carbon, mixed with cotton pulp and dried in a current of warm air. Colorimetric tests for tryptophane (Hopkins-Cole, Rosenheim) were negative. The mixture was placed in the diet in lieu of the whole casein and cotton pulp. Results with this diet are given in Table II.

It will be seen from Table II that chicks given only the basal diet suffered a distinct loss in weight. This loss was clearly indicated within the first 24 hours of the experiments. Evidently, there was no appreciable tryptophane reserve. On the other hand, growth took place in the groups receiving as little as 0.2% l-tryptophane in the diet. The tendency of the latter groups to grow was also clearly indicated within 24 hours in most cases, although there was some evidence that chicks did not become fully accustomed to the new diet in this length of time. The magnitude of the differences in growth rates would indicate that the basal diet was practically free of tryptophane but that no other serious deficiency existed.

Maximum rate of growth was attained at 0.5 to 0.6% of added l-tryptophane. This rate was substantially less than that of chicks on the whole casein diets. Such differences in growth-promoting values of whole as compared to hydrolysed casein for the chick have been previously reported[2, 3] even in the case of enzymatic hydrolysis,[3] and are, therefore, to be expected.

Summary. The l-tryptophane requirement for optimum growth of the young chick is approximately 0.5% of the diet.

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Similarities and Possible Relationships Among Viruses of Psittacosis, Meningopneumonitis, and Lymphogranuloma Venereum.

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Findlay, Mackenzie and MacCallum[1] have described a developmental cycle for the virus of lymphogranuloma venereum in the brains of infected mice and have pointed out that the developmental

2 Klose, A. A., Stokstad, E. L. R., and Almquist, H. J., *J. Biol. Chem.*, 1938, **123**, 691.

3 Stokstad, E. L. R., *Poultry Science*, 1940, **19**, 42.

1 Findlay, G. M., Mackenzie, R. D., and MacCallum, F. O., *Nature*, 1938, **141**, 877; *Trans. Roy. Soc. Trop. Med. and Hyg.*, 1938, **32**, 183.

forms present many analogies to those exhibited by the causal agent of psittacosis.[2, 3] More recently Rake, Jones and Shaffer[4] have studied the developmental cycle of the virus of lymphogranuloma venereum in the yolk-sac cells of the developing chicken embryo and have pointed out the quite amazing similarity in morphology and staining reaction between the respective developmental forms in the two viruses.

The viruses of lymphogranuloma venereum, psittacosis, meningopneumonitis,[5] and a virus causing atypical pneumonia in human beings[6] all produce meningitis after intracerebral inoculation, and pneumonia after intranasal inoculation in mice, and the lesions thus produced by each of the viruses are practically indistinguishable grossly or microscopically. After intradermal or subcutaneous injection these 4 agents produce granulomatous infiltrations in the skin of experimental animals.

Since the development of complement fixation tests for lymphogranuloma venereum,[7] and psittacosis, fixation with sera from venereally exposed but clinically non-lymphogranulomatous persons and certain lymphogranuloma venereum antigens has been observed.[8] False positive complement fixation reactions between psittacosis antigen and sera from syphilitic persons have also been reported.[9, 10] It was noted particularly[8] that as far as complement fixation between the lymphogranuloma antigen and the sera of venereally exposed persons was concerned, there was no correlation with the results of the Wassermann test. Persons with gonorrhea who had a negative Wassermann reaction gave positive lymphogranuloma fixation in as high a proportion as did syphilitics. The possibility that subclinical infection with the virus of lymphogranuloma venereum might be the common factor in these cross reactions, and the other similarities of the viruses under consideration as noted above, led us to investigate the serological relationship of these viruses.

On investigation, cross-reactions between the 3 viruses by comple-

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3 Yanamura, H. Y., and Meyer, K. F., *J. Inf. Dis.*, 1941, **68**, 1.

4 Rake, G., Jones, H. P., and Shaffer, M. F., *Am. J. Path.*, 1941, **17**, 460.

5 Francis, T., Jr., and Magill, T. P., *J. Exp. Med.*, 1938, **68**, 147.

6 Eaton, M. D., Beck, M. D., and Pearson, H. E., *J. Exp. Med.*, 1941, **73**, 641.

7 McKee, C. M., Rake, G., and Shaffer, M. F., PROC. SOC. EXP. BIOL. AND MED., 1940, **44**, 410.

8 Shaffer, M. F., Rake, G., Grace, A. W., McKee, C. M., and Jones, H. P., *Am. J. Syph., Gon. and Ven. Dis.*, in press.

9 Bedson, S. P., *Lancet*, 1935, **2**, 1277.

10 Meyer, K. F., and Eddie, B., *J. Inf. Dis.*, 1939, **65**, 225.

TABLE I.

