differs markedly from phenobarbital, whose central depressant action we have found[4] to reduce the mortality from anaphylactic shock by over 50%.

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Intranuclear Inclusions in Pertussis.

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For many years pathologists have been interested in a peculiar type of pneumonia that frequently complicates certain epidemic diseases, termed interstitial bronchopneumonia because of the cellular infiltration in the walls of the bronchioles and alveoli, and commonly seen in epidemic influenza, measles and pertussis. Dr. Muckenfuss and I[1] have been impressed by the similarity of the pneumonia produced by vaccine virus in the rabbit's lung to human interstitial pneumonia. We, therefore, suspected that a virus might be concerned with human interstitial pneumonia in measles, influenza and whooping cough. Measles is a virus disease, and many investigators now believe that the primary etiological agent of epidemic influenza may also be a virus. On the other hand, the Bordet-Gengou bacillus is almost universally regarded as the etiological agent of pertussis; although a critical study of the relation of this bacterium to the disease reveals many discrepancies. (Löwenthal and St. Zurukzoglu.[2]) Furthermore, a vaccine prepared from the bacillus is of doubtful value both as a prophylactic and as a curative agent. Pertussis sometimes is complicated by encephalitis, as are the known virus diseases such as measles and vaccinia. Finally, the interstitial character of the pneumonia associated with pertussis is similar to that seen in other virus diseases and therefore suggests the possibility of a virus in pertussis also.

Since inclusion bodies are associated with many virus diseases, we examined the sections from 35 cases of pertussis and found intranuclear inclusions in the lungs of 12. These were found in the cells lining the alveoli as well as in the bronchial epithelium. The cells containing the inclusions were always larger than their neigh-

[1] Muckenfuss, R. S., McCordock, H. A., and Harter, J. S., *Am. J. Path.*, 1932, **8**, 63.

[2] Löwenthal, W., and St. Zurukzoglu, *Kolle u. Wassermann*, 1928, **5**, 1271.

bors and their cytoplasm more basophilic. In a few cases, they were found in liver cells about areas of necrosis and, under the same circumstances, in cells of the adrenal. They have been observed also in the mucous glands of the smaller bronchi. These inclusions are acidophilic, and a clear zone separates the inclusion from the nuclear membrane to which small fragments of chromatin are often found adhering.

As control material we examined the organs from 90 autopsies, in none of which pertussis had been diagnosed. Of these, 78 were children dying of various diseases, including measles, diphtheria and epidemic influenza, and 12 were adults who succumbed to influenza during the 1918-19 pandemic. In the lungs of 2 of the infants, 4 and 5 months old, similar inclusions were found. In each instance there was present also a peribronchial infiltration with large mononuclear cells and lymphocytes.

The presence of these inclusion bodies in slightly more than one-third of all the cases of pertussis and their absence in all but 2 of the 90 control cases seems significant.

Intranuclear inclusions not unlike those described here in association with pertussis have been found in various organs by a number of investigators. Jesionel and Kiolemenoglou[3] first reported them in the lungs, liver and kidneys of a premature syphilitic foetus. Farber and Wolbach,[4] reviewing the literature, tabulate 8 reported cases in which such inclusions were found in the lungs and add 2 more of their own. Von Glahn and Pappenheimer[5] report inclusions in the organs of a man 36 years old, but all the other reported instances noted in the lungs, concerned either stillborn foetuses or infants under 2 months of age. Pneumonia or interstitial cellular infiltration was reported in only 2 cases, namely those of Smith and Weidman[6] and of Goodpasture and Talbot.[7] In none of these 10 cases in which inclusions occurred in the lungs is there any mention of pertussis. However, Feyrter[8] reported intranuclear inclusions in the lungs of an infant 2½ years of age, whose fatal illness had been pertussis. Our cases of pertussis in which inclusions were present in the lungs outnumber all the other reported cases in which they have been observed in that organ.

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[3] Jesionel and Kiolemenoglou, *München. med. Wehnschr.*, 1904, **43**, 1905.

