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A New Nutritional Disease of the Chick Embryo.

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From 1930 to 1934, inclusive, a disease, not heretofore described, has caused the death of many chick embryos during the third week of incubation of eggs produced by chickens receiving certain diets and management at the Beltsville Research Center. This disease is characterized by shortness of the bones. Shortness of the antero-posterior axis of the skull and shortness of the tarso-metatarsi are particularly striking, as shown in Fig. 1. The shafts of the leg bones are extremely osteoporotic.*

Affected embryos occasionally hatch. Some of the hatched chicks behave abnormally, presenting an appearance very much like that caused by polyneuritis. A few affected chicks have been reared on normal chick diets and they lost all abnormal appearance in the course of 10 weeks.

Data on incidence of affected embryos in eggs from birds receiving various diets and management are presented in Tables 1, 2 and 3. The data presented in Table 1 are from birds of the Single-Comb Rhode Island Red variety, as are a part of those presented in Tables 2 and 3. The remainder of the data presented in Tables 2 and 3 are from F_1 birds from a cross between Single-Comb White Leghorns and Jersey Black Giants. The data presented are for embryos of more than 13 days' incubation and for the hatched chicks. Embryos of less than 13 days' incubation could not be classified with certainty. Eggs were incubated during each month of the year.

Each of the diets fed the birds used in the experiments summarized in Table 1 was compounded so as to contain 20% of protein and to have a Ca/P ratio of 2.5:1. Each diet also contained 0.5 part by weight of common salt, 0.5 part by weight of anhydrous sodium sulphate, and 2 parts by weight of cod-liver oil. In compounding this diet, and all diets subsequently described which contained a D supplement in oil, the dry ingredients of the diet were made up to one hundred parts by weight and the oil added in the quantities indicated.

* A report on the histological features of the affected chicks will be presented by W. Landauer in another place.

The basal diet contained 94-95 parts by weight of a mixture of pearled hominy and meat meal. In compounding the supplemented diets, a portion of the pearled hominy and commercial meat meal was replaced by the supplement used.

TABLE I.
Incidence of short-boned embryos and chicks in eggs from birds receiving simple diets.

Supplement		——Embryos and chicks classified——		
		Total	Short-boned individuals	
Kind	Parts by wt.	No.	No.	%
None	—	300	16	5.33
Dried yeast cells	15	146	57	39.04
Rice bran	15	1,658	111	6.63
Wheat germ	15	871	11	1.26
" "	15			
Dried whey	10	268	0	0.00
Wheat germ	15			
Dried liver	10	441	0	0.00

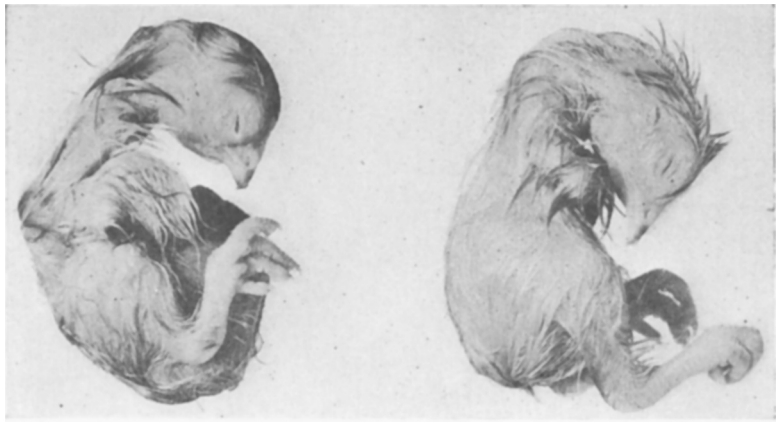

FIG. 1.
Short boned (left) and normal (right) embryos of 21 days' incubation.

The unsupplemented basal diet of Table 1 was shown by Ellis and coworkers,[1] by means of rat tests, to be very deficient in vitamins B and G. The eggs produced by the birds which received it were shown to be very deficient in vitamin B, but rat-feeding tests failed to indicate a marked G deficiency in these eggs. Barnum[2] has

[1] Ellis, N. R., Miller, D., Titus, H. W., and Byerly, T. C., *J. Nutr.*, 1933, **6**, 243.
[2] Barnum, G. L., *J. Nutr.*, 1935, **9**, 621.

shown that eggs produced by birds receiving the basal diet are deficient in vitamin E. The data presented have shown that the addition of vitamins B and G by means of yeast or rice bran certainly did not reduce the incidence of short-boned embryos. On the other hand, addition of wheat germ, which is a rich source of vitamin E, greatly reduced the incidence. Supplements of whey or dried liver, in addition to wheat germ, apparently eliminated the disease.

The diets fed the birds used in the experiments summarized in Table II contained 94-96 parts, by weight, of a basal feed mixture consisting of 50 parts, by weight, of ground yellow corn, 24.5 parts, by weight of wheat bran, 15 parts, by weight, of oat meal, and 5.5 parts, by weight, of alfalfa leaf meal. They also contained 6-4 parts, by weight, of a mineral mixture consisting of such quantities of ground limestone and steamed bone meal as were required to give a Ca/P ratio of about 2.5:1, and 0.5 parts, by weight, of common salt and anhydrous sodium sulphate, respectively. Cod-liver oil was added to the finally compounded diets in the quantities indicated in Table II.

