

# THE MORPHOLOGY AND HISTOLOGY OF A CERTAIN STRUCTURE CONNECTED WITH THE PARS INTERMEDIA OF THE PITUITARY BODY OF THE OX<sup>1</sup>

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SEVENTEEN FIGURES

Certain physiological experiments are now being conducted in the Rudolph Spreckels Physiological Laboratory of this University which necessitate the separation of a great number of ox pituitaries into their two main divisions. As an interesting anatomical feature was in this way brought to our attention the material was used in addition for this anatomical study. This feature has not been mentioned by the following who have written more or less fully upon the pituitary body of the ox, Peremeschko ('67), Dostojewski ('86), Herring ('08), and Trautmann ('11).

The pituitary body of the ox, like that of other vertebrates, is composed of two distinct portions. One, the pars nervosa, is derived from the brain as an outgrowth of the hypothalamus. The other originates as a hollow buccal evagination which in time is completely separated from the digestive tract. That portion of this evagination which comes into contact with the pars nervosa is called the pars intermedia. It is a comparatively thin sheet of epithelium which spreads as a coating over much

<sup>1</sup> Material amounting to thousands of pituitary bodies was most kindly supplied by the Oakland Meat and Packing Company through the courtesy of the Superintendent. It was derived from cows, bulls and steers. As the cone structure was present indifferently in these three varieties, its appearance can have little to do with sex or castration.

## ABBREVIATIONS

<i>P.N.</i> , Pars nervosa	<i>CL.</i> , Cleft (residual lumen)
<i>P.G.</i> , Pars glandularis	<i>I.S.</i> , Infundibular stalk
<i>P.I.</i> , Pars intermedia	<i>B.S.</i> , Blood sinuses
<i>C.</i> , Cone	

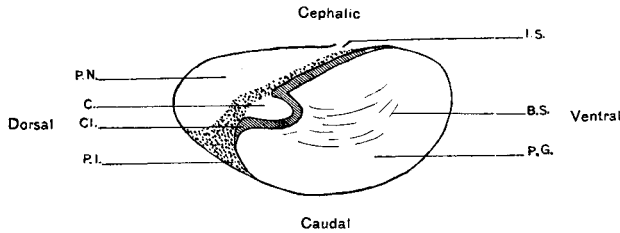


Fig. 1 Tracing of a mid sagittal section of ox pituitary, natural size. The pars glandularis is caudad and ventrad, the pars nervosa cephalad and dorsad. The pars intermedia lies between the two but is separated by the cleft from the pars glandularis. Note the cone upon the pars intermedia and the cavity of the pars glandularis into which it fits, also the blood sinuses coursing through the pars glandularis toward the cone.

of the pars nervosa. The cells in the remainder of the evagination proliferate greatly to form the pars glandularis, the bulkiest part of the pituitary body. Between the pars intermedia and the pars glandularis appears the remnant of the lumen in the original evagination. This is the residual lumen or cleft of the pituitary body. Figure 1 represents these parts as they appear in mid sagittal section. I have taken the side of the pituitary toward the brain to be 'cephalic,' that opposite 'caudal,' the side toward the nose to be 'ventral,' that opposite, 'dorsal.'

The pituitary body lies in the sella turcica roofed with thick dura mater which is perforated ventrally by the opening which transmits the infundibulum. Just underneath this covering is found the pars nervosa, a flask-shaped structure with a long narrow neck, the infundibulum, passing to the brain through the aperture in the dura. The pars glandularis surrounds the pars nervosa throughout its length and enfolds it on either side to such an extent that its only free portions are its dorsal extremity and a strip of its cephalic surface in contact with the dura. The cleft of the pituitary body is easily opened for examination. It

is found to have the same shape as the pars nervosa and thus the broadest portion is close to the dorsal extremity. In the greater number of cases the two walls of the cleft are closely approximated, but sometimes they are spread widely apart by the liquid or solid material which gathers in the cavity. Occasionally the main divisions of the pituitary are so extensively attached to one another that the cleft is obliterated except in its ventral extremity around the neck of the pars nervosa.

