

mental canine pneumonia accompanied by bacteremia. In such instances consolidation of at least one lobe occurs and the usual finding is that of multilobar involvement.

To control shock effect as a possible factor in these results, non-specific protein shock was induced in 5 dogs, at the time of infection, by the intravenous injection of peptone and precipitable substance from uninoculated culture media. One developed a mild transient bacteremia; all recovered. Heterologous SSS (Type II and III) was given to 4 dogs. Although bacteremia occurred in all cases (one death in an animal developing multilobar involvement and empyema) the lesions produced were similar to those of the control series and involved the entire infected lobe. Only one dog had complete loss of serum pneumococcal-promoting power which occurred at the time of a demonstrable empyema 24 hours post infection.

Conclusions. Intravenous administration of 0.1 g or more per kg of SSS produces death in normal dogs. 0.03 g per kg was found to be compatible with life. Injection of this quantity produced marked alteration in the usual course of the disease. Although serum-leukocyte mixtures did not always show complete abolition of blood pneumococcal power, the presence of this substance in the blood and tissues resulted in overwhelming bacteremia, inability of the dog to localize infection and impaired phagocytosis in the pulmonary lesion.

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Neutralizing Antibodies Against St. Louis and Western Equine Encephalitic Viruses in Horses and Fowl.

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It had previously been noticed that certain serums from healthy domestic fowl in California¹ showed neutralizing antibodies against the Br strain of western equine encephalomyelitic virus. Serums from areas where this disease is endemic appeared to yield more positive results than those from supposedly non-endemic regions. A correlation had also been observed with human serums between the presence of antibodies for both the western equine virus and that

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¹ Howitt, B. F., *J. Inf. Dis.*, 1940, **67**, 177.

of the St. Louis encephalitic type. About 26% of 69 serums of encephalitic patients in the Central Valley areas of California were positive to both viruses.²

To determine if a similar relationship existed with animals, neutralization tests were performed on serums of domestic fowl and horses collected from endemic and presumably non-endemic areas of California.[†] The same technic and the same strains of virus (Br and St. Louis) were used as previously described,¹ the serums being considered positive or weakly positive according to the number of virus dilutions neutralized.

It was interesting to find that antibodies against the St. Louis virus were present in the blood of many horses and domestic fowl and that, with but a few exceptions, they were in association with the neutralizing substance against the western equine virus. Of 43 unvaccinated normal horses and 2 recovered animals from the endemic regions of Kern, Fresno and Yolo Counties, all (95.3%) except 2 showed neutralizing antibodies against the western equine virus. With the exception of 10, the serums were positive to the St. Louis virus as well, but none was positive to the latter alone. Serums were tested from 19 horses vaccinated against the equine strain in a Northern California area. All were positive to the homologous virus but were negative to that of the St. Louis. Of 3 unvaccinated animals 2 were negative to both strains and one weakly positive to the equine. Many of these horses had been imported from the East, and therefore had not been long exposed to the western environmental factors.

Of 12 horses from coastal areas where encephalomyelitis was rarely reported, 4 (33.3%) showed antibodies for the equine virus and 2 for the St. Louis (16.6%). It was among the latter group that one serum was positive to this virus alone. Nine unvaccinated horses were bled from the supposedly non-endemic desert portion of Kern County. Four were negative to both viruses and 5 positive to the equine strain, while all were negative to the St. Louis.

By far the greatest proportion of serums positive for both viruses was obtained from known endemic regions, 100% of the 21 Kern County horses in the farming areas being positive to the equine and

² Howitt, B. F., *Am. J. Pub. Health*, 1939, **29**, 1083.

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90.9% to the St. Louis virus as well, while at Davis in Yolo County 100% of the 15 unvaccinated horses had antibodies for the equine and 78.5% for both viruses.

