead before a September 2 circus performance in Jefferson City, Dr. Loren Kintner's veterinary pathology class took advantage of a rare opportunity to conduct a necropsy of gigantic proportions.

Tasha arrived at the College the next day. Because her six-ton carcass was more than the Diagnostic Laboratory's 1 1/2-ton hoist could handle, a nearby parking lot served as the necropsy table. Three hours later, the investigation was complete and the cause of death was readily apparent—intussusception, a telescope-like retraction of the bowel into the secum.

The animal's owner, Circus Vargas, donated Tasha's body to the College. The anatomy-physiology department has retained the head, cervical vertebrae and legs for further study.

### Researchers awarded grant for von Willebrand's study

Two College veterinarians have been awarded a \$9,620 grant for research into a hemophilia-like disease of dogs.

Dr. Gary S. Johnson, assistant professor of veterinary pathology, and Dr. Cecil P. Moore, assistant professor of veterinary medicine and surgery, hope to devise improved diagnostic tests for canine von Willebrand's disease. The project, funded by the Morris Animal Foundation of Englewood, Colo., will be conducted at the College.

Von Willebrand's disease is the most common of all canine inherited bleeding disorders. It also occurs in humans and swine. Caused by a deficiency in plasma protein necessary for normal platelet function, von Willebrand victims usually experience abnormal hemorrhage from mucosal surfaces and may bleed to death after injuries or surgery. It has been diagnosed in a wide variety of dog breeds, but is a major problem for Scottish terriers, Doberman pinschers and Pembroke Welsh corgis.

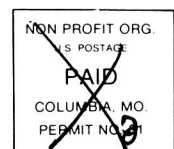
Because the disease can be eradicated through selective breeding, Drs. Johnson and Moore plan to improve tests that identify von Willebrand carriers.

## Veterinary Medical Review

College of Veterinary Medicine  
and Cooperative Extension Service

Editor: Kathy Casteel  
W-203 Veterinary Medicine  
College of Veterinary Medicine  
University of Missouri-Columbia 65211

Return Requested



● Supported in part by the UMC Extension Division ● University of Missouri is an equal opportunity institution.