

The PITUITARY GLAND

*Clinical
Application of its
Hormone Factors*

ARMOUR
LABORATORIES



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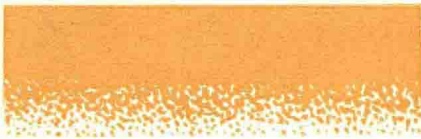


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ARMOUR AND COMPANY
CHICAGO, ILLINOIS



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TO THE PHYSICIAN

PROGRESS in the study of the pituitary gland in the last few decades has made it evident that this remarkable little body of tissue at the base of the brain is truly deserving of the title, "the master gland." Not only does it regulate, by means of its hormones, a number of the bodily functions such as growth, sexual activity and development, and lactation; but in addition, it exerts a powerful influence upon many of the other endocrine glands.

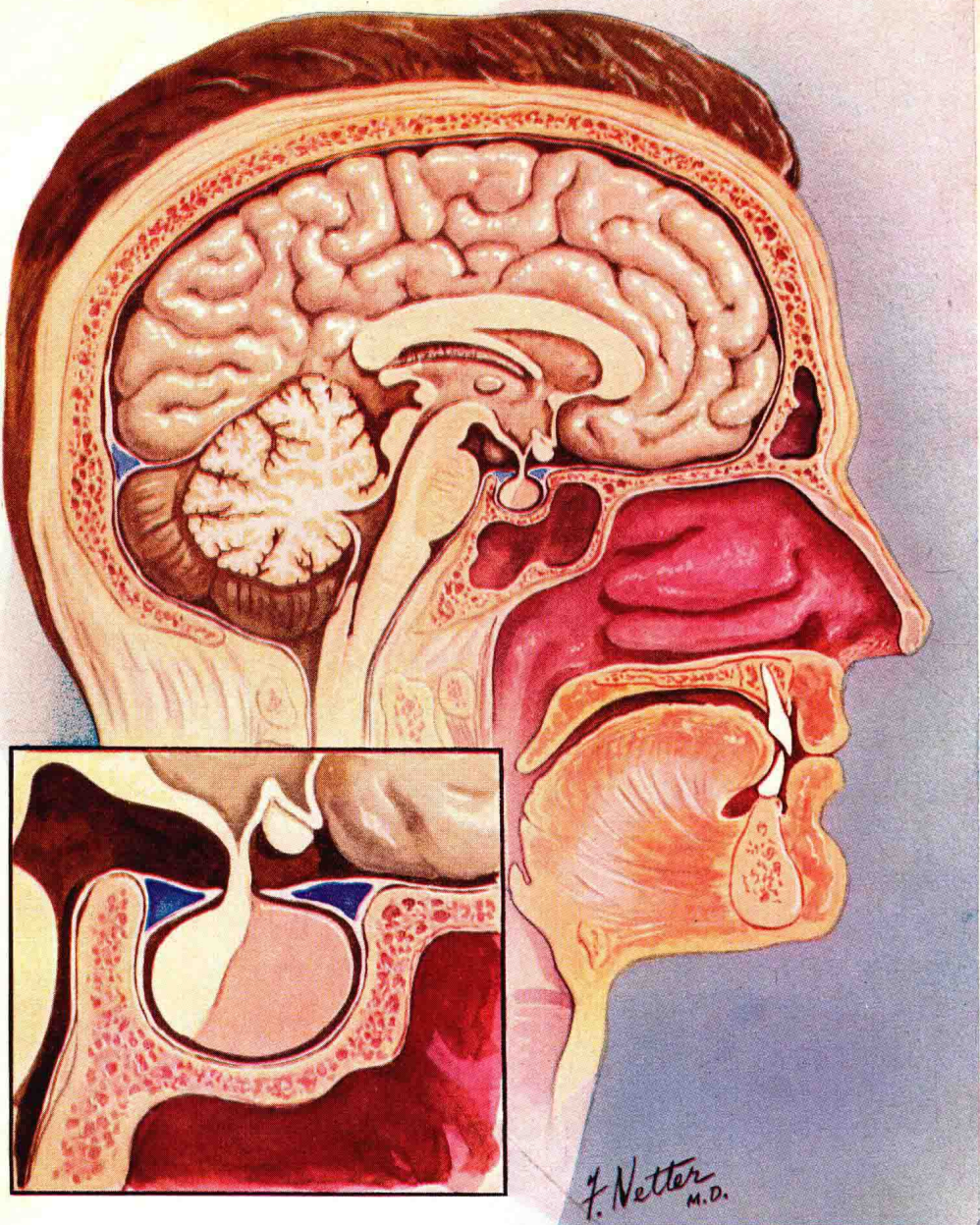
The pituitary gland has great clinical as well as physiologic significance, for a variety of formerly little understood clinical entities and syndromes have been found basically traceable to pituitary hypofunction, hyperfunction, or malfunction. From the practical point of view, probably the most noteworthy advance has been the isolation of the various hormone fractions of the anterior pituitary lobe. This has made it possible to apply therapy more directly toward the correction of specific disorders and ailments. The results thus obtained have been encouraging, and the applications of this form of therapy have been found to extend to almost every field of medicine and surgery. But it is realized likewise that the study of these preparations is progressing rapidly and there is no foretelling what benefits their still unexplored potentialities may reveal.