The same relationship in antibody formation was found for the serums of domestic fowl as for the horses. Of 96 chicken serums from known endemic regions, 43 (46.8%) were positive against the equine virus and 23 (25.5%) of 90 serums tested were positive against the St. Louis strain. All of the birds were over 1 or 2 years of age and had lived through at least one summer, when an inapparent infection might have occurred. Of 65 normal chickens, mainly White Leghorns, from non-endemic coastal areas, including 28 hatched at the laboratory, only 5 (7.0%) showed antibodies for the equine virus and none for the St. Louis. All the positive birds came from one place. None of those from the 3 other regions nor those hatched in the laboratory was positive. Ten old hens survived an intracerebral injection of the St. Louis strain but one 3-weeks-old chick and one English sparrow both succumbed. The virus was recovered from the brains of each bird.

The largest number of serums positive to the equine virus came from chickens of varied breeds on small farms in Kern County, where either human or equine cases of encephalomyelitis had occurred. Only those birds were bled that had been present at the time of the illness. Twenty-two (66.6%) serums out of 33 protected against the equine virus, while 12 (42.8%) gave protection against the St. Louis strain. All those positive to the latter were also positive to the equine virus. Blood from 12 chickens of non-encephalitic homes in the city of Bakersfield, Kern County, showed 4 (33.3%) positive tests for the equine virus and one weakly positive for the St. Louis strain as well.

The 27 serums from the endemic Davis area only showed 4 (14.8%) positive to the equine strain alone and 3 (11.1%) to the St. Louis. These birds had largely been kept within breeding pens, not roaming at large. On the other hand 13 turkeys from Davis that were allowed more freedom to range outside, showed 8 positive serums (61.5%) for the equine virus and none for the St. Louis. The serums of one out of 5 ducks, 2 out of 5 pheasants, and of 2 peacocks from the endemic areas were positive for the equine virus. The latter also had antibodies for the St. Louis strain and one duck was weakly positive for this virus alone.

It is difficult to decide as to the significance of the antibodies to both of these viruses among apparently healthy domestic animals, especially when it had been found¹ that fowl without neutralizing

substances were often insusceptible to either virus. Further work is being done in this regard, however, and a detailed discussion will be presented later. At present, there is apparently a correlation between certain environments contributing the clinical disease in man and horses and the development of antibodies to both viruses in the blood of fowl and horses. A common vector or common reservoir may be responsible for both apparent and inapparent infections.

Because of the presence of neutralizing substances for the St. Louis virus among relatively insusceptible animals, one may surmise that man is not the only host for this disease, which may be more widespread in nature than supposed. Harrison and Moore³ have found young chicks somewhat susceptible, Pearson⁴ has reported that although clinical symptoms are absent, the virus may persist in the brain of chicks up to 20 days after inoculation, and Broun, *et al.*,⁵ have shown that the hamster can be readily infected. These findings may alter the previous supposition that the St. Louis virus had been imported to California from the midwest states² and lead one to consider its possible endemicity in an environment common to the virus of equine encephalomyelitis. Recent observations have shown that similar conditions may occur in the Yakima Valley, Washington,⁶ and since this work was done, Philip, Cox and Fountain⁷ and Cox, Philip and Kilpatrick⁸ have not only found neutralizing antibodies to the St. Louis virus in horses but have proven the latter experimentally susceptible to this virus. More recently Hammon, *et al.*,⁹ have recovered the viruses of both western equine and St. Louis encephalitis from the mosquito, *Culex tarsalis*, taken in the Yakima Valley.

³ Harrison, R. W., and Moore, E., *Am. J. Path.*, 1937, **13**, 361.

⁴ Pearson, H. E., *PROC. SOC. EXP. BIOL. AND MED.*, 1940, **44**, 413.

⁵ Broun, G. O., Muether, R. O., Mezera, R. A., and LeGier, M., *PROC. SOC. EXP. BIOL. AND MED.*, 1941, **46**, 601.

⁶ Hammon, W. McD., and Howitt, B. F., in press; Hammon, W. McD., *J. A. M. A.*, 1941, **117**, 161.

⁷ Philip, C. B., Cox, H. R., and Fountain, J. H., *Pub. Health Rep.*, 1941, **56**, 1388.

⁸ Cox, H. R., Philip, C. B., and Kilpatrick, J. W., *Pub. Health Rep.*, 1941, **56**, 1391.

⁹ Hammon, W. McD., Reeves, W. C., Brookman, B., Izumi, E. M., and Gjullin, C. M., *Science*, 1941, **94**, 328.