In the cleft there is almost invariably found a mass of tissue attached to the pars intermedia but very different from it. This structure is usually symmetrically placed in the mid sagittal plane one-third or less of the way from the dorsal to the ventral end of the cleft. Its general shape is that of a cone one side of which may be longer than the other. The cones differ in proportion; some are broad and low, even flat, others are tall and narrow at the base. Rarely there are two cones. The following are the dimensions of a few:

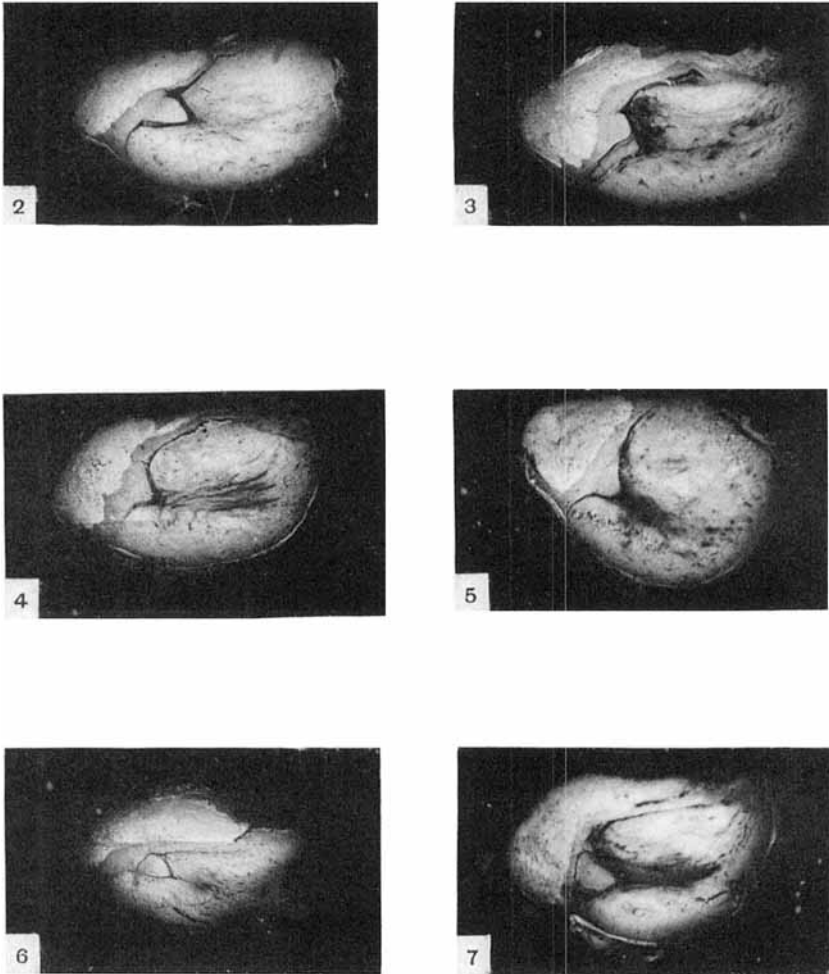
Length <i>mm.</i>	Breadth <i>mm.</i>	Height <i>mm.</i>
2	2	5
7	5	4
4	3	2
2	3	4
3	3	2
3	2	2

They vary from such sizes as the above to specks so small as to be just visible. Rarely they are not to be seen. Thus out of 760 tabulated cases 38 showed no such structure. Probably almost all of the 38 would have revealed it had a microscope been used. The writer has examined at least five thousand of these pituitaries and has come to the conclusion that the cone structure in some form is practically always present. Sometimes the cone has the shape of a bulb which is connected by a slender stalk with the pars intermedia, the whole structure being 8 or 9 mm. in length. In these cases the bulb may be so deeply imbedded in the pars glandularis as to reach almost to its opposite extremity.