We of The Armour Laboratories wish to express our great respect for the biochemists and clinicians who have carried out, and are continuing, this research. On the other hand, we have undertaken the responsibility of making available to the medical profession the

various pituitary substances, extracts, and hormone "fractions." We realize that in hormone therapy, reliable preparations of high potency and accurate standardization are essential for good results. We exert every possible effort to make our preparations fulfill these specifications. The Armour Laboratories are well equipped for this work. Situated directly at the stockyards, we have available the world's largest supply of fresh raw materials. We utilize the services of leading experts in handling animal products—and the proper care and handling of these substances is no simple task. The actual preparation, standardization, and packing of the hormone products is supervised in every detail by competent pharmaceutical chemists—and their equipment is the finest obtainable. These are the reasons why THE ARMOUR LABORATORIES are "headquarters for medicinal products of animal origin."

In this booklet we have attempted briefly to summarize and illustrate the present knowledge of the pituitary gland, its functions, disorders, and therapy. In a work of this size it has been necessary, of course, to condense and abstract considerably. In a field advancing so rapidly it is inevitable that there should be certain differences of opinion, but we have tried, in so far as possible, to present the most accepted views. We hope that this booklet will prove of value to the practicing physician.

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THE POSITION OF THE PITUITARY GLAND
WITHIN THE SKULL SHOWING RELATIONS
TO SPHENOIDAL SINUS, ETC. INSERT SHOWS
DETAIL OF GLAND AS IT RESTS WITHIN
THE SELLA TURCICA—NOTE MEMBRANES.

THE ANATOMY OF THE PITUITARY GLAND

THE pituitary gland is an ovoid, slightly flattened body of tissue situated at the base of the brain. It is attached to the end of the infundibulum, a funnel shaped stalk which extends downward and forward from the tuber cinereum. The cavity of the infundibulum is a prolongation of the cavity of the tuber cinereum and is thus part of the third ventricle.