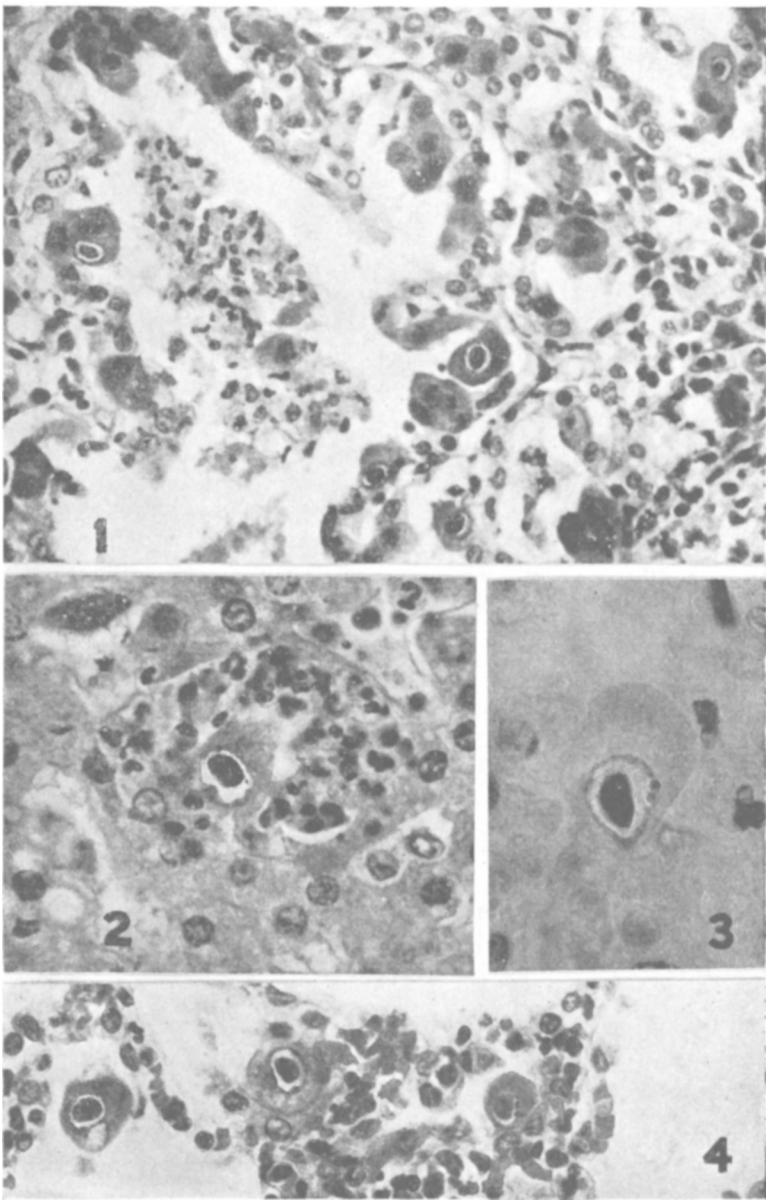
[4] Farber, S., and Wolbach, S. B., *Am. J. Path.*, 1932, **8**, 123.

[5] Von Glahn, W. C., and Pappenheimer, A. M., *Am. J. Path.*, 1925, **1**, 445.

[6] Smith, A. J., and Weidman, F. D., *Am. J. Trop. Dis.*, 1914, **2**, 256.

[7] Goodpasture, E. W., and Talbot, F. B., *Am. J. Dis. Child.*, 1921, **21**, 415.

[8] Feyrter, F., *Frank. Z. f. Path.*, 1927, **35**, 213.



1. Lung with several intranuclear inclusions in the cells lining the alveoli.
2. Focal necrosis of liver with inclusion in liver cell.
3. Oil immersion micrograph of an inclusion shown in Fig. 1.
4. Lung, showing 3 inclusions. One cell is free in the alveolus.

It is impossible to decide in what way, if at all, the intranuclear inclusions we have found so frequently in pertussis are related to those already described in a variety of pathological conditions. Inclusions have not yet been observed in the salivary glands from cases of pertussis, but in only 3 instances have these organs been available for examination.

The presence of intranuclear inclusions in the lungs in such a high percentage of our cases of pertussis and their infrequency in a variety of other childhood diseases indicate that they are intimately associated with whooping cough and suggest that the possible rôle of a filterable virus must be considered in this disease.

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Note on the Cultivation of the Typhus Fever Rickettsia.

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In our recent paper[1] on the cultivation of the typhus fever rickettsiae. it was stated that "of several tissues tested, only tunica and peritoneum gave satisfactory results in the medium described." Since then, we have succeeded in obtaining good growth with guinea pig testicle and kidney tissues in the serum Tyrode medium. Multiplication also occurred when various other tissues (guinea pig brain, heart, adrenal, lung, spleen, embryo) were used.

In these experiments, phenol red was added to the Tyrode solution in order to follow changes in reaction, as produced by the tissues during the incubation of the cultures. By reducing the amount of tissue in the medium, it was possible to retard the change in reaction, a circumstance which in our opinion may be significant in obtaining positive results.

[1] Nigg, C., and Landsteiner, K., *J. Exp. Med.*, 1932, **55**, 563.