Figures 2 to 7 show typical forms of the cone. The sections are approximately mid sagittal. By comparison with figure 1 their various parts may be easily identified. The bulkier and lower portion of each specimen is *pars glandularis*. The *pars nervosa* constitutes the larger part of the remainder. Between the two is the *pars intermedia* which is joined irregularly with the *pars nervosa* but is separated from the *pars glandularis* by the well developed cleft. Within the cleft is more or less colloid. Each specimen possesses a well marked cone which occupies a corresponding depression in the *pars glandularis* but is in no way attached to it. In figures 2 to 5 the cone is firmly attached to the *pars intermedia*. In figures 6 and 7 a line of division runs all around the cone separating it from *pars intermedia* as well as from *pars glandularis*. Probably in these the cone is attached to the *pars intermedia* by a slight strand of tissue which would be shown in a different section. Many cones partly separated in this way from *pars intermedia* have been found.

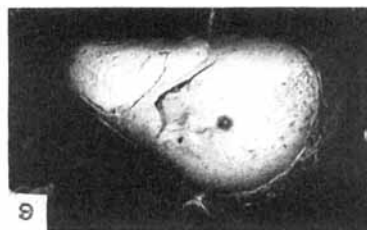
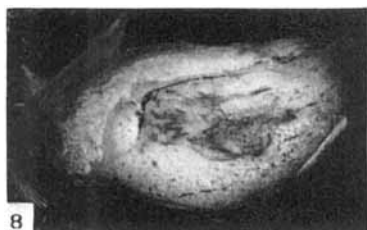
Occasionally the cone is shifted in position to the dorsal end of the cleft. It thus comes into contact with the *pars glandularis* and may be firmly attached to it. Figures 8 to 13 are examples of this arrangement. The sections are similar to the preceding ones, the difference being that here the cone is firmly attached to *pars glandularis*. Figures 8 and 9 show a transition between the forms preceding and those following. The larger part of each cone is separated from *pars glandularis* by the cleft but there is nevertheless an area of firm attachment to the tissue of the *pars glandularis*.

In order that the remaining specimens may be understood, it is necessary to notice the arrangement of the blood sinuses of the *pars glandularis*. When a sagittal section of the *pars glandularis* is made it is seen to have a dark core arching toward the cleft. This is composed of large blood sinuses. Though present elsewhere in the glandular substance they are most prominent here. They often stretch through the gland as an almost flat sheet in the mid sagittal plane and go with surprising directness to the cleft where they come to the surface in the mesial line and distribute themselves with the greatest liberality over the



Figs. 2 to 7 Approximately mid sagittal sections of ox pituitaries showing typical forms of the cone structure. Specimens were hardened in Zenker, stained lightly with alum-cochineal, and sectioned by hand. See description in text. Photograph  $\times 2$ . These and the following photographs were made by L. R. Newhart to whom the writer wishes to extend thanks.