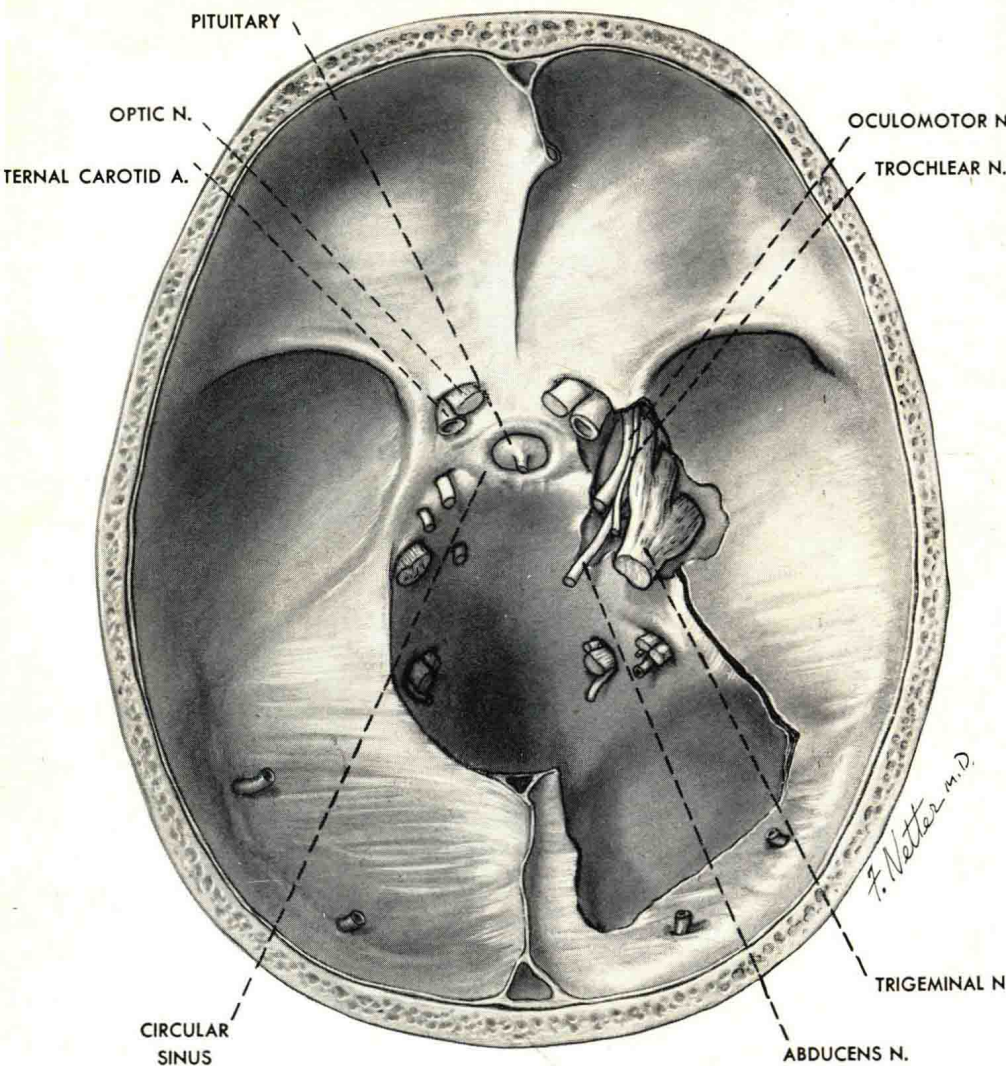
The gland itself lies within a recess in the sphenoid bone, known as the sella turcica because of its resemblance to a Turkish saddle. The floor of this bony hollow forms the roof of the sphenoidal sinus, and its four corners are elevated to form the two anterior and two posterior clinoid processes, which in profile serve to accentuate further the saddle-like appearance of the fossa. The sella turcica is lined by dura mater and is roofed almost completely by a fold of the dura, the diaphragma sellae. Through an opening in this membranous roof, the hypophyseal stalk passes.

The cavernous venous sinuses lie on each side of the sella turcica and communicate with each other by the anterior and posterior intercavernous sinuses which course in the attached border of the diaphragma sellae. The stalk of the gland is thus surrounded completely by venous channels and to these sinuses collectively the term, "circular sinus," is sometimes applied.

