

It appears, then, that a fundamental tendency toward rhythmic feather marking was manifested by these birds in two ways: in color pattern and in structure. Under normal conditions, the color type was exhibited by typically barred breeds such as Barred Rocks and Campines (body only). Under the condition of hyperthyroidism experimentally produced, the structural type was demonstrated in feathers with barred color pattern, in pigmented feathers without barred color pattern, and in non-pigmented feathers. The rhythm characteristic of these two types is not referable directly to diurnal metabolic rhythms that appear to determine the fundamental barring which Whitman had described in pigeons.<sup>3</sup>

Whatever the underlying mechanism, its activity has been associated experimentally with the activity of the thyroid.

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**Further evidence concerning the significance of nuclear inclusions as indicators of a transmissible agent.**

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In 1920 Jackson<sup>1</sup> reported the occurrence of what she described as a protozoan infection of the ducts of the salivary glands of guinea pigs. "Round oval, encysted organisms" were found lying in the duct cells of 54 per cent of the guinea pigs examined by this author. Jackson concluded that these structures represented the vegetative cycle of an intracellular protozoan, probably belonging to the group of coccidia.

In 1921 Goodpasture and Talbot<sup>2</sup> confirmed Jackson's findings. These authors found a striking resemblance between the structures described by Jackson and certain protozoan-like cells found by them in the lung, liver and kidney of a two months old baby. The occurrence of cells of this type in infants had been previously

<sup>3</sup> Riddle, O., *Biol. Bull.*, 1908, xiv, 328.

<sup>1</sup> Jackson, L., *J. Infect. Dis.*, 1920, xxvi, 347.

<sup>2</sup> Goodpasture, E. H., and Talbot, F. B., *Am. J. Dis. Child.*, 1921, xxi, 415.

described by several observers, the majority of whom had considered these structures to be protozoan parasites. Goodpasture and Talbot, however, were of the opinion that neither the protozoan-like cells observed in infants, nor the structures in the ducts of the sub-maxillary glands of guinea pigs described by Jackson, were protozoa. They concluded that all these peculiar cells arise through the metamorphosis of certain tissue cells. They showed that the first evidence of this transformation consisted in the appearance of acidophilic intranuclear inclusions and drew attention to Tyzzer's<sup>3</sup> observations of similar nuclear inclusion bodies occurring in the cells of the cutaneous lesions of varicella.

Von Glahn and Pappenheimer<sup>4</sup> in 1925 reported the occurrence of cells similar to those observed in infants in the viscera of an adult man, and thought that the large inclusion bodies were identical in morphology and staining reactions with the inclusion bodies described by B. Lipschütz,<sup>5</sup> and others, in spontaneous and experimental herpes simplex. Lipschütz has held that these bodies represent a specific reaction of the nucleus to the presence of a virus.

Studies which we have made of the structures described by Jackson have led us to the opinion that they arise by transformation of the epithelial cells and that the large acidophilic bodies are intranuclear inclusions probably of the same general nature as the intranuclear inclusions found in herpes simplex and other virus diseases. It has seemed of interest, therefore, to determine whether a transmissible agent could be demonstrated in the sub-maxillary glands of guinea pigs in which these structures were present.

We have examined the sub-maxillary glands of 55 full grown guinea pigs and have found the structures described by Jackson in 82 per cent. Some of the glands showed numerous enlarged duct cells with acidophilic intranuclear inclusion bodies, others showed only a few of these cells. In contrast to the findings in old guinea pigs, the submaxillary glands of very young pigs, approximately less than three weeks of age, have showed these cells only rarely, in three instances, out of 43 glands examined. We have inoculated sterile emulsions of the sub-maxillary glands of

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<sup>3</sup> Tyzzer, E. E., *Philippine J. Sci.*, 1906, i, 4.

<sup>4</sup> Von Glahn, W. C., and Pappenheimer, A. W., *Am. J. Path.*, 1925, i, 445.

<sup>5</sup> Lipschütz, B., *Arch. Dermat. u. Syph.*, 1921, cxxxiv, 428.

old guinea pigs into the brain, testicle and sub-maxillary gland of young guinea pigs. A piece of each sub-maxillary gland used for inoculation was examined histologically in order to determine the presence of these cells in the material used for injection. In making the emulsions for injection, the glands of several old pigs were usually combined. Young pigs inoculated intracerebrally died in most instances on the fifth or sixth day with meningitic symptoms. The histological examination of the brain of these animals has shown an intense meningitis, the exudate containing chiefly mononuclear cells, in many of which are acidophilic nuclear inclusion bodies. Neither the nuclear inclusion bodies nor the cells containing them are as large as those found in the sub-maxillary glands of the full grown pigs, and the inclusion bodies resemble closely those found in herpes simplex, herpes zoster and varicella. Similar inclusion bodies are found in the testicles and sub-maxillary glands of young guinea pigs inoculated with the sub-maxillary glands of old guinea pigs. In the testicle they occur both in the cells of the tubules and in those of the interstitial tissue; in the sub-maxillary gland only in the cells of the interstitial tissue.

The inoculation of the sub-maxillary glands of old guinea pigs into the brain of old pigs has not produced any meningitic symptoms and the histological examination of the brains of the old pigs has so far been negative. Young rabbits and young rats inoculated intracerebrally with an emulsion of sub-maxillary gland of old guinea pigs have failed to develop symptoms and their brains have been negative on histological examination.

Control inoculations of the sub-maxillary glands of very young pigs (one to two days old), the sub-maxillary glands of old rabbits and the pancreas of an old guinea pig into the brains of young pigs have all been negative.

It has been found difficult to transmit the agent through a series of animals. So far it has been possible to infect only the second animal of a series and this only in four instances; in one instance the second transfer was made from testicle to testicle, in the second, from testicle to brain, and in the third and fourth instances, from brain to testicle.

The sub-maxillary glands of old guinea pigs are still active after being exposed to 50 per cent glycerine for seven days. Heating at 54° centigrade for one hour destroys the activity.