EXPERIMENTAL STUDY OF THE CHICKEN AS A POSSIBLE TYPHOID CARRIER.*

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Since it has been shown by several investigators that some of the lower animals may, by experimental methods, be made typhoid carriers, attention should be given to animals which, by reason of environment or habits, might possibly become such. The work of Doerr,¹ Blumenthal,² and others has demonstrated that lower animals, particularly rabbits, quite readily become carriers when the organism is injected into the blood stream.

A domestic animal which frequently comes in contact with typhoid excreta is the chicken. If given an opportunity the chicken will readily partake of feces and the practice may be observed in a locality where open closets abound. The droppings of chickens are so widely scattered that they would be serious sources of danger should they contain typhoid bacilli. It must be borne in mind that the mechanical transference of typhoid bacilli on the feet and bill of a chicken does, without question, occur, but such transmission cannot be called "carrier transmission," which refers to the harboring and multiplication of the germs within the body of an animal.

The methods of administration of *B. typhosus* to chickens were as follows: first, the excreta of a typhoid patient, which upon culture yielded numerous typhoid colonies; second, the addition of stock cultures of *B. typhosus* to normal feces; and third, the addition of stock cultures to corn chop. All of these preparations were fed to chickens. Attempts were made at frequent intervals to isolate *B. typhosus* from the feces of the chickens and later, at autopsy,

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from various parts of the body. A fourth method was intravenous injection of typhoid bacilli and attempts at isolation as in the other experiments.

For the isolation of the typhoid bacillus, Endo medium was used. It was always freshly prepared just before using and large Petri dishes (fifteen centimeters in diameter) were employed. After the medium had cooled, three strokes were made on the surface with a bent glass rod which had been dipped into a sixteen to twenty-four-hour bouillon culture. The bouillon used for the first culture was 1.5 acid to phenolphthalein and ten cubic centimeters to the tube. Bouillon of this acidity has been found by Anderson and McClintic³ to be especially favorable to the growth of the typhoid organism.

On Endo medium the colon bacillus develops in from sixteen to twenty-four hours as pink or red colonies and the typhoid bacillus as small, translucent, dewdrop-like colonies. From all suspicious colonies stabs and streaks were made on dextrose-litmus-agar. If after twenty-four hours' incubation the tubes were blown up they were discarded. If they showed the absence of gas and acid they were also discarded. When, however, acid but no gas was produced agglutination tests with typhoid immune serum were made. If agglutination occurred more extensive cultural tests were made.

The chickens were kept in small coops, the bottoms of which were covered daily with new building paper. They were fed out of small deep pans in which the mixtures of feces or bacilli were placed. After each feeding the bills of the chickens were cleaned with a 1-500 bichloride of mercury solution and their feet were often sterilized in the same manner.

Experimental data.—On Feb. 12, 1914, two hens were placed in separate coops and cultures made from their feces to determine the normal intestinal flora. On Feb. 23, 1914, cultures were made from the excreta

of Mr. M., a typhoid patient. Typhoid bacilli were easily isolated from the feces.

From February 24 to March 14, a period of nineteen days, the chickens were fed upon the patient's feces nearly every day. Difficulty was experienced in getting the chickens to eat the feces, so that finally it became necessary to mix corn chop with them. During this time bouillon cultures and Endo plates were made daily from the feces of the chickens. In only four instances did the plates show suspicious colonies and these proved to be gas producers. Control cultures from the human feces showed *B. typhosus* to be present during the entire time of this experiment.

On March 21 the feeding of the chickens on normal human feces with two tubes of a twenty-four-hour bouillon culture of *B. typhosus* was begun. It was necessary to mix corn chop with the feces to induce the chickens to eat. Cultures were made daily for ten days from the feces but typhoid organisms were never recovered.

The two chickens were again placed in the coops on April 18th and fed on chop soaked in water to which two tubes of twenty-four-hour bouillon cultures were added each day. They were thus fed until May 9, when No. 1 was released. During the experiment cultures from the feces were constantly negative for *B. typhosus*. From May 9th to May 25th Chicken No. 2 was given all the typhoid corn chop it could eat. On May 25th No. 2 was killed and cultures taken from the heart's blood, liver, gall bladder, craw, gizzard, duodenum, jejunum, ileum colon, and anus. No typhoid organisms were isolated.