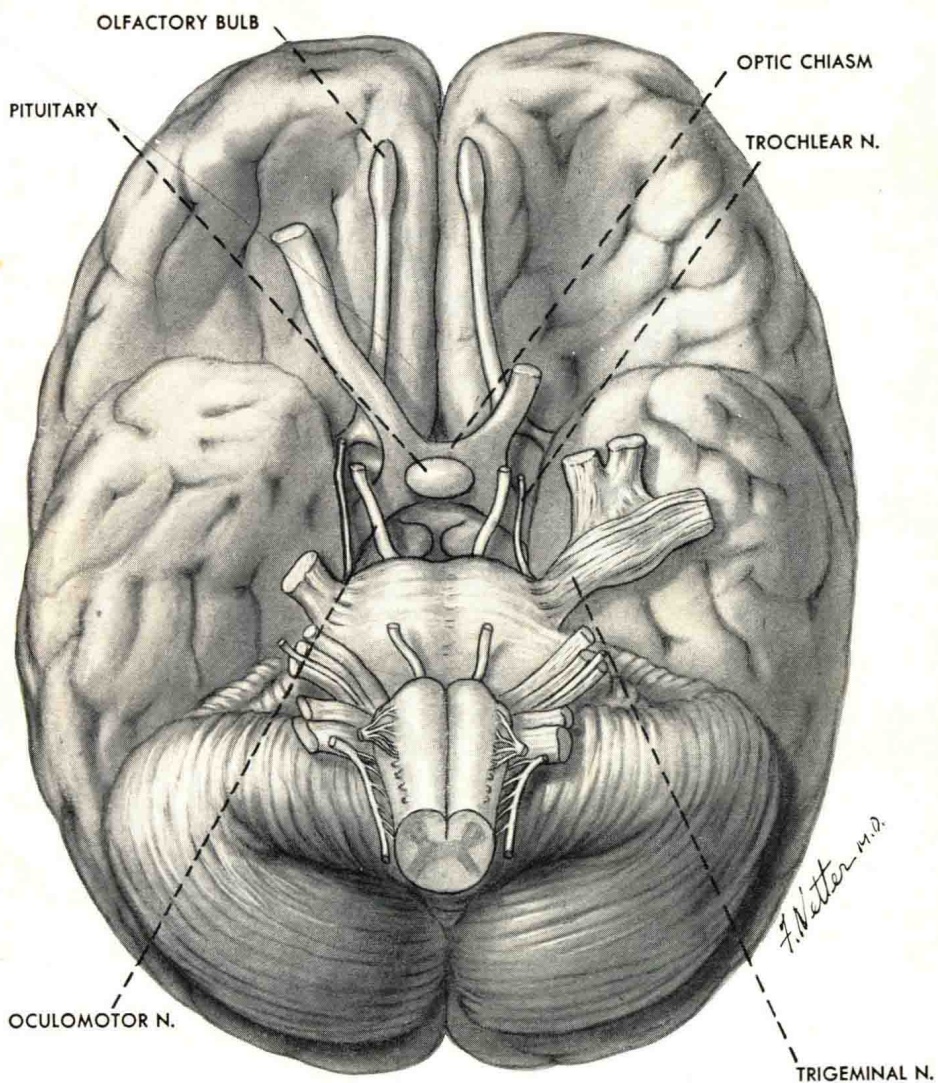
In close proximity to the pituitary gland on either side are the third (oculomotor), fourth (trochlear), ophthalmic division of the fifth, and the sixth (abducens) nerves as they pass within the cavernous sinuses. Just above and in front of the pituitary, and separated from it by the diaphragma sellae, is the optic chiasm. These relations are of considerable clinical and surgical importance in a consideration of pressure effects from pituitary gland enlargement, and they explain why visual disturbances occur so frequently in cases of pituitary tumor.

There appears to be quite some variation in the size of the pituitary, the size of the gland being somewhat proportional to the size of the individual.¹ The approximate average dimensions of the pituitary are, 6 to 8 mm. in antero-posterior diameter, 6 to 8 mm. in vertical diameter, and 12 to 15 mm. in transverse diameter. It is significant that the pitui-

¹ Bell, W. Blair—"The Pituitary," William Wood & Co. 1919, page 15



THE BASE OF THE SKULL VIEWED FROM ABOVE, SHOWING THE PITUITARY GLAND IN SITU AND ITS RELATIONS TO CIRCULAR SINUS, INTERNAL CAROTID ARTERY, ETC.



THE BASE OF THE BRAIN, SHOWING THE
 RELATIONS OF THE PITUITARY GLAND TO
 ITS SURROUNDING NEURAL STRUCTURES.

tary gland is somewhat larger in women who have borne children than in men and in non-parous females. This variation seems to hold true in the matter of weight as well as of dimensions. Thus Erdheim and Stumme² found that in nulliparous females, the average weight of the gland was approximately the same as that of men—the maximum weight during the reproductive period being 0.75 gram. In recently confined primiparae the average weight was 0.847 gram, while in multiparae at the end of pregnancy, the average weight was 1.06 grams.

