Table 1 shows the results of pneumococcus rat protection tests with DRI rabbit antiserum B-4651 against culture types I, II, V, VIA, VII, VIII and XIV. It is observed that the DRI antiserum gives marked cross-immunity against all the types of pneumococci used.

It appears that rat protection tests show wider non-type-specific action of rabbit antipneumococcus serum than do mouse protection tests. Proper selection of culture as antigen contributes to the preparation of broad coverage rabbit antiserum. Just as heterophile antibodies can not be produced by the immunization of horses, it likewise appears that other antigenic components of the pneumococcus engender better response in the rabbit than in the horse. While heterophile antigen and antibody play a part in selection of culture and production of antiserum, it is evident that other factors likewise are of importance. More appropriate terms for use in discussing the broad coverage antipneumococcus serum may well be "somatic antigen" and "somatic antibodies."

On the basis of the results obtained in rat protection tests with DRI serum, the possibility of the development of a breed coverage antipneumococcus serum sufficiently high in "somatic" (species specific) antibodies to be of therapeutic value is indicated.

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THE AVAILABILITY OF MANGANESE IN AVIAN DIGESTION

THE perosis-aggravating action of certain calcium and phosphorus salts has long been known, but no explanation for this action has been advanced. The great contrast between the efficient utilization of manganese injected peritoneally[1] and the inefficient utilization of the manganese in the diet, particularly in the presence of high levels of calcium and phosphorus,[2] suggested that in the latter case the manganese may be rendered unavailable due to reactions within the intestinal tract. The fact that tri-calcium phosphate is dissolved in the upper part of the digestive tract, and is reprecipitated in the lower part, suggested that such an action might be responsible for rendering manganese unavailable through either adsorption or chemical combination.

This hypothesis was tested *in vitro* by precipitating calcium phosphate from solutions containing calcium, phosphate and manganous ions in known amounts approximating the concentrations previously used in producing perosis in this laboratory. Analyses of the precipitate, filtrate and washings showed that the manganese was carried down quantitatively by the calcium phosphate precipitate.

These results were substantiated by *in vivo* experiments. Dialysis of the contents of the digestive tracts of White Leghorn pullets showed that manganese in the digestive tract, in the excreta and even in the ration is rendered markedly less diffusible by the addition of excessive steamed bone meal to the diet. It has also been observed in this laboratory that as little as 0.17 per cent. of ferric citrate added to the basal diet caused an increase in the severity of perosis. It was observed *in vitro* that ferric chloride solution, when boiled with a known concentration of manganous ions present, allowed to pass through the colloidal state and precipitated by neutralizing with sodium hydroxide, removed the manganese quantitatively from solution.

It therefore appears that the perosis-producing action of calcium phosphate and of ferric citrate is due at least in a large part to the removal of manganese from solution in the intestinal tract, either by adsorption or chemical combination. This would also explain the perosis-aggravating action of calcium carbonate, since the presence of this compound in excess favors the formation of tri-calcium phosphate in the digestive tract. On the other hand, phosphoric acid and its monosodium and disodium salts, when added to a diet relatively low in calcium, would not tend to form tri-calcium phosphate. Consequently, the addition of these compounds to the diet should not increase the severity of perosis, and such has been shown to be the case.[3,4]

It would seem possible that the interference of calcium salts with iron assimilation,[5] the greater requirement for iodine on a high-calcium diet and other similar instances might prove to be explainable on a like basis.

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[1] M. Lyons, W. M. Insko and J. H. Martin, *Poultry Science*, 17: 12, 1938; C. D. Caskey and L. C. Norris, *ibid.*, 17: 433, 1938; A. C. Wiese, B. C. Johnson, C. A. Elvehjem and E. B. Hart, SCIENCE, 88: 383, 1938.

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[3] Unpublished results, Colorado Agricultural Experiment Station.

[4] P. J. Schaible, J. M. Moore and R. A. Conolly, *Poultry Science*, 12: 324, 1933.

