

nar epithelium (Pl. XLVI, Fig. A-6). Few goblet cells were observed.

In the 36-hour chick no lymphoid tissue was observed, but in the 1½-year-old specimen it resembled the proximal part of the caeca, the lymphoid tissue was so large in amount.

Another section taken from a laboratory dissector of unknown age (adult) showed a wall of four layers: the inner, a columnar epithelial layer (no folds or crypts); the second, a lymphoid layer which had obliterated the tunica propria; the third, a thick circular muscle layer; and the outer, the serosa.

DISCUSSION

According to Krause (1922), there are four layers in the beak, but the author observed only three. The corium consisted of one layer and was not divided into two as Krause described it.

No evidence of teeth was found, thus agreeing with previous authors.

A hard palate was present, but no soft palate was observed. This was in agreement with Heidrich (1905), Ward and Gallagher (1926), and Bradley and Grahame (1951).

There was no microscopic line of demarcation between the mouth and pharynx, but the last row of papillae on the hard palate and those at the base of the tongue seemed to divide these two cavities. If one considers these as boundaries, then it may be stated that there is an exact line of demarcation between the mouth and the pharynx. Heidrich (1905), Grossman (1927), Bradley and Grahame (1951), and Foust (1952) used these as convenient marks for separating the two. The author agrees with Heidrich that the muscularis mucosae began in the posterior part of the pharynx but cannot agree with him on the musculature of the pharynx. Heidrich (1905) stated that the pharynx had no muscle. A thick muscle inserted itself obliquely in the wall of the pharynx.

Taste corpuscles were not observed.

A tonsil as such is not regarded as a structure belonging to the chicken. There was present only a lymphocytic infiltration of the tunica propria with some lymph nodules present. This was observed only in adult birds and was particularly prominent in the region of the aditus laryngis. Killian (1888) described a tonsil in the region of the Eustachian tubes.

Schauder's (1923) classification of the salivary glands was fol-

lowed. The structure of these glands was found to be similar, in agreement with Kovacs (1928). Heidrich (1905) found basket cells, while Holting (1912) did not. The author did not definitely determine whether basket cells were present or not. Heidrich studied also the changes taking place in the gland in the physiologic state, but this was not considered in the present study.

In agreement with Barthels (1895), Heidrich (1905), Kaupp (1918), Browne (1922), Batt (1925), Kovacs (1928), and Bradley and Grahame (1951), the author found the outer layer of the lamina muscularis of the entire digestive tract (except the gizzard) to be longitudinal.

The esophageal tonsil of Zietschmann (1911), Schauder (1923), and Kovacs (1928) was not observed. There were four layers in the wall of the esophagus as Marschall (1895), Batt (1925), and Grossman (1927) have agreed. The detachment of the surface layers of the mucosa, as observed by Barthels (1895), was also observed by the writer.

The author found that the crop had the same general structure as the esophagus. In agreement with Barthels (1895), no glands were found in the diverticulum of the crop but were confined to the area adjacent to the esophageal wall.

The macroscopic structure of the papillae on the inside of the proventriculus was described in some detail. The concept of superficial tubular glands was found to be erroneous as Elias (1945) reported. These were merely simple columnar epithelial cells covering the plicae and lining the sulci which were between them.

The glands of the proventriculus were multilobular. Schreiner (1900) and Zietschmann (1911) also described them as multilobular. No evidence was found that would lead one to say that there was a variation in size of the glands in different regions of the proventriculus. Wilczewski (1870) thought they were larger at the esophageal end and smaller toward the gizzard, and Marschall (1895) found them to be small in size at both extremities. There was some variation in the size of the lobules but this may have been because of the way they were cut. It is doubtful if one should try to compare the glands of either the proventriculus or the gizzard to regions in mammalian stomachs, as did many authors, because the variation is too great.

There were reasons to support Zietschmann's (1911) and Bradley and Grahame's (1951) idea that the deep glands were

beneath the muscularis mucosae and that the lamina muscularis had three layers, because of the fact that there was much connective tissue about the glands. This could easily be taken for the submucosa as there was such a thin layer of connective tissue between the two inside muscle layers. However, there were fibers from the inner longitudinal layer which coursed in between the glands; hence, the inner longitudinal muscle layer was considered the muscularis mucosae. This is in agreement with Batt (1925).

The section of the gut between the proventriculus and gizzard was characterized by the lack of deep propria glands as Cazin (1886b), Hässe (1886), Zietschmann (1908), Schauder (1923), and Kovacs (1928) described.

There was little disagreement on the structure of the mucous membrane of the gizzard, and the findings in this study agreed with those of previous authors. However, elastic tissue was not confined to an area beneath the gland region alone as Zietschmann (1911) said, but was also found in the tunica propria of adult specimens and in the subserous layer. The thin outer longitudinal muscle which Batt (1925) described was not observed in any specimens studied.