Age also seems to be a factor in the variation of size and weight of the pituitary, an increase taking place up to middle life, after which there is a gradual decline.

The measurements of the *sella turcica* are probably of greater practical value than are the dimensions of the gland itself. In a general way, the *sella turcica* is proportional to the gland which it houses, although of course the secretory function of the gland is by no means always related directly to the dimensions of its bony encasement. Most important, however, is the fact that *tumors of the pituitary gland, or in the region of the pituitary gland may produce an erosion, enlargement, or distortion of the sella turcica which is recognizable roentgenographically.*

Cushing³ states that radiographic measurements exceeding 15 mm. in the antero-posterior diameter and 10 mm. in depth may be considered as an enlargement of the *sella turcica*. Bell⁴ considers those measurements to be rather generous and quotes somewhat smaller figures. Friedman⁵ tells us that for roentgenologic interpretation, an antero-posterior length of 10 to 14 mm. and a depth of 6 to 10 mm. may be considered average for the normal adult.

Evidences of erosion or distortion of the *sella turcica* are also of great x-ray significance. Friedman classifies the types of normal sellae as circular, oval, and flat or saucer-shaped. The deformities discernable most commonly by x-ray are erosion of the clinoid processes, erosion or absorption of the dorsum sellae, and erosion of the floor. Such findings are usually rather definite evidences of some disorder of the pituitary or its neighboring structures—usually a tumor sufficiently far advanced to cause bony destruction. *On the other hand, considerable pathology may be present without any positive x-ray findings. And a hypo-functioning gland often produces no roentgenologic evidence whatsoever.*

² Erdheim, J. and Stumme, E.—*Beitr. z. Pathol. Anat. u. z., Allg. Pathol.*, 1909, xlv, 1

³ Cushing, H.—*"The Pituitary Body and its Disorders,"* Lippincott, Philadelphia, 1912, page 241

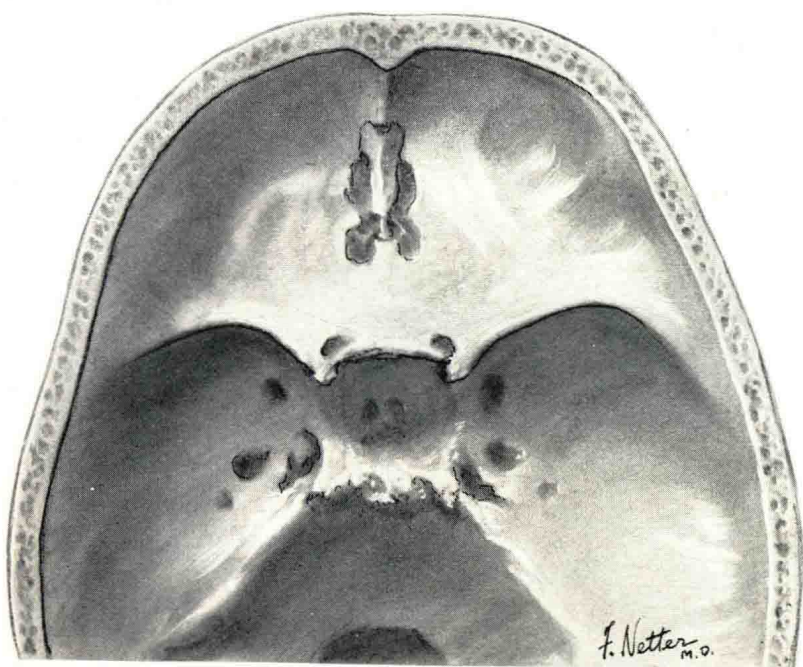
⁴ Bell, W. B.—*ibid.*, page 17

⁵ Friedman, L. J.—*"Textbook of Diagnostic Roentgenology,"* Appleton-Century, N. Y., 1937, page 234