On May 14th another chicken was given an intravenous injection of two cubic centimeters of a suspension of typhoid organisms from an agar culture. The suspension was injected into one of the large superficial veins in the pit under the wing. Cultures from the feces for the next twelve days failed to reveal *B. typhosus*. Another intravenous injection was given on May 26th. Forty-eight hours after this injection the chicken was killed and cultures made from the liver, gall bladder, cystic duct, hepatic duct, gizzard, spleen, and kidneys. Except for a growth of *staphylococcus* from the liver, gall, and spleen the cultures were negative.

Controls were made from time to time of the strain of the typhoid bacillus used in these experiments to test the media. In all instances characteristic growths were produced.

CONCLUSIONS.

From the work done it would seem that the chicken is highly resistant to the typhoid organism. It not only fails to take the disease, but also, as these experiments seem to indicate, it cannot be made a carrier either by feeding the organism or by intravenous inoculation. The limited time, however,

in which the work was pursued and also the limited number of chickens used must be borne in mind in weighing the evidence adduced by these experiments, and a greater number of experiments covering a longer period should be done before it is said absolutely that the chicken cannot become a typhoid carrier.

REFERENCES.

1. Doerr, R. *Centralbt. für Bakt., etc., 1 Abt., Jena*, 1905, xxxix.
2. Blumenthal, E. *Centralbt. für Bakt., etc., 1 Abt., Jena*, 1910, lvii.
3. Anderson, J. F., and McClintic, T. B. *Hygienic Lab. Bulletin* No. 82.

TABLE — GIVING ESSENTIAL DATA FOR EACH INDIVIDUAL CASE.

