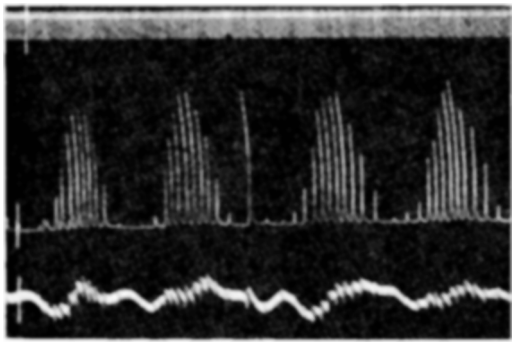

FIG. 2. Cheyne-Stokes breathing in dog after bilateral vagotomy and isolation of carotid sinuses and bodies. *Above:* Record of respiration. Upstroke indicates inspiration. *Below:* Blood pressure from femoral artery.

prominent after completion of the denervation. A record of the breathing at this stage is shown in Fig. 2. Shortly following this 1 mg of NaCN injected intravenously was found to have no effect on breathing. It must be concluded that oxygen-lack drive from the chemoreceptors was not a factor in the production of the Cheyne-Stokes breathing which developed under our conditions. Also, since sino-aortic pressoreceptors are isolated or denervated by the same procedures, rhythmic alterations in pressure in the sino-aortic zones are not concerned in the Cheyne-Stokes breathing observed.

Although the Cheyne-Stokes breathing illustrated here was independent of influences from carotid and aortic chemoreceptors and sino-aortic pressoreceptors, it still is possible that a similar type of irregularity can be produced by an imbalance of central and reflex drive. Several facts lead one to believe that Cheyne-Stokes breathing may be produced by 2 or more different mechanisms. For example, the mean arterial blood pressure shows a cyclic rise and fall during Cheyne-Stokes breathing, but in some instances the rise in blood pressure occurs during the apneic phase and in other instances the rise is during the hyperpneic phase. In both of the records shown here the latter type is seen. Possibly this type of periodic breathing has a purely central basis, while in the other type oxygen-lack drive from chemoreceptors may be a factor.

Summary. Typical Cheyne-Stokes breathing has been observed in 2 dogs having the vagi sectioned bilaterally at the upper cervical level (denervating aortic bodies and aortic pressoreceptors) and having the carotid bodies and sinuses isolated or excised bilaterally. Therefore, neither oxygen-lack drive from chemoreceptors nor reflex effects on breathing from rhythmic fluctuations in pressure in the sino-aortic zones are concerned invariably in the production of Cheyne-Stokes breathing.

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Effect of Beta-Aminopropionitrile on Reproduction of Chickens.* (23134)

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Diets containing *Lathyrus odoratus* seeds or beta-aminopropionitrile (BAPN) cause extreme abnormalities of the skeleton, hernias, dissecting aneurysms of the aorta and reproductive failure in rats(1-4). In turkeys, which are more sensitive to BAPN(5) than rats, nerve damage, internal hemorrhages and hock deformities are observed with only slight abnormality of the skeleton. Skeletal deformities were the outstanding effect observed in rats which indicates that BAPN interferes with calcium metabolism. The high level of calcium metabolism of the laying hen suggested a study of the susceptibility of this animal to BAPN toxicity.

* Technical Contribution No. 267, S. Carolina Agri. Exp. Station. Published by permission of Director.

TABLE I. Basal Ration.

	%
Ground yellow corn	60
" wheat	10
Soybean oil meal (44% protein)	10
Alfalfa meal	5
Dried whey	3
Fish meal	2.5
Meat scraps	"
Vitamin and UGF supplement*	"
Defluorinated rock phosphate	3.0
Ground limestone	1.0
Salt	.3
Manganese sulfate	.025
Vitamin A	498 USP units/lb
" D	205 ICU/lb

* Contains sardine fish meal, condensed fish solubles, whey solubles, hydrolyzed cod livers, active dry yeast, grass juice concentrate, penicillin mycelium meal, riboflavin feed supplement, B_{12} feed supplement, niacin, choline chloride and calcium pantothenate. Guaranteed analysis in mg/lb: riboflavin 44, B_{12} 0.3, niacin 500, choline 4,500 and pantothenic acid 50.

Methods. Single Comb White Leghorn hens were distributed at random into 5 groups each containing 6 birds. They were maintained in laying batteries with raised wire floors. Feed, water and oyster shells were supplied *ad libitum*. All birds received the basal diet (Table I) for 3 weeks. Each of 3 groups were then fed the basal diet with 0.01%, 0.03% or 0.06% added mono-beta-aminopropionitrile • fumarate (BAPN) for 4 weeks followed by the basal diet for 3 weeks. Two groups received the basal diet throughout the 10-week period. All birds were artificially inseminated weekly with 0.1 cc pooled semen. Eggs were set at weekly intervals and were candled after one week of incubation. Those eggs not containing live embryos were broken out and examined carefully to distinguish infertiles from early deaths. All dead embryos were carefully examined for determination of approximate time of death and gross abnormalities.

