TABLE II. Summary of Effect of Dihydroergotamine on Blood Flow Response to Epinephrine Injected Intra-arterially in Hind-Limb of Dogs. Epinephrine injected between ½ and 2½ hr after intra-arterial injection of 20 γ/kg of dihydroergotamine.

Epinephrine, γ/kg I.A.	Constriction Complete block	Dilation Complete block	Dilation Partial block	Dilation No change	Dilation Iner. response
1	+		+		
	+				+
	+	+			
	+		+		
	+	+			
	+				+
	+			+	
3	+				+
	+		+		
	+				+
	+		+		
	+				+

Complete block = >75%
Partial " = 25% to 75%
No change = 25% or less
} decrease in epinephrine response after dihydroergotamine.

ergotamine on the epinephrine dilator mechanism or a recovery of the vasoconstrictor action.

Conclusions. In blood flow experiments in the hind-limb of dogs, dihydroergotamine completely blocks the vasoconstrictor action of epinephrine but fails to uniformly block the vasodilator action of epinephrine.

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Effect of Dietary Molybdenum Upon Chicks and Poults.* (19664)

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When cattle and sheep graze on pastures in which the molybdenum exceeds approximately 10 p.p.m., toxic symptoms may appear which include diarrhea, anemia, weight loss and a change in the color of the hair or wool(1,2). Rats and rabbits can tolerate molybdenum better than ruminants although 500 p.p.m. caused a definite growth retardation and 5000 p.p.m. resulted in the death of all of the rats in one experiment(3-6). Copper is capable of counteracting the symptoms of molybdenum toxicity in both ruminants and rats. The present studies were undertaken to determine the effects of feeding various levels of molybdenum and copper to chicks and poults.

Experimental. Exp. 1, 2 and 3 were conducted with S. C. White Leghorn male chicks while Bronze poults were used in Exp. 4, 5 and 6. Practical chick and poult starting rations were used as basal rations to which various levels of sodium molybdate dihydrate and copper sulfate were added. The basal rations contained 1.5, 1.5, 1.3, 4.0, 6.0, and 1.5 p.p.m. molybdenum in the successive trials. The copper in the basal ration was determined only in Exp. 2, 3, 5 and 6 in which it was found to be 9.9, 8.2, 20.0 and 10.0 p.p.m., respectively. The birds were housed in electrically heated batteries with wire floors and were supplied feed and water *ad libitum*. The birds were weighed at frequent intervals. There were 7, 13, 10, 6, 7 and 10 one-week-

TABLE I. Effect of Molybdenum and Copper in the Ration upon Growth of Chicks and Poults. Avg gain (g).

Chicks			Poults		
Exp. 1	Exp. 2	Exp. 3	Exp. 4	Exp. 5	Exp. 6
Days					
23	28	32	34	30	31
229 (0, 0)*	281	276	594	620	484
	260 (50, 0)				
244 (85, 0)					
	225 (100, 0)	323		617	516
217 (170, 0)			460		
	237 (200, 0)	289		612	374
	251 (200, 100)				481
194 (255, 0)			397		
199 (255, 150)			418		
	204 (300, 0)	279		481	
		304 (300, 100)			
		305 (300, 200)			
		306 (300, 300)			
174 (340, 0)			293		
193 (340, 200)			398		
	199 (400, 0)				
	236 (400, 200)				
	203 (400, 400)				

* p.p.m. added molybdenum and copper respectively.

TABLE II. Effect of Molybdenum and Copper in the Diet upon Hemoglobin, Molybdenum and Copper in the Blood of Chicks and Poults.

Chicks		Poults							
Hemoglobin, %	Mo. in blood, p.p.m.	Hemoglobin, %		Cell vol, %	Mo. in blood, p.p.m.			Cu. in blood, p.p.m.	
Exp. 2	Exp. 2	Exp. 5	Exp. 6	Exp. 6	Exp. 4	Exp. 5	Exp. 6	Exp. 5	Exp. 6
8.9 (0, 0)*	1.2	13	10.4	37.5	2.1	.1	.4	1.9	1
8.5 (50, 0)	12.9								
8 (100, 0)	26.4	12	10.6	36.2		3.2	13	1.5	1
					4.3 (170, 0)				
8.4 (200, 0)	34.1	12.1	10.9	35.6		8.2	12.8	1.8	1.8
8.3 (200, 100)	24.3		11.3	37.6			12.9		1.2
					18 (255, 0)				
					9.7 (255, 170)				
8.8 (300, 0)	32.2	12.4				15.5		1.8	
					24.7 (300, 0)				
					7.2 (300, 200)				
9.3 (400, 0)	16.7								
9.2 (400, 200)	28.6								
9.9 (400, 400)	21.6								

* p.p.m. added molybdenum and copper respectively.

old birds started per group in the successive trials. Hemoglobin determinations were made on some of the birds at the end of some experiments by the method of Matterson(7). Molybdenum was determined by a slight modification of the method of Marmony(8) and copper by the method of Association of Official Agricultural Chemists(9). Samples of excreta were saved for moisture determination by leaving a waxed paper overnight on the dropping pan in the battery and obtaining a sample from the accumulated excreta the next morning.

Results. With but one exception in Exp. 1, there was generally a reduction in growth of chicks as the molybdenum of the ration was increased (Table I). The growth reduction was approximately 25% when 300 p.p.m. molybdenum was fed. When copper was added to the rations containing molybdenum there was an improvement in growth, although it was usually only slight. With one exception the growth of poults was also decreased approximately as much as chicks when molybdenum was added to the ration. The addition of copper to the ration improved

TABLE III. Effect of Molybdenum and Copper in the Ration upon Moisture in Excreta of Chicks and Poults.

