marked permeability increase. The actual membrane resistance of crustacean axons is of the order of 1500 ohms cm^2 for opener axons, 1000 ohms cm^2 for fast closer axons, and 800 ohms cm^2 for nonrepetitive medial giant axons(5) and a 25-40% reduction would place the R_m values in the range below 1000 ohms cm^2 where oscillatory activity is lost, critical firing level significantly increased, and conduction block may occur. In marked contrast, there was no such indication of a permeability increase in most *Panulirus* fibers even at 35°C or slightly higher (Fig. 2). Indeed, there was very little change whatsoever in *Panulirus* axon characteristics unless the temperature was raised to 40°C.

Discussion. These preliminary data indicate a very definite temperature tolerance difference between nervous tissues of *Homarus* and of *Panulirus* when the temperature is elevated. As the temperature of the surrounding medium is raised to 30°C and higher the nerve fiber membrane of *Homarus* becomes (non-selectively) permeable at a significantly lower temperature than does *Panulirus* nerve fiber membranes. The reasons for this species difference are not known. There is considerable evidence that a loss of selective permeability takes place with elevated temperatures(1,2,3,4) and a pronounced permeability decrease, even selective permeability decrease, with cooling(1,2,3,6). Thus, warming produces an intra-axonal loss of potassium and gain in sodium, accounting for inactivation at certain temperatures. Cooling, on the other hand, decreases the loss of potassium and gain in sodium even with continuous stimulation(3). But, with regard to function failure with heating, the important question, "Why should the nerve fiber membrane of one species become inactivated presumably by a profound permeability shift at a significantly different temperature value (lower) than the nerve fiber membrane from another closely related species?" remains unanswered. In this regard an investigation of the effects of temperature variation on nerve fibers of a single species, such as *Callinectes sapidus,* which may be taken from both northern and southern waters, should be of considerable interest and is presently under way.

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Relationship of Age and Sex of Turkeys to Aortic Ruptures Induced by Diethylstilbestrol.* (30222)

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Treatment of male turkeys with diethylstilbestrol (DES) produces a high incidence of aortic ruptures(1). Mortality rates can be modified by manipulation of the protein, energy, and salt content of the diet(2,3). Moreover, the estrogen causes hyperlipemia and relative hypotension in treated birds. However, all of these effects were produced in males which were injected for the first time

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at 10 weeks of age. Thus, the relationships of age and sex to DES-induced aortic ruptures have not been determined. This paper describes the effects of DES on male and female turkeys in which injections were initiated at 4 different ages.

Materials and methods. In all experiments, Broad-Breasted Bronze poults were raised by routine methods and fed a 20% protein commercial-chick-starter mash(2). At 4 weeks of age they were changed to a 19% protein diet which contained 0.5% NaCl (Diet 1). They were changed again at either 8 or 10 weeks of age to a diet that contained 23% protein, 6% animal fat, and 3.0% NaCl (Diet 2). Birds were injected subcutaneously in the neck region with 30 mg of DES in liquid form,† and these treatments were administered weekly until the experiments terminated. Birds were deliberately excited at least twice daily.

Whole blood was collected from 20% of the injected birds at the time of first injection and every other week thereafter for total serum cholesterol determinations(4). Indirect systolic blood pressures were measured on these same birds using a Physiograph‡ attached to the leg with an adjustable 1 inch wide cuff.

Experiment 1. Thirty-two male and 32 female poults were first injected with DES at 6 weeks of age; one-half of these were changed to Diet 2 at 8 weeks and the remainder at 10 weeks of age. Sixteen males and 16 females were first injected with DES at 8 weeks, and a similar number of each sex were treated initially at 10 weeks of age. These groups consisting of 64 turkeys were changed to Diet 2 at 10 weeks of age. Two control birds were included in each trial for every group of 8 birds that were injected. The experiment terminated when birds were 16 weeks of age.

Experiment 2 was a duplicate of Exp. 1 except that it was conducted 3 months later.