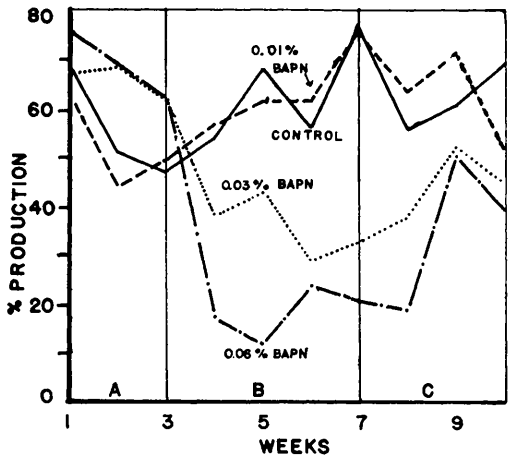

FIG. 1. Effect of BAPN on egg production. During period A all birds received basal diet. Experimental diets were fed during period B and all birds were returned to the basal diet during period C.

Results. The average *egg production* of the 2 control groups fluctuated from a low of 47% at the beginning of the supplemental period to a high of 77% at the end of this period (Fig. 1). The birds fed 0.01% BAPN laid at the rate of 50% the week before its addition and reached 76% production at the end of 4 weeks supplementation.

The week prior to addition of 0.03% BAPN to the diet those birds laid at the rate of 62%. During the 4-week supplemental period they reached a low of 29% production. The birds which received 0.06% BAPN dropped from 62% pre-supplemental to a low of 12% during the supplemental period. Both groups increased their rate of production after removal of BAPN although they did not reach their previous level in the 3-week post-supplemental period.

Shortly after BAPN was administered to certain groups *soft shelled and malformed eggs* were laid by those birds consuming .03% and .06% of this material. The incidence of soft shelled eggs increased until 33% of all eggs laid were soft shelled in the group fed .03% BAPN, and 78% of all eggs laid were soft shelled in the group receiving .06% BAPN (Table II). Malformations included

TABLE II. Effect of BAPN* on Incidence of Soft Shelled Eggs.

% BAPN added during supplemental period	% of eggs laid which were soft shelled									
	Basal period			Supplemental period				Basal period		
	Weeks									
	1	2	3	4	5	6	7	8	9	10
.0	0	0	0	0	0	0	6	14	3	3
.0	0	0	0	0	0	0	7	13	14	9
.01	0	0	0	0	0	0	0	4	3	14
.03	0	0	0	6	11	25	33	13	0	0
.06	0	0	0	0	0	60	78	38	14	12

* BAPN in the form of mono-beta-aminopropionitrile • fumarate.

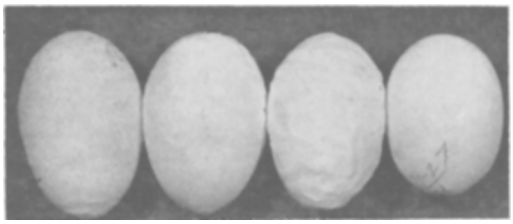

FIG. 2. Malformed eggs caused by feeding BAPN at .03% or .06% of the diet.

wrinkled, checked and ridged eggs (Fig. 2). BAPN fed at the level of .01% did not affect shell formation.

Hatchability of fertile eggs of the control groups varied from a high of 91% the second week of the experimental period to a low of 61% at the end of the experimental period (Fig. 3). The group receiving .01% BAPN dropped from 92% hatchability prior to treatment to 41% at the end of the experimental period. The birds supplemented with .03% dropped from 65% hatchability to 0% at the end of the experimental period and the group receiving 0.06% dropped from 84% to 0% after three weeks of BAPN supplementation. The hatchability immediately improved in all groups following the withdrawal of BAPN. It should be pointed out that the poor rate of production and the high incidence of soft shelled and malformed eggs reduced the number of eggs incubated to 4 or 5 fertile eggs in some instances and to no fertile eggs on the fifth and seventh setting at the highest level of supplementation. The hatchability of the control group was based on settings of no less than 26 fertile eggs.

Discussion. Addition of .01% BAPN to the diet of the laying hen appeared to have no detrimental effect on egg production or shell formation. Levels of .03% and .06% BAPN reduced rate of production and induced a high percentage of soft shelled and malformed eggs. BAPN at .01% reduced hatchability to 41% while .03% and .06% BAPN caused hatchability to drop to 0 in 3 or 4 weeks. Hatchability promptly returned to a satisfactory level following removal of the toxic compound from the diet of the birds.