[5] S. W. Kletzien, *Jour. of Nutrition*, 15: 6, 1938.

MOVEMENT OF RADIOPHOSPHORUS IN BEAN SEEDLINGS[1]

BEAN seedlings (var. Red Mexican) were allowed to

[1] The writer wishes to express his appreciation to the National Research Council for aid in this project, also to Drs. E. O. Lawrence and J. H. Lawrence for the sample of radiophosphorus.

grow for varying lengths of time in a nutrient solution containing radiophosphorus (obtained through the courtesy of E. O. Lawrence) at the approximate concentration of 3.5 uc/cc. The bean seedlings had been previously grown without phosphorus, and at the time of use gave slight evidence of phosphorus deficiency by the dark color of the leaves. When placed in the solution containing radiophosphorus, the opposite leaves and the first alternate leaf appeared fully mature. The third alternate leaf was just unfolding.

The plants were placed, one after another, in the radiophosphorus containing nutrient solution. After the required interval of time the plant was removed, the roots carefully washed and the plant dissected and placed in the drying oven. When thoroughly dry the parts were ground to a fine powder and samples weighed for analysis. Each sample was placed in a thin Cellophane (du Pont #3100) cone, which was mounted immediately above the sensitive window of a Geiger counter. The Neher-Harper "High Speed Geiger-Counter Circuit"[2] in connection with "A Direct-Reading Counting Rate Meter for Random Pulses"[3] was used for detecting radiophosphorus in the plant samples. The results are shown in Table I.

TABLE I

DISTRIBUTION OF RADIOPHOSPHORUS IN VARIOUS PARTS OF BEAN SEEDLINGS

Length of time in solution	48 hrs.	24 hrs.	2½ hrs.
Mg. of sample used	4 mg.	10 mg.	10 mg.
	Counts/min.	Counts/min.	Counts/min.
Roots	2,364*	1,968	1,092
Hypocotyl } Stem }	804	744 468	228
Opposite leaves	1,104	504	144
First alternate leaf	1,934	888	204
Second alternate leaf	2,124	1,380	240
Third alternate leaf	2,364*		216
Background	36		

* Counter reached end of scale. True value slightly higher.

It was possible, under conditions of the experiment, to detect radiophosphorus in the uninjured plant by moving the shielded counter tube over the leaves and stem. In order to get away from stray radiation, the following technique was adopted.

Discs of fresh leaf tissue were cut from a plant which had been in the radiophosphorus containing nutrient solution for two and one half hours. They were held over the sensitive window of the Geiger counter. A lead shield with a circular hole 7.5 mm in diameter was used to determine the area of leaf tissue exposed to the sensitive window of the counter tube. The results are shown in Table II.

[2] H. V. Neher and W. W. Harper, *Phys. Rev.*, 49: 940, 1936.

[3] N. S. Gingrich, R. D. Evans and H. E. Edgerton, *R. S. I.*, 7: 450, 1936.

TABLE II

DISTRIBUTION OF RADIOPHOSPHORUS IN FRESH LEAF TISSUE

	Counts/min.	Distance from base of hypocotyl
Opposite leaves	10	18.0 cm
First alternate leaf,		
tip leaflet	46	25.5 "
lateral leaflet	54	23.4 "
Second alternate leaf,		
tip leaflet	20	22.3 "
lateral leaflet	62	20.6 "
Third alternate leaf,		
tip leaflet	38	18.7 "
lateral leaflet	33	17.8 "
Background	36	

The results indicate that phosphorus may be absorbed by the apparently uninjured roots of phosphorus-deficient plants and transported at a rate exceeding 10 cm/hr. From the distribution of radiophosphorus in the plant it appears that movement in the aerial parts is dependent on the transpiration stream, and that the "excretion" of phosphorus into the xylem occurs only after considerable accumulation has taken place in the living cells of the root. Detailed results will be published elsewhere.

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