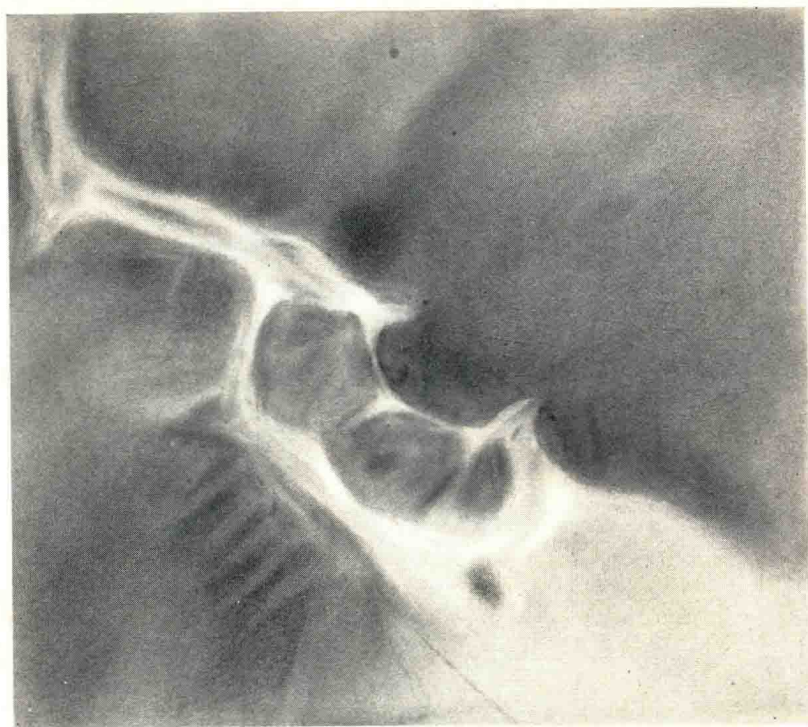
The human pituitary gland is described commonly as consisting of two lobes—an anterior and a posterior. The ease with which the two parts may be separated at the cleft by coarse dissection forms the anatomical basis for this subdivision.⁶ The anterior lobe is much the larger of the two and its posterior aspect is hollowed out so as to fit like a cap over the posterior lobe. In other words, the posterior lobe rests in the hollow of the anterior lobe very much as a ball within the palm of the hand. On section, the anterior lobe is seen to be soft but tough in consistency and rather yellowish pink in color. The posterior lobe is very soft and pasty, and is pearly white.

⁶ Atwell, Wayne, J.—*N. Y. Med. Jour.*, March 2, 1921

BASE OF THE SKULL SHOW-
ING EROSION AND DISTOR-
TION OF SELLA TURCICA
AS SEEN IN ACROMEGALY



Roentgenographic Studies of Normal and Pathological Sellae



ENLARGED AND DISTORTED SELLA TURCICA
(NOTE DEFORMITY OF DORSUM SELLAE)

NORMAL SELLA
TURCICA WITH
CIRCULAR
CONFIGURATION



NORMAL SELLA
TURCICA WITH
OVAL
CONFIGURATION



NORMAL SELLA
TURCICA WITH
FLAT OR
SAUCER-LIKE
CONFIGURATION



DEVELOPMENT OF THE PITUITARY GLAND

EMBRYOLOGICALLY the subdivision of the pituitary gland varies somewhat from its simple morphologic subdivision. Developmentally the gland consists of an epithelial portion and a neural portion, and these do not coincide precisely with its grossly discernable anterior and posterior lobes. Thus the posterior lobe consists of *all* the neural portion plus some of the epithelial portion.

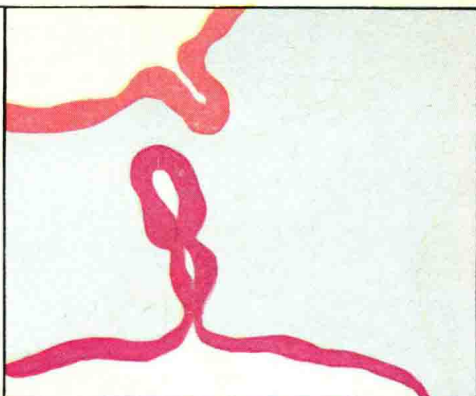
In fetal life a dorsal outpocketing of the oral (stomadeal) epithelium appears just anterior to the pharyngeal membrane. This is known as Rathke's pouch. This pushes progressively upward to meet an evagination from the hypothalamic region of the brain. As Rathke's pouch advances toward the neural process, its attachment to the oral epithelium becomes constricted to an epithelial stalk. Later, however, the pouch becomes separated from its stalk and proceeds to develop into a portion of the pituitary gland. Haberfeld⁷ was first to point out that the remnants of the stalk often persist and develop into a pharyngeal hypophysis in the dorsal wall of the pharynx. This pharyngeal hypophysis may have a histologic structure similar to that of the anterior pituitary lobe, but is said to be capable of function only if hypertrophied⁸. Other rests of this epithelial stalk may also persist and indeed a "parahypophysis" is sometimes found within the sella turcica. Such epithelial rests may be the initial seat of tumors.