The muscles were found to be invaded by a network of white fibrous connective tissue. White fibrocartilage was observed between the fibrous aponeurosis and the muscle mass presumably serving to make a stronger connection between the two. Skeletal muscle as described by Bradley and Grahame (1951) was not observed. However, heavy contraction bands were seen in the keel area and presented a microscopic appearance similar to their description of "striated" muscle.

Neither the fold described by Marschall (1895) and Kaupp (1918) nor the valve mentioned by Otte (1928) was observed between the gizzard and the duodenum.

A thin submucosa was found in the small intestine. This finding was in contrast to Cloetta's (1893) idea that the submucosa was absent and that the blood and lymph vessels were in the tunica propria. The outer layer of the muscularis mucosae was so intimately associated with the circular layer of the lamina muscularis that the submucosa was not discernible in places.

The two bile and three pancreatic ducts entered through a papilla as described by Gadow (1879).

There was evidence that the structure of the villi changed with age in accordance with Bujard's (1906) observations, because the villi of the 36-hour chick had a somewhat different aspect than that of all the other specimens studied. The villi were leaflike in some parts of the small intestine at this age. No observations were made on the geometric regularity of the villi described by Clara (1927b).

Neither the position of goblet cells in birds of different ages as Cloetta (1893) described nor the numbers of goblet cells as investigated by Ackert *et al.* (1939) were studied, nor was any consideration given to the cells of Paneth. Greschik (1922), Clara (1926b and 1927a) and Bradley and Grahame (1951) found them, while Cloetta doubted their presence.

The writer agrees with Retterer and Lelièvre (1910a) that areas were present which had the appearance of Peyer's patches but that no true Peyer's patches, as described by Otte (1928), were present.

Sufficient observations were not made to prove that lymph nodules were more abundant in one region of the intestine than another, only that they were observed in all sections from adult specimens studied. Batt (1925) found more lymph nodules in the duodenum than in the remainder of the small intestine.

The author agrees with Cloetta (1893) and Otte (1928) that the duodenum had the widest lumen of the small intestine, except in the 36-hour chick, in which the small intestine just beyond the duodenum was wider.

An iliac sphincter as described by Zietschmann (1911) was observed.

Much lymphoid tissue was found in the mucosa of the caeca of all birds studied except in the 36-hour chicks; and as Looper and Looper (1929) described, there were many lymph nodules. The lymphoid area was observed in the proximal portion of the caeca as described by several authors [Oppel (1897), Zietschmann (1911), Kaupp (1918), and Bradley and Grahame (1951)].

Observation did not bear out the findings of Batt (1925) that the muscularis mucosae of the caeca was well developed, but agreed with Looper and Looper (1929) that it was absent in many places.

The blind ends of the caeca presented such a varied structure in different specimens that one can agree with either Zietschmann

(1911) and Browne (1922) that the villi were short or absent, or with Batt (1925) that the mucous membrane was thrown into folds having the appearance of villi.

No particular attention was given to the goblet cells of the caeca except that they were present. Zietschmann (1911) stated that they were lacking where lymphoid tissue was plentiful.

Observations bore out the statement of Looper and Looper (1929) that lymphoid tissue infiltrated the caeca with increasing age.

The rectum was similar in structure to the small intestine. The findings agreed with those of Greschik (1912) that the villi were the same height as those of the small intestine, that lymphoid tissue was present, and that the submucosa was weakly developed and in places not discernible.

The rectum was separated from the cloaca by a constriction in the circular muscle which might be termed a sphincter, according to Bütschli (1924), or a valvular circular orifice, according to Owen (1866) and Otte (1928).

The cloaca was divided into three compartments. Gadow (1891a), Schauder (1923), Thomson (1923), Bütschli (1924), Ward and Gallagher (1926), Bennett (1944), Chamberlain (1944), Bradley and Grahame (1951), Foust (1952), and Sisson and Grossman (1953) found the same.

The writer did not agree with Marschall (1895) that the anal opening was a horizontal slit. The lips of the vent met horizontally but the actual opening was a vertical slit.

This study agreed with that of Bradley and Grahame (1951) that the chicken liver contained tubules of epithelium, a cross section of which showed four to seven cells arranged around an intralobular bile capillary or canaliculus. Portal trinities and central veins were observed. Batt (1926) described central veins, but Zietschmann (1911) stated that they were lacking. Elastic fibers were found in the capsule of Glisson in addition to the vessel walls as Zietschmann observed them, and a reticulum was observed but not "scant" as Batt (1926) stated. Observations made on the color of the liver did not agree with those of Doyle and Mathews (1928), who stated that the liver changed from a yellow color to a maroon at the age of one week to 10 days. The author found that the change took place at approximately 15 days of age.