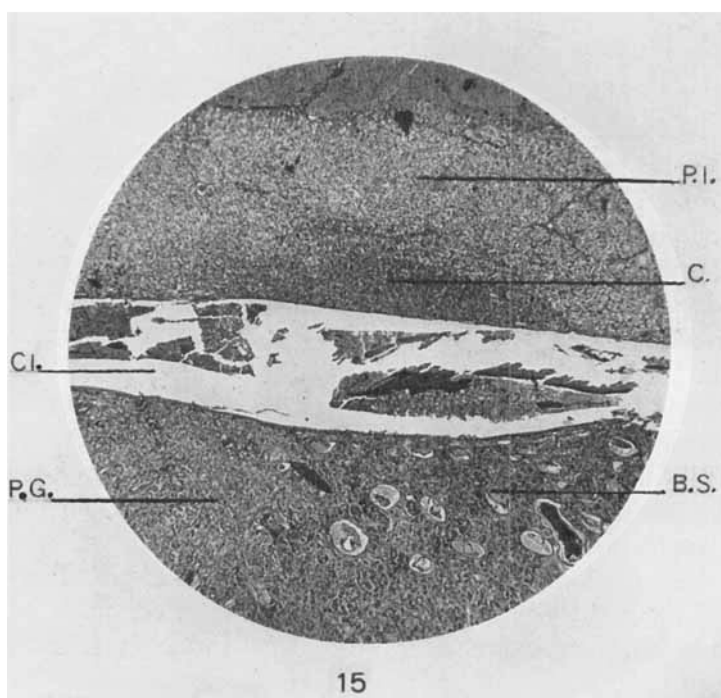
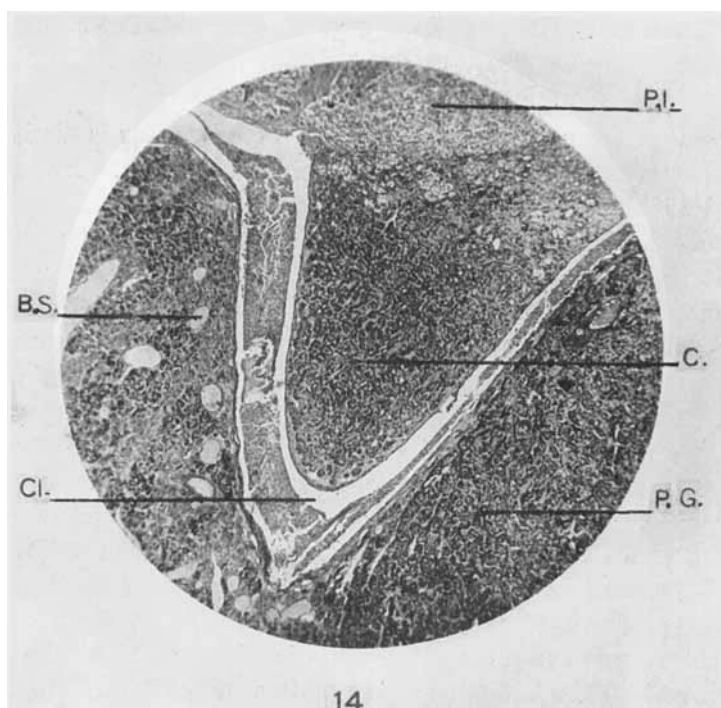
surface of the depression into which the cone fits. In every specimen examined the cone projects into this most vascular portion of the pars glandularis. The blood vessels are often so close to the surface in this region that they bleed with a touch.



Figs. 8 to 13 Specimens prepared similarly to those in figures 2 to 7. These forms are somewhat exceptional. See description in text. Photograph  $\times 2$ .

Fig. 14 Mid sagittal section of ox pituitary in the region of the cone. Note the abrupt transition between pars intermedia and cone, cellular debris in the cleft, and numerous blood sinuses in pars glandularis. The band crossing cone and pars glandularis is an artifact. Section stained with Mallory's connective tissue stain. Photograph  $\times 25$ .

Fig. 15 Description the same as for figure 14. Here the cone tissue does not project into the cleft but it is seen to be as distinct from the pars intermedia as in the former case. Photograph  $\times 25$ .



In several of the specimens this core of blood vessels is distinctly seen as it travels to the exact location of the cone. In figures 10 and 11 the cleft appears only around the neck of the pars nervosa. The impression would be that there is no cone present were it not for the arrangement of the blood vessels. This is quite clear in both but is photographed most plainly in figure 10. Instead of arching to meet the pars intermedia at the apparent junction between pars intermedia and pars glandularis the blood sinuses come to an abrupt stop. In this way they mark out a large cone which is as well shaped as if it were separated completely from the pars glandularis by the cleft, no trace of which is here visible. In figure 11 the cone is marked out just as definitely. This also occurs in figures 12 and 13 but the outline of the cone is not so perfect, probably owing to incorrect section.

In color and consistency the cone is different from the pars intermedia. This difference which has been found to hold throughout the macroscopical examination is shown somewhat in the figures. The cone is composed of compact, creamy white tissue suggestive of the pars glandularis, whereas the pars intermedia is soft and more or less brown. The cone is often whiter and firmer than the pars glandularis itself.