After Rathke's pouch becomes pinched off from its stalk its ventral aspect proceeds to grow much thicker. Harvey Cushing has described this process very aptly by stating that it comes to resemble a boxing glove, one surface (the punching surface) being very thick, and the other (the palmar) quite thin. This glove-like structure now wraps itself partially around the neural evagination so that the neural process comes to rest in the palm of the glove. The neural evagination has in the meantime become thickened at its tip to form the infundibular body or pars nervosa of the hypophysis, and it has become narrowed proximally to form the infundibular stalk. The thin palmar surface of Rathke's pouch

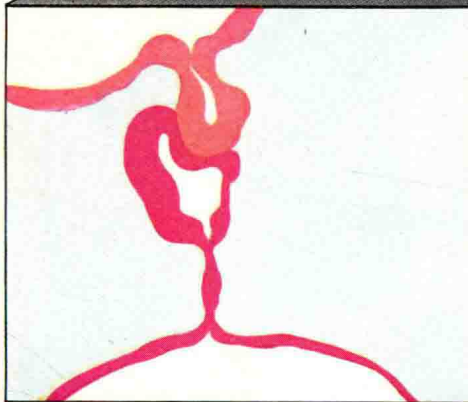
⁷ Haberfeld, W.—*Beitr. z. Path. Anat. u. z. Allg. Path.*, Jena 46:133, 1909

⁸ Smith, Philip E.—*In Nelson's New Loose-leaf Medicine*, 1938, Vol. III, page 239

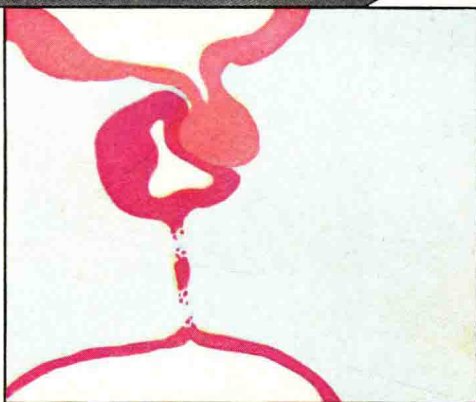
Schematic Presentation of the DEVELOPMENT OF THE PITUITARY GLAND