TABLE II.

Incidence of short-boned embryos and chicks in eggs from birds which received a diet chiefly of vegetable origin with or without direct sunlight or cod-liver oil.

Supplement Kind	Parts by wt.	Embryos and chicks classified: Total No.	Short-boned individuals No.	Short-boned individuals %
Cod-liver oil	2	489	9	1.84
Sunlight through glass	—			
Cod-liver oil	2	3,734	7	0.18
Direct sunlight	—			
Cod-liver oil	2	643	0	0.00
Direct sunlight	—			
Range	?			
Cod-liver oil	0			
Direct sunlight	—	835	0	0.00
Range	?			

The data presented in Table II indicate that direct sunlight and perhaps some substance obtained from the soil or green plants are effective in reducing the incidence of short-boned embryos. Access to range may have induced the birds to expose themselves to direct sunlight for longer periods than the birds which had access only to concrete-floored runyards.

The diets fed the birds used in the experiments summarized in Table III contained 74-76 parts, by weight, of the same basal feed mixture as that used in the diets for the experiments summarized

in Table II, 6-4 parts, by weight, of a mineral mixture similar to that used in the diets for the experiments summarized in Table II which was varied to maintain a Ca/P ratio of 2.5:1, and the various supplements stated in Table III. The 3 pens in the commercial meat meal-cod-liver oil-high corn oil series received 2, 4, and 8 parts, by weight, of cod-liver oil and 6, 4, and 0 parts, by weight, of corn oil, respectively. Viosterol was fed in the 3 pens of the high corn oil series at a level of 10, 20, and 40 D units, respectively, and in the 4 pens of the low corn oil series at a level of 20, 80, 160, and 320 D units, respectively. The meat meal used in compounding these diets was obtained in a single lot while that used in the commercial meat meal-cod-liver oil-direct sunlight pens consisted of several lots purchased at various times and places. The commercial meat meal containing liver was a specially prepared product.

TABLE III.

Incidence of short-boned embryos and chicks in eggs from birds which received diets supplemented by different types of meat meal and vitamin sources with or without access to direct sunlight.

Supplement		——Embryos and chicks classified——		
		Total	Short-boned individuals	
Kind	Parts by wt.	No.	No.	%
Commercial meat meal	20			
Sunlight through glass		686	94	13.70
Cod-liver oil	2-8			
Corn oil	6-0			
Sunlight through glass				
Commercial meat meal	20	574	185	32.40
Viosterol	(see text)			
High corn oil	8			
Sunlight through glass				
Commercial meat meal	20	337	132	39.17
Viosterol	(see text)			
Low corn oil	0.5			
Commercial meat meal	20			
Cod-liver oil	2	4,036	27	0.67
Direct sunlight				
Special commercial meat meal containing 10% liver	20	9,994	6	0.06
Cod-liver oil	2			
Direct sunlight				

The data in Table III show a very great difference in incidence of short-boned individuals in eggs from confined birds and those with access to direct sunlight. Part of the difference is probably due to composition or mode of preparation of the meat meals used. The

data indicate, as do the data in Table 1, that liver contains some substance which reduces the incidence of the short-boned condition. The authors are not ready to advance an explanation for the difference between the sets of data from confined birds which received cod-liver oil and from those which received viosterol.

Summary and Conclusions. Abnormal embryos and chicks, with relatively short bones, were frequently produced in eggs laid by birds which received diets lacking in some factor or factors present in wheat germ, liver, and whey. The activity, amount or utilization of this factor or these factors was augmented by permitting the birds access to direct sunlight and green range.

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Reaction at Site of Injection of Mercurial Diuretics as Influenced by Theophylline.

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The comparative toxicity of mercurial preparations has usually been studied from the point of view of "minimal toxic dose" in the sense of causing death in a fixed period of time. The literature on this subject has been fully reviewed by Fourneau and Melville.[1] However, very little attention has been paid to the local reaction at the site of injection. The frequent occurrence of venous thrombosis and necrosis from the use of mercurial diuretics is of considerable importance. v. Issekutz and v. Vegh[2] combined a mercurial diuretic with theophylline and suggested that the latter, having weak acidic properties, neutralized the alkaline reaction (responsible for the pain) that is produced upon hydrolysis of the mercurial salt. This combination was introduced as novurit, but is known in this country as mercupurin.* Recently Fulton and Bryan[3] found that

[1] Fourneau, E., and Melville, K. I., *J. Pharm. and Exp. Therap.*, 1931, **41**, 21.

[2] v. Issekutz, B., and v. Vegh, F., *Arch. f. exp. Path. u. Pharm.*, 1928, **138**, 245.

* Mercupurin is a complex mercurial salt differing from that of salyrgan in possessing a cyclopentane instead of a benzol ring. In addition, it has 5% theophylline, 3.5% of which is claimed to be chemically bound to it. Aminophylline is the double salt or mixture of theophylline and ethylene diamine. It has the advantage over theophylline of greater solubility.

[3] Fulton, N. M., and Bryan, A. H., personal communication.