#### HISTOLOGY

Pituitary bodies were fixed in Zenker's, Bensley's or Orth's fluids, were sectioned sagittally and stained with hematoxylin and congo red, eosin and methylene blue, or Mallory's connective tissue stain. Ten specimens were examined. Of these eight showed the cone structure undoubtedly present, and in one it was probably lost through poor technique. Figure 14 shows the cone projecting from the pars intermedia into the hollow of the pars glandularis. The cleft separates the two. That the tissue of the cone differs markedly from pars intermedia can be seen at a glance, the transition between the two being well marked. Figure 15 is a similar section of another specimen. The cleft runs through the center separating pars intermedia above from pars glandularis below. Here the cone tissue is raised only



slightly from the surface. It is, however, a fairly definitely circumscribed area which is strikingly different from pars intermedia. Even when the cone was so small as to be composed of a few cells only, its appearance was unmistakable. Greater magnification reveals the reason for the difference. Cone tissue contains as its most striking characteristic, deeply staining acidophile cells with coarsely granular protoplasm which are apparently identical with those of the pars glandularis. As far as I have been able to determine, acidophile cells have never before been noticed so closely associated with the pars intermedia. Indeed, Herring ('08) says "The intermediate portion, although derived from the same source as the main anterior lobe (pars glandularis), differs from it in adult mammals in that it contains no eosinophile cells." Tilney ('11) joins him in the remark, "The juxta-neural epithelial portion (pars intermedia) is invariably basophilic." These statements have great weight in that both investigators have made careful examinations of the pituitary bodies in many different animals. The remaining cell elements of the cone are similar to those of the pars glandularis. But certain differences exist which, though perhaps of slight importance, make it possible to distinguish between pars glandularis and cone tissue. The connective tissue septa are finer and the interstices are ordinarily smaller and contain fewer cells in the cone than in the pars glandularis. On this account the grouping of the cone cells into acini may appear to be lacking, while the acini of the pars glandularis are apparent at a glance (figs. 16 and 17).

One of the specimens examined was found to resemble the condition shown in figures 10 and 11. The cone was firmly joined to pars glandularis as well as to pars intermedia. Microscopically it showed itself to be as typical a cone as any of the others. A definite connective tissue septum outlined the surface of the cone, adjacent to the pars glandularis. Its tissue differed in the same manner as the other cones from the surrounding tissue of the pars glandularis.

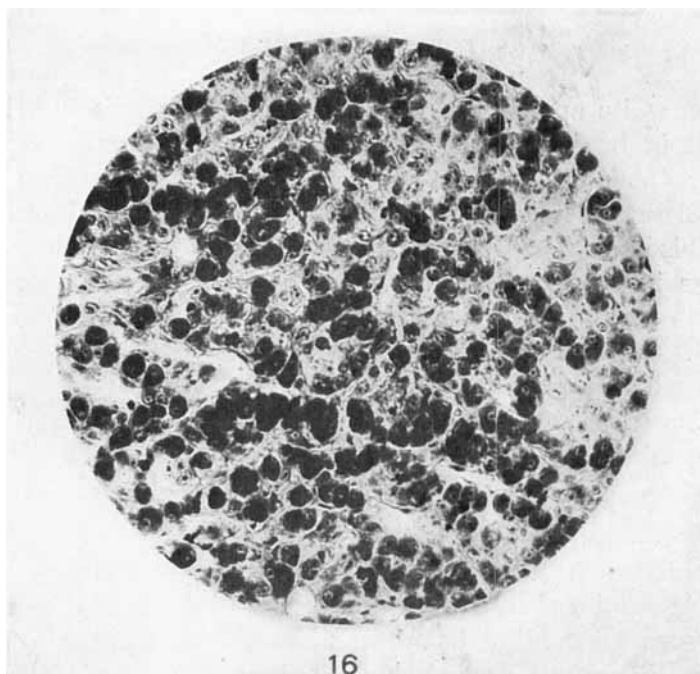
It is noteworthy that in the only specimen in which the cone was actually lacking the cleft was very small, appearing only

around the neck of the pars nervosa. The pars intermedia over-lapped the cleft at its dorsal end and spread irregularly some distance into the pars glandularis. Also large portions of the pars glandularis had the characteristic appearance of cone tissue, that is, the acini had few cells and were separated by very fine strands of connective tissue. In no other specimen did the pars glandularis have this appearance.