Cross Reaction in Complement Fixation Tests with Sera and Antigens of Psittacosis, Meningopneumonitis and Lymphogranuloma Venereum.

Serum	Case	Complement fixation titre with antigen from virus of: Psittacosis	Meningopneumonitis	Lymphogranuloma venereum
L.G.V. No. 9	Lymphogranuloma venereum		16	>240
L.G.V. No. 31	" "		8	120
L.G.V. No. 45	" "		4	>120
L.G.V. No. 51	" "	32		>120
L.G.V. No. 60	" "	256		>120
L.G.V. No. 66	" "	128		120
Ps. 7	" "	+		>240
Ps. 11	" "	++		>240
Rs	" "		8	16
Pu	" "		32	32
A.R. 11	Psittacosis	++		480*
A.R. 13	"	++		240*
A.R. 18	"	++		120*
Ps. 1	" (Pigeon)	+		< 15
2	" "	++		480
3	" "	+		120
4	"	+		>240
5	"	++		480
8	"	++		>1920
9	"	++		240
6	Pneumonitis	+		120
B†	"	256	32	64
P†	"	64	16	32*
Da	"	32	8	30
Gu	"		8	30
Rod.	"	4	8	6
MG.	"	256	16	32
LC.	"		32	4
St‡	"		16	16
Mi	"		64	32
Mey†	"		8	32
Jo‡	"		64	16
Ma†	"		8	8
Ra‡	"		16	32
Gr†	"		8	8
W.P.M.†	Contact with pneumonitis		0	0
M.D.E.‡	" " "		0	0
O.B.†	" " "		0	0

*Fixation also with soluble antigen of lymphogranuloma venereum.
†Frei test positive.
‡Frei test negative.
+ positive.
++ strongly positive.

ment fixation have been found. Thus it will be seen from Table I that sera from cases of lymphogranuloma venereum fix not only with their homologous antigen, but also with antigens prepared from the viruses of psittacosis or meningopneumonitis; sera from cases of psittacosis fix not only with homologous antigen but also in high

dilution with the antigen from lymphogranuloma venereum; while sera from cases of atypical pneumonia fix not only the meningopneumonitis antigen but also with antigens from lymphogranuloma venereum or psittacosis. None of the antigens gave fixation with normal human sera. The tests with psittacosis antigen on sera furnished by us were kindly done by Dr. K. F. Meyer at the laboratories of the George Williams Hooper Foundation, San Francisco. The psittacosis sera tested by us were received through the kindness of Dr. Meyer. More detailed studies with sera of immunized animals are being done in order to determine the exact nature of the cross reaction. The tests suggest the presence of a common antigenic factor in the viruses of psittacosis, meningopneumonitis, and lymphogranuloma venereum, but the possibility of cross reactions between these antigens and other unrelated viruses or microörganisms has not been completely excluded at the present stage of the work.

As is also shown in Table I, preliminary tests with soluble antigen prepared from virus of lymphogranuloma venereum[11] have shown that the heterologous fixation can be produced with this antigen. Whether it is responsible for all of the heterologous reaction remains to be investigated. Moreover, preliminary Frei tests carried out with the lymphogranuloma venereum yolk-sac antigen (Lygranum) have shown that in 5 out of 8 cases of atypical pneumonia a positive skin reaction could be elicited. Thus the antigen responsible for this reaction would seem to be either the same as that producing the cross reaction in the complement fixation test or another antigen common to this group of viruses.

Experiments to test the relationship by another method, namely, active immunity tests in mice, have shown that the viruses of meningopneumonitis and lymphogranuloma venereum do produce a reciprocal partial cross immunity.[12] Preliminary tests at New Brunswick suggest that some cross-relationship may exist between the viruses of lymphogranuloma venereum and meningopneumonitis as far as passive immunity is concerned.

From the fact that the viruses of psittacosis, meningopneumonitis, and lymphogranuloma venereum share similar morphology, developmental forms, and tinctorial characteristics, as well as common or closely related antigenic constituents, it is apparent that differentiation of these viruses must be made on the basis of source, quantitative antigenic differences, and a comparison of the differences in their pathogenicity for experimental animals.

11 Rake, G., Shaffer, M. F., Jones, H. P., and McKee, C. M., PROC. SOC. EXP. BIOL. AND MED., 1941, **46**, 300.

12 Eaton, M. D., Martin, W. P., and Beck, M. D., *J. Exp. Med.*, to be published.