	Diet.	Fowls Numbered.	Original Weight.	Per Cent Loss.	First Symptoms of Paralysis Appeared.	Duration of Disease. Bird Completely Paralyzed.	Termination of Experiment.	Histological Study of Sections.	Remarks.
GROUP I.	White bread made with yeast.	1	2910 gms.	16	22d day.	6 days.	Chloroformed sixth day of disease.	Sciatic nerves — axis cylinders swollen, no evidence of Marchi degeneration of sheath.	Forced feeding began on fifteenth day. About seventy-five grams given every other day.
		2	1975 "	16	26th "	4 "	Chloroformed fourth day of disease.	Sciatic nerve — mild Marchi degeneration of myelin sheath. Heart muscle, some infiltration of leucocytes.	Forced feeding began on twelfth day. Seventy-five grams every other day.
		3	2465 "	23	22d "	3 "	Chloroformed third day of disease.	Sciatic nerve — mild Marchi degeneration of myelin sheath.	Forced feeding began on tenth day. Seventy-five grams every other day.
		4	1700 "	25	40th "		Chloroformed on day first symptoms of paralysis appeared.	Sciatic nerves and heart muscle — both negative.	No forced feeding.
		38	2982 "	32	33d "	4 days.	Chloroformed fourth day of disease.	Sciatic nerves — marked diffuse Marchi degeneration of myelin sheath. Leg muscles, marked fatty infiltration. Selective action for certain fibers.	No forced feeding. On nineteenth day given a feeding of corn by mistake.
		42	2300 "	44	42d "	7 "	Chloroformed seventh day of disease.	Sciatic nerves and leg muscles — same findings as in number 38.	No forced feeding. On nineteenth day given a feeding of corn by mistake.
		47	1972 "	40	39th "	9 "	Chloroformed ninth day of disease.	Sciatic nerves and leg muscles — same findings as in number 38.	No forced feeding. On nineteenth day given a feeding of corn by mistake.
		46	2964 "	38	60th "	8 "	Chloroformed eighth day of disease.	Sciatic nerves and leg muscles — same findings as in number 38.	No forced feeding. On nineteenth day given a feeding of corn by mistake. After disease appeared given alcoholic extract whole wheat bread in an effort to prolong life.
		30	2857 "	38	82d "	10 "	Chloroformed tenth day of disease.	Sciatic nerves and leg muscles — same findings as in number 38.	No forced feeding. On nineteenth day given a feeding of corn by mistake. Alcoholic extract of whole wheat bread given as in case number 46.
		50	3201 "	33	40th "	2 "	Fowl found dead.	Sciatic nerves and leg muscles — same findings as in number 38.	No forced feeding. On nineteenth day given a feeding of corn by mistake.
GROUP II.	White bread made without yeast.	5	2082 gms.	30	24th day.	12 days.	Chloroformed twelfth day of disease.	Sciatic nerves — some evidence of mild Marchi degeneration of myelin sheath. Not convincing.	Forced feeding began on twelfth day. Seventy-five grams every other day. During illness given wheat bran. No marked improvement but life apparently prolonged.
		6	2705 "	25	24th "	4 "	Chloroformed fourth day of disease.	Sciatic nerves negative.	Forced feeding began thirteenth day. Seventy-five grams every other day.
		7	1715 "	40	34th "	4 "	Chloroformed fourth day of disease.	Sciatic nerves — evidence of mild Marchi degeneration of myelin sheath.	No forced feeding.
		8	2608 "	20	19th "	6 "	Found dead morning of seventh day of disease.	Sciatic nerves and heart muscle negative.	Forced feeding began on sixteenth day. Seventy-five grams every other day.
GROUP III.	Whole wheat bread made without yeast.	9	No weight records kept.				Fowl well for 45 days, then died suddenly without previous symptoms.	Sciatic nerves apparently normal.	Autopsy showed congested lungs with considerable solidification.
		10	1700 gms.	15			Chloroformed after seventy-five days.	Sciatic nerves apparently normal.	Experiment lasted seventy-five days. Fowl perfectly well during entire time.
		11	1919 "	2 gain.	} gain. 5 gain. 4 loss.	}	Fowls put back on normal diet after seventy-one days.		Experiment lasted seventy-one days. All fowls perfectly well during this time.
		12	1975 "	5					
		13	1558 "	4					
GROUP IV.	White bread with yeast plus 75 gms. corn once a week.	39	3556 gms.	20	}		Fowls chloroformed after seventy-eight days.	Sciatic nerves and muscles normal.	Experiment lasted seventy-eight days. Both fowls remained perfectly well throughout this time.
		40	2140 "	14					
GROUP V.	Houiny.	14	1919 gms.	50	40th day.	4 days.	Chloroformed fourth day of disease.	No tissues examined.	No forced feeding.
		15	2000 "	50	59th "	10 "	Found dead tenth day of disease.	Sciatic nerves — marked Marchi degeneration of myelin sheath.	No forced feeding.
GROUP VI.	Whole corn.	16	2055 gms.	9 gain.	} gain. 20 loss.		Fowls put back on normal diet after sixty-three days.		Both fowls remained perfectly well for sixty-three days.
		17	1925 "	20					
GROUP VII.	Wheat grain in kernel.	18	1938 gms.	2 gain.	} gain. .5 loss.		Fowls put back on normal diet after sixty-three days.		Both fowls remained perfectly well for sixty-three days.
		19	2047 "	.5					
GROUP VIII.	White rice, gradual reduction in amount of food until nothing but water given.	20	2130 gms.	40	36th day.	8 days.	Chloroformed eighth day of disease.	Sciatic nerves — mild Marchi degeneration of myelin sheath.	No forced feeding.
		21	2020 "	30	29th "	3 "	Fowl found dead morning of fourth day of disease.	Sciatic nerves — mild Marchi degeneration of myelin sheath.	No forced feeding.
GROUP IX.	Starvation diet. Gradual reduction in amount of food until nothing but water given.	22	No weight records kept.		55th day.	4 days.	Fowl found dead fourth day of disease.	Sciatic nerves — no clear-cut evidence of Marchi degeneration.	Fowl went without any food whatsoever, except water, for thirty-eight days, disease not typical of polyneuritis.
		23	1940 gms.	50	67th "	10 "	Fowl found dead tenth day of disease.	Liver — many areas of necrosis, no fat vacuoles seen. Sciatic nerves — no good evidence of Marchi degeneration.	Fowl went without food, except water, for fifty-six days. Disease did not run typical course. Fowl found dead after appearing slightly unsteady for ten days.