The effect of BAPN on shell formation suggests that hatchability might be reduced because of poor shell formation. Examination of the dead embryos, however, revealed that 40% to 80% of the embryonic mortality on the .03% and .06% levels of BAPN was due to hemorrhages occurring primarily in the 3rd week of incubation. These figures are based on a small number of observations but they suggest that embryonic mortality is not a mere reflection of poor shell quality but is due in part at least to degeneration of the circulatory system as observed in rats(4) and turkeys(5). The ability of BAPN to inhibit shell formation suggests its use in further elucidating the mechanism of shell formation and indirectly in studying its method of interference with calcium metabolism of rats.

Summary. Mono-beta-aminopropionitrile • fumarate (BAPN) at .03% and .06% of the diet of laying hens reduced egg production from 62% to 29% at the lower level and from 62% to 12% at the higher level of supplementation. These levels of supplementation caused a high incidence of soft shelled and malformed eggs. After 4 weeks supplementation 33% of all eggs laid were soft shelled at the .03% dietary level of BAPN and 78% were soft shelled at the .06% level. BAPN at the level of .01% of the diet did not affect egg production or shell formation. Hatch-

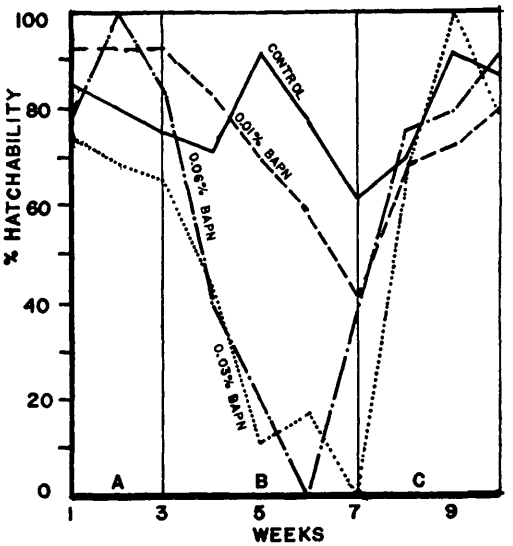

FIG. 3. Effect of BAPN on hatchability of fertile eggs. During period A all birds received basal diet. Experimental diets were fed during period B and all birds were returned to basal diet during period C. There were no fertile eggs set during week 5 or 7 at the .06% level.

ability of fertile eggs was decreased by levels of .01%, .03% and .06% of BAPN in the diet. Hatchability was reduced to 41% in the group receiving .01% BAPN after 4 weeks supplementation compared to the control at 61%. Hatchability decreased to 0 in 4 weeks at the .03% level and to 0 in 3 weeks in the group receiving .06% BAPN. Following removal of BAPN from the diet both egg production and hatchability increased and the percent of soft shelled eggs decreased. Hemorrhages were found in 40% to 80% of the dead embryos from the groups fed .03% and .06% BAPN.

The authors are grateful to Abbott Laboratories, N. Chicago, Ill., for supplying the beta-aminopropionitrile • fumarate.

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Secondary Shock in the Dog Produced by Total and Partial Aortic Occlusion.* (23135)

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Secondary shock is typically characterized by a reduced cardiac output, arterial hypotension and generalized stagnant anoxia. The result is usually a marked hypofunction of internal organs which if continued leads to death of the organism. Of the vital processes and organs which fail in irreversible shock, it is not known which failures are primary and which secondary, or conversely which systems or organs if protected from the anoxia would exert maximum survival benefit. There is reason to believe that increased perfusion of the liver(1,2) will lower the mortality in experimental shock but evidence of this type with reference to other organs or systems is scarce. It would seem that a method of producing experimental shock which permitted graded and controlled degrees of anoxia of various parts of the body might be helpful in this problem; regulation of degree of arterial flow appears to be one of the best means of achieving this. Aortic occlusion shock was produced by Erlanger and Gasser(3) but this method has since been little used.

The object of the present study was a) to determine whether repeatable experimental shock could be induced by total or partial aortic occlusion and b) to determine whether such a method might be effective in producing different degrees of anoxia in different parts of the body. The ultimate aim was to study the relative importance of various systems and organs in the genesis of fatal shock.

Methods. Mongrel dogs were anesthetized with morphine sulfate (3 mg/kg) and intravenous sodium barbital (120 to 180 mg/kg). Blood pressures were recorded with damped mercury manometers. Temporary occlusion of the lower thoracic aorta (Th 8-9) was produced either by careful tightening of a polyethylene noose placed surgically 2 to 3 weeks before, or by inflation of an intraaortic balloon catheter containing radioopaque liquid; the catheter was passed via the femoral or carotid artery under fluoroscopic guidance. The two methods yielded comparable results but the balloon catheter was used almost ex-

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