Experiment 3. Twenty-eight male poults were first injected with DES at 6 weeks, and an equal number of males were injected initially at 10 weeks of age. All birds were changed from Diet 1 to Diet 2 at 10 weeks of age. Three control birds were maintained for every group of 7 treated birds.

TABLE I. Relationship of Age and Sex to DES-Induced Aortic Ruptures.

Sex	Initial DES*	Diet change*	% mortality†—Exp: 1	2	3	4	5
♀	6	8	46	47			
♂	6	8	43	50			
♀	6	10	23	31			
♂	6	10	40	29	73		
♀	8	10	20	43			
♂	8	10	67	50			
♀	10	10	25	29			
♂	10	10	47	54	67		
♂	17	10				7	
♀	17	10					7
♂	17	10					0

* Age in weeks.
† Birds that died for reasons other than aortic rupture were not included in calculating percent mortality.

Experiment 4. Sixty-four male poults were first injected with DES at 17 weeks after being on Diet 2 since 10 weeks of age. Treatment continued weekly until the experiment terminated at 22 weeks. Two control poults were maintained for each group of 8 injected birds.

Experiment 5 was similar to Exp. 4 except that it involved 8 males and 16 females and was conducted 6 months later.

Results. The influence of age at time of first injection and sex on the incidence of aortic ruptures induced by DES is shown in Table I. Immature males and females were essentially equally susceptible to the disease when injected at 6 weeks of age; however, when injections were commenced at 8 or 10 weeks of age, males were more prone to the development of aortic ruptures. Treating of male or female poults initially at 6 weeks of age, with a diet change at 8 weeks caused about as great an incidence of aortic ruptures as occurred in male birds 10 weeks of age at the time of first DES injection. However, this was not true when male birds were injected initially at 6 weeks and the diet was changed at 10 weeks of age. This confirms an earlier report that changes in com-

† Caponade, Vineland Laboratories, Vineland, N. J.
‡ E&M Instrument Co., Houston, Texas.

TABLE II. Influence of DES on Systolic Blood Pressure of Turkeys.

Exp No.	Treatment	Sex	Systolic blood pressure* Time 1st DES	2 weeks after 1st DES	Last recording/ age‡
2	DES-6†	♂	165	165	180/15
2	Control-6	"	165	200	250/15
2	DES-6	♀	170	170	180/15
2	Control-6	"	170	200	250/15
2	DES-8	♂	200	180	180/15
2	Control-8	"	200	210	255/15
2	DES-8	♀	200	175	185/15
2	Control-8	"	200	210	250/15
2	DES-10	♂	210	200	180/15
2	Control-10	"	210	230	255/15
2	DES-10	♀	208	195	185/15
2	Control-10	"	208	220	250/15
3	DES-6	♂	165	175	170/16
3	Control-6	"	165	210	260/16
3	DES-10	"	220	190	175/16
3	Control-10	"	220	230	270/16
5	DES-17	"	270	220	180/21
5	Control-17	"	270	280	285/21
5	DES-17	♀	260	210	—
5	Control-17	"	260	265	—

* mm Hg.
† Numbers are age at 1st injection.
‡ Denominator is age in weeks.

position of the diet influence the incidence of aortic ruptures(3), and, in addition indicates that diet changes should occur in an interval between the first injection of DES and a period 2 weeks later. The incidence of aortic ruptures was insignificant when birds were first treated at 17 weeks of age.

Injection of DES resulted in increased total serum cholesterols. This was true regardless of sex or age (6, 8 or 10 weeks) at time of first injection. Total serum cholesterol levels of untreated males and females at 6 weeks of age averaged 140 mg/100 ml serum. Readings averaging 1100 mg/100 ml serum were recorded 4 weeks post-initial DES treatment, and values were not materially influenced by either sex or age at first injection. Data were calculated for this period because 95% of all mortality due to aortic ruptures occurred 10 to 24 days following the first treatment. Birds first injected at 17 weeks of age had average total serum cholesterol values of 927 mg/100 ml serum 3 weeks later, as compared to readings of 124 mg/100 ml for controls. Serum cholesterol values for males and females were approximately the same.