1 Outpocketing of oral epithelium (Rathke's pouch) pushing upward to meet neural evagination.



2 Rathke's pouch has met the neural process. Formation of epithelial stalk.



3 Epithelial stalk pinched off leaving a remnant.



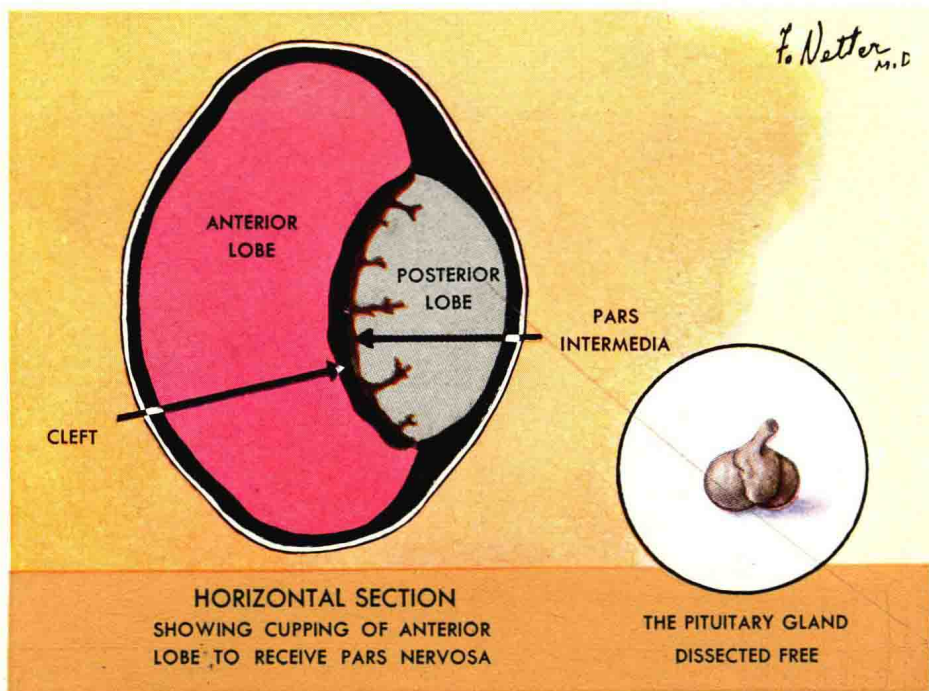
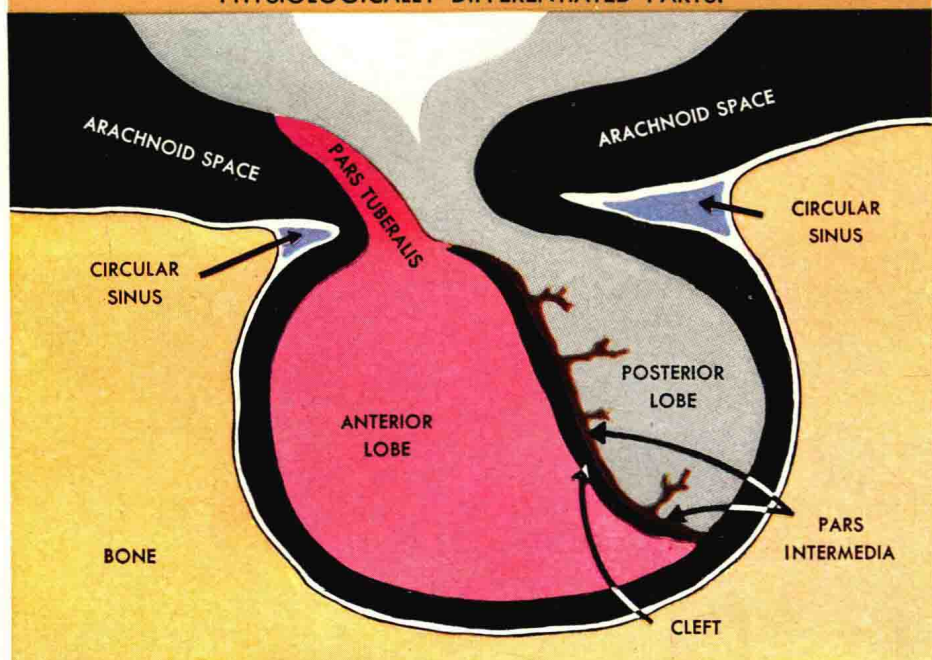
4 Ventral wall of Rathke's pouch greatly thickened. Dorsal wall forms pars intermedia.



5 Residual lumen of Rathke's pouch reduced to a cleft, separating the lobes. Note pars tuberalis.

SAGITTAL SECTION OF PITUITARY GLAND

SHOWING SUBDIVISION INTO LOBES AND
PHYSIOLOGICALLY DIFFERENTIATED PARTS.



becomes adherent to the pars nervosa so that the structure now appears to be composed of two lobes separable by a cleft *which is the residual lumen of Rathke's pouch*. It is thus evident that what appears to be the anterior lobe represents in reality only part of the original epithelial outpocketing. What appears to be the posterior lobe represents all of the neural evagination plus the thin epithelial wall of the oral evagination. This thin epithelial layer adherent to the neurohypophysis is known as the *pars intermedia*. In addition, there develop from Rathke's pouch, two buds which grow up along the infundibular stalk to form the pars tuberalis. The latter, however, always remains relatively small, although the question of whether or not it has any physiologic function has been much debated.