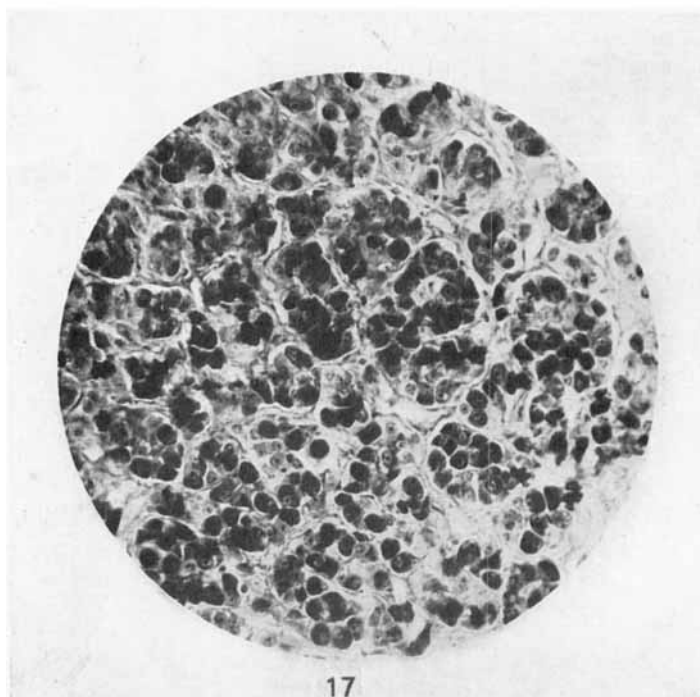
Microscopically the vascularity of the cone appears to be slight but in spite of this when the cleft of a fresh specimen is opened the cone is often flushed with blood. The blood vessels appear to be superficial and are spread mainly about the base of the cone.

This preliminary work leaves many problems unsolved. What are the phylogenetic relationships of this very constant structure? Can any light be thrown upon it by the study of its development? Has it any physiological significance? If this study suggests anything it suggests a closer relationship between pars glandularis and pars intermedia than has hitherto been suspected. The distribution of the blood sinuses of the pars glandularis about the cone is often so striking that it is impossible to avoid the impression that such an appearance cannot be an anatomical chance. Thus when the cone penetrates deeply into the pars glandularis, the walls of the cavity into which it is so closely fitted are solidly packed with blood sinuses. This would appear to be an excellent arrangement for the absorption into the blood stream of any secretions from the cone or pars intermedia. Certain color changes should also be mentioned in this connection. The pars intermedia is ordinarily distinctly tinged. It assumes all colors between dull white and bright orange or yellow or brown. The pars nervosa never shares its color. It is a uniform dull white. On the other hand the pars glandularis may have its characteristic creamy or

Figs. 16 and 17 Detail from the specimen shown in figure 14. Figure 16 shows typical tissue of the cone, figure 17 typical tissue of pars glandularis. Note the prominence of the deeply staining acidophile cells in both, but observe that in the pars glandularis the acini are more prominent and the connective tissue septa are broader. Photograph  $\times 275$ .



16



17

grayish white appearance when the pars intermedia is brightly colored or it may share the coloration of the pars intermedia. Thus it too is sometimes a deep orange. It, however, has never been observed to be highly colored unless the pars intermedia as well is brightly colored. This also suggests a common activity of pars intermedia and pars glandularis or some interrelation between them. Work is being carried out along the lines suggested.

Acknowledgment is due to Dr. P. E. Smith for his kindly help.

#### CONCLUSIONS

1. A structure of more or less definite cone shape appears constantly upon the pars intermedia of the ox pituitary.
2. Its cellular elements resemble those of the pars glandularis. Numerous acidophile cells are its most striking feature.
3. It differs from pars glandularis through having in a general way finer connective tissue septa and smaller acini.

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