Moisture in droppings, %		
Chicks		Poults
Exp. 2	Exp. 3*	Exp. 6†
77 (0, 0)‡	62	57
75 (50, 0)		
75 (100, 0)	68	67
64 (200, 0)	61	71
68 (200, 100)		67
59 (300, 0)	67	
	56 (300, 100)	
	53 (300, 200)	
	56 (300, 300)	
54 (400, 0)		
70 (400, 200)		
68 (400, 400)		

* Avg of 2 separate collections.
† Avg " 3 " "
‡ p.p.m. added molybdenum and copper respectively.

growth in the 3 groups on which it was tested.

Hemoglobin was determined in one chick and 2 poult experiments but showed no variation which could be attributed to the levels of molybdenum and copper in the ration (Table II). Blood molybdenum increased enormously as the molybdenum in the ration increased in both chicks and poults. When copper was added, a slight reduction usually was noted in the blood molybdenum levels. In Exp. 6, analyses on plasma and whole blood samples of poults indicated that approximately 90% of the molybdenum was in the plasma. The level of copper in the blood of poults did not appear to be related to the molybdenum and copper levels of the ration under our conditions (Table II).

The data for the moisture content of the excreta (Table III) show no consistent differences as the rations varied in molybdenum and copper content. The results may be interpreted to show that diarrhea is not a symptom of molybdenum toxicity in chicks and poults.

In the 3 experiments with poults there was no evidence of faulty pigmentation.

Discussion. Chicks and poults seem to resemble rats in their molybdenum tolerance (3-6). High levels are needed to depress growth and anemia has not been noted. The response in ruminants seems much different since much lower levels may be detrimental (2). The simultaneous feeding of copper improved the growth of chicks and poults as it does with rats and ruminants, but it did not overcome the effect of molybdenum completely.

No diarrhea was noted in poults and chicks fed high-molybdenum rations. This is in contrast to ruminants on a high molybdenum pasture; however, cattle and sheep have been fed dry hay rations containing 200 p.p.m. with no diarrhea(12).

Cattle and sheep fail to form hair pigment properly when they are fed molybdenum and dark colored animals become light colored. Intravenous injections of molybdenum, however, did not cause a change in pigment formation in sheep while the same quantity fed produced a color change in a few days(12). In poults, lysine has been shown to be necessary for normal feather pigment formation (11) and approximately 2 weeks are required for the effect of feeding a lysine-low ration to be shown in the feathers(10). Molybdenum had no effect on pigmentation in turkey poults for a period of over 4 weeks. This suggests that either a different mechanism is involved in pigment formation in turkeys than in ruminants or the level of copper was adequate in the poult rations while it may have been marginal in the experiments with ruminants.

Comar *et al.*(4) have concluded that the unavailability of other elements due to molybdenum complex formation probably cannot account alone for the toxic action of molybdenum. This view would seem to apply to chicks and poults. Although no attempt was made to reduce the copper content of the rations used, there was no indication of a copper deficiency in which one might expect to observe anemia in the birds. The results suggest that the growth depressing effect of molybdenum is due to the presence of the element itself in the tissues. The slightly beneficial effect of copper may have been due to a reduction of the tissue molybdenum level, although the blood molybdenum was not reduced in all instances. Barshad(13) has shown that the uptake of molydenum by plants is much greater in forage material than in the seeds. Since poultry rations consist mainly of seeds, and chicks and poults have a high tolerance for molybdenum, there is little

likelihood that molybdenum poisoning will ever be a practical problem with poultry.

Summary. Growth of chicks and poults was depressed by approximately 25% by the addition of 300 p.p.m. molybdenum to their rations. The addition of copper to the rations containing molybdenum caused slightly improved growth. There was no evidence of anemia or diarrhea in birds on the high molybdenum diets. Poults fed high molybdenum rations for over 4 weeks had normal feather pigmentation.

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A Method for Quantitative Identification of Canine Erythrocytes. (19665)

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Studies of erythrocyte metabolism and function in the dog have been hindered by the lack of a reliable quantitative method of red cell identification. Hamilton(1) and Young *et al.*(2) have recently alluded to serologic, and Harrison *et al.*(3) to isotopic technics. In the present communication, we report a method for the quantitative identification of canine erythrocytes by differential agglutination utilizing lyophilized anti-sera. Young and his collaborators(2,4) have described 6 erythrocyte agglutinogens in dogs. These have been arbitrarily designated as A, B, C, D, E, and F. These canine agglutinogens do not correspond to human agglutinogens of similar terminology. In random examination of a large group of dogs, the A agglutinogen was found in about 63% of dogs, the B in about 5%, the C in 99%, the D in about 30% and the E in 80%. The incidence of the F agglutinogen has not been reported. Presumably there are other agglutinogens not yet identified. Christian *et al.*(4) have observed that variants of the A agglutinogen exist. These have been designated A′ and are present in about 40% of A dogs. The A-A′ differences are partly qualitative and are thought to resemble human D-D^u differences more closely than human A_1-A_2 differences.

Isohemagglutinins have been demonstrated in dog sera. Anti-D has been observed as a naturally occurring antibody, while anti-A,-B,-C,-E, and -F have been demonstrated only in dogs transfused with erythrocytes containing the respective factors.

Methods. The A agglutinogen is strongly antigenic, and high titre anti-A sera can be produced by multiple transfusions of A cells into dogs whose erythrocytes do not contain the A agglutinogen. However, at the same time there is produced an hemolysin which is not specific for A cells. It was found that