DES had a hypotensive effect for both male and female poults. The systolic blood pressures of both sexes, 2 weeks following the first injection at 6, 8, or 10 weeks, were usually the same but not more than 25 mm Hg lower or 10 mm higher than those recorded at time of first injection (Table II). Comparisons were made at this 2-week period because mortality patterns were well developed by this time. The systolic blood pressures of treated male and female birds, 19 weeks of age, were 50 mm of Hg lower than those recorded 2 weeks previously when treatment was commenced (Table II). The systolic blood pressures of normal males appeared to be stabilized after reaching 21 weeks of age, being 285 mm Hg.

Discussion. Substantial mortality was produced in male and female poults as a result of initiating DES treatment at 6, 8, or 10 weeks of age; however, females experienced greatest mortality when DES was first injected at 6 weeks of age. This is in contrast to reports of the natural occurrence of the disease in which males are stated to be more susceptible to the condition(5). Because of these reports, and until the present work, only male turkeys have been utilized in experimental studies of aortic ruptures that develop as a consequence of dissecting aneurysms.

The data in this paper do not resolve the debatable question as to the relationship of hypertension to the development of aortic ruptures(2). Nevertheless it becomes increasingly apparent as more observations are made of DES-induced aortic ruptures of turkeys that the primary factor involved in the development of fatal cases of the syndrome is loss of integrity of adjacent smooth muscle cells in the tunica media of the affected aorta. This has been shown in *Beta*-aminopropionitrile toxicosis in which loss of integrity was caused by elastolysis(6). Following such initial damage, it is possible that in some cases, such as DES treatment, an interplay of blood pressure is required for production

of the terminal lesion, which is aortic rhexis. In fact, lowering of systolic blood pressure in 2 weeks by 50 mm of Hg in turkeys treated initially at 17 weeks of age might be the reason that older turkeys were essentially refractive to DES-induced aortic ruptures. However, this explanation is not completely convincing because in Exp. 2 more females died which were injected first with DES at 6 weeks than did females which were treated initially at 8 weeks (Tables I, II). Yet, the systolic blood pressures of untreated 8 weeks old females were 200 mm Hg as contrasted to 170 mm Hg for 6 weeks old control females.

Summary. Male and female turkeys were first injected with DES at 6, 8, 10 and 17 weeks of age. A high incidence of aortic ruptures occurred in all birds except those which were injected initially at 17 weeks of age, and these were essentially refractory to the disease. Total serum cholesterol was elevated and systolic blood pressure was lowered by all treatments.

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Convulsive Responses in Developing Chickens.* (30223)

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Functional development of the nervous system of the chicken has been studied in a number of ways. For example, electroencephalographic activity has been recorded in chick embryos and was found to increase gradually in amplitude from the 15th day of incubation to hatching time(1,2). Castillo and Vizoso(3) reported that action potentials can be recorded on stimulation of the sciatic nerve in 9-day-old chick embryos. The conduction velocity was low on the 10th day of incubation and progressively increased to hatching time.

The present investigation was designed to study further the functional development of the chick embryo central nervous system (CNS) by observing maximal electroshock seizures (MES) and spinal cord convulsions.

Materials and methods. The chick embryos and chicks used in this study were from eggs of White Leghorn chickens. Spinal cord convulsions were produced by direct stimulation of the spinal cord. Square-wave, supramaximal (30V, 1 msec pulse duration) stimuli were delivered by a Grass stimulator. The technic of spinal cord stimulation was that described by Esplin and Freston(4) and modified by Vernadakis(5).

Maximal electroshock seizures were produced by a stimulator delivering a sine wave current of 60 cycles/sec for 0.2 second through corneal electrodes. The apparatus and techniques have been described in detail by Woodbury and Davenport(6). Stimulus intensities from 50 to 300 milliamperes (mA) were employed. Chick embryos younger than 14 days of incubation could not be stimulated since the embryos were too small to handle.

Results. Durations of